Codes and Standards Enhancement (CASE) Initiative

2028 California Energy Code

Indoor Lighting Controls

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Executive Summary

The Statewide Codes and Standards Enhancement (CASE) Team developed these proposed updates to indoor lighting control requirements for potential inclusion in the 2028 update to the California Energy Code (Title 24, Part 6 or Energy Code). The proposals were developed to improve installed lighting system performance, strengthen compliance clarity, and support California's long-term energy efficiency and greenhouse gas (GHG) reduction goals. There are four measures in this CASE Report applicable to nonresidential buildings, excluding hotel/motel and Group R occupancies: Parking Garage Daylight Adaptation Zone Nighttime Controls, Require Occupant Sensing Controls in More Spaces, Reduce Occupant Sensing Control Delay Time, and Update Multilevel Lighting Controls Requirements.

This proposal is submitted to the California Energy Commission (CEC) and will be evaluated on its technical feasibility and cost effectiveness. The benefits to the proposed measures include a reduction in lighting energy use, improving occupant sensing and daylight responsive control strategies, and simplifying and clarifying the requirements that affect occupancy-based controls on HVAC systems.

The Statewide CASE Team discussed these proposals with manufacturers, lighting designers, engineers, contractors, energy consultants, building operators, and other stakeholders. Engagement activities included stakeholder workshops (September 2025 and March 2026), surveys, and targeted interviews. During these discussions, stakeholders provided information on technical feasibility, identified compliance challenges, and informed revisions to code language, cost assumptions, and implementation strategies.

The Statewide CASE Team recognizes ongoing systemic inequities in environmental and social justice (ESJ) communities and evaluated each measure to minimize unintended impacts. Each measure in this report was evaluated by the Statewide CASE Team and was found to have no impact on ESJ communities.

Parking Garage Daylight Adaptation Zone Nighttime Controls

Proposed Code Change

This measure would require lighting in parking garage daylight adaptation zones to be automatically reduced from sunset to sunrise using photocell or time-switch controls. The proposal would apply to nonresidential parking garages in new construction, additions, and alterations and would introduce a new mandatory lighting control requirement for these daylight adaptation zones.

Benefits of Proposed Change

This measure supports California's energy and climate goals by reducing wasteful lighting energy, improving system performance, and enhancing driver visual responses and safety. It aligns with industry standards and supports long-term decarbonization objectives.

Compliance and Enforcement

The proposal builds on existing Title 24 lighting control requirements and leverages established compliance infrastructure. Minor updates to compliance forms, documentation, and acceptance testing procedures are anticipated. Stakeholder feedback identified manageable implementation challenges that can be addressed through training and updated guidance.

Market Assessment

Lighting control technologies required by this proposal are mature and widely available. Stakeholder engagement and market research indicate that the market is prepared to implement these requirements, and the proposal reflects current or emerging standard practice.

Cost Effectiveness

The proposed code change is cost-effective across applicable climate zones based on lifecycle cost analysis using long-term system cost (LSC) methodology. The estimated cost-to-benefit ratios range from 12.4 to 20.0 across new construction, additions, and alterations, as well as different climate zones and control implementations, far exceeding the minimum requirement of 1.0 for cost-effectiveness.

First-Year Statewide Impacts

Table 1: Summary of Statewide Impacts – Parking Garage Daylight Adaptation Zone Nighttime Controls

Metric	Total Statewide Impacts [a]
Annual Electricity Savings (GWh)	3.40
Peak Demand Reduction (MW)	0.00
Annual Natural Gas Savings (Million Therms)	0.00
Annual Source Energy Savings (Million kBtu)	9.20
30-Year Long-term System Cost Savings (Million 2029 PV$)	35
Annual Avoided GHG (Metric Tons CO2e/yr)	486

a. Values represent impacts from buildings permitted during the first year the code is in effect (2029).

Require Occupant Sensing Controls in More Spaces

Proposed Code Change

This measure would expand the list of space types required to use partial- or full-OFF occupant sensing controls instead of time-based controls. The proposal would apply to nonresidential buildings and would affect intermittently occupied spaces such as lounges, breakrooms, waiting areas, laboratories, and computer rooms.

Benefits of Proposed Change

This measure supports California's energy and climate goals by reducing wasteful lighting energy, improving system performance, and enhancing occupant comfort and safety. It aligns with industry standards and supports long-term decarbonization objectives.

Compliance and Enforcement

This measure builds on existing Title 24, Part 6 lighting control requirements and leverages established compliance infrastructure. Minor updates to compliance forms, documentation, and acceptance testing procedures are anticipated. Stakeholder feedback identified manageable implementation challenges that can be addressed through training and updated guidance.

Market Assessment

Lighting control technologies required by this proposal are mature and widely available. Stakeholder engagement and market research indicate that the market is prepared to implement these requirements, and the proposal reflects current or emerging standard practice.

Cost Effectiveness

The proposed code change is cost effective across applicable climate zones based on lifecycle cost analysis using long-term system cost (LSC) methodology. The estimated average benefit-to-cost ratio is 1.08 across all climate zones for new construction, additions, and alterations, exceeding the minimum cost-effectiveness requirement of 1.0.

First-Year Statewide Impacts

Table 2: Summary of Statewide Impacts–Require Occupant Sensing Controls in More Spaces

Metric	Total Statewide Impacts [a]
Annual Electricity Savings (GWh)	3.2
Peak Demand Reduction (MW)	0.2
Annual Natural Gas Savings (Million Therms)	0.0
Annual Source Energy Savings (Million kBtu)	2.3
30-Year Long-term System Cost Savings (Million 2029 PV$)	23
Annual Avoided GHG (Metric Tons CO2e/yr)	113

a. Values represent impacts from buildings permitted during the first year the code is in effect (2029).

Reduce Occupant Sensing Control Delay Time

Proposed Code Change

This measure would reduce the allowable delay time before lights turn off or dim after a space becomes unoccupied. The proposal would apply to spaces using occupant sensing controls and would improve the responsiveness of lighting controls to better reflect actual occupancy patterns.

Benefits of Proposed Change

This measure supports California's energy and climate goals by reducing wasteful lighting energy, improving system performance, and enhancing occupant comfort and safety. It aligns with industry standards and supports long-term decarbonization objectives.

Compliance and Enforcement

The proposal builds on existing Title 24 lighting control requirements and leverages established compliance infrastructure. Minor updates to documentation and acceptance testing procedures are anticipated. Stakeholder feedback identified manageable implementation challenges that can be addressed through training and updated guidance.

Market Assessment

Lighting control technologies required by this proposal are mature and widely available. Stakeholder engagement and market research indicate that the market is prepared to implement these requirements, and the proposal reflects current or emerging standard practice.

Cost Effectiveness

The proposed code change is extremely cost-effective across applicable building types based on lifecycle cost analysis using long-term system cost (LSC) methodology. The benefit-to-cost ratios are infinite for all the scenarios evaluated because there is no incremental cost expected for implementing this proposed code change.

First-Year Statewide Impacts

Table 3: Summary of Statewide Impacts – Reduce Occupant Sensing Control Time Delay

Metric	Total Statewide Impacts [a]
Annual Electricity Savings (GWh)	34.4
Peak Demand Reduction (MW)	1.9
Annual Natural Gas Savings (Million Therms)	0.0
Annual Source Energy Savings (Million kBtu)	54.1
30-Year Long-term System Cost Savings (Million 2029 PV$)	1,880
Annual Avoided GHG (Metric Tons CO2e/yr)	2,861

a. Values represent impacts from buildings permitted during the first year the code is in effect (2029).

Update Multilevel Lighting Controls Requirements

This measure was supported by California Energy Alliance.

Proposed Code Change

This measure would update multilevel lighting control requirements, including clarified requirements for manual dimmers, updates to thresholds triggering manual dimming controls, and expanded continuous dimming requirements for daylight responsive controls.

Benefits of Proposed Change

This measure supports California's energy and climate goals by reducing wasteful lighting energy, improving system performance, and enhancing occupant comfort and safety. It aligns with industry standards and supports long-term decarbonization objectives.

Compliance and Enforcement

The proposal builds on existing Title 24 lighting control requirements and leverages established compliance infrastructure. Minor updates to compliance forms and documentation are anticipated. Stakeholder feedback identified manageable implementation challenges that can be addressed through training and updated guidance.

Market Assessment

Lighting control technologies required by this proposal are mature and widely available. Stakeholder engagement and market research indicate that the market is prepared to implement these requirements, and the proposal reflects current or emerging standard practice.

Cost Effectiveness

The proposed code change is cost effective across applicable climate zones based on lifecycle cost analysis using long-term system cost (LSC) methodology. The estimated benefit-to-cost ratios for the updated threshold triggering manual dimming controls requirement range from 1.32 to 10.93, depending on space type and climate zones. The estimated benefit-to-cost ratios for requiring continuous dimming for daylight responsive controls range from 1.40 to 4.68, depending on space type, daylit zone type, and climate zone. The benefit-to-cost ratios all exceed the minimum cost-effectiveness requirement of 1.0.

First-Year Statewide Impacts

Table 4: Summary of Statewide Impacts – Update Multilevel Lighting Controls Requirements

Metric	Total Statewide Impacts [a]
Annual Electricity Savings (GWh)	24.0
Peak Demand Reduction (MW)	1.3
Annual Natural Gas Savings (Million Therms)	0.0
Annual Source Energy Savings (Million kBtu)	9.5
30-Year Long-term System Cost Savings (Million 2029 PV$)	132
Annual Avoided GHG (Metric Tons CO2e/yr)	500

a. Values represent impacts from buildings permitted during the first year the code is in effect (2029).

1. Introduction

1.1 Report Context

This proposal describes specific energy efficiency code changes (referred to as “measures”) aimed at reducing wasteful, uneconomic, inefficient, or unnecessary consumption in California. These measures are submitted to the California Energy Commission (CEC) for consideration and potential inclusion in California’s Energy Code (Title 24, Part 6), which sets statewide energy efficiency requirements for newly constructed buildings and for additions and alterations to existing buildings. Measures may also be considered for inclusion in CALGreen (Title 24, Part 11) as voluntary energy efficiency standards, which would take effect only if adopted by a local jurisdiction seeking to exceed the minimum requirements of the Energy Code. Measures submitted to the CEC will be reviewed, may be modified, and may be incorporated into a broader regulatory package proposed and adopted by the CEC. To be included in the Energy Code, proposed measures must be both cost effective and technically feasible.

1.2 Proposal Sponsors and Support

Three California investor-owned utilities (IOUs)—Pacific Gas & Electric Company, San Diego Gas & Electric, and Southern California Edison jointly sponsored this effort. Where the term “Statewide CASE Team” is used in this report, it refers to the authors and State Building Codes Advocacy activities supported through the Codes and Standards program.

The California Energy Alliance (CEA) proposed to revise the current threshold for triggering the multilevel lighting controls requirement. This proposal was included within this CASE Report and the CEA has remained engaged, providing support on this measure.

1.3 Stakeholder Engagement to Inform Proposal

When developing the code change proposal and associated technical information presented in this report, the Statewide CASE Team worked with many industry stakeholders, including manufacturers, industry associations, lighting specifiers, electrical engineers, energy consultants, commissioning providers, lighting controls acceptance test technicians, facility managers, Title 24 energy analysts, state agencies, and others involved in the code compliance process. The proposal incorporates feedback received during public stakeholder workshops that the Statewide CASE Team held on September 24, 2025, and March 19, 2026.

The Statewide CASE Team discussed the proposed code changes with lighting control solution manufacturers, most of whom are also part of the same industry association and confirmed the technical feasibility of the proposed changes from the manufacturers' perspective. The team organized follow-up calls with facility managers at large institutions, who provided initial feedback during the public stakeholder workshop, to better understand users' viewpoints and revised the proposed changes presented in this final report based on their input. For changes that involve updating the acceptance test methods, lighting controls Acceptance Test Technicians (ATTs) were consulted to confirm feasibility, assess potential test burden, and estimate the resulting cost impacts. The Statewide CASE Team conducted two surveys to collect data and insights into the proposed changes. The first survey, containing high-level, mostly multiple-choice questions, was distributed to the broad stakeholder group. The second survey targeted a smaller group of stakeholders with whom the Statewide CASE Team maintains close contact and who would be willing to spend more time providing detailed feedback.

See Appendix E for details on the Statewide CASE Team's stakeholder engagement.

1.4 Addressing Energy Equity and Environmental Justice

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in environmental and social justice (ESJ) communities.[1] These issues persist today. To minimize the risk of perpetuating inequity, code change proposals were developed with intentional consideration of the unintended consequences on ESJ communities.

When analyzing impacts for nonresidential buildings, the Statewide CASE Team reviewed each nonresidential building type through the lens of the four criteria: cost, health, resiliency, and comfort. The Statewide CASE Team examined which building types are used by ESJ communities most frequently and evaluated the allocation of impacts related to the following areas among all populations. Some building types have unique environmental justice concerns due to their common uses, location, or other factors.

[1] The CPUC refers to ESJ communities as "low-income or communities of color that have been underrepresented in the policy setting or decision-making process, are subject to a disproportionate impact from one or more environmental hazards, and likely to experience disparate implementation of environmental regulations and socio-economic investments in their communities" (CPUC 2022). ESJ communities also include the CPUC definition for Disadvantaged Communities, which comprises "(1) Census tracts receiving the highest 25 percent of overall scores in CalEnviroScreen 4.0 (1,984 tracts); (2) Census tracts lacking overall scores in CalEnviroScreen 4.0 due to data gaps, but receiving the highest five percent of CalEnviroScreen 4.0 cumulative pollution burden scores (19 tracts); (3) Census tracts identified in the 2017 DAC designation as disadvantaged, regardless of their scores in CalEnviroScreen 4.0 (307 tracts); and (4) Lands under the control of federally recognized Tribes (OEHHA 2022) .

The Statewide CASE Team will continue to build relationships with community-based organizations and other stakeholders to improve the identification of potential impacts for future code cycles and is open to additional resources that can contribute to this effort.

2. Parking Garage Daylight Adaptation Zones Nighttime Controls

2.1 Parking Garage Daylight Adaptation Zones Nighttime Controls – Measure Description

2.1.1 Proposed Code Change

This proposed measure requires nighttime controls in parking garage daylight adaptation zones, which will increase energy savings and, more importantly, ensure proper visual adaptation for drivers entering parking garages at night. During the day, adaptation zones lessen the visual transition from light to dark by using high-lighting power density (LPD) daylight adaptation zone lighting near entrances. These areas improve driver visibility during daylight hours but have ten times the LPD of other garage areas and are not dimmed after sunset. The proposed measure would add controls to lower the lighting power in daylight adaptation zones from sunset to sunrise to match the rest of the parking garage's lighting levels. This proposal would include daylight adaptation controls as recommended by IES RP-8-25 and require similar adaptation compensation controls as in ANSI/ASHRAE/IES 90.1-2022: Energy Standard for Buildings § 9.4.1.2(c). The proposed measure would implement nighttime adaptation compensation controls within designated daylight adaptation zone lighting systems. This proposal will affect new construction, additions, and alterations. However, this code change would not affect residential or multifamily building types. It would need a dedicated acceptance test as part of the lighting controls acceptance tests for the garage space.

Table 5 summarizes the scope of the proposed code change.

Table 5: Scope of Proposed Code Change

A ☑ indicates the proposed code change is relevant.

Building Type(s)	Construction Type(s)	Type of Change
☐ Single Family	☑ New Construction	☑ Mandatory
☐ Multifamily	☑ Additions	☐ Prescriptive
☑ Nonresidential (Not Group R uses)	☑ Alterations	☐ Performance

Application Climate Zones	Energy Code Sections	Compliance Forms	Sections of ACM Reference Manuals
Climate Zones 1-16	• Section 601.2.2 *[Section 130.1]* • Nonresidential Reference Appendix Section	NRCC/LMCC-LTI-E; NRCI/LMCI-LTI-E; NRCA-LTI-02-A; NRCA-LTI-03-A	N/A

Third Party Verification)	Updates to Compliance Software
☑ No changes to third party verification	☑ No updates
☐ Update existing verification requirements	☐ Update existing feature
☑ Add new verification requirements	☐ Add new feature

a. The scope of this proposed code change does not include Group R residential and multifamily buildings.

2.1.2 Benefits of Proposed Change

Current requirements in 2025 Title 24, Part 6 allow the daylight adaptation zone to have an LPD allowance ten times higher than the rest of the garage space to increase light levels and improve visibility, as drivers' eyes adapt from bright outdoor daylight to the more dimly lit garage areas. This is the purpose of the adaptation zone LPD allowance in the Energy Code. However, during nighttime hours, the same high LPD lighting can negatively impact the driver's vision as they transition from the garage to the outdoor lighting environment.

The proposed revisions to the mandatory control requirements are consistent with the lighting standards outlined in ASHRAE 90.1-2022. The proposed controls for parking garage daylight adaptation zones reduce lighting power consumption during nighttime hours to align with other garage areas. This adjustment yields substantial energy savings because the adaptation zones have LPD values that are ten times the baseline allowance for the remainder of the garage. It also improves safety from a lighting engineering perspective by reducing illuminance in the daylight adaptation zones during nighttime hours, so drivers experience lower contrast as they transition from the garage to the outdoor lighting environment.

2.1.3 Background Information

A daylight adaptation zone in a parking garage is the interior pathway for vehicles near the entrance or exit, where drivers must adapt from outdoor daylight levels to interior lighting levels. This transition can significantly reduce driver visibility as drivers' eyes adapt from light to dark in areas with potentially high vehicle and foot traffic and the potential for vehicle and pedestrian conflicts. To address concerns about low visual performance, parking garages use daylight adaptation zone lighting to extend the transition zone from high illuminance to much lower interior illuminance, allowing the eyes to adapt while maintaining better visual performance. Carefully considering the adaptation zone when completing a lighting plan for a parking facility is standard industry practice. Control of the daylight adaptation zone lighting systems are independent from the rest of the parking garage lighting. Title 24, Part 6 sets the maximum LPD for these lighting systems at ten times the level of all other garage lighting and exempts them from automatic daylighting controls, which reduce electric light levels in response to changes in daylight availability. This additional LPD allowance enables the daylight adaptation zones to deliver the high lighting levels necessary to support visual adaptation when drivers enter the parking garage during daylight hours.

However, from sunset to sunrise, the high LPD in these zones can have the opposite effect, making adaptation more complex by having drivers enter a very high-illuminance zone and then transition to one with approximately one-tenth the light levels beyond the adaptation zone. In addition, these areas are often also garage exits. Operating the adaptation lighting at night presents the opposite problem: drivers exiting the garage are driving from an area of very high illuminance to an area of much lower illuminance beyond the garage confines. This visual adaptation challenge is a concern for drivers departing an area of higher illuminance to an area of lower illuminance because the visual system adapts slower when entering darker zones (Hood 1986). The current code also allows for greatly increased energy consumption in the adaptation zone and allows these systems to operate at maximum capacity regardless of ambient light levels or time of day.

2.1.4 Modifications to Energy Code Documents

This section provides descriptions of how the proposed code change will affect each Energy Code document. See Section 2.6: Parking Garage Daylight Adaptation Zones Nighttime Controls – Proposed Language of this report for detailed revisions to code language.

2.1.4.1 Energy Code Change Summary

130.1 – MANDATORY INDOOR LIGHTING CONTROLS

SECTION 601.2.2.7 ***[New section]:*** The proposed measure adds subsection 601.2.2.7, requiring separate daylight adaptation zone controls to reduce lighting power from sunset to sunrise automatically. Daylight adaptation zones are currently exempt from parking garage daylighting control requirements.

EXCEPTION to Section 601.2.2.7: The proposed measure adds an exception to section 601.2.2.7 that applies to hotel/motel buildings and nonresidential buildings with *Group R occupancies.*

EXCEPTION to Section 601.2.2.3.6.5 ***[Section130.1(d)]*****:** The proposed measure adjusts this exemption for luminaires located in the daylight adaptation zones so that it only applies to hotel/motel buildings and nonresidential buildings with *Group R occupancies.*

2.1.4.2 Reference Appendices Change Summary

NA7.6.1. Indoor Lighting Controls Acceptance Tests and **NA7.6.2 Shut-OFF Controls Acceptance Tests**: The proposed will add language to both of these sections to address the adaptation lighting controls compliance technology pathways that are possible in modern lighting systems.

2.1.4.3 Compliance Manuals Change Summary

5. Nonresidential Indoor Lighting. Daylight Responsive Controls in Parking Garages:

Add the following language:

“For parking garage daylight adaptation zones, daylight responsive or timeclock controls are required to meet the following criteria:

> The LPD of daylight adaptation zones must be reduced to match parking areas and loading and unloading areas between sunset and sunrise.”

Remove the following on page 5-33:

“EXCEPTION: Daylight Responsive controls are not required for luminaires in the daylight adaptation zone within the parking garage areas.”

2.1.4.4 Alternative Calculation Method Reference Manual Change Summary

There are no proposed changes to the Nonresidential and Multifamily Alternative Calculation Method Reference Manual.

2.1.4.5 Compliance Forms Change Summary

The Statewide CASE Team anticipates that updates to forms NRCC/LMCC-LTI-E, NRCI/LMCI-LTI-E, NRCA-LTI-02-A, and NRCA-LTI-03-A will be required for the design team to certify that they have designed an adaptation zone lighting control system that has the controls capability that meets the proposed regulations, including either a photocell or an astronomic clock and operating either a switched lighting system or a dimming system.

2.1.5 Measure Context

2.1.5.1 Comparable Model Codes or Standards

The proposed revisions to the mandatory control requirements align with ANSI/ASHRAE/IES 90.1-2022: Energy Standard for Buildings lighting requirements. The nighttime adaptation compensation controls for the parking garage daylight adaptation zone are an existing requirement in ANSI/ASHRAE/IES 90.1-2022: Energy Standard for Buildings §9.4.1.2(c).

The proposed code change also aligns with ANSI/IES RP-8-25 Recommended Practices for Lighting Roadway and Parking Facilities. Although the ANSI/IES RP-8 lighting industry standard does not explicitly require nighttime dimming controls, it provides a recommended luminance ratio between the daylight adaptation zones and the general parking areas, which this code change would help to facilitate.

2.1.5.2 Interactions with Other Regulations

There are no known federal, state, or local regulatory requirements that address or conflict with the proposed measure.

2.2 Parking Garage Daylight Adaptation Zones Nighttime Controls – Compliance and Enforcement

2.2.1 Compliance Considerations

The Statewide CASE Team worked with stakeholders to develop a recommended compliance and enforcement process and to identify how this process would affect various market actors. While developing this proposal, the Statewide CASE Team considered ways to streamline the compliance and enforcement process and how to reduce negative impacts on market actors involved. The activities that need to occur during each phase of the project are as follows:

- Design Phase: Designers will need to include daylight adaptation zone controls in the design set that meet new specifications. They will also need to notate the added testing protocol triggered by these new requirements. Designers will need to ensure that there is adequate lighting in the adaptation zone through the general lighting allowance for the space to meet lighting requirements during the daytime, since the adaptation zone lighting will not be operating at full power during that time.

- Permit Application Phase: Design packages submitted for permits will need to include new controls and support controlled daylight adaptation zones. Plan examiners will need to be aware of the new requirements when reviewing the project design set submitted.
- Construction Phase: The design drawings approved for the building permit will include and support the installation of new controlled daylight adaptation zone lighting.
- Inspection Phase: The Statewide CASE Team anticipates the addition of a lighting controls acceptance test to confirm that the adaptation zone controls are functioning as intended.

Care must be taken during these phases to ensure continued recognition that due to Assembly Bill 130 Group R occupancies are exempt from these requirements.

2.2.2 Impact on Market Actors

As shown in Table 6 below, the proposed compliance process would slightly increase the workload for many market actors. Changes include documenting compliance with the new requirement for both lighting designers and energy consultants, new equipment and testing for the controls contractors, and new testing protocols for the ATTs. Table 6 summarizes the impacts and recommends outreach and education efforts that could help them prepare. Since this change would not affect residential or multifamily buildings, market actors working exclusively in those sectors would not be affected.

Table 6: Impacts on Market Actors and Suggested Training and Education Opportunities

Market Actor	Impact(s)	Suggested Outreach and Education
Owner/Developer[a]	• Would require additional training and testing. • Be able to support user experience with installed daylight adaptation zone lighting controls.	Provide controls programming training materials for lighting designers/engineers, as well as lighting ATTs.
Design Professional[b]	Would need to include daylight adaptation zone controls in the design set that meet new specifications. They would also need to notate the added testing protocol triggered by these new requirements, and document compliance with new requirement. New code may dictate alterative lighting fixture selections.	• Coordinate with lighting designers or engineers, and, if necessary, controls contractor regarding the control systems for parking structure. • Update NRCC forms with new requirements.
Construction Team[c]	Would need to acquire, install, and facilitate testing of daylight adaptation zone lighting controls.	• Update NRCA testing criteria. • Coordinate new controls programing with lighting designers/engineers, as well as lighting controls ATTs.
Building Department[d]	Be aware of and enforce new mandatory control requirements and ATT verification requirements.	Update training to include all new control requirements.
Verification Tester[e]	Require new testing protocols for new controls.	• Update NRCA testing criteria. • If there is commissioning, commissioning agent would work with controls contractors, and lighting ATTs.
Manufacturers and Distributors	Adapt production and purchasing practices to accommodate additional sales of existing lighting control equipment.	Consider developing a publicly available listing of product types that meet the new controls requirement.

a. Owner/Developer is funding the project and is the primary decision-maker.

b. Design professionals include architects, engineers (mechanical, electrical, plumbing, structural), specification writers, cost estimators, commissioning agents, lighting designers, and energy consultants.

c. Construction team includes general contractors, design-build contractors, installation contractors (e.g., HVAC, plumbing, electrical), commissioning agents, and tradespeople.
d. Building departments include plans reviewers, building inspectors, specialty inspectors, permit counter technicians, and third-party plan review and inspection.
e. Verification testers include commissioning agents, Energy Code Compliance (ECC)-Raters, and ATTs.

The 2028 CASE Methodology Report presents a quantitative assessment of how changes to the California Building Code impact builders, building designers and energy consultants, and building owners and occupants. The analysis in the methodology report is not specific to the code change presented in this report. The following provides a qualitative description of how this specific code change affects various market actors and additional quantitative analyses of its potential impacts on building industry subsectors.

Builders. The proposed change would not affect all firms and workers in the commercial building industries equally; instead, it would primarily affect specific subsectors within the industry. Table 7 shows the commercial building subsectors the Statewide CASE Team expects to be impacted by the changes proposed in this report. The proposed measure primarily impacts nonresidential electrical contractors, who will be responsible for installing compliant control systems.

Building occupants (owners and tenants). The proposed code change would have incremental costs and would reduce building owners' utility bills throughout the measure lifetime. See the 2028 CASE Methodology Report for a description of how Long-Term System Cost (LSC) savings relate to occupant utility bill savings.

Table 7: Specific Subsectors of the California Commercial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2025 (Estimated)[2]

Construction Subsector	Establishments*	Employment	Annual Payroll (Billions $)
Commercial Building Construction	5,491	87,450	$10.6
Nonresidential Electrical Contractors	3,245	72,794	$7.8
Nonresidential Plumbing & HVAC Contractors	2,270	55,182	$5.8

Source: Analysis by the Title 24 CASE Team of QCEW data from the California Employment Development Department https://labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=industry

*An establishment is a single economic unit, typically at one physical location, that engages in one, or predominantly one, type of economic activity for which a single industrial classification may be applied. Many businesses are composed of multiple establishments. United States (U.S.) Bureau of Labor Statistics, Handbook of Methods. https://www.bls.gov/opub/hom/cew/concepts.htm

Manufacturers. This proposed controls change may have a minor impact on some California-based lighting or lighting control manufacturers. The Statewide CASE Team does not anticipate a significant impact since many building construction applications already require these systems. The measure proposes adding a new layer of lighting controls, which may lead to a slightly higher number of lighting control device sales in the state.

2.2.3 Compliance Software Updates

The proposed measure would necessitate an update to an existing software feature.

2.2.4 Cost of Enforcement

The Statewide CASE Team acknowledges that changes to the code will impact enforcement costs. This report is an evaluation of specific measures, and the collective impact of all proposed changes for the 2028 Title 24, Part 6 may represent an increase in training and/or workload for enforcement personnel.

The Statewide CASE Team expects no additional costs to the state or local governments associated with the enforcement of the proposed measure. The current enforcement framework already accounts for lighting controls requirements, and the proposed measure only adds the daylight adaptation controls in the daylight transition

[2] This proposed change excludes Group R occupancies and Group R common use and public areas as mandated by California Assembly Bill 130.

zone. This incremental adjustment does not require the development of new programs or significant changes to existing enforcement protocols.

The existing training infrastructure sufficiently supports the minor increase in enforcement activity, so officials do not anticipate creating new training programs. Similarly, in the construction industry, the proposed measure does not introduce new design or installation practices, so they do not anticipate additional workforce training beyond that already covered under current guidelines.

As such, the state will not incur any new costs for compliance assurance, enforcement, or training associated with this proposal.

The plan reviewers will need to identify that the adaptation lighting zone controls are included in the appropriate sections for shutoff controls and/or multilevel controls in the NRCC-LTI-E compliance form on page 6.

Inspectors reviewing the project will need to look at NRCI-LTI-E and verify that the lighting adaptation controls are documented as included in the Indoor Lighting Controls section on Page 4 of the form.

Controls acceptance will require an ATT to employ a new series of steps that will be included in either NRCA-LTI-03-A for daylight responsive controls if the control is managed by a photocell, or through NRCA-LTI-02-A for an astronomic time clock shutoff control.

2.3 Parking Garage Daylight Adaptation Zones Nighttime Controls – Market and Economic Analysis

2.3.1 Market Structure and Availability

2.3.1.1 Current Market Structure and Availability

The Statewide CASE Team verified estimates of current product availability, market trends, and how the proposed standard would impact individual market players, including additional costs associated with complying with the proposed measure. The Statewide CASE Team verified estimates of market size and measure applicability through outreach to stakeholders. The Statewide CASE Team stakeholder outreach included a stakeholder survey completed between October and December 2025 by utility program employees, Energy Commission staff, and a wide range of industry participants. The CASE team conducted personalized outreach and interviews with market experts, as well as requested input on the current market structure and potential barriers during utility-sponsored stakeholder meetings on September 24, 2025, and March 19, 2026 (Statewide CASE Team 2026) (Statewide CASE Team 2025).

2.3.1.2 Market Challenges and Solutions

The Statewide CASE Team assessed market readiness by establishing whether practitioners, primarily lighting designers and electrical engineers, can specify and implement nighttime dimming controls. The Statewide CASE Team conducted an analysis of the current market adoption of these control systems through stakeholder interviews and utility-sponsored stakeholder meetings.

The Statewide CASE Team found that market readiness is unlikely to be a barrier because the same requirements are already part of ASHRAE 90.1-2022 building energy standards.

See Section 2.2 for a description of potential workforce training to ensure effective design, installation, and commissioning.

2.3.2 Design and Construction Practices

2.3.2.1 Current Design and Construction Practices

ANSI/ASHRAE/IES Standard 90.1-2022 guidelines require the use of daylight-reactive dimming controls for parking garage daylight adaptation zones. This international organization considers installing dimming or shutoff controls for garage entrance lighting systems as standard practice for energy efficiency and enhancing safety. Compliant control systems can use clock or photocell controls to reduce nighttime demand. The adaptation zone lighting design can also use a separate lighting system from the main garage lighting system with on/off switching, or an extension of the main lighting system with separate dimming controls for LPD reduction.

2.3.2.2 Health and Safety Considerations

The proposed nighttime dimming measure for the garage daylight adaptation zones would improve driver visual performance at garage entrances and exits from sunset to sunrise. IES RP-8-25 recommends light-level ratios between the daylight adaptation zones and general parking areas that are not achievable without the proposed nighttime dimming controls. Dimming controls improve drivers' visibility when entering and exiting the parking garage, increase safety, and potentially reduce accident risk. The proposed measure does not modify any current federal, state, or local safety and health regulations, including those enforced by the California Division of Occupational Safety and Health (DOSH). All existing health and safety rules will stay in effect.

2.3.2.3 Design and Construction Challenges and Solutions

The Statewide CASE Team does not believe there will be significant technical challenges to implementing nighttime dimming in garage daylight adaptation zones. This technology, needed for compliant designs, has a mature market, given that ASHRAE 90.1 and the IECC already have these requirements in place. The technology needed for such control is not dependent on climate zone or geographic region, so technologies designed to meet ASHRAE 90.1 and IECC will comply with the proposed code change.

See Table 6 in Section 2.2.2 for a description of workforce training that could support effective design, installation, and commissioning.

2.3.3 Energy Equity and Environmental Justice

Each measure in this CASE Report was evaluated for ESJ impacts using 4 criteria: cost, health, resiliency, and comfort. The details of that evaluation can be found in Section 1.4 and the 2028 CASE Methodology Report.

Based on the review, the Statewide CASE Team assessed the potential impacts of the proposed measure and determined that the measure is unlikely to have significant impacts on energy equity or environmental justice.

The Statewide CASE Team expects the proposal to improve the comfort of drivers' visual performance and safety, reduce light pollution, and reduce energy costs.

The Statewide CASE Team does not expect any impacts on the health, safety or disaster preparedness of ESJ communities.

2.3.4 Impacts on Jobs and Businesses

The Statewide CASE Team does not anticipate significant employment or financial impacts on any particular sector of the California economy. However, the proposed change may have modest impacts on employment in California. The Statewide CASE Team estimates the proposed change would affect statewide employment and economic output directly and indirectly through its impact on builders, designers, energy consultants, and building inspectors. Table 8, Table 9, and Table 10 outline the statewide implications for these job categories. For more information on the Statewide CASE Team's economic impacts methodology, see the 2028 CASE Methodology Report.

The Statewide CASE Team does not anticipate that the proposed changes would lead to the creation of new types of jobs or the elimination of existing types of jobs. In other words, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. Rather, it would lead to modest changes in the employment of existing jobs as seen in the tables below.

Table 8: Estimated Impact that Adoption of the Proposed Measure would have on the California Nonresidential Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income (Millions)	Total Value Added (Millions)	Output (Millions)
Direct Effects (Additional spending by Commercial Builders)	6	$ 0.47	$ 0.65	$ 1.32
Indirect Effect (Additional spending by firms supporting Commercial Builders)	3	$ 0.22	$ 0.37	$ 0.66
Total Economic Impacts	**9**	**$ 0.69**	**$ 1.02**	**$ 1.98**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[3]

Table 9: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultant Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building designers and energy consultants)	3	$298,848	$295,856	$467,629
Indirect Effect (Additional spending by firms supporting building designers and energy consultants)	1	$88,982	$123,667	$199,079
Total Economic Impacts	**4**	**$387,830**	**$419,524**	**$666,708**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

Table 10: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building inspectors)	1	$162,274	$192,437	$233,849
Indirect Effect (Additional spending by firms supporting building inspectors)	0	$15,029	$23,407	$40,767
Total Economic Impacts	**2**	**$177,302**	**$215,844**	**$274,616**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

The proposed change represents a modest adjustment, which is not expected to excessively burden or competitively disadvantage California businesses, nor is it

[3] IMPLAN® model, 2020 Data, IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078 www.IMPLAN.com

expected to lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not expect the proposed code changes to result in the creation of new businesses or the elimination of existing ones.

The proposed code changes would apply to all businesses operating in California, regardless of whether the business is incorporated inside or outside of the state.[4] Therefore, the Statewide CASE Team does not anticipate that the proposed changes would have advantageous or an adverse effect on the competitiveness of California businesses.

The Statewide CASE Team derived a reasonable estimate of the change in investment by California businesses based on the estimated change in economic activity associated with the proposed measure and its expected effect on business income. The Statewide CASE Team's IMPLAN modeling resulted in an estimated $93,385 increase in California business income due to the proposed code change. The Statewide CASE Team assumed that net business investment is positively correlated with business income and that a portion of business income will be allocated to net business investment.[5]

To estimate the portion of business income that would be allocated to net investment, the Statewide CASE Team analyzed national data on corporate profits and net capital investment by businesses that expand a firm's capital stock, referred to as net private domestic investment (NPDI).[6] As Table 11 shows, between 2020 and 2024, NPDI as a percentage of corporate profits ranged from a low of 18 percent in 2020 due to the worldwide economic slowdowns associated with the COVID-19 pandemic to a high of 28 percent in 2022, with an average of 23 percent. While only an approximation of the proportion of business income used for net capital investment, it provides a reasonable estimate of the proportion of proprietor income that business owners would reinvest into expanding their capital stock.

[4] Gov. Code, §§ 11346.3(c)(1)(C), 11346.3(a)(2); 1 CCR § 2003(a)(3) Competitive advantages or disadvantages for California businesses currently doing business in the state.

[5] 26 percent of proprietor income was assumed to be allocated to net business investment; see Table 11.

[6] Net private domestic investment is the total amount of investment in capital by the business sector that is used to expand the capital stock, rather than maintain or replace due to depreciation. Corporate profit is the money left after a corporation pays its expenses.

Table 11: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2020	389	2,212	18
2021	545	2,888	19
2022	825	2,951	28
2023	836	3,069	27
2024	885	3,441	26
5-Year Average	**Intentionally blank**	**Intentionally blank**	**23**

Source: (Federal Reserve Economic Data (FRED) n.d.)

Given the estimated total increase in California business income and net business investment ratio described above, the Statewide CASE Team estimates the proposed code change would result in a $21,921 increase in net private investment by California businesses.

2.3.5 Economic and Fiscal Impacts

The Statewide CASE Team does not anticipate that the economic impacts associated with the proposed measure would lead to a significant change (increase or decrease) in investment, directly or indirectly, in any affected sectors of California's economy. The proposed change would not result in economic disruption to any sector of the California economy. For more information on the Statewide CASE Team's economic and fiscal impacts methodology, see the 2028 CASE Methodology Report.

Adoption of this code change proposal would result in relatively modest economic impacts through the additional direct spending by including only those in the commercial building industry, architects, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2028 code cycle regulations would result in additional spending by those businesses.

Adoption of this code change proposal would result in relatively modest economic impacts through additional direct spending by including only those that are applicable: industrial contractors, architects, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by businesses or other organizations affected by the proposed 2028 code cycle regulations would result in additional spending by those businesses.

2.3.5.1 Effects on the State General Fund, State Special Funds, and Local Governments

The Statewide CASE Team does not expect the proposed code changes to have a measurable impact on California's General Fund, any state special funds, or local government funds.

Cost to State: The state government already has a budget for code development, education, and compliance enforcement. While the state government would be allocating resources to update the Title 24, Part 6 Standards, including updating education and compliance materials and responding to questions about the revised requirements, these activities are already covered by existing state budgets. The costs for the state government are small when compared to the overall cost savings and policy benefits associated with the code change proposals.

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this retraining is an expense to local governments, it is not a new cost associated with the 2025 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training, and resources provided by the IOU Codes and Standards program, such as Energy Code Ace. As noted in Section 2.2.2, the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

2.3.5.2 Mandates on Local Agencies or School Districts

There are no relevant mandates to local agencies or school districts. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

2.3.5.3 Costs to Local Agencies or School Districts

There are no costs to local agencies or school districts. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

2.3.5.4 Costs or Savings to Any State Agency

There are no costs or savings to any state agencies. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

2.3.5.5 Other Non-Discretionary Cost or Savings Imposed on Local Agencies

There are no added non-discretionary costs or savings to local agencies. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

2.3.5.6 Costs or Savings in Federal Funding to the State

There are no costs or savings in federal funding to the state. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

2.4 Parking Garage Daylight Adaptation Zones Nighttime Controls – Cost Effectiveness

2.4.1 Cost-Effectiveness Methodology

The Statewide CASE Team collaborated with the CEC staff to confirm that the cost-effectiveness methodology aligns with the CEC guidelines, including cost inclusion parameters. The 2028 CASE Methodology Report and Appendix A provide reproducibility details.

Per California Law (Public Resources Code 25000), a measure is considered cost effective if its benefit-to-cost ratio (BCR) is 1.0 or greater, amortized over the economic life of the structure. The Statewide CASE Team calculates BCR by dividing total dollar benefits by total dollar costs over a 15-year analysis period for lighting equipment.

Benefits are based on LSC, which assigns an hourly dollar value to energy use. LSC hourly factors assign different weights to each hour based on its long-term system value, with hours of high grid demand or high marginal emissions receiving greater weight than low-demand, off-peak periods. These factors are not utility rates, forecasts, or bill estimates. The CEC develops and publishes LSC hourly conversion factors for each code cycle.

Costs include first costs and ongoing maintenance costs assessed over the 30-year period. Benefits and costs are evaluated incrementally, relative to the most recently adopted Energy Code. The analysis excludes design costs and incremental code compliance verification costs.

2.4.2 Energy and Energy Cost Savings Results

To estimate energy savings from daylight adaptation zone lighting controls in parking garages, the Statewide CASE Team developed a model based on average daylight adaptation zone square footage. This model uses the mandatory maximum LPD from Title 24, Part 6 Table 601.3-C *[Table 140.6-C]* for garage lighting to determine the total daylight adaptation zone demand at full power, aligning with standard garage lighting LPD levels. These demand values are used to establish both the baseline and measure case models of per-unit demand.

The Statewide CASE Team calculated the base case annual per-unit demand using the full power adaptation zone lighting 24 hours a day for a full year.

The Statewide CASE Team calculated the measure case annual per-unit demand using sunrise and sunset times at California's geographic center in 2029. The Statewide CASE Team developed an hourly model covering a full year (8,760 hours), noting the portion of each hour in daylight, and then applied the adaptation zone lighting demand at each LPD to the appropriate hours and partial hours of the model to generate the annual measure case adaptation zone demand. The calculation then converted the base case and measure case demand levels to per-square-foot based on an average for the daylight adaptation zone size across all building types and climate zones.

The per-unit energy savings of this measure are not dependent on the climate zone or building type. Based on the data collected so far, the Statewide CASE Team calculated the per-square-foot energy savings for the first year to be 3.88 kWh. This energy savings calculation applies to both the dimming and on/off switching options because lighting provides the daylight adaptation zone with the applicable LPD for the same number of hours per year, regardless of the switching system installed. The proposed system controllers do not reduce peak demand during daylight hours, so the Statewide CASE Team does not anticipate any reduction in peak demand kW. The estimate for the first-year source energy savings per square foot is 10.9 kBtu.

Table 12 presents the per-square-foot energy savings and energy cost savings for parking garage new construction and additions across all 16 climate zones, excluding Group R occupancies.

Table 13 presents the per-square-foot energy savings and energy cost savings in terms of LSC savings realized over a 30-year period, in 2029 present value dollars (2029 PV$) for parking garage alterations, excluding Group R occupancies. The LSC methodology values peak electricity savings more than electricity savings during non-peak periods.

Table 12: Energy and Energy Cost Savings – Per Square Foot – New Construction and Additions – Parking Garage

Climate Zone	First Year Electricity Savings (kWh)	First Year Peak Demand Reduction (kW)	First Year Natural Gas Savings (kBtu)	First Year Source Energy Savings (kBtu)	Total 30-Year LSC Savings (2029 PV$)
1	3.88	0.0	0.0	10.6	40.37
2	3.88	0.0	0.0	10.6	40.35
3	3.88	0.0	0.0	10.6	40.75
4	3.88	0.0	0.0	10.6	40.21
5	3.88	0.0	0.0	10.6	39.67
6	3.88	0.0	0.0	10.6	41.28
7	3.88	0.0	0.0	10.6	40.73
8	3.88	0.0	0.0	10.6	40.11
9	3.88	0.0	0.0	10.6	39.00
10	3.88	0.0	0.0	10.6	39.88
11	3.88	0.0	0.0	10.6	40.28
12	3.88	0.0	0.0	10.6	39.78
13	3.88	0.0	0.0	10.6	40.11
14	3.88	0.0	0.0	10.6	41.23
15	3.88	0.0	0.0	10.6	40.35
16	3.88	0.0	0.0	10.6	39.20

Table 13: 2029 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – Parking Garage

Climate Zone	30-Year LSC Electricity Savings (2029 PV$)	30-Year LSC Natural Gas Savings (2029 PV$)	Total 30-Year LSC Savings (2029 PV$)
1	40.37	0.0	40.37
2	40.35	0.0	40.35
3	40.75	0.0	40.75
4	40.21	0.0	40.21
5	39.67	0.0	39.67
6	41.28	0.0	41.28
7	40.73	0.0	40.73
8	40.11	0.0	40.11
9	39.00	0.0	39.00
10	39.88	0.0	39.88
11	40.28	0.0	40.28
12	39.78	0.0	39.78
13	40.11	0.0	40.11
14	41.23	0.0	41.23
15	40.35	0.0	40.35
16	39.20	0.0	39.20

2.4.3 Incremental First Cost

As described in the energy analysis, the Statewide CASE Team considered two measure cases:

1. Compliance with time-switch or daylight sensor controls that dim the daylight adaptation lighting.
2. Compliance with time-switch or daylight sensor on/off controls that shut off the daylight adaptation lighting.

The Statewide CASE Team collected costs for both proposed code-change-compliant control systems and compared the base case with each system to estimate two incremental first costs. This is because the proposed updates to Section 601.2.2.3 *[Section130.1(c)]* in Title 24, Part 6 allow builders the flexibility to implement these controls in either an isolated daylight adaptation zone lighting system that turns off completely or an integrated system that dims to match the main garage lighting levels.

The Statewide CASE Team used RSMeans (2025 Q3) to generate initial cost estimates for the two measure cases for the proposed code change. The collected costs include an overhead and profit (O&P) cost estimate adjustment. To get more accurate cost estimates, the Statewide CASE Team engaged with industry stakeholders through polls, utility-sponsored stakeholder meetings, and interviews (Statewide CASE Team 2026).

The results in this Final CASE Report reflect a combination of stakeholder feedback and RSMeans data. Stakeholder engagement included input from lighting representatives, controls sales representatives, and manufacturers to ensure that the design methodology and cost estimates are based on reasonable assumptions.

The first incremental cost for daylight adaptation zone controls in parking garages involves the components listed in Table 14. The cost of these components represents the full incremental cost since the base case is a system without these controls. The Statewide CASE Team estimates the additional costs for design, commissioning, and ATT labor for this system as negligible. The entire garage lighting system already requires dimming systems that need these services, and the adaptation zone accounts for between 0.9 and 6.3 percent of the total parking garage square footage. The Statewide CASE Team estimated the average cable run length from the lighting fixtures to the control system and power source at 40 feet based on the interviews with a lighting subject matter expert and stakeholder feedback gathered during utility-sponsored stakeholder meetings (Statewide CASE Team 2026). The incremental cost estimate does not include the cost of the daylight adaptation zone lighting fixtures because the base case scenario already requires them.

Table 14: Incremental Measure First-Cost Components per installation in (2029 PV$) - Photocell and Timeclock designs

Cost Component ($/entrance)	Materials (incl. O&P)	Labor (incl. O&P)	Total Timeclock	Total Photocell	Source
Intermediate Metal conduit, 3/4" diameter	$252	$586	$838	$838	RSMeans
Intermediate Metal Conduit Elbows	$27	$75	$102	$102	RSMeans
Intermediate Metal Conduit Couplings	$1721	$3036	$56	$56	RSMeans
Conduit Beam Clamp	$8299	$197	$296	$296	RSMeans
Wire, copper solid, 600 volt, #12	$5366	$179	$246	$246	RSMeans
Astronomic Clock	$572	$132	$703	$0	Web Crawl
Circuit Breaker, 3 pole 600V	$777	$376	$1153	$0	RSMeans
Lighting Control Relay	$0	$105	$105	$0	RSMeans
Daylight Level Sensor, on/off or dimming	$177	$132	$0	$309	Industry Consultant
Weatherproof Junction Box, Connectors, Terminations	$6	$111	$117	$117	RSMeans
Total	NA	NA	$3,617	$1,964	N/A

2.4.4 Incremental Maintenance and Replacement Costs

Incremental maintenance cost is the incremental cost of replacing equipment or its parts, as well as the periodic maintenance required to keep the equipment operating, relative to current practices, over the 30-year analysis period. The CEC has established a 30-year measure life for assessing nonresidential lighting measures. The energy savings would persist throughout.

Daylight photocell sensors and timeclock controls typically last 15 years or more and do not require regular maintenance unless they include battery-operated wireless components, such as sensors. Because the proposed measure applies to parking garages where visible conduit is standard practice, and it is possible to implement the proposed code change with sensors and controls that do not require batteries, it is unlikely that a building owner would install a wireless system that is more expensive and requires maintenance.

For these reasons, the Statewide CASE Team did not include battery replacement in the maintenance cost for daylight photocell sensors or timeclock controls, so the incremental maintenance and replacement cost would be the cost of replacing the photocell itself once per 30-year period for 309 dollars, including labor (2026 Quarter 2). There are no anticipated maintenance or replacement costs for the time clock option. This assumption is similar to the work done in the 2013 Indoor Lighting Controls Final CASE Report (Statewide CASE Team 2011).

A description of the incremental maintenance and replacement costs, as well as estimation of present value of maintenance and replacement costs, are provided in the 2028 CASE Methodology Report.

2.4.5 Cost Effectiveness

Table 15 through Table 18 present the results of the per-unit cost-effectiveness analyses for the two design scenarios. In the tables below, all values are presented in 2029 PV$. Benefits represent 30-year LSC savings and other savings, including incremental first-cost savings if the proposed first cost is less than the current first cost, incremental maintenance cost savings if the proposed maintenance costs are less than the current maintenance costs, and incremental residual value if proposed residual value is greater than current residual value at the end of the 30-year period of analysis. Costs represent the total incremental PV cost, including incremental equipment, replacement, and maintenance costs over the period of analysis. The analysis treats a negative incremental maintenance cost as a positive benefit. If total incremental costs are zero, the BCR is considered infinite. Costs and other savings are discounted at a real (inflation-adjusted) three percent rate. If there are no total incremental PV costs, the BCR is infinite.

The Statewide CASE Team presents 30-year cost-effectiveness results for both the photocell and timeclock control system designs. The systems offer the same savings per square foot but differ in initial costs. Although the time clock design method has nearly double the upfront cost of the photocell, both systems demonstrate a very positive BCR. The Statewide CASE Team conducted the analysis using an average for the daylight adaptation zone size across all building types and climate zones.

While the size of the adaptation zone will differ, the cost of the control system will stay the same. Thus, the larger the zone, the lower the cost per square foot. However, since the required LPDs are based on the watts used per square foot, the energy savings per square foot will remain consistent. For this reason, for the BCR to reach 1.0 or below, the daylight adaptation zone would need to be 141 square feet for the timeclock design and 74 square feet for the photocell design. Using a minimum one-way commercial garage entrance with a width of 12 feet, the zones would be 11.7 and 6.2 feet deep, respectively. Recommended practice is two times the vertical clearance. In California, the minimum mandatory height is 8.16 feet, making the minimum zone 16.32 feet deep, with maximum adaptation zone depths of 66 feet. The Statewide CASE Team used a representative average daylight adaptation zone size of 25 feet wide and 45 feet deep, or 1,125 square feet for calculations. This size is a conservative estimate based on the 2021 International Zoning Code (IZC) minimum commercial two-lane entrance width of 24 feet, and the Title 24, Part 6 Table 601.3-C *[Table 140.6-C]* maximum daylight adaptation zone depth of 66 feet.

Table 15: 30-Year Cost-Effectiveness Summary Per Square Foot – New Construction and Additions – Photocell Design

Building Prototype	Benefits LSC Savings + Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
Assembly	39.92	2.02	19.76
Grocery	39.92	2.02	19.76
Hospital	40.08	2.02	19.84
OfficeLarge	39.94	2.02	19.77
OfficeMediumLab	40.42	2.02	20.01
ParkingGarage	40.16	2.02	19.88
RetailLarge	40.18	2.02	19.89
SchoolLarge	40.17	2.02	19.85
Total	40.11	2.02	19.85

Table 16: 30-Year Cost-Effectiveness Summary Per Square Foot – Alterations – Photocell Design

Building Prototype	Benefits LSC Savings + Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
Assembly	40.04	2.02	19.82
Grocery	40.07	2.02	19.83
Hospital	40.05	2.02	19.82
OfficeLarge	39.99	2.02	19.79
OfficeMediumLab	40.28	2.02	19.94
ParkingGarage	40.08	2.02	19.84
RetailLarge	40.08	2.02	19.88
SchoolLarge	40.17	2.02	19.84
Total	40.11	2.02	19.85

Table 17: 30-Year Cost-Effectiveness Summary Per Square Foot – New Construction and Additions – Timeclock Design

Building Prototype	Benefits LSC Savings + Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
Assembly	39.92	3.22	12.42
Grocery	39.92	3.22	12.42
Hospital	40.08	3.22	12.47
OfficeLarge	39.94	3.22	12.42
OfficeMediumLab	40.42	3.22	12.57
ParkingGarage	40.16	3.22	12.49
RetailLarge	40.18	3.22	12.50
SchoolLarge	40.17	3.22	12.49
Total	40.11	3.22	12.48

Table 18: 30-Year Cost-Effectiveness Summary Per Square Foot – Alterations – Timeclock Design

Building Prototype	Benefits LSC Savings + Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
Assembly	40.04	3.22	12.45
Grocery	40.07	3.22	12.46
Hospital	40.05	3.22	12.46
OfficeLarge	39.99	3.22	12.44
OfficeMediumLab	40.28	3.22	12.53
ParkingGarage	40.08	3.22	12.47
RetailLarge	40.08	3.22	12.46
SchoolLarge	40.17	3.22	12.50
Total	40.11	3.22	12.47

2.5 Parking Garage Daylight Adaptation Zones Nighttime Controls – Statewide Impacts

2.5.1 Statewide Energy and Energy Cost Savings

To assess statewide impacts, the Statewide CASE Team used the California Building Energy Code Compliance Software (CBECC) building prototype model floor plans to estimate the number of daylight adaptation zones in the 2029 nonresidential construction forecast. The Statewide CASE Team used the square footage of the Open Parking Garage prototype to estimate the number of parking spaces, then used this parking space count to estimate the entrance counts for these parking structures based on potential traffic flow. The Statewide CASE Team used a similar process to capture statewide impacts on parking garages attached to other types of commercial buildings not included as the Open Parking Garage building type in the construction forecast. The Statewide CASE Team used CBECC building prototype model floor plans for the Large Office, Large Retail, Large School, Assembly, Hospital, Laboratory, and Grocery prototypes to develop estimated average entrance counts for building type specific attached commercial parking garages.

The Statewide CASE Team estimated that 50 percent of the appropriate building types in urban climate zones in the 2029 nonresidential construction forecast will include attached parking garages. The Statewide CASE Team then applied the entrance counts for each prototype to estimate the statewide impacted square footage and to calculate the annual base case and measure case statewide energy use. Because the analysis does not include all building types across all climate zones, some climate zones do not show impacted new construction.

While the Statewide CASE Team's analysis used multiple building types to estimate statewide impacted square footage, the attached building type does not affect parking garage construction standards or the energy impacts of the proposed code change.

See the 2028 CASE Methodology Report for more details on how statewide savings are calculated. Appendix C presents the assumptions on the percentage of the total construction forecast that the proposed measure would impact.

For more details on the methodology and context of estimating the current market share rate, as well as statewide energy and energy cost savings, see the 2028 CASE Methodology Report.

The tables below present the first-year statewide energy and LSC savings from newly constructed buildings and additions (Table 19) and alterations (Table 20) by climate zone. Table 21 presents first-year statewide savings from new construction, additions, and alterations.

Table 19: Statewide Energy and LSC Impacts – New Construction and Additions

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026 (Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	-	-	0.00	-	-	$0.00
2	2,500	0.01	0.00	-	0.03	$0.10
3	30,500	0.12	0.00	-	0.32	$1.24
4	20,500	0.08	0.00	-	0.22	$0.82
5	1,000	0.00	0.00	-	0.01	$0.04
6	18,000	0.07	0.00	-	0.19	$0.74
7	20,500	0.08	0.00	-	0.22	$0.83
8	30,500	0.12	0.00	-	0.32	$1.22
9	41,500	0.16	0.00	-	0.44	$1.62
10	20,500	0.08	0.00	-	0.22	$0.82
11	3,500	0.01	0.00	-	0.04	$0.14
12	21,500	0.08	0.00	-	0.23	$0.86
13	1,000	0.00	0.00	-	0.01	$0.04
14	2,500	0.01	0.00	-	0.03	$0.10
15	1,000	0.00	0.00	-	0.01	$0.04
16	1,000	0.00	0.00	-	0.01	$0.04
Total	**216,000**	**0.84**	**0.00**	**-**	**2.28**	**$8.66**

Table 20: Statewide Energy and LSC Impacts – Alterations

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2026 (Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	67	0.00	0.00	-	0.00	$0.00
2	3,233	0.01	0.00	-	0.03	$0.13
3	95,400	0.37	0.00	-	1.01	$3.89
4	57,300	0.22	0.00	-	0.61	$2.30
5	1,733	0.01	0.00	-	0.02	$0.07
6	60,467	0.23	0.00	-	0.64	$2.50
7	49,700	0.19	0.00	-	0.53	$2.02
8	96,433	0.37	0.00	-	1.02	$3.87
9	133,367	0.52	0.00	-	1.41	$5.20
10	68,433	0.27	0.00	-	0.72	$2.73
11	2,467	0.01	0.00	-	0.03	$0.10
12	71,600	0.28	0.00	-	0.76	$2.85
13	2,633	0.01	0.00	-	0.03	$0.11
14	5,033	0.02	0.00	-	0.05	$0.21
15	900	0.00	0.00	-	0.01	$0.04
16	2,467	0.01	0.00	-	0.03	$0.10
Total	**651,233**	**2.53**	**0.00**	**-**	**6.88**	**$26.10**

Table 21: Statewide Energy and LSC Impacts – New Construction, Additions, and Alterations

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First -Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
New Construction & Additions	0.8	-	-	2.3	9
Alterations	2.5	-	-	6.9	26
Total	**3.4**	**-**	**-**	**9.2**	**35**

2.5.2 Statewide Greenhouse Gas Emissions Reductions

Table 22 presents the estimated first-year reduction in greenhouse gas (GHG) emissions resulting from the proposed code change. In this initial year, the Statewide CASE Team expects to avoid 572 metric tons of carbon dioxide equivalent (CO_2e) emissions. The Statewide CASE Team calculated these reductions, along with their associated monetary value, using hourly GHG emissions factors published alongside the LSC hourly factors and source energy hourly factors in the research versions of CBECC, as well as data from the CEC's 2028 Metrics Report. See the [2028 CASE Methodology Report] for additional information.

Table 22: First-Year Statewide GHG Emissions Impacts

Construction Type	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2e)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO2e)	Total Reduced GHG Emissions (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions ($)
New Construction & Additions	121	0.0	121	$14,896
Alterations	365	0.0	365	$44,911
Total	**486**	**0.0**	**486**	**$59,807**

2.5.3 Statewide Water Use Impacts

The proposed code change would not result in water use impacts.

2.5.4 Statewide Material Impacts

The proposed code change requires the installation of new equipment where there was previously none. This would increase the usage of all materials present in the new equipment including copper, steel, and plastic. The proposed measure is built to allow for multiple compliance pathways with different equipment. For this reason, there are two potential material impact tables included below. The Statewide CASE team researched the required equipment to determine the typical composition to develop estimates of how this would increase statewide usage of these materials. Statewide CASE Team discussion with subject matter experts showed that parking structure lighting controls and systems are constructed of steel, plastic, and copper. These material impacts were scaled based on the number of anticipated installations in new construction and alterations and the amount of each material (per unit) to develop statewide impacts

For more information on the Statewide CASE Team's methodology and assumptions used to calculate embodied GHG emissions, see the 2028 CASE Methodology Report.

Table 23: First-Year Statewide Impacts on Material Use, Timeclock Design

Material	Impact	Per-Unit Impacts (Pounds per Square Foot)	First-Year Statewide Impacts (Pounds)	Embodied GHG emissions saved (Metric Tons CO2e)
Mercury	No Change	0	0	0
Lead	No Change	0	0	0
Copper	Increase	0.003022	60,351	-77
Steel	Increase	0.024983	498,888	-274
Plastic	Increase	0.001867	37,275	-31
Total	**N/A**	**N/A**	**N/A**	**-382**

Table 24: First-Year Statewide Impacts on Material Use, Photocell Design

Material	Impact	Per-Unit Impacts (Pounds per Square Foot)	First-Year Statewide Impacts (Pounds)	Embodied GHG emissions saved (Metric Tons CO2e)
Mercury	No Change	0	0	0
Lead	No Change	0	0	0
Copper	Increase	0.002756	55,026	-70
Steel	Increase	0.019561	390,611	-215
Plastic	Increase	0.000756	15,088	-13
Total	**N/A**	**N/A**	**N/A**	**-297**

2.5.5 Environmental Impacts

The proposed measure would not have a significant environmental impact.

2.5.6 Other Non-Energy Impacts

The proposed measure may minimize light pollution and light trespass due to the reduced light levels at parking garage entries at night.

2.6 Parking Garage Daylight Adaptation Zones Nighttime Controls – Proposed Language Code

The proposed code language in this section includes only changes relevant to this measure. The intent is to clearly illustrate the scope of this measure. The proposed code language that encompasses the changes resulting from all the measures in this CASE Report can be found in Appendix I.

2.6.1 Guide to Markup Language

The proposed changes to the standards, Reference Appendices, and the Alternative Calculation Method (ACM) Reference Manuals are provided below. Changes to the 2025 documents should be marked with dark blue underlining (new language) and ~~strikethroughs~~ (deletions). New to the 2028 Energy Code is to italicize defined terms when the terms are being used in their defined context. In-line comments that are not part of the proposed code language but are used to help describe the purpose of what is proposed are included with grey highlight and italics.

Markups are provided to the restructured 2025 Energy Code that the CEC developed in response to feedback that aligning the structure of Title 24, Part 6 with other parts of the California Building Standards Code (Title 24) would improve readability, usability, and navigation. New section numbers are shown in bold, followed by square brackets that document the section in the 2025 Title 24, Part 6 section numbers prior to the restructuring. For example, "**Section 601.1** [Section 130.0(a)] **General**" contains the content that is in the current Section 130.0(a).

Posting the proposed code language in this format is useful, as it helps describe how the Energy Code changes proposed for nonresidential occupancies are isolated from the requirements for residential occupancies, which are prohibited from being changed until the 2031 code cycle by Assembly Bill 130.

2.6.2 Administrative Code (Title 24, Part 1)

There are no proposed changes to Title 24, Part 1.

2.6.3 Energy Code (Title 24, Part 6)

SUBCHAPTER 6 ELECTRICAL AND LIGHTING

601.2 Mandatory Requirements (Newly Constructed, Additions, Alterations)

601.2.2 Indoor lighting controls.

EXCEPTION to Section 601.2.2.3.6.5: Luminaires located in a parking garage daylight adaptation zone and dedicated to providing illuminance for daylight adaptation.

601.2.2.7 *[New Section]* Parking Garage Daylight Adaptation Zone Lighting Controls.

Parking garage daylight adaptation zone lighting shall be separately controlled to automatically reduce the lighting power density per Table 601.3-C Parking Garage Area - Parking Zone and Ramps from sunset to sunrise and be increased to the lighting power density for Daylight Adaption Zones from sunrise to sunset.

EXCEPTION to Section 601.2.2.7: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

2.6.4 Reference Appendices

There are two manners that the adaptation lighting controls can be implemented, so there are two additions recommended to the Indoor Lighting Acceptance Tests document (NA7.6)

The first method (in order as they appear in the NA7.6 document) is to employ a photocell to indicate to the lighting system that it is time to be in "daytime" or "nighttime" mode. This section proposed below is an addition to Section NA7.6.1 Automatic Daylight Controls Acceptance Tests and is an addition of one more section that is specific to daylight adaptation zone lighting systems.

Note that the daylight adaptation lighting zone system doesn't have a specific performance requirement related to dimming responsiveness (most don't use any dimming at all), so the acceptance tests do not include an intermediate range test, regardless whether the system employs dimming controls. The end point performance is important, and an intermediate point is not.

Add the following to Section NA7.6.1

NA7.6.1.6 Switching or Dimming Control Systems Functional Testing for Parking Garage Daylight Adaptation Zone Applications

Switching or dimming control systems for daylight adaptation controls are required to manage the adaptation zone lights in a manner that turns OFF the added lighting power allowance in the adaptation zone but is not required to impact the general lighting system if it is separate, or is permitted to maintain an output that is consistent with the general lighting LPA if the systems are combined for the adaptation zone.

1. **Reference location.** The reference location for the adaptation zone lighting system is a location near the photocell that will control the adaptation lighting zone lighting equipment.

2. **Reference illuminance.** A reference illuminance of 10 footcandles should be used for testing the function of the adaptation lighting zone system unless another value is specified by the design engineer in the lighting controls documents. Note that this illuminance value is at the photocell and in the orientation of the photocell receptor and is not an illuminance on the garage deck or ramp.
3. **Nighttime test.** Simulate or provide conditions without daylight on the photocell sensor. Verify and document the following:
    a. *If the adaptation zone lighting is a separate system:* Document that the adaptation zone lighting system is turned OFF when illuminance at the reference location is below the 50 percent intended design illuminance trigger level (or 5 footcandles, if not designated in the design documents).
    b. *If the adaptation zone lighting is part of a combined dimming system:* Document that the combined lighting control system is dimmed to 10 percent of the maximum output when the reference location is below 50 percent of the intended design or reference illuminance. Circuit amperage, a lighting control system reading, or a focused illuminance meter that reads only the output of the lighting equipment are all suitable methods for verification of this output.
    c. Light output is stable with no visible flicker.
4. **Daytime test.** Simulate or provide bright conditions where the illuminance is greater than 150 percent of the intended design illuminance trigger level (or 15 footcandles, if this is not designated in the design documents) at the reference location photocell. Verify and document the following:
    a. The daylight adaptation zone lighting system is operating at the fully intended adaptation lighting output per the specifications of the design engineer.

    No intermediate test is required for dimming systems in a daylight adaptation zone lighting system.

The second method of compliance for a lighting control system associated with a daylight adaptation lighting zone is to use an astronomic time clock device. There is already a time clock section is NA7.6, so this is a proposed addition to the appropriate area to use when a daylighting adaptation lighting zone uses an astronomic time clock for the control device. In this circumstance, Section NA7.6.2.5 (Automatic Time Switch Lighting Controls Construction Inspection) will apply, but does not require modification. In addition to this section, the following addition is proposed.

Add the following to Section NA7.6.2:

NA7.6.2.7 Automatic Astronomic Time Switch Lighting Controls Functional Testing for Parking Garage Adaptation Zone Lighting

1. "Daylight" Test. Simulate a daytime condition in the controlled adaptation zone. Verify and document the following:
    a. The automatic time switch control turns the controlled adaptation zone lighting ON.
2. "Nighttime" Test. Simulate a nighttime condition in the controlled space. Verify and document the following:
    a. The automatic time switch control turns OFF or dims the lighting equipment that is designated as adaptation zone lighting. Circuit amperage, a lighting control system reading, or a focused illuminance meter that reads only the output of the lighting equipment are all suitable methods for verification of this output.

2.6.5 Compliance Manuals

The Statewide CASE Team will provide the CEC with recommended revisions to compliance manuals after the 45-Day Language is published.

2.6.6 ACM Reference Manual

There are no proposed changes to the ACM Reference Manual.

2.6.7 Compliance Forms

As discussed in Section 2.1.4.5, updates to forms NRCC/LMCC-LTI-E, NRCI/LMCI-LTI-E, NRCA-LTI-02-A, and NRCA-LTI-03-A will be required to incorporate the proposed code change.

The Statewide CASE Team can support the CEC in implementing these updates if the proposed change is adopted.

The NRCC-LTI-E form should have a minor modification done to Table H to add a "Parking Garage Adaptation Zone Control" column in the Area Level Controls portion of the table.

The NRCI-LTI-E form should have a field added to the **Section F: INSTALLATION DETAILS; Indoor Lighting Controls** section that designates a "Parking Garage Adaptation Zone Control."

Whether the designer uses an astronomic time clock or a photocell to control the adaptation zone lighting equipment will determine if they use NRCA-LTI-02-A or NRCA-LTI-03-A for acceptance testing.

If the designer used an astronomic timeclock, the ATT must use NRCA-LTI-02-A. The recommended changes in this form are as follows:

- Add a check box near the top indicating the type of controls being tested: "Parking garage adaptation zone lighting control."
- Duplicate Table B-1 and reduce/simplify it and change the terminology to be simulating "Daytime" and "Nighttime" operation. Make it clear the lights are supposed to be ON during the daytime and OFF at night.
- Adjust the weekend/holiday language to ensure that the adaptation lights are intended to remain functional whenever the access to the parking garage is possible and not specifically tied to weekends/holidays unless this syncs with the specific gate schedule for access.

If the designer uses a photocell to control the lighting, the ATT must use NRCA-LTI-03-A. The recommended changes to this form are as follows:

- Add a check box item in Table A below Step 3 (possibly labelled 3A) to check on adaptation zone lighting; "The adaptation zone lighting is controlled by a daylight responsive controller that functions independently of the other daylight controls in the parking garage."
- Duplicate Table B-2 and label it "B-3: Parking Garage Adaptation Zone Control System Functional Testing."
- Simplify this new table to test that the system is turning ON above 150 percent of the design target illuminance (presumed to be 10 footcandles) and that the lights are turned OFF below 50 percent of the same target illuminance.
- The testing does not need to demonstrate illuminance at a specific location on the garage floor, which would simplify the process considerably. Also, since the system isn't needed to be responsive/adaptive to daylight in the same manner as a typical indoor lighting system in a workspace, there is no need for an intermediate light level test. Only the end points are needed to prove that that lighting system is turning OFF at night and ON again once daylight is strong enough to potentially cause an adaptation zone visual concern.

3. Require Occupant Sensing Controls in More Spaces

3.1 Require Occupant Sensing Controls in More Spaces – Measure Description

3.1.1 Proposed Code Change

The proposed measure expands the list of space types in Section 601.2.2.3.6 *[Section 130.1(c)6]* that would be required to use partial- or full-OFF occupant sensing controls, rather than being permitted to comply using time-based automatic shut-OFF controls. Additional space types under consideration, along with the proposed lighting control strategies, include:

- **Computer room** – Full-OFF lighting
- **Laboratory** – Partial-OFF lighting
- **Lounge, breakroom, or waiting area** – Full-OFF lighting

This proposed change excludes hotel/motel buildings and nonresidential buildings with Group R occupancies and Group R common use and public areas as mandated by California Assembly Bill 130.

Expanding occupancy sensing control of lighting to these space types would result in energy savings compared to the current code baseline of scheduled (time switch) control of lighting.

Table 25 summarizes the scope of the proposed code change.

Table 25: Scope of Proposed Code Change – Occupancy Sensing Controls

A ☑ indicates the proposed code change is relevant.

Building Type(s)	Construction Type(s)	Type of Change
☐ Single Family	☑ New Construction	☑ Mandatory
☐ Multifamily	☑ Additions	☐ Prescriptive
☑ Nonresidential (Not Group R uses)	☑ Alterations	☐ Performance

Application Climate Zones	Energy Code Sections	Compliance Forms	Sections of ACM Reference Manuals
Climate Zones 1–16	• Part 6, Section 601.2.2.3.6 *[Section 130.1(c)6]* • Part 6, Section 601.5.2.2.4 *[Section 141.0(b)2I]*	NRCC/LMCC-LTI-E, NRCI/LMCI-LTI-E, NRCC/LMCC-MCH-E, and NRCI/LMCI-MCH-E	Update to include new control requirements and baseline energy use assumed for spaces now required to use occupancy sensors for both lighting and HVAC occupied standby

Acceptance Testing	Updates to Compliance Software
☑ No changes to third party verification	☐ No updates
☐ Update existing acceptance testing requirements	☑ Update existing feature
☐ Add new verification requirements	☐ Add new feature

3.1.2 Proposed Code Change – Interaction with HVAC Control Requirements

For some of the proposed space types, the lighting control requirements would also trigger compliance with additional HVAC control requirements per Section 401.2.1.2.5 *[Section 120.1(d)5]* or Section 912.2.1 *[Section 140.9(c)1]*.

Table 26: Proposed space types for occupancy sensing lighting controls and interaction with HVAC controls requirements

Space Primary Function Type	Lighting Reduction	HVAC Interaction	HVAC Section
Computer room	Full-OFF	Occupied Standby	Section 401.2.1.2.5 [Section *120.1(d)5]*
Laboratory	Partial-OFF	Airflow Reduction	Section 912.2.1 [Section 140.9(c)1]
Lounge, breakroom, or waiting area	Full-OFF	Occupied Standby	Section 401.2.1.2.5 [Section *120.1(d)5]*

3.1.2.1 HVAC Occupied Standby Controls

HVAC occupied standby controls set cooling setpoints, set back heating setpoints, and shut off ventilation air to the zone when spaces are sensed by vacancy sensors as being unoccupied. This control is required for spaces where occupant sensing lighting controls are required by Section 601.2.2.3 *[Section 130.1(c)]* and where HVAC occupied standby zone controls and airflow reductions are allowed by Section 401.2.1.2.5 *[Section 120.1(d)5].* Spaces are identified as occupied standby capable in accordance with Section 401.2.1.2.5 *[Section 120.1(d)5]* in Table 401.2-A *[Table 120.1-A]* for all spaces that in the "Notes" column are designated as F, with the footnote indicating, "F – Ventilation air for this occupancy category shall be permitted to be reduced to zero when the space is in occupied-standby mode."

Requiring HVAC occupied standby in all space types where lighting must include occupancy controls and where HVAC systems are permitted to reduce ventilation rates to zero when a space is sensed as unoccupied, encourages integrated use of occupancy sensing controls for both lighting and HVAC systems. However, the HVAC designer could still specify a separate occupancy sensing system to control HVAC operation independently, without integrating with the occupancy sensors used for lighting controls.

In alignment with the 2028 Air Distribution CASE report, this proposal includes editorial updates to Table 401.2-A *[Table 120.1-A]* to align with recent ASHRAE 62.1 addenda. ASHRAE 62.1-2022 Addendum b removes "Breakrooms" from the Office Buildings occupancy category because a related "Breakrooms" space type already exists in the General occupancy category which permits the ventilation air to be reduced to zero when the space is in occupied-standby mode. Removing the duplicative breakroom space type reduces ambiguity and aligns the proposed code language with ASHRAE 62.1. As such, energy savings associated with the clarified office breakrooms space type are included in the claimed savings for this measure.

3.1.2.2 Laboratory Ventilation and Safety Considerations

Although improper operation of occupied standby controls is inconvenient, the implications are more significant for laboratory ventilation systems, which are a life safety function. Section 912.2.1 *[Section 140.9(c)1]* requires laboratory ventilation exhaust systems to maintain a default ventilation rate of six air changes per hour (ACH) when the laboratory is occupied and to reset to four ACH when the space is sensed as unoccupied. Alternate ventilation rates are permitted where required by other applicable codes or by the environmental health and safety (EH&S) department.

As discussed for occupied standby controls, both initial setup and ongoing verification of occupancy sensing performance are substantially easier when the same occupancy sensors used for the laboratory ventilation system also control lighting. Lighting provides immediate visual feedback that the control system is correctly detecting occupancy within the space. Integrating laboratory ventilation reset controls with lighting occupancy controls therefore improves both system verification and operational safety.

In laboratory environments, occupants may be transporting hazardous materials or conducting sensitive work, making it undesirable for lighting to turn fully off while the space is occupied. For this reason, occupancy controls in laboratory spaces should only partially reduce lighting when vacancy conditions are detected during a building's scheduled occupied periods. This provides a clearly noticeable reduction in lighting energy use while maintaining illumination levels that support safe movement and task visibility within the space.

In addition to enhancing safety, this control approach also captures energy savings during temporary vacancy periods such as lunch breaks, meetings, or other short-duration absences. Separate scheduling controls can then provide full lighting shutoff during scheduled unoccupied periods after normal operating hours.

3.1.2.3 Energy Savings Methodology

Energy savings from reduced lighting and ventilation operation are expected, and evaluation of interactive effects between lighting and HVAC systems is included in the analysis. For energy savings analysis, the proposed space types are evaluated within the following building types where they are explicitly identified as key space types and have established prototype models in energy modeling software:

- Large Office
- Medium Office
- Small Office
- Large School
- Small School
- Large Retail
- Medium Retail
- Strip Mall Retail

3.1.2.4 Applicability

The proposed change is being considered for new construction, additions, and alterations for nonresidential buildings that include the previously listed space types. The proposed measure applies to new construction and additions of newly considered space types for all building types. This measure is only required for alterations complying with Section 601.5.2.2.4(1) *[Section 141.0(b)2Ii]* and includes an exemption for alterations complying with Section 601.5.2.2.4(2) and 601.5.2.2.4(3) *[Sections 141.0(b)2Iii and 141.0(b)2Iiii].*

3.1.2.5 Acceptance Testing

Existing acceptance test procedures for occupant sensing controls are sufficient to verify compliance, and no new or modified test methods are anticipated.

3.1.3 Benefits of Proposed Change

Expanding the application of partial- or full-OFF occupant sensing controls supports California's long-term goals for reducing energy use and GHG emissions in the building sector. Occupant Sensing controls ensure that lighting and ventilation systems operate only when needed, minimizing wasted energy in unoccupied spaces. This measure represents a meaningful step toward more adaptive, occupant-based control strategies that are essential for achieving deeper energy savings and advancing statewide objectives.

This approach also responds to opportunities identified in prior codes and standards research, including the application of occupant sensing controls in rooms housing server racks in data centers (Code Readiness 2026).

3.1.3.1 Alignment with State and National Energy Goals

By requiring these controls in additional space types, the proposal strengthens alignment between California's Title 24, Part 6, and ASHRAE 90.1-2025, improving consistency for designers, manufacturers, and building operators who work across jurisdictions. ANSI/ASHRAE/IES Addendum bd to ANSI/ASHRAE/IES Standard 90.1-2022, which establishes select lighting requirements in ASHRAE 90.1-2025, already requires occupant sensing controls in several space types not currently covered in Title 24, including copy rooms, lounges, breakrooms, and hospital lounges, as well as newly added spaces such as atriums, data centers, and nursing stations (ASHRAE 90.1 Addendum bd 2025). Incorporating similar requirements into Title 24 helps ensure that California buildings continue to reflect leading energy efficiency practices while remaining compatible with national standards.

3.1.3.2 Energy and Cost Savings

Implementing this measure results in measurable reductions in lighting and HVAC energy use. These savings translate into lower operating costs for building owners and occupants, as well as reduced peak demand and emissions on a statewide scale. The measure builds on the framework and assumptions developed in the 2022 Indoor Lighting CASE Report (The Statewide CASE Team 2020).

3.1.3.3 Integrated Occupancy Sensing Benefits

In spaces where occupancy-based lighting controls also trigger HVAC occupied standby controls, the analysis conducted in this study found that heating and cooling electricity savings from the HVAC occupied standby controls can provide up to 23 percent more savings than the lighting savings alone, depending on building type.

The integrated control approach provides additional operational and maintenance benefits. Using the same occupancy sensors for both lighting and HVAC control simplifies verification that the system is functioning properly. When occupancy is not detected correctly, lighting responses such as lights turning OFF or dimming provide immediate and visible feedback, making sensor or control issues easier to identify than HVAC-only control responses.

Integrated systems also simplify confirmation of adequate sensor coverage within a space. Inadequate sensor placement is more readily apparent when lighting controls are affected because portions of a room may remain unlit or dimmed during occupancy. By comparison, troubleshooting HVAC-only occupancy sensing can be more difficult because impacts occur gradually and intermittently, such as delayed airflow reduction or gradual temperature drift in occupied areas.

3.1.4 Background Information

Occupant Sensing controls are a lighting control strategy that automatically adjusts lighting based on whether a space is occupied. Control solutions supporting this control strategy typically use passive infrared (PIR), ultrasonic, or dual-technology sensors to detect movement or body heat. Microwave and microphonic occupant sensing technologies are also available but less frequently installed. When no occupants are detected, the system reduces or turns OFF lighting power after a preset delay period, and in some cases, communicates an unoccupied signal to the HVAC system to reduce ventilation or conditioning in the space. By ensuring that lighting and HVAC systems operate only when needed, occupant sensing controls save energy, reduce operating costs, and improve overall building efficiency.

Title 24, Part 6 currently requires occupant sensing controls in certain space types, such as offices, classrooms, restrooms, and corridors. However, several other space types are still permitted to meet lighting shut-OFF requirements using time-based controls. Time-based controls turn lights OFF on a schedule; however, they cannot account for variations in actual occupancy, leading to wasted energy in intermittently used areas such as lounges, breakrooms, and waiting areas. Expanding the use of occupant sensing controls to these additional spaces would reduce this waste and improve system responsiveness.

In addition to lighting savings, the proposed change supports integration with HVAC “occupied standby” operation, which allows systems to reduce or shut-OFF ventilation when spaces are unoccupied. This coordination between lighting and HVAC controls can deliver additional energy savings and reduce peak electricity demand, helping buildings operate more efficiently and respond more effectively to grid conditions. As California continues to advance toward a decarbonized energy system that includes options for demand management when price signals or grid needs impose cost or energy-reducing pressures, occupant-based control strategies play an important role in ensuring that buildings consume energy only when needed.

Over the past decade, occupant sensing technologies have become more reliable, cost-effective, and easier to integrate with building management systems. Market adoption has been supported through utility incentive programs, including prescriptive rebates for lighting control retrofits and demand-responsive HVAC systems. Prior research funded through the CEC's Electric Program Investment Charge (EPIC) and PG&E's Code Readiness initiatives has also evaluated the energy performance and code readiness of occupant-based controls, including a 2025 Code Readiness study that identified computer rooms as a key opportunity for expanding occupant sensing control requirements (Code Readiness 2026).

National standards and other model codes have also advanced similar provisions. ANSI/ASHRAE/IES Addendum bd to ANSI/ASHRAE/IES Standard 90.1-2022, which establishes select lighting requirements in ASHRAE 90.1-2025, includes expanded requirements for partial- or full-OFF occupant sensing controls across a wide range of space types, including copy rooms, lounges, hospital lounges, and data centers. Aligning Title 24 requirements with ASHRAE 90.1 promotes consistency for designers and manufacturers while maintaining California's leadership in energy efficiency and code innovation. Expanding these requirements represents a natural progression of the state's ongoing effort to modernize lighting control requirements, enhance interoperability with HVAC systems, and achieve greater whole-building energy savings.

3.1.5 Modifications to Energy Code Documents

This section provides descriptions of how the proposed code change will affect each Energy Code document. See Section 3.7 of this report for detailed revisions to code language.

3.1.5.1 Energy Code Change Summary

The changes to the code sections are summarized below. The proposed changes apply to all nonresidential occupancies, except Residential Group R occupancies and any associated accessory occupancies.

SECTION 601.2.2 *[SECTION 130.1]* – MANDATORY INDOOR LIGHTING CONTROLS

Section 601.2.2.3.6 *[Subsection 130.1(c)6]:* The proposed regulations update the shut-OFF control requirements to ensure that all installed indoor lighting automatically reduces lighting power when spaces are typically unoccupied. This update enhances energy savings opportunities by expanding requirements for full- or partial-OFF occupant sensing controls to a broader set of space types, including lounge, breakrooms, waiting areas, laboratory, and computer rooms.

3.1.5.2 Reference Appendices Change Summary

This proposal revises specific sections of the Reference Appendices.

Appendix NA7 – Installation and Acceptance Requirements for Nonresidential Buildings and Covered Processes

NA7.6.2.3 – Occupancy Sensing Lighting Control Functional Testing: Updates the acceptance test procedure to include additional space types where partial-OFF testing is required.

3.1.5.3 Compliance Manuals Change Summary

The proposed code change revises the following section of the Nonresidential Compliance Manual:

Section 4.5.1.3 – Occupied Standby Controls:
Expands the table summarizing proposed building space types required to include occupied standby controls.

Section 5.4.3.4 – Lighting Occupant Sensing Controls:
Update the existing partial- or full-OFF occupant sensing controls section to include new space types. Clarify that the occupancy sensors used for lighting systems and HVAC systems can be independent of each other or integrated. Clarify that when integrated, the occupancy sensor signal should be used to inform the HVAC and lighting system decisions as opposed to a signal that could include variation from other lighting control strategies such as manual overrides or daylight harvesting.

Applicability Guidance – Group R Occupancies:
Adds clarifying guidance that Group R occupancies are not subject to the proposed 2028 requirements and will continue to comply with the 2025 requirements.

3.1.5.4 Alternative Calculation Method Reference Manual Change Summary

The proposed measure relies on occupancy-sensor strategies—full-OFF and partial-OFF—that are already supported within existing CBECC rulesets and EnergyPlus objects. Accordingly, updates would primarily consist of revising compliance assumptions and documentation rather than introducing new software capabilities. Specifically, Table N4 in the nonresidential performance compliance form NRCC/LMCC-PRF-E would need to be updated to incorporate the revised mandatory lighting control requirements established by the proposed change. Corresponding updates to the Nonresidential ACM Reference Manual would also be required to align performance modeling assumptions within CBECC, including revisions to lighting and HVAC control schedules to reflect the proposed occupancy sensor requirements and associated savings assumptions.

3.1.5.5 Compliance Forms Change Summary

The nonresidential lighting and mechanical compliance and installation forms (NRCC/LMCC-LTI-E, NRCI/LMCI-LTI-E, NRCC/LMCC-MCH-E, and NRCI/LMCI-MCH-E) would require updates to Table H to incorporate the revised mandatory lighting control requirements. The nonresidential performance form NRCC/LMCC-PRF-E would require updates to Table N4 to align with the updated mandatory control requirements.

3.1.6 Measure Context

3.1.6.1 Comparable Model Codes or Standards

The proposed code change aligns closely with the provisions of ANSI/ASHRAE/IES Addendum bd to ANSI/ASHRAE/IES Standard 90.1-2022, which establishes select lighting requirements in the forthcoming ASHRAE Standard 90.1-2025 (ASHRAE 90.1 Addendum bd 2025). The forthcoming ASHRAE Standard 90.1 expands requirements for partial-OFF and full-OFF occupant sensing controls to a broader range of space types, including copy rooms, lounges, hospital lounges, and data centers. The proposed Title 24 updates mirror this direction by requiring occupant sensing controls in additional intermittently occupied spaces, such as lounges, breakrooms, waiting areas, and other spaces that are currently permitted to meet shut-OFF requirements using only time-based controls. Aligning California's requirements with ASHRAE 90.1 promotes national consistency in code requirements and simplifies compliance for design professionals and manufacturers working across jurisdictions. For California in particular, this update supports statewide decarbonization and grid reliability goals by reducing unnecessary lighting and HVAC energy use during peak demand periods, when these intermittently occupied spaces are most likely to be vacant. By shifting from purely schedule-based controls to real-time, occupant-responsive strategies, the proposal helps capture energy savings that reflect actual building use patterns common in California's flexible, hybrid, and extended-hour commercial and institutional facilities.

The timing of this alignment is driven by rapid growth in advanced lighting controls, building automation systems, and connected devices across new construction and major retrofits in California. Establishing clear, consistent requirements now ensures these systems are designed and commissioned with occupant-based functionality as a baseline capability, rather than as an optional or value-engineered feature, improving long-term persistence of energy savings.

The proposal does not rely on a specific industry standard test procedure. Performance characteristics of occupant sensing controls, such as detection technology, coverage, and delay timing, are already addressed through existing product standards and manufacturer specifications (e.g., NEMA WD 7 for occupancy motion sensors). The code change does not modify product performance testing; rather, it expands the application of these controls to additional space types.

Overall, the proposed update is consistent with national model code direction and industry best practices, advancing California's leadership in whole-building energy management by expanding the use of occupant-based control strategies.

3.1.6.2 Interactions with Other Regulations

There are no known federal, state, or local regulations, codes, standards, or certification programs that address the same topic, conflict with, or duplicate the proposed change.

3.2 Require Occupant Sensing Controls in More Spaces – Compliance and Enforcement

3.2.1 Compliance Considerations

The proposed code change is designed to be straightforward to enforce and verify through existing compliance and acceptance testing processes for lighting controls. The proposal expands the application of occupant sensing controls to additional space types but does not introduce new control technologies, test procedures, or documentation forms that would add complexity for designers, installers, or enforcement authorities. It is important to note that Group R occupancies are excluded and will follow the 2025 code instead for consistency with Assembly Bill 130.

Feasibility of Compliance and Enforcement: While the proposed measure builds on existing mandatory lighting control requirements and HVAC occupied standby requirements for small offices, stakeholder feedback from enforcement agencies and design professionals provided to the Compliance Improvement Team indicates that compliance and enforcement are currently challenging. Existing requirements related to occupancy sensing and occupied standby are frequently misunderstood and inconsistently applied, particularly where they intersect with HVAC system design. Expanding the space types subject to occupied standby will increase complexity and is expected to have direct implications for HVAC system selection, control strategies, and equipment sizing. To support effective implementation, compliance documentation, guidance, and training would need to be updated and clarified. The NRCC/LMCC-LTI-E, NRCC/LMCC-MCH-E, and NRCC/LMCC-PRF-E forms will be revised to reflect the expanded space types and associated requirements, with additional emphasis on improving clarity for designers and enforcement agencies.

Field Verification or Diagnostic Testing: While no new lighting-specific field verification or diagnostic testing requirements are proposed, the expansion of occupant sensing and occupied standby requirements is expected to have implications beyond lighting controls. Occupant Sensing controls will continue to be verified through existing Lighting Controls Acceptance Tests (NRCA-LTI-02-A) conducted by certified ATTs; however, stakeholder feedback indicates that these changes may also affect mechanical system testing and acceptance. Additional coordination will be needed to determine how mechanical testing protocols may need to be updated to verify appropriate HVAC system response to occupancy status. Further clarification and potential revisions to testing procedures and guidance documents may be required to ensure consistent application and enforcement across lighting and mechanical systems.

Compliance Burden: Stakeholder feedback from enforcement authorities and design professionals indicates that existing occupancy sensing and occupied standby requirements are already challenging to interpret, implement, and verify in practice. Expanding these requirements to additional space types introduces additional layers of complexity that will further complicate design coordination, inspection, and acceptance. These changes may affect control sequences, HVAC system configuration, and equipment selection, increasing the effort required for plan review and field verification. As a result, enforcement authorities will require clearer documentation, enhanced guidance, and targeted training to support consistent and effective enforcement of the proposed requirements.

Definitions and Harmonization: No new definitions are required for this measure. All terminology related to occupant sensing controls and lighting shut-OFF requirements remains consistent with existing definitions in Title 24, Part 6, and coordinated with related sections of the California Electrical Code and California Mechanical Code to avoid confusion and maintain alignment across code parts.

3.2.2 Impact on Market Actors

Table 27 summarizes impacts on market actors and suggests outreach and education that might be helpful to support market actors as they prepare for the effective date of the requirements.

Table 27: Impacts on Market Actors and Suggested Training and Education Opportunities

Market Actor	Impact(s)	Suggested Outreach and Education
Owner/Developer[a]	Reduced energy bills: Lighting use is expected to reduce overall energy costs for the building. Potentially higher costs: May require replacing single-zone HVAC systems with multizone systems or adding equipment so areas can be controlled separately from zones not using the occupancy sensor. Additional costs may also result from	Additional outreach on cost implications, coordination strategies, and design considerations for retrofits or additions is recommended.

Market Actor	Impact(s)	Suggested Outreach and Education
	expanded lighting control requirements, including increased use of occupancy sensors and associated acceptance testing.	
Design Professional[b]	Specify occupancy sensors for additional space types, coordinate with HVAC and lighting zones, and be aware of how these requirements may dictate alternative mechanical design considerations.	Recommended training for lighting design professionals and HVAC design professionals on new space-type requirements, best practices for HVAC coordination, and lighting scene/control integration.
Construction Team[c]	Lighting Team: Expanded installation of occupancy sensing controls across additional space types beyond current applications. HVAC Team: Increased need to coordinate HVAC zoning and controls with occupancy sensing requirements where applicable.	Lighting Team: Recommended training for lighting controls contractors on installation, calibration, and functional testing of partial-OFF and full-OFF controls in newly applicable space types. HVAC Team: Recommended training for HVAC contractors on integrating occupancy-based control strategies, including coordination with lighting control signals where appropriate.
Building Department[d]	Apply existing plan review and inspection processes to expanded space types.	Updated existing reference materials and guidance documents on new space-type applications, including clarification that Group R occupancies remain subject to 2025 requirements.
Verification Tester[e]	Use existing procedures; verify correct operation in newly covered spaces; more time may be needed for each project due to the increased number of tests.	Recommended training for verification testers of lighting and HVAC systems on new space-type requirements, best practices for verifying HVAC coordination, and verifying lighting scene/control integration.
Manufacturers and Distributors	No major changes for lighting: products are already available to support new space types.	Outreach should include guidance on market trends, equipment capabilities, and

Market Actor	Impact(s)	Suggested Outreach and Education
	Changes for HVAC: Changes in how HVAC manufacturers and distributors support equipment choices.	best practices for supporting occupancy sensor requirements.

a. Owner/Developer is funding the project and is the primary decision-maker.

b. Design professionals include architects, engineers (mechanical, electrical, plumbing, structural), specification writers, cost estimators, commissioning agents, lighting designers, and energy consultants.

c. Construction team includes general contractors, design-build contractors, installation contractors (e.g., HVAC, plumbing, electrical), commissioning agents, and tradespeople.

d. Building departments include plans reviewers, building inspectors, specialty inspectors, permit counter technicians and third-party plan review and inspection.

e. Verification testers include commissioning agents, ECC-Raters, and ATTs.

The 2028 CASE Methodology Report presents a quantitative assessment of how changes to the California building code impact builders, building designers and energy consultants, and building owners and occupants. The analysis in the methodology report is not specific to the code change presented in this report. The following provides a qualitative description of how this specific code change affects various market actors and additional quantitative analyses of its potential impacts on building industry subsectors.

Builders. The proposed change would not affect all firms and workers in the commercial building industries equally; instead, it would primarily affect specific subsectors within the industry. Table 28 shows the commercial building subsectors that the Statewide CASE Team expects to be impacted by the changes proposed in this report.

Table 28: Specific Subsectors of the California Commercial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2025 (Estimated)

Construction Subsector	Establishments*	Employment	Annual Payroll (Billions $)
Commercial Building Construction	5,491	87,450	$10.6
Nonresidential Electrical Contractors	3,245	72,794	$7.8
Nonresidential Plumbing & HVAC Contractors	2,270	55,182	$5.8

Source: Analysis by the Title 24 CASE Team of QCEW data from the California Employment Development Department
https://labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=industry

*An establishment is a single economic unit, typically at one physical location, that engages in one, or predominantly one, type of economic activity for which a single industrial classification may be applied. Many businesses are composed of multiple establishments. U.S. Bureau of Labor Statistics, Handbook of Methods. https://www.bls.gov/opub/hom/cew/concepts.htm

Manufacturers. Major manufacturers offering occupancy-sensor and lighting control solutions include Legrand (WattStopper), Lutron, Acuity Brands, Signify (Philips), Leviton, and Hubbell Control Solutions. These companies supply a full range of sensor technologies—including ceiling-mounted, wall-mounted, and integrated luminaire-based sensors—along with compatible control hardware and commissioning tools. Many of these manufacturers maintain distribution centers, technical support staff, and commissioning resources within California.

3.2.3 Compliance Software Updates

If the proposal is adopted, only minor updates to CBECC are expected. The measure relies on occupancy-sensor strategies—full-OFF and partial-OFF—that are already supported within existing CBECC rulesets and EnergyPlus objects. Accordingly:

- **Scope of updates:** An adjustment to the current lighting and HVAC controls schedules would be required to reflect the proposed mandatory occupancy sensor requirements and associated savings assumptions.
- **Software functionality:** No new functionality is expected to be needed. Existing EnergyPlus objects can model the measure without modification.
- **Additional data needs:** Only updated schedule assumptions would need to be incorporated. No new datasets are required.

If ongoing coordination with the CBECC development team indicates that broader updates are necessary, the Statewide CASE Team will provide detailed recommendations on software enhancements in Summer 2026.

3.2.4 Cost of Enforcement

The Statewide CASE Team acknowledges that changes to the code will impact enforcement costs. This report is an evaluation of specific measures, and the collective impact of all proposed changes for the 2028 Title 24, Part 6 may represent an increase in training and/or workload for enforcement personnel. The proposed measure leverages existing compliance infrastructure and acceptance testing protocols. While this approach generally results in minimal incremental enforcement costs for the state or local governments, it will likely increase costs for acceptance testing of lighting and mechanical systems.

No new programs, technology platforms, or staff positions are required to implement or enforce this measure. Any additional training or guidance would be delivered through existing, ongoing education channels at a small marginal cost relative to overall code enforcement budgets.

The nonresidential lighting and mechanical compliance and installation forms (NRCC/LMCC-LTI-E, NRCI/LMCI-LTI-E, NRCC/LMCC-MCH-E, and NRCI/LMCI-MCH-E) would require updates to Table H to incorporate the revised mandatory lighting control requirements. The nonresidential performance compliance form NRCC/LMCC-PRF-E would also require updates to Table N4 to align with the updated mandatory control requirements.

Plan review activities would consist of reviewing the applicable Certificates of Compliance forms (NRCC/LMCC-LTI-E and NRCC/LMCC-MCH-E) to verify that the proposed lighting and HVAC occupancy-sensor control strategies meet the new mandatory requirements and are consistent with the construction drawings and specifications.

Inspection activities would consist of reviewing the applicable Certificates of Installation forms (NRCI/LMCI-LTI-E and NRCI/LMCI-MCH-E), as well as any required Certificates of Acceptance, to verify that the installed lighting and HVAC control systems are consistent with the approved compliance documentation and with the systems installed in the field.

3.3 Require Occupant Sensing Controls in More Spaces – Market and Economic Analysis

3.3.1 Market Structure and Availability

3.3.1.1 Current Market Structure and Availability

The market for occupant sensing lighting controls in California is mature and supported by a well-established network of manufacturers, distributors, lighting designers, electrical contractors, and commissioning professionals. In addition, California has a mature mechanical controls market, including HVAC manufacturers, controls vendors, building automation system (BAS) providers, mechanical engineers, and mechanical contractors with experience integrating occupancy-based control strategies. Expanding the application of these controls to additional space types—such as computer room, laboratory, lounge, breakroom, or waiting areas—would influence how mechanical systems are designed, zoned, and controlled, particularly where occupancy signals are used to initiate HVAC standby or ventilation reduction sequences. The proposed measure builds on existing technologies and practices already in common use for other space types covered by the Energy Code.

Leading manufacturers of occupant sensing controls include Lutron Electronics, Leviton Manufacturing, Acuity Brands, Signify (Genlyte Solutions and Cooper Lighting Solutions), WattStopper (Legrand), and Current Lighting. Several of these companies have regional headquarters or major operations in California, including Acuity Brands Lighting (West Coast operations in Irvine) and Legrand North America (regional distribution in San Jose). These manufacturers supply a wide range of ceiling-mounted, wall-mounted, and integrated fixture sensors that support both partial- and full-OFF operation and can communicate through wired or wireless protocols. On the mechanical side, major HVAC and controls manufacturers—such as Carrier, Trane, Daikin, Johnson Controls, and Honeywell—offer equipment and control platforms capable of supporting occupancy-based setback, ventilation reduction, and zone-level airflow modulation. Many systems already support BACnet-based integration and can receive occupancy signals through BAS programming when properly configured.

The proposed measure does not rely on proprietary or patented technologies. Occupant sensors that meet the functional requirements for time-out duration, partial-OFF operation, and multilevel control are available from multiple manufacturers. Competing products are interoperable with a variety of lighting control systems, reducing the risk of vendor lock-in. For spaces that require networked lighting control, open communication protocols such as BACnet, DALI, and Bluetooth Mesh are already supported by most major manufacturers. Similarly, most modern commercial HVAC systems support open-protocol communication (e.g., BACnet) that enables integration with occupancy-based control sequences without requiring proprietary platforms. However, implementation may require additional BAS programming, zone controllers, or commissioning in some alteration projects.

Design, installation, and commissioning of occupant sensing controls are typically performed by lighting designers, electrical engineers, and licensed electrical contractors, all of whom have significant experience with these systems due to existing Energy Code requirements. California's strong base of lighting professionals routinely specifies occupant sensors in Title 24-compliant designs. Mechanical engineers and controls contractors likewise have experience implementing temperature setback, variable air volume (VAV) minimum airflow reduction, and demand-controlled ventilation strategies, which provide a technical foundation for occupancy-based HVAC standby where applicable.

Electrical contractors regularly install occupant sensing and networked lighting control systems. Commissioning agents and ATTs already perform verification of occupant sensing control functionality under current acceptance test procedures, which are sufficient to support this measure without modification.

Based on the expanded space types in the proposed measure, mechanical ATTs and commissioning providers would experience increased testing scope when occupancy signals interface with HVAC systems, resulting in increased time and cost for verifying standby sequences and airflow reduction strategies. As discussed in Section 3.2.2, existing training infrastructure—such as the California Advanced Lighting Controls Training Program (CALCTP) and National Lighting Contractors Association of America (NLCAA)—provides a strong foundation for any additional training that might be needed to address new space types or integrated lighting-HVAC control strategies. Comparable mechanical training and certification programs for acceptance testing and BAS programming would support implementation on the HVAC side.

The proposed regulation supports and accelerates several existing market trends:

- **Integration of lighting and HVAC controls** through shared occupancy data to reduce both lighting and ventilation energy use.
- **Increased deployment of networked and wireless sensors**, which simplify installation in retrofits and enable more granular control.
- **Growth in data-driven building performance analytics**, leveraging occupancy data to optimize comfort and energy use.

By expanding the required use of occupant sensors, the proposal encourages manufacturers to further develop interoperable devices that communicate across building systems. This is expected to spur innovation in both sensor technology and integrated control algorithms. It may also encourage HVAC manufacturers and BAS providers to standardize occupancy-based standby sequences and improve factory-supported integration pathways.

Absent regulation, occupant sensing controls are commonly used in offices, classrooms, restrooms, and conference rooms where code already mandates them, while adoption in other space types such as lounges, waiting areas, and lobbies remains inconsistent. Voluntary adoption in these spaces is estimated at 15 percent of new construction projects, typically driven by corporate energy management policies or LEED certification. On the mechanical side, occupancy-based HVAC standby is less consistently implemented in addition and alteration projects unless a BAS upgrade or major HVAC replacement occurs. This limited baseline adoption will be discounted from statewide savings calculations to ensure that estimated energy impacts reflect only incremental effects of the proposed code change.

3.3.1.2 Market Challenges and Solutions

Stakeholder engagement throughout the development of this proposal was central to identifying and resolving market challenges. The Statewide CASE Team conducted targeted discussions with manufacturers, lighting designers, and facility maintenance teams to assess feasibility, field readiness, and market capability. Participants included representatives from two lighting designers and UC Davis Facilities Management. Two main challenges emerged from these discussions: (1) the appropriateness of occupant-sensing controls in certain space types, and (2) the integration of lighting and HVAC control systems to support coordinated operation (Statewide Utility Codes and Standards Team 2025).

During stakeholder discussions, lighting designers highlighted that applying automatic occupancy sensing in complex space types—such as auditoriums, theaters, and large assembly areas—poses significant operational risks during performances. Automatic-ON occupancy sensors could unintentionally disrupt performances by activating lighting scenes, conflicting with the primary theatrical control system. In response to this feedback, the Statewide CASE Team refined the proposal to remove these space types from the measure, thereby eliminating the identified operational risks and avoiding conflicts with theatrical lighting control systems.

During stakeholder discussions, concerns about the complexity of integrating HVAC and lighting occupancy controls were raised, especially in complex space types such as laboratories. Additional technical issues were noted, including mismatched zoning between HVAC and lighting systems, communication delays, and challenges with troubleshooting and maintenance when systems are coupled at the building level rather than locally. In response to this, the Statewide CASE Team continued gathering information on laboratory space types. The Statewide CASE Team determined to keep this space type for consideration as part of the measure, based on feedback supporting its inclusion if specific exemptions are defined to address identified laboratory risks, such as the ASHRAE Classification of Laboratory Design Levels.

See Section 3.2.2 for a description of workforce training that may be needed to ensure effective design, installation, and commissioning.

3.3.2 Design and Construction Practices

3.3.2.1 Current Design and Construction Practices

Occupancy-based lighting control systems are well established in nonresidential building design. Current best practices focus on aligning sensor selection, placement, zoning, and control logic with space function and occupant behavior. Designers typically select between occupancy (auto-ON/auto-OFF) and vacancy (manual-ON/auto-OFF) modes based on expected usage patterns, activity types, and potential for false triggering.

Best-practice sensor layout is guided by manufacturer specifications and room geometry, with ceiling- or wall-mounted sensors providing line-of-sight coverage. For larger or more complex spaces—such as auditoriums or museums—zones are subdivided to maintain sensor accuracy and ease of commissioning.

Overall, the proposed measure reinforces and clarifies existing best practices rather than introducing major design or construction impacts. The main change lies in emphasizing functional zoning, control coordination, and programmable flexibility across a wider range of space types. The measure aligns with standard design workflows for lighting control, with minimal implications for electrical infrastructure or physical layout. It does, however, encourage earlier coordination between lighting and mechanical design disciplines to ensure that both systems respond appropriately to occupancy signals without compromising usability or reliability.

3.3.2.2 Health and Safety Considerations

The proposed code change does not alter any existing federal, state, or local regulations pertaining to safety and health, including rules enforced by the California DOSH. All existing health and safety rules would remain in place. Complying with the proposed code change is not anticipated to have adverse impacts on the safety or health of occupants or those involved with the construction, commissioning, and maintenance of the building.

Where systems affected by this code change control critical functions—such as lighting in laboratories or ventilation serving hazardous processes—existing safety protocols, overrides, and minimum operational requirements must continue to be implemented. The code change does not supersede these requirements, and any adjustments must ensure that occupant safety and process integrity are maintained at all times.

3.3.2.3 Design and Construction Challenges and Solutions

The proposed expansion of occupancy sensing to more space types in nonresidential buildings, in coordination with additional HVAC occupied standby operation in appropriate spaces, represents a natural extension of established control practices first advanced under the 2022 Title 24 Lighting CASE Report (The Statewide CASE Team 2020). Table 29 summarizes technical challenges and proposed solutions identified by the Statewide CASE Team.

Table 29: Technical Challenges and Proposed Solutions for Expanding Space Types for Full or Partial-OFF Occupancy Sensors

Technical Challenge	Description	Proposed Solutions
Implementing HVAC systems for occupied standby controls in more space types	Feasible in systems with digital controls but may not be practical for standalone HVAC equipment without communication capabilities.	Identify specific space types that should be exempted from occupied standby controls.
Conflicts with existing control strategies (e.g., demand ventilation, fume hood, or process controls)	Not feasible where performance-based, life-safety, or process-critical ventilation requirements must take precedence.	Remove requirements for performance spaces and revise requirements for laboratory spaces based on stakeholder feedback recommending alignment with laboratory hazard level classifications from ASHRAE.

By overcoming the identified challenges through targeted design guidance, California's design, construction, and enforcement community would continue to advance its technical capabilities, supporting modern, grid-responsive, and energy-efficient building operation statewide. See Table 27 in Section 3.2.2 for a description of workforce training that could support effective design, installation, and commissioning.

3.3.3 Energy Equity and Environmental Justice

Each measure in this CASE Report was evaluated for ESJ impacts using 4 criteria: cost, health, resiliency, and comfort. The details of that evaluation can be found in Section 1.4 and the 2028 CASE Methodology Report.

Based on a preliminary review, the measures in this proposal are unlikely to have significant impacts on environmental and social justice (ESJ) outside of any impacts mentioned in the 2028 CASE Methodology Report, therefore reducing the impacts of disparities on ESJ communities.

The Statewide CASE Team expects initial equipment and installation costs may disproportionately affect small or independent nonresidential building operators serving local markets, particularly in rural or low-income regions. The improved nonresidential indoor lighting control standards may reduce waste heat and worker comfort, providing long-term health and safety benefits. Over time, energy savings can improve the financial viability of operations, creating more sustainable employment opportunities in ESJ communities. After review, the Statewide CASE Team does not expect impacts on the resiliency or disaster preparedness of ESJ communities.

3.3.4 Impacts on Jobs and Businesses

The Statewide CASE Team does not anticipate significant employment or financial impacts on any particular sector of the California economy from the proposed requirement to install occupancy sensors in additional spaces. However, the proposed change may result in modest impacts on employment and economic output in California through changes in spending associated with design, product specification, installation, acceptance, and enforcement activities.

For this measure, the primary affected sectors are expected to include commercial building construction, electrical contracting and controls installation, building design and engineering services, energy consulting, and local code enforcement. The proposed change would increase the use of occupancy-sensor controls in spaces that are not currently required to have them, which would modestly increase first costs for affected projects while also reducing energy use over the life of the measure.

The Statewide CASE Team estimates that these changes would affect statewide employment and economic output directly and indirectly through their impact on builders and electrical contractors, designers and energy consultants, building inspectors, and household discretionary spending associated with utility bill savings. Table 30 through Table 32 summarize the estimated statewide impacts for these categories for both new construction and alterations. For more information on the Statewide CASE Team's economic impacts methodology, see the 2028 CASE Methodology Report.

The Statewide CASE Team does not anticipate that the proposed code change would lead to the creation of new occupations or the elimination of existing occupations. Instead, the measure is expected to result in modest changes in demand for existing job classifications. The proposed code change therefore would not cause economic disruption to any sector of the California economy, but rather would modestly shift activity within existing industries involved in construction, controls installation, compliance, and supporting supply chains.

Table 30: Estimated Impact that Adoption of the Proposed Measure would have on the California Nonresidential Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income (Millions)	Total Value Added (Millions)	Output (Millions)
Direct Effects (Additional spending by Commercial Builders)	33	$3	$4	$8
Indirect Effect (Additional spending by firms supporting Commercial Builders)	17	$1	$2	$4
Total Economic Impacts	**50**	**$4**	**$6**	**$12**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[9]

Table 31: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultant Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building designers and energy consultants)	26	$2,901,759	$2,872,707	$4,540,584
Indirect Effect (Additional spending by firms supporting building designers and energy consultants)	11	$864,000	$1,200,787	$1,933,022
Total Economic Impacts	**37**	**$3,765,759**	**$4,073,494**	**$6,473,606**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

Table 32: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building inspectors)	14	$1,575,648	$1,868,526	$2,270,632
Indirect Effect (Additional spending by firms supporting building inspectors)	2	$145,924	$227,277	$395,840
Total Economic Impacts	**16**	**$1,721,573**	**$2,095,803**	**$2,666,472**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

The proposed change represents a modest adjustment, which is not expected to excessively burden or competitively disadvantage California businesses, nor is it expected to lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not expect the proposed code changes to result in the creation of new businesses or the elimination of existing ones.

The proposed code changes would apply to all businesses operating in California, regardless of whether the business is incorporated inside or outside of the state.[10] Therefore, the Statewide CASE Team does not anticipate that the proposed code

[9] IMPLAN® model, 2020 Data, IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078 www.IMPLAN.com

[10] Gov. Code, §§ 11346.3(c)(1)(C), 11346.3(a)(2); 1 CCR § 2003(a)(3) Competitive advantages or disadvantages for California businesses currently doing business in the state.

changes would have advantageous or an adverse effect on the competitiveness of California businesses.

The Statewide CASE Team derived a reasonable estimate of the change in investment by California businesses based on the estimated change in economic activity associated with the proposed measure and its expected effect on business income. The Statewide CASE Team's IMPLAN modeling resulted in an estimated $1,553,391 increase in California business income due to the proposed code change. The Statewide CASE Team assumed that net business investment is positively correlated with business income and that a portion of business income will be allocated to net business investment.[11]

To estimate the portion of business income that would be allocated to net investment, the Statewide CASE Team analyzed national data on corporate profits and net capital investment by businesses that expand a firm's capital stock, or NPDI).[12] As Table 33 shows, between 2020 and 2021, NPDI as a percentage of corporate profits ranged from a low of 18 percent in 2020 due to the worldwide economic slowdowns associated with the COVID-19 pandemic to a high of 28 percent in 2022, with an average of 23 percent. While only an approximation of the proportion of business income used for net capital investment, it provides a reasonable estimate of the proportion of proprietor income that business owners would reinvest into expanding their capital stock.

Table 33: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2020	$ 389	$ 2,212	18%
2021	$ 545	$ 2,888	19%
2022	$ 825	$ 2,951	28%
2023	$ 836	$ 3,069	27%
2024	$ 885	$ 3,441	26%
5-Year Average	Intentionally blank	Intentionally blank	23%

Source: (Federal Reserve Economic Data (FRED) n.d.)

[11] 26 percent of proprietor income was assumed to be allocated to net business investment; see Table 15.

[12] Net private domestic investment is the total amount of investment in capital by the business sector that is used to expand the capital stock, rather than maintain or replace due to depreciation. Corporate profit is the money left after a corporation pays its expenses.

Given the estimated total increase in California business income and net business investment ratio described above, the Statewide CASE Team estimates the proposed code change would result in a $364,641 increase in net private investment by California businesses.

3.3.5 Economic and Fiscal Impacts

The Statewide CASE Team does not anticipate that the economic impacts associated with the proposed measure would lead to a significant change (increase or decrease) in investment, directly or indirectly, in any affected sectors of California's economy. The proposed change would not result in economic disruption to any sector of the California economy. For more information on the Statewide CASE Team's economic and fiscal impacts methodology, see the 2028 CASE Methodology Report.

Adoption of this code change would result in modest economic activity associated with:

- Lighting controls manufacturers and distributors
- Electrical contractors and installers
- Lighting designers and energy consultants
- Building officials and compliance verification activities

Energy cost savings associated with the measure are expected to slightly reduce operating expenses for building owners and tenants. These savings are not expected to meaningfully change broader spending or investment patterns but may contribute to minor reallocation of expenditures within the California economy.

The proposed measure would not result in economic disruption or the creation or elimination of job categories. Rather, it would lead to small changes in the level of activity within existing occupations.

3.3.5.1 Effects on the State General Fund, State Special Funds, and Local Governments

The Statewide CASE Team does not expect the proposed code changes to have a measurable impact on California's General Fund, any state special funds, or local government funds.

Cost to State: The state government already has a budget for code development, education, and compliance enforcement. While the state government would be allocating resources to update the Title 24, Part 6 Standards, including updating education and compliance materials and responding to questions about the revised requirements, these activities are already covered by existing state budgets. The costs for the state government are small when compared to the overall cost savings and policy benefits associated with the code change proposals.

The proposed measure may apply to state-owned nonresidential buildings, including new construction, additions, and alterations. In these cases, the state may incur modest incremental first costs for additional controls. However, these costs are expected to be cost-effective over the lifecycle of the equipment and offset by reduced energy expenditures in state facilities.

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this retraining is an expense to local governments, it is not a new cost associated with the 2025 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training, and resources provided by the IOU Codes and Standards program, such as Energy Code Ace. As noted in Section 3.2.2, the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

3.3.5.2 Mandates on Local Agencies or School Districts

There are no relevant mandates to local agencies or school districts. The proposed measure updates building energy efficiency standards applicable at the time of construction or alteration and does not require local agencies or school districts to implement new programs or provide new levels of service beyond existing code enforcement responsibilities.

3.3.5.3 Costs to Local Agencies or School Districts

There are no costs to local agencies or school districts requiring reimbursement pursuant to California Constitution, Government Code Sections 17500 et seq. Any costs associated with training or compliance are part of the normal code update cycle and do not represent a new program or higher level of service.

3.3.5.4 Costs or Savings to Any State Agency

There are no significant costs or savings to any state agency. While state agencies constructing or renovating nonresidential buildings may incur modest incremental costs for additional occupancy sensors, these costs are expected to be offset by energy savings and do not represent a net fiscal impact at the agency level.

3.3.5.5 Other Non-Discretionary Cost or Savings Imposed on Local Agencies

There are no added non-discretionary costs or savings to local agencies. The measure does not impose requirements beyond standard building code enforcement responsibilities.

3.3.5.6 Costs or Savings in Federal Funding to the State

There are no costs or savings in federal funding to the state. The proposed measure does not affect federal funding streams or require changes to federally funded programs.

3.4 Require Occupant Sensing Controls in More Spaces – Cost Effectiveness

3.4.1 Cost-Effectiveness Methodology

The Statewide CASE Team collaborated with the CEC staff to confirm that the cost-effectiveness methodology aligns with the CEC guidelines, including cost inclusion parameters. The 2028 CASE Methodology Report and Appendix A provide reproducibility details.

Per California Law (Public Resources Code 25000), a measure is considered cost-effective if its BCR is 1.0 or greater, amortized over the economic life of the structure. The Statewide CASE Team calculates BCR by dividing total dollar benefits by total dollar costs over a 30-year analysis period.

Benefits are based on LSC, which assigns an hourly dollar value to energy use. LSC hourly factors weigh the long-term value of each hour differently, where times of peak demand are valued more than off-peak hours. These factors are not utility rates, forecasts, or bill estimates. The CEC develops and publishes LSC hourly conversion factors for each code cycle.

Costs include first costs and ongoing maintenance costs assessed over the 30-year period. Benefits and costs are evaluated incrementally, relative to the most recently adopted Energy Code. The analysis excludes design costs and incremental code compliance verification costs.

3.4.2 Energy and Energy Cost Savings Results

The Statewide CASE Team completed energy savings analysis using nonresidential prototype buildings representative of typical California building operations. Because the measure affects lighting and HVAC controls in common nonresidential space types, the analysis uses two complementary modeling approaches: (1) a spreadsheet-based method for occupancy-sensor lighting savings, and (2) CBECC for HVAC occupied-standby impacts.

CBECC was not used for lighting energy savings because Title 24 compliance software does not currently calculate occupancy-sensor lighting reductions for each space type at the granularity needed for this analysis. Instead, the spreadsheet model applies published occupancy-sensor savings factors to prototype-specific schedules. Specifically, the Statewide CASE Team cited a 25 percent occupancy reduction based on findings from the Lawrence Berkeley National Laboratory's *Meta Analysis Study of Energy Savings from Lighting Controls in Commercial Buildings* and ASHRAE 90.1 Table G3.7-1 (LBNL 2011) (ASHRAE 2022). CBECC is used for HVAC occupied-standby analysis because this functionality is already embedded within the software's HVAC framework.

The Statewide CASE Team modeled occupancy-sensor impacts for lighting and HVAC systems using the Large Office, Medium Office, Small Office, Large School, Small School, Large Retail, Medium Retail, and Strip Mall Retail prototype buildings. Specific to laboratory spaces, the Statewide CASE Team developed a conservative savings estimate using the worst-case assumption that all research labs will claim the health and safety exception and therefore will not control lighting with occupancy sensors. As a result, lighting energy savings from classroom laboratories only were claimed. Key assumptions are provided in Appendix A.

The analysis accounts for the fraction of prototype floor area affected by the proposed requirements. For each prototype building, the Statewide CASE Team estimated the percentage of floor area containing applicable space types where lighting occupancy controls would be added or modified, as well as the percentage of floor area where HVAC occupied standby controls would newly apply. These assumptions were developed using the CEC's 2029 construction forecasts, prototype building characteristics, and the distribution of applicable space types within each building type. Additional details regarding impacted building types, affected floor area assumptions, and climate zone scaling factors are provided in Appendix C.

Energy savings and peak demand reductions per square foot of modeled buildings are presented in Table 34 through Table 37. First-year electricity savings range from 0.00 to 0.033 kWh per square foot (kWh/ft²), depending on climate zone.[13] First-year peak

[13] When modeling the Medium Retail prototype for Climate Zones 09, 11, and 14 and Strip Mall prototype for CZ16, the Statewide CASE Team identified an issue in the simulation model that resulted in negative electricity savings. At the time this report was prepared, the Statewide CASE Team had submitted a Help Ticket to the EnergyPlus development team to assist in resolving the issue. Pending resolution, the Statewide CASE Team conservatively adjusted the negative electricity savings values for the aforementioned prototype/CZ combinations to zero for purposes of this report.

demand reductions range from -1.63 to 2.00 watts per square foot (W/ft²) across climate zones.

Natural gas impacts indicate slight increases in natural gas use, ranging from -0.03 to 0.00 kBtu/ft², depending on climate zone. This increase occurs because the proposed lighting schedule reduces internal heat gains from lighting fixtures and occupants. As a result, space heating loads increase slightly in some climate zones.

First-year source energy savings range from -0.01 to 0.02 kBtu/ft², depending on climate zone. In most climate zones, reduced electricity consumption outweighs the small increase in natural gas use, resulting in positive source energy savings. In Climate Zone 16, average source energy savings are slightly negative (-0.002 kBtu/ft²); however, the magnitude of this impact is very small and considered effectively neutral for the measure.

Total 30-year LSC savings range from -$0.00 to $0.21 per square foot (2029 PV$), depending on climate zone (Table 38). As shown in Table 39, 30-year electricity LSC savings range from $0.00 to $0.21 per square foot, while 30-year natural gas LSC impacts range from -$0.01 to $0.00 per square foot, resulting in total net savings of $0.01 to $0.21 per square foot (2029 PV$).

Table 34: First Year Electricity Savings (kWh) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	0.0096	0.0101	0.0097	0.0103	0.0100	0.0103	0.0105	0.0108	0.0104	0.0106	0.0103	0.0100	0.0108	0.0104	0.0103	0.0099
Large Retail	0.0070	0.0051	0.0081	0.0098	0.0098	0.0102	0.0133	0.0183	0.0089	0.0037	0.0081	0.0071	0.0080	0.0162	0.0332	0.0102
Medium Office	0.0072	0.0082	0.0085	0.0089	0.0087	0.0094	0.0098	0.0098	0.0098	0.0100	0.0089	0.0087	0.0093	0.0090	0.0103	0.0075
Medium Retail	0.0059	0.0128	0.0089	0.0122	0.0107	0.0082	0.0255	0.0110	0.0000	0.0095	0.0000	0.0061	0.0110	0.0000	0.0062	0.0170
Small Office	0.0105	0.0110	0.0112	0.0109	0.0112	0.0116	0.0118	0.0116	0.0115	0.0116	0.0111	0.0111	0.0111	0.0111	0.0118	0.0107
Small School (Primary)	0.0018	0.0019	0.0019	0.0019	0.0019	0.0020	0.0021	0.0021	0.0006	0.0018	0.0019	0.0017	0.0026	0.0020	0.0031	0.0025
Strip Mall Retail	0.0122	0.0125	0.0141	0.0108	0.0135	0.0129	0.0117	0.0166	0.0176	0.0176	0.0139	0.0154	0.0242	0.0198	0.0235	0.0000
Large School	0.0070	0.0073	0.0072	0.0075	0.0074	0.0077	0.0082	0.0079	0.0078	0.0080	0.0076	0.0077	0.0079	0.0076	0.0090	0.0073

Table 35: First Year Peak Demand Reduction (W) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	0.70	0.82	0.76	0.70	0.68	0.74	0.64	0.72	0.74	0.78	0.64	0.74	0.80	0.84	0.72	0.72
Large Retail	0.29	0.42	0.46	0.00	0.62	0.96	0.87	1.04	1.83	2.00	0.63	0.79	0.79	0.46	1.04	1.50
Medium Office	0.37	0.37	0.93	0.37	0.75	0.75	0.75	0.75	0.56	0.75	0.75	0.56	0.19	0.37	0.75	0.37
Medium Retail	0.41	0.41	0.41	-1.63	1.22	0.41	1.63	1.22	0.00	0.41	0.00	0.41	-0.41	0.00	0.41	0.81
Small Office	1.82	1.82	0.00	0.00	1.82	0.00	0.00	1.82	1.82	1.82	0.00	1.82	1.82	0.00	1.82	1.82
Small School (Primary)	0.41	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.41
Strip Mall Retail	1.07	1.07	0.00	1.07	1.07	1.07	1.07	0.00	1.07	1.07	1.07	1.07	0.00	0.00	1.07	0.00
Large School	0.62	0.66	0.66	0.66	0.62	0.66	0.66	0.71	0.52	0.66	0.66	0.62	0.71	0.57	0.71	0.57

Table 36: First Year Natural Gas Savings (kBtu) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	-0.0065	-0.0049	-0.0047	-0.0037	-0.0038	-0.0028	-0.0031	-0.0026	-0.0019	-0.0021	-0.0050	-0.0043	-0.0029	-0.0027	-0.0021	-0.0073
Large Retail	-0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0293
Medium Office	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Medium Retail	-0.0069	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0153
Small Office	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0164
Small School (Primary)	-0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033
Strip Mall Retail	-0.0200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Large School	-0.0112	-0.0072	-0.0067	-0.0062	-0.0051	-0.0033	-0.0036	-0.0039	-0.0032	-0.0032	-0.0081	-0.0060	-0.0053	-0.0057	-0.0023	-0.0105

Table 37: First Year Source Energy Savings (kBtu) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	0.0034	0.0049	0.0048	0.0059	0.0058	0.0069	0.0069	0.0070	0.0075	0.0075	0.0050	0.0054	0.0068	0.0073	0.0079	0.0028
Large Retail	0.0064	0.0054	0.0063	0.0019	0.0068	0.0119	0.0094	0.0155	0.0061	0.0076	0.0090	0.0032	0.0107	0.0092	0.0143	-0.0149
Medium Office	0.0054	0.0052	0.0075	0.0061	0.0075	0.0079	0.0085	0.0084	0.0083	0.0086	0.0070	0.0065	0.0067	0.0059	0.0090	0.0056
Medium Retail	0.0053	0.0061	0.0062	0.0108	0.0109	0.0043	0.0203	0.0079	0.0000	0.0183	0.0000	0.0029	0.0038	0.0000	0.0176	-0.0057
Small Office	0.0096	0.0102	0.0111	0.0101	0.0111	0.0122	0.0126	0.0119	0.0117	0.0119	0.0097	0.0103	0.0107	0.0098	0.0124	-0.0030
Small School (Primary)	0.0018	0.0023	0.0022	0.0021	0.0022	0.0024	0.0025	0.0025	-0.0032	0.0022	0.0019	0.0010	0.0024	0.0023	0.0075	-0.0001
Strip Mall Retail	-0.0074	0.0088	0.0097	0.0068	0.0100	0.0124	0.0086	0.0089	0.0130	0.0129	0.0088	0.0097	0.0141	0.0090	0.0201	0.0000
Large School	-0.0016	0.0023	0.0023	0.0035	0.0037	0.0059	0.0056	0.0052	0.0058	0.0065	0.0018	0.0036	0.0039	0.0022	0.0095	-0.0010

Table 38: Total 30-Year LSC Savings (2029 PV$) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	0.064	0.069	0.067	0.070	0.069	0.070	0.071	0.073	0.072	0.073	0.069	0.068	0.074	0.072	0.072	0.064
Large Retail	0.049	0.055	0.062	0.061	0.063	0.065	0.069	0.070	0.071	0.071	0.063	0.062	0.065	0.061	0.073	0.053
Medium Office	0.076	0.080	0.083	0.080	0.084	0.085	0.087	0.086	0.086	0.087	0.080	0.082	0.082	0.079	0.088	0.064
Medium Retail	0.014	0.015	0.015	0.015	0.015	0.015	0.016	0.017	-0.008	0.015	0.014	0.013	0.019	0.015	0.033	0.016
Small Office	0.053	0.040	0.057	0.051	0.069	0.078	0.097	0.142	0.071	0.053	0.063	0.054	0.075	0.102	0.205	0.060
Small School (Primary)	0.045	0.079	0.061	0.082	0.100	0.056	0.206	0.091	0.000	0.124	0.000	0.006	0.064	0.000	0.068	0.100
Strip Mall Retail	0.068	0.086	0.097	0.071	0.097	0.093	0.076	0.099	0.127	0.123	0.094	0.108	0.164	0.120	0.167	0.000
Large School	0.045	0.052	0.050	0.052	0.053	0.055	0.058	0.060	0.056	0.062	0.054	0.055	0.057	0.049	0.069	0.046

Table 39: 2029 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions – Occupancy Sensors

Climate Zone	30-Year LSC Electricity Savings, per SF (2029 PV$)	30-Year LSC Natural Gas Savings, per SF (2029 PV$)	Total 30-Year LSC Savings, per SF (2029 PV$)
1	0.05	-0.01	0.05
2	0.08	0.00	0.08
3	0.06	0.00	0.06
4	0.08	0.00	0.08
5	0.10	0.00	0.10
6	0.06	0.00	0.06
7	0.21	0.00	0.21
8	0.09	0.00	0.09
9	0.00	0.00	0.00
10	0.12	0.00	0.12
11	0.00	0.00	0.00
12	0.01	0.00	0.01
13	0.06	0.00	0.06
14	0.00	0.00	0.00
15	0.07	0.00	0.07
16	0.11	-0.01	0.10

Table 40: 2029 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – Occupancy Sensors[14]

Climate Zone	30-Year LSC Electricity Savings, per SF (2029 PV$)	30-Year LSC Natural Gas Savings, per SF (2029 PV$)	Total 30-Year LSC Savings, per SF (2029 PV$)
1	0.05	-0.01	0.05
2	0.08	0.00	0.08
3	0.06	0.00	0.06
4	0.08	0.00	0.08
5	0.10	0.00	0.10
6	0.06	0.00	0.06
7	0.21	0.00	0.21
8	0.09	0.00	0.09
9	0.00	0.00	0.00

[14] This proposed change excludes Group R occupancies and Group R common use and public areas as mandated by California Assembly Bill 130.

10	0.12	0.00	0.12
11	0.00	0.00	0.00
12	0.01	0.00	0.01
13	0.06	0.00	0.06
14	0.00	0.00	0.00
15	0.07	0.00	0.07
16	0.11	-0.01	0.10

3.4.3 Incremental First Cost

The baseline for this analysis is indoor lighting control systems that meet the 2025 Title 24, Part 6 requirements for general lighting control, with luminaires for the space types under consideration controlled only by time-based scheduling. Because both the baseline and proposed systems rely on the same lighting equipment and electrical infrastructure, incremental first costs are assumed to arise solely from adding occupancy sensors and performing the associated commissioning.

The Statewide CASE Team collected first-cost estimates through February 2026 using manufacturer quotes, distributor pricing, lighting control and mechanical system acceptance testing, and stakeholder interviews. The Statewide CASE Team will interview key market actors, targeting lighting control manufacturers, acceptance testers, and design professionals. All costs will reflect pricing available at the time of data collection.

Incremental first costs will be calculated as the difference between the proposed and baseline systems and include the following components:

- **Baseline Control Costs:** Timeclock ON/OFF control per lighting zone ($/zone).
- **Proposed Control Costs:** Occupancy sensors with integrated or panel-based control logic ($/zone).
- **Installation and ATT:** Incremental wiring, sensor mounting, and commissioning required to verify sensor coverage, time-out settings, and functional operation.

3.4.3.1 First Costs

A lighting design firm on the Statewide CASE Team derived first-cost data from projects. The Statewide CASE Team compiled average distributor net costs for 36 occupancy sensors, including direct-wired, indirect-wired, and wireless infrared, ultrasonic, and dual technology sensors. A 50 percent markup was applied to account for supply chain costs such as contractor profit, shipping, and freight; and the statewide average sales tax of 8.84 percent (effective October 1, 2025) was applied to calculate after-tax costs. Based on this approach, the average first cost is $254 per occupancy sensor.

The number of occupancy sensors per building was determined using each building prototype's typical square footage for the applicable space types, as defined in Appendix A. A representative coverage area of 400 square feet per sensor was assumed to estimate the total number of sensors required to implement this measure in each prototype building.

The Statewide CASE Team interviewed mechanical designers and installers to understand their standard design practice for complying with the proposed requirements with standalone lighting and HVAC systems. Respondents indicated that zoned thermostats are commonly used, with a representative cost of approximately $64 per thermostat added for the occupancy sensor feature. Incremental cost to install was considered negligible based on the assumption that a thermostat would be installed in the space regardless of this measure.

While not included in the analysis since the integration of lighting and HVAC systems is not required to comply with the proposed requirements, incremental costs associated with enabling HVAC occupied standby control through lighting system occupancy signals were collected through stakeholder interviews. These costs are estimated to be $2,000 per zone, assuming the addition of one VAV, VAV box controller, time to run wires from sensor to VAV box controller for an input signal from an occupancy sensor, and programming to be developed and uploaded for communication between the occupancy sensor, VAV controller, and the air handler's variable frequency drive.

The baseline equipment for shut-OFF controls is assumed to be a timeclock programmed to control multiple zones (e.g., whole building or floor, depending on size). The Statewide CASE Team considers the incremental cost of this baseline to be negligible for the proposed measure, as timeclock controls are typically installed to meet other mandatory lighting control requirements (e.g., manual area controls and multilevel lighting controls) and would still likely be installed regardless of this proposal.

The Statewide CASE Team surveyed ATTs to estimate the time difference between verifying the baseline and proposed requirements. On average, responses indicate that the occupancy sensor acceptance test requires an additional 0.625 hours compared to the timeclock acceptance test.

The Statewide CASE Team assumes that there are no significant differences in first cost between new construction and alterations.

3.4.3.2 Labor Costs

Sensor Installation First Costs

To estimate incremental labor costs, the Statewide CASE Team compiled typical installation and programming times for each device from real-world projects and multiplied these by the projected 2029 electrician labor rate (see below). On average, the reviewed projects showed that each occupancy sensor requires 3.6 minutes for installation and 4.2 minutes for programming.

The installation labor rate was developed using multiple sources. The 2025 RSMeans national average electrician rates (including overhead and profit) are $85.95 per hour for non-union and $109.10 per hour for union labor. Applying the 2025 RSMeans City Cost Index for California (132.6 percent) adjusts these rates to $113.97 per hour (non-union) and $144.67 per hour (union). The Statewide CASE Team also reviewed California prevailing wage data for the inside wireman classification, resulting in a weighted average rate of $98.02 per hour across all counties and climate zones based on the CEC 2029 construction forecast. Averaging these three sources provides the 2025 labor rate, which was then escalated to 2029 dollars, assuming a three percent annual inflation rate, for a final labor rate of $133.80 per hour.

Finally, the estimated labor hours for the number of occupancy sensors to cover the building were converted to total labor costs for the representative building prototypes using this projected 2029 rate. Results are provided in Table 41.

Acceptance Testing Incremental First Costs

The Statewide CASE Team conducted a survey of ATTs between April 9 and April 29, 2026, which included questions regarding hourly labor rates and acceptance testing duration. Of the 88 total responses received, 55 were determined to be valid for analysis. Reported hourly rates ranged from $50 to $500, with the largest share of respondents (38 percent) reporting rates between $125 and $150 per hour. An additional 19 percent reported rates between $150 and $175 per hour, and another 19 percent reported rates between $175 and $200 per hour.

To estimate the incremental cost of acceptance testing, the Statewide CASE Team used the midpoint of the reported hourly rates, resulting in an average labor rate of $154.95 per hour.

To understand any potential incremental costs associated with acceptance test burden increase, the Statewide CASE Team surveyed ATTs regarding the time required to complete acceptance testing for occupant sensing lighting controls compared to automatic time switch controls. Based on 62 comparable survey responses, the reported testing durations for the two control types were generally similar. Approximately 71 percent of respondents indicated that occupant sensing and automatic time switch testing require the same amount of time to complete, while 16 percent reported that occupant sensing testing takes longer and 13 percent reported that it takes less time.

Across all responses, the average reported testing duration was approximately 47.7 minutes for occupant sensing controls and 48.9 minutes for automatic time switch controls. The median reported duration for both control types was 30 minutes. These results indicate that occupant sensing functional testing does not result in a meaningful incremental testing burden relative to automatic time switch testing and can generally be completed within a comparable timeframe using existing acceptance testing procedures.

However, acceptance testing for automatic time switch controls and occupant sensing controls is not a direct one-to-one comparison. First, acceptance testing requirements for occupant sensing controls allow sampling when more than seven sensors are installed within spaces of similar geometry and control configuration, effectively requiring testing of approximately one sensor for every eight installed sensors rather than testing every individual sensor. This sampling approach substantially reduces the testing burden in buildings with large numbers of similar spaces. Second, the assumed baseline automatic time switch design is based on a typical per-floor zoning approach, where each lighting control zone or time switch serving a floor area requires its own acceptance test. As a result, the number of required automatic time switch acceptance tests may scale differently than occupancy sensor testing depending on the building layout and control strategy. To account for these differences, the Statewide CASE Team used prototype building characteristics and control assumptions to estimate the incremental labor costs associated with the proposed expansion of occupant sensing requirements. These incremental acceptance testing costs were incorporated into the cost-effectiveness analysis. First-cost assumptions are provided in Table 41.

Table 41: Baseline, Proposed, and Incremental Cost for Equipment and Installation, Per Zone – Require Occupant Sensing in More Spaces ($/zone)

	Baseline Equip. Cost	Proposed Equip. Cost	Incremental Equipment Cost	Baseline Install Cost	Proposed Install Cost	Incremental ATT Test Cost	Total Incremental First Cost
Lighting System Costs	$0	$254	$254	$0	$18	$123	$395
HVAC System Costs	$332	$396	$64	$0	$0	$0	$64
TOTAL	-	-	-	-	-	-	$459

3.4.4 Incremental Maintenance and Replacement Costs

The proposed occupancy-sensor measure for additional nonresidential space types is expected to deliver long-term, persistent energy savings due to the reliability and durability of modern control hardware and sensor technologies. For control hardware, the Statewide CASE Team did not find any documented lifetime information in the product literature. The manufacturers that the Statewide CASE Team consulted also did not observe or estimate any systematic time-dependent failure patterns for control hardware in indoor applications. As an alternative, the Statewide CASE Team used the estimated luminaire lifetime as a proxy for the lifetime of control hardware. This is a conservative assumption, since control hardware typically outlasts luminaires.

According to the lighting schedule provided in the 2025 ACM, the annual lighting operating hours range from 1,687 hours (warehouse) to 4,754 hours (restaurant). Assuming a 50,000-hour nominal rated lifetime for commercial-grade light emitting diode (LED) luminaires, the luminaire would last 10.5 to 29.7 years, based on the annual lighting operating hours in the ACM. The average lifetime, weighted by the square footage of different non-residential building types estimated in the CEC's 2029 construction forecast, is 20.3 years. This estimate excludes parking garage lighting, which, although treated as an indoor application in Title 24, Part 6, is considered to operate in a harsher environment exposed to outdoor conditions and to have significantly longer operating hours. Also, parking garages are not expected to be impacted by this proposed code change. The Statewide CASE Team conservatively assumed a 15-year lifetime for luminaire and control hardware, resulting in one replacement during the 30-year analysis period.

Routine maintenance for occupancy-based lighting control systems typically includes periodic cleaning of sensors, functional testing, and verification of time-out settings. These tasks are commonly performed during standard facility maintenance cycles and are expected to have minimal impact on overall maintenance costs. Occupancy sensors are solid-state devices without moving parts and generally require little servicing. Routine maintenance requirements are therefore anticipated to be similar between the baseline and proposed cases. Although occasional recalibration or reprogramming may be required to optimize sensor performance, these activities are generally integrated into ongoing lighting and building controls maintenance and were not added as incremental costs.

3.4.5 Cost Effectiveness

The cost-effectiveness analysis evaluates incremental first, labor, maintenance, and replacement costs relative to the baseline. It quantifies the PV of benefits over a 30-year analysis period using a three percent real discount rate. All values are expressed in 2029 PV dollars to align with the expected code implementation year. Incremental maintenance costs were estimated using the sensor's useful life and replacement assumptions described in Section 3.4.4. The analysis assumes the proposed occupancy-sensor control hardware has an expected useful life of 15 years.

Energy and cost savings were modeled using nonresidential prototype buildings that the DEER database (CPUC 2022) cited as having the considered space types for this measure as typical. Each prototype incorporates representative operating schedules, space-applicable lighting power densities from 2025 Title 24 Table 140.6-B (California

Energy Commission 2022), and published savings estimates for full- and partial-OFF occupancy sensing strategies from ANSI/ASHRAE/IES Addendum bd to ANSI/ASHRAE/IES Standard 90.1-2022, which establishes select lighting requirements in the forthcoming ASHRAE 90.1-2025 (ASHRAE 2022, ASHRAE 90.1 Addendum bd 2025). Savings were calculated as the difference in lighting and HVAC energy use and annual energy cost between baseline timeclock-only controls and the proposed occupancy-sensor strategies for each prototype, scaled by the square footage of the applicable space types being considered and applied across all California climate zones.

Results of the per-unit cost-effectiveness analysis are presented in Table 42 and Table 43 for new construction, additions, and alterations.

Table 42: 30-Year Cost-Effectiveness Summary Per Square Foot – New Construction and Additions

Climate Zone	Benefits LSC Savings & Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
1	0.05	0.09	0.59
2	0.06	0.07	0.84
3	0.06	0.05	1.06
4	0.06	0.05	1.13
5	0.06	0.07	0.89
6	0.06	0.06	1.11
7	0.08	0.05	1.67
8	0.08	0.06	1.37
9	0.05	0.06	0.96
10	0.08	0.06	1.38
11	0.04	0.05	0.75
12	0.04	0.05	0.77
13	0.05	0.07	0.81
14	0.05	0.06	0.83
15	0.08	0.06	1.43
16	0.05	0.06	0.87
Average	**0.06**	**0.06**	**1.08**

Table 43: 30-Year Cost-Effectiveness Summary Per Square Foot – Alterations

Climate Zone	Benefits LSC Savings & Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
1	0.05	0.10	0.55
2	0.05	0.07	0.77
3	0.06	0.06	1.03
4	0.06	0.06	1.05
5	0.07	0.08	0.85
6	0.06	0.06	1.10
7	0.08	0.06	1.48
8	0.07	0.05	1.38
9	0.06	0.05	1.03
10	0.07	0.06	1.25
11	0.05	0.07	0.72
12	0.05	0.06	0.83
13	0.07	0.07	1.01
14	0.06	0.06	0.99
15	0.10	0.07	1.45
16	0.05	0.06	0.74
Average	**0.06**	**0.06**	**1.08**

3.5 Require Occupant Sensing Controls in More Spaces – Statewide Impacts

3.5.1 Statewide Energy and Energy Cost Savings

The Statewide CASE Team estimated statewide savings for both new construction and alterations using a bottom-up approach consistent with the 2028 CASE Methodology Report. The per-unit energy impacts were extrapolated to statewide impacts using the Statewide Construction Forecasts provided by the CEC. These forecasts estimate new construction and additions anticipated in 2029, the first year the 2028 Title 24, Part 6 requirements are in effect, as well as the total existing building stock forecasted for 2029, which was used to approximate savings from building alterations. See the 2028 CASE Methodology Report for details on how statewide savings are calculated. Appendix C presents the assumptions on the percentage of the total construction forecast that the proposed measure would impact.

The tables below present the first-year statewide energy and LSC savings from newly constructed buildings and additions (Table 44) and alterations (Table 45) by climate zone. Table 46 presents first-year statewide savings from new construction, additions, and alterations.

Table 44: Statewide Energy and LSC Impacts – New Construction and Additions

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026 (Million Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction	First-Year Natural Gas Savings (Million Therms)	First-Year Natural Gas Savings (Million Therms) First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	273,785	0.00	0.00	(0.00)	0.00	$0.01
2	1,659,880	0.01	0.00	(0.00)	0.01	$0.09
3	7,772,995	0.06	0.00	(0.00)	0.04	$0.44
4	4,050,590	0.04	0.00	(0.00)	0.02	$0.24
5	914,345	0.01	0.00	(0.00)	0.01	$0.06
6	5,513,015	0.05	0.00	(0.00)	0.04	$0.35
7	3,883,225	0.04	0.00	(0.00)	0.03	$0.31
8	7,884,770	0.09	0.01	(0.00)	0.07	$0.63
9	13,228,040	0.10	0.01	(0.00)	0.07	$0.72
10	6,556,900	0.05	0.00	(0.00)	0.07	$0.50
11	1,400,715	0.01	0.00	(0.00)	0.01	$0.06
12	8,020,345	0.06	0.00	(0.00)	0.03	$0.33
13	2,831,520	0.02	0.00	(0.00)	0.01	$0.15
14	1,554,225	0.01	0.00	(0.00)	0.01	$0.08
15	902,955	0.01	0.00	(0.00)	0.01	$0.07
16	510,595	0.00	0.00	(0.00)	(0.00)	$0.03
Total	**66,957,900**	**0.57**	**0.04**	**(0.00)**	**0.43**	**$4.07**

Table 45: Statewide Energy and LSC Impacts – Alterations

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026 (Million Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Natural Gas Savings (Million Therms) First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	1,151,657	0.01	0.00	(0.00)	0.00	$0.06
2	6,833,213	0.05	0.00	(0.00)	0.04	$0.38
3	31,402,467	0.26	0.02	(0.00)	0.17	$1.86
4	15,981,317	0.14	0.00	(0.00)	0.09	$0.94
5	3,146,453	0.03	0.00	(0.00)	0.02	$0.21
6	24,431,400	0.22	0.02	(0.00)	0.18	$1.55
7	18,502,139	0.21	0.01	(0.00)	0.16	$1.51
8	35,152,600	0.37	0.02	(0.00)	0.27	$2.63
9	55,486,947	0.45	0.04	(0.00)	0.31	$3.10
10	31,550,773	0.27	0.03	(0.00)	0.29	$2.31
11	6,147,017	0.04	0.00	(0.00)	0.03	$0.30
12	34,196,120	0.27	0.02	(0.00)	0.17	$1.80
13	12,707,921	0.12	0.00	(0.00)	0.09	$0.87
14	7,319,097	0.06	0.00	(0.00)	0.04	$0.42
15	4,417,448	0.06	0.00	(0.00)	0.06	$0.44
16	2,299,080	0.02	0.00	(0.00)	(0.00)	$0.11
Total	**290,725,650**	**2.60**	**0.18**	**(0.00)**	**1.91**	**$18.48**

Table 46: Statewide Energy and LSC Impacts – New Construction, Additions, and Alterations

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First -Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million Therms)	30-Year Present Valued LSC Savings (Million 2029 PV$)
New Construction & Additions	0.6	0.0	(0.0)	0.4	4
Alterations	2.6	0.2	(0.0)	1.9	18
Total	**3.2**	**0.2**	**(0.0)**	**2.3**	**23**

3.5.2 Statewide Greenhouse Gas Emissions Reductions

Table 47 presents the estimated first-year reduction in GHG emissions resulting from the proposed code change. In the initial year, the Statewide CASE Team expects to avoid 44 metric tons of CO_2e emissions. These reductions, along with their associated monetary value, were calculated using hourly GHG emissions factors published alongside the LSC hourly factors and source energy hourly factors in the research versions of CBECC, as well as data from the CEC's 2028 Metrics Report. See the 2028 CASE Methodology Report for additional information.

Table 47: First-Year Statewide GHG Emissions Impacts

Construction Type	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2e)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO2e)	Total Reduced GHG Emissions (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions ($)
New Construction, Additions, & Alterations	133	-20	113	$13,919

3.5.3 Statewide Water Use Impacts

The proposed code change would not result in water use impacts.

3.5.4 Statewide Material Impacts

The proposed code change does not directly replace one lighting technology with another and does not introduce an entirely new category of equipment to the market, since the required equipment already exists and is commonly used in the industry. However, the proposal would increase the use of occupancy sensors, associated control hardware, and, depending on implementation, cables and low-voltage wiring.

For this proposed measure, material impacts were evaluated by comparing the material composition of the affected control components in the baseline and proposed case, estimating the net change in units of each component per square foot, and scaling those per-unit impacts to statewide first-year affected floor area. The analysis focused on materials of interest including lead, copper, steel, plastic, zinc, and other materials contained in lighting controls and associated wiring. Mercury was not expected to change.

The Statewide CASE Team aligned with the 2022 CASE Report analysis, which characterized the primary affected components as cable connectors, junction boxes, occupancy sensors, and power cables. Material composition estimates were based on manufacturer specifications and product information for representative products. Key assumptions included the following:

- **Cable connectors:** assumed to contain 0.32 pounds of zinc per unit.
- **Junction boxes:** assumed to contain 0.85 pounds of steel per unit.
- **Occupancy sensors:** assumed to contain approximately 0.10 pounds of plastic, 0.08 pounds of other materials, and trace amounts of lead, copper, steel, and zinc.
- **Power cable:** assumed to contain copper conductor material, plastic insulation and covering, aluminum armor, and other materials based on representative cable specifications.

The 2022 CASE Report found that the proposal would result in a net increase in lead, copper, steel, plastic, zinc, and other materials, and no change in mercury. This outcome reflects the increased use of occupancy sensors and related controls.

Relevant stakeholder outreach informing this analysis included manufacturer and product specification review used to estimate representative material composition of the affected control components. The material analysis relied primarily on product literature and representative equipment assumptions developed for the CASE cost and design analysis from the 2022 CASE Report.

Table 48 summarizes the first-year statewide impacts on material use based on the 2022 CASE Report analysis.

Table 48: First-Year Statewide Impacts on Material Use

Material	Impact	Per-Unit Impacts (Pounds per Sensor	First-Year Statewide Impacts (Pounds)	Embodied GHG Emissions Saved (Metric Tons CO2e)
Mercury	No Change	N/A	-	-
Lead	No Change	N/A	-	-
Copper	No Change	N/A	-	-
Steel	Increase	0.85	28,026	-15
Plastic	Increase	0.10	3,297	-3
Zinc	Increase	0.32	10,551	-
Total	**N/A**	**N/A**	**N/A**	**-18**

Because the analysis is based on representative products and design assumptions, actual material impacts may vary by manufacturer, control system architecture, and installation practice. In addition, trace quantities of some materials were identified in control components but were not always large enough to materially affect the statewide totals shown.

For more information on the Statewide CASE Team's methodology and assumptions used to calculate embodied GHG emissions, see the 2028 CASE Methodology Report.

3.5.5 Environmental Impacts

Integration of occupancy sensors in more spaces with both lighting and HVAC occupied standby modes will decrease unnecessary lighting, ventilation, and conditioning during unoccupied periods, resulting in direct environmental benefits, including lower electricity consumption and reduced GHG emissions from power generation. The Statewide CASE Team did not identify any indirect environmental benefits or any direct or indirect adverse environmental impacts. The Statewide CASE Team also did not identify any other reasonable alternatives that would achieve the same goal of reducing lighting and HVAC energy consumption while maintaining occupant comfort and system performance.

3.5.6 Other Non-Energy Impacts

In addition to energy-related benefits, the proposed code change is expected to result in several non-energy impacts that may be relevant to the California Environmental Quality Act (CEQA) analysis. Enhanced occupancy sensor requirements are expected to improve lighting control effectiveness and HVAC occupied standby implementation across nonresidential building types, reducing unnecessary lighting operation, ventilation, and associated waste heat. These improvements may contribute to improved occupant comfort.

Reduced lighting and ventilation energy use and peak demand may also enhance grid reliability and resilience, particularly during periods of high system stress. While initial equipment and installation costs may be higher for some building owners or operators, especially small businesses or those in older facilities. The resulting long-term energy savings can improve operational sustainability and reduce ongoing utility expenses. These savings may support more stable business operations, create opportunities for reinvestment, and strengthen economic resilience in disadvantaged or ESJ communities.

No additional impacts beyond those identified have been found that would require further CEQA consideration at this time, though the Statewide CASE Team acknowledges that the list of impacts may evolve with continued stakeholder engagement and data collection.

3.6 Require Occupant Sensing Controls in More Spaces – Proposed Language Code

The proposed code language in this section includes only changes relevant to this measure. The intent is to clearly illustrate the scope of this measure. The proposed code language that encompasses the changes resulting from all the measures in this CASE Report can be found in Appendix I.

3.6.1 Guide to Markup Language

The proposed changes to the standards, Reference Appendices, and the ACM Reference Manuals are provided below. Changes to the 2025 documents should be marked with dark blue underlining (new language) and ~~strikethroughs~~ (deletions). New to the 2028 energy code is to italicize defined terms when the terms are being used in their defined context. In-line comments that are not part of the proposed code language but are used to help describe the purpose of what is proposed are included with grey highlight and italics.

Markups are provided to the restructured 2025 Energy Code that the CEC developed in response to feedback that aligning the structure of Title 24, Part 6 with other parts of the California Building Standards Code (Title 24) would improve readability, usability, and navigation. New section numbers are shown in bold, followed by square brackets that document the section in the 2025 Title 24, Part 6 section numbers prior to the restructuring. For example, “Section 601.1 [Section 130.0(a)] General” contains the content that is in the current Section 130.0(a).

Posting the proposed code language in this format is useful, as it helps describe how the Energy Code changes proposed for nonresidential occupancies are isolated from the requirements for residential occupancies, which are prohibited from being changed until the 2031 code cycle by Assembly Bill 130.

3.6.2 Administrative Code (Title 24, Part 1)

There are no proposed changes to the Administrative Code (Title 24, Part 1).

3.6.3 Energy Code (Title 24, Part 6)

401.2.1 *[Section 120.1]* **– Ventilation and indoor air quality**

…

(CONTINUED): TABLE 401.2-A [TABLE 120.1-A]– MINIMUM VENTILATION RATES

Occupancy Category - *Office Buildings*	**Minimum Occupant Load Density (persons / 1000 ft^2)**	**Area-based Minimum Ventilation R_a (cfm/ft^2)**	**Air Class**	**Notes**
~~Breakrooms~~	~~33~~	~~0.15~~	~~1~~	~~--~~
Main entry lobbies	33	0.15	1	F

Occupancy Category - *Office Buildings*	Minimum Occupant Load Density (persons / 1000 ft^2)	Area-based Minimum Ventilation R_a (cfm/ft^2)	Air Class	Notes
Occupiable storage rooms for dry materials	2	0.15	1	--
Office space	5	0.15	1	F
Reception areas	5	0.15	1	F
Telephone/data entry	33	0.15	1	F

…

SECTION 601.2 – MANDATORY REQUIREMENTS (Newly Constructed, Additions, Alterations)

…

601.2.2.3.6 *[Section 130.1(c)6]* **Full or partial-OFF occupant sensing controls.**

For *warehouse aisle ways*, *warehouse* open areas, library book stack aisles, corridors, *stairwells*, offices greater than 250 square feet, parking *garages*, parking areas, loading areas, and unloading areas, laboratories, lounges, breakrooms, waiting areas, and computer rooms, the installed *lighting* shall meet the following requirements:

601.2.2.3.6.1 *[Section 130.1(c)6A]* **– Warehouse aisle ways and open areas.** In *warehouse aisle ways* and *warehouse* open areas, *lighting* shall be controlled with *occupant sensing controls* that automatically reduce *lighting* power by at least 50 percent when the areas are unoccupied. The *occupant sensing controls* shall independently control *lighting* in each *warehouse aisle way*, and shall not control *lighting* beyond the *aisle way* being controlled by the sensor.

Exception to Section 601.2.2.3.6.1: When metal halide *lighting* or high pressure sodium *lighting* is installed in *warehouses*, *occupant sensing controls* shall reduce *lighting* power by at least 40 percent.

601.2.2.3.6.2 *[Section 130.1(c)6B]* **– Library book stack aisles.** In library book stack aisles 10 feet or longer that are *accessible* from only one end, and library book stack aisles 20 feet or longer that are *accessible* from both ends, *lighting* shall be controlled with *occupant sensing controls* that automatically reduce *lighting* power by at least 50 percent when the areas are unoccupied. The *occupant sensing controls* shall independently control *lighting* in each *aisle way*, and shall not control *lighting* beyond the *aisle way* being controlled by the sensor.

601.2.2.3.6.3 *[Section 130.1(c)6C]* **– Corridors and stairwells.** In corridors and *stairwells*, *lighting* shall be controlled by *occupant sensing controls* that separately reduce the *lighting* power in each space by at least 50 percent when the space is unoccupied. The *occupant sensing controls* shall be capable of automatically turning the *lighting* fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress. *Lighting* in *stairwells* and common area corridors that provide access to guestrooms of *hotel/motels* shall meet requirements of this section instead of complying with Section 601.2.2.3.1 *[Section 130.1(c)1]*.

601.2.2.3.6.4 *[Section 130.1(c)6D]* **– Office spaces greater than 250 square feet.** In office spaces greater than 250 square feet, *general lighting* shall be controlled with *occupant sensing controls* that meet all of the following:

1. The *occupant sensing controls* shall be configured so that *lighting* shall be controlled separately in control zones not greater than 600 square feet. All control zones in offices greater than 250 square feet shall be shown on the plans; and
2. In 20 minutes or less after the control zone is unoccupied, the *occupant sensing controls* shall uniformly reduce *lighting* power in the control zone to no more than 20 percent of full power. Control functions that switch control zone *lights* completely off when the zone is vacant meet this requirement; and
3. In 20 minutes or less after the entire office space is unoccupied, the *occupant sensing controls* shall automatically turn off *lighting* in all control zones in the space; and
4. In each control zone, *lighting* shall be allowed to automatically turn on to any level up to full power upon *occupancy* within the control zone. When *occupancy* is detected in any control zone in the space, the *lighting* in other control zones that are unoccupied shall operate at no more than 20 percent of full power.

Exception to Section 601.2.2.3.6.4: Under-shelf or furniture-mounted *task lighting* controlled by a local switch and either a time switch or an *occupancy* sensor.

601.2.2.3.6.5 *[Section 130.1(c)6E]* **– Parking garages, parking areas and loading and unloading areas.** In parking *garages*, parking areas and loading and unloading areas, *general lighting* shall be controlled by *occupant sensing controls* that meet the requirements below instead of complying with Section 601.2.2.3.1 *[Section 130.1(c)1]*:

1. The *occupant sensing controls* shall uniformly reduce *lighting* power in the control zone to between 20 percent and 50 percent of full power and with at least one control step; and
2. No more than 500 watts of rated *lighting* power shall be controlled together as a single zone; and
3. The *occupant sensing controls* shall be capable of automatically turning the *lighting* fully ON only in the separately controlled zone, and shall be automatically activated from all designed paths of egress.

Interior areas of parking *garages* are under the classification of indoor *lighting* and shall comply with Section 601.2.2.3.6.5 *[Section 130.1(c)6E]*.

Parking areas on the *roof* of a parking structure are under the classification of outdoor *hardscape* and shall comply with Section 601.2.3 *[Section 130.2]*.

601.2.2.3.6.6 *[New section]* – Laboratory spaces. In laboratory spaces, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power to between 20 percent and 50 percent of full power when the space is unoccupied for no more than 15 minutes during normally occupied hours and shall turn off lighting when the space is unoccupied for an additional 15 minutes during normally unoccupied hours.

Where the lighting system occupant sensors are providing the occupancy status of the laboratory space for airflow reduction control in accordance with Section 912.2.1 *[Section 140.9(c)1]*, the occupancy signal shall be independent of daylighting or manual lighting overrides of lighting.

Exception to 601.2.2.3.6.6: Laboratory spaces where occupancy sensing control of lighting conflicts with facility environmental health and safety department requirements.

601.2.2.3.6.7 *[New section]* – Lounges, breakrooms, and waiting areas. In lounges, breakrooms, and waiting areas, lighting shall be controlled by occupant sensing controls that automatically turn lighting OFF when the space is unoccupied for no more than 15 minutes. The occupant sensing controls shall be capable of automatically turning the lighting fully ON upon detection of occupancy.

Exception to 601.2.2.3.6.7: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

601.2.2.3.6.8 *[New section]* – Computer rooms. In *computer rooms*, *general lighting* shall be controlled by occupant sensing controls that automatically turn lighting OFF when the space is unoccupied for no more than 15 minutes. The occupant sensing controls shall be capable of automatically turning the lighting fully ON upon detection of occupancy. In *server aisles*, the occupant sensing controls shall independently control lighting in each aisle way.

Exception to 601.2.2.3.6.8: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

…

3.6.4 Reference Appendices

NA7.6.2.3 Occupant Sensing Lighting Controls Functional Testing

This requirement applies to areas where occupant sensing controls are required to comply with Section 130.1(c) with the exception of Section 130.1(c)6D.

For each sensor to be tested do the following:

(a) **Unoccupied Test**. Simulate an unoccupied condition in the controlled space. Verify and document the following:

1. The occupant sensing control turn the controlled lighting off or partially-off in 20 minutes or less from the start of an unoccupied condition. In addition:
    a. For partial-on occupant sensing controls, occupant sensing controls and vacancy sensing controls, the controlled lighting is turned off in unoccupied condition.
    b. In the partially off state, partial off occupant sensing controls automatically reduce lighting power by at least 50 percent, or automatically reduce in one of the following:
        1. For warehouses with metal halide or high pressure sodium lighting, reduce lighting power by at least 40 percent;
        2. For aisle ways and open areas in warehouses in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, reduce lighting power by at least 40 percent;
        3. For corridors and stairwells that provide access to guestrooms and dwelling units of high-rise residential buildings and hotel/motels in which the installed lighting power is 80 percent or less of the valued allowed under the Area Category Method, reduce lighting power by at least 40 percent.
    c. For occupant sensing controls in laboratories, parking garages, parking areas, and loading and unloading areas, the control has at least one control step between 20 to 50 percent of the design lighting power, or the controls has at least one control step between 20 to 60 percent of the design lighting power - for the controls serving metal halide luminaires with a lamp plus ballast mean system efficacy of 75 lumens per watt. In the partially off state, partial off occupant sensing controls automatically reduce lighting power by one control step.

(b) **Occupied Test**. Simulate an occupied condition in the controlled space. Verify and document the following:

1. Status indicator or annunciator operates correctly.
2. Immediately upon an occupied condition:
    1. The occupant sensing control or partial off occupant sensing control turns on controlled lighting; or
    2. The vacancy sensing control indicate a space is occupied and the controlled lighting can be turned on manually; or

3. The partial-on occupant sensing control automatically turns on the controlled lighting at between 50 to 70 percent of controlled lighting power. After the partial-on stage, manual switches can be activated to turn on the controlled lighting at full controlled lighting power.

…

3.6.5 Compliance Manuals

The Statewide CASE Team will provide the CEC with recommended revisions to compliance manuals after the 45-Day Language is published.

3.6.6 ACM Reference Manual

The Statewide CASE Team will provide the CEC with recommended revisions to the ACM Reference Manual after the 45-Day Language is published.

3.6.7 Compliance Forms

As discussed in Section 3.2.1, the nonresidential lighting compliance and mechanical compliance forms would be updated to reflect the proposed change, including NRCC/LMCC-LTI-E, NRCI/LMCI-LTI-E, NRCC/LMCC-MCH-E, NRCI/LMCI-MCH-E, as well as the nonresidential performance form NRCC/LMCC-PRF-E. The Statewide CASE Team can support the CEC in implementing these updates if the proposed change is adopted.

4. Reduce Occupant Sensing Control Delay Time

4.1 Reduce Occupant Sensing Control Delay Time – Measure Description

4.1.1 Proposed Code Change

This proposed measure reduces the occupant sensing control delay time for lighting systems from 20 minutes to 15 minutes, which would increase energy savings in affected lighting systems and space types.

The proposed measure would affect new construction, additions, and alterations and require an update to the acceptance test procedure, revising the current 20-minute delay time to 15 minutes.

To align with the standards, the Statewide CASE Team has also provided potential updated code language that reduces the delay time for HVAC occupied standby requirements. This alignment would provide consistency for systems and space types that use the same sensor for both lighting occupancy control and HVAC occupied standby.

Table 49: Scope of Proposed Code Change

A ☑ indicates the proposed code change is relevant.

Building Type(s)	Construction Type(s)	Type of Change
☐ Single Family	☑ New Construction	☑ Mandatory
☐ Multifamily	☑ Additions	☐ Prescriptive
☑ Nonresidential (Not Group R uses)	☑ Alterations	☐ Performance

Application Climate Zones	Energy Code Sections	Compliance Forms	Sections of ACM Reference Manuals
Climate Zones 1-16	Lighting controls: Part 6, Section 601.2.2.3.5 *[Section 130.1(c)5]* HVAC controls: Part 6, Sections 401.2.1.2.5 and 912.1.2*[Sections 120.1(d)5 and 140.9(c)1]*	N/A	N/A

Third Party Verification)	Updates to Compliance Software
☐ No changes to third party verification	☑ No updates
☑ Update existing verification requirements	☐ Update existing feature
☐ Add new verification requirements	☐ Add new feature

4.1.2 Benefits of Proposed Change

The proposed measure would provide energy savings by reducing the amount of time that lighting remains ON when a space is unoccupied. Because the measure only requires a change in setting to currently required equipment, there would be no incremental cost.

ANSI/ASHRAE/IES 90.1-2022 addendum bd estimates that reducing the shut-OFF time from 20 minutes to 15 minutes will provide lighting energy savings from two percent to five percent (ASHRAE 90.1 Addendum bd 2025). Reducing occupancy delay time may extend the life expectancy of the lighting system or of individual components, reducing lifecycle operating and maintenance cost.

The savings associated with the proposed measure depend on occupancy patterns in a space that include periods of no occupancy when the delay time is being employed by the occupancy controller. The greater the number of unoccupied periods that occur in a day, the greater the energy savings from turning OFF the lights with a shorter delay time.

In high-activity spaces with brief periods shorter than the occupancy sensor delay, lights may remain ON or at a 50-percent light-level reduction, limiting energy savings. A shorter delay time provides savings where longer delays, like 20 minutes, would not.

In addition, updating the HVAC occupied standby delay time to 15 minutes would maintain consistency within the standards, and would create alignment with national standards, while providing additional HVAC energy savings. As with the change to lighting controls described above, because the reduction in occupied standby delay time only requires a change in setting to currently required equipment, there would be no incremental cost. In conversations with the Statewide CASE Team, industry stakeholders also indicated a strong preference for maintaining alignment in delay times for lighting occupancy controls and HVAC occupied standby, and HVAC subject matter experts reported that there are no indoor air quality concerns with reducing the occupied standby delay time to 15 minutes.

4.1.3 Background Information

If a space becomes unoccupied, an occupancy sensor will detect that condition and start a countdown timer, referred to as the sensor delay time. Occupancy sensors use the delay time because they cannot precisely determine the moment the space becomes unoccupied. The sensor may not detect a hidden occupant or one that may be stationary for a period of time. To reduce false OFF triggers, the delay time keeps the lights ON while observing the space for new activity. When that occurs, the occupancy sensor determines if the space is occupied and waits until it senses that the space is unoccupied to reset the delay timer. If the programmed delay time elapses without detecting a new occupancy event, the occupancy sensor will turn the lights OFF.

The current Energy Code requires lighting controls capable of reducing lighting power or shutting off all lighting within 20 minutes of a space becoming unoccupied.

Several other national and state energy codes have adopted or are considering 15-minute delay times for occupancy controls, as section 4.1.5.1 details. The proposed measure would make the California Energy Code consistent with those other codes.

4.1.4 Modifications to Energy Code Documents

This section provides descriptions of how the proposed code change will affect each Energy Code document. See Section 4.6 - Reduce Occupant Sensing Control Delay - Proposed Language Code of this report for detailed revisions to code language.

4.1.4.1 Energy Code Change Summary

Lighting Controls

SECTION 601.2.2 *[Section 130.1]* – MANDATORY INDOOR LIGHTING CONTROLS

Section 601.2.2.3 *[Subsection 130.1(c)]:* The proposed measure would modify sections 601.2.2.3.1.1, 601.2.2.3.5.1, and 601.2.2.3.6.4, revising all references to occupancy sensor delay time from 20 minutes to 15 minutes in nonresidential buildings.

HVAC Occupied Standby Controls

SECTION 401.2.1 *[Section 120.1]* – REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

Section 401.2.1.2.5 *[Subsection 120.1(d)5]:* For alignment, the Energy Code could modify the time delay for occupied standby zone controls from 20 minutes to 15 minutes.

SECTION 912.2 *[Section 140.9]* – PRESCRIPTIVE REQUIREMENTS FOR LABORATORY AND FACTORY EXHAUST SYSTEMS

Section 912.2.1 *[Subsection 140.9(c)1]:* For alignment, the Energy Code could modify the time delay for minimum unoccupied exhaust airflow in laboratory and factory exhaust systems from 20 minutes to 15 minutes.

4.1.4.2 Reference Appendices Change Summary

The proposed measure would update references to occupancy control time delay and occupied standby time delay in reference appendices from a 20-minute delay time to 15 minutes.

4.1.4.3 Compliance Manuals Change Summary

The proposed measure would require compliance manuals to update references of a 20-minute occupancy sensor time delay to 15 minutes.

4.1.4.4 Alternative Calculation Method Reference Manual Change Summary

The proposed measure will impact the ACM Manual baseline assumptions for reducing lighting energy use. “Lighting control zones are typically smaller than HVAC zones, making their zone-level sensors more than capable of detecting occupancy in typical HVAC zones. Lighting systems with sensors integrated into every luminaire can serve even the smallest HVAC zone sizes. In principle, such systems can even be configured to support reduced HVAC zone sizes that might result from retrofits targeting the greater energy savings that temperature setpoint-widening control schemes can deliver with smaller zones" (Poplawski 2024).

4.1.4.5 Compliance Forms Change Summary

The proposed measure would require revisions to the SHUT-OFF LIGHTING CONTROL 2025-CEC-NRCA-LTI-02-A compliance form to reflect the change in required occupancy control delay time from 20 minutes to 15 minutes.

Any modifications to HVAC occupied standby delay time would require revisions to the associated compliance forms to reflect the change in delay time from 20 minutes to 15 minutes. Associated compliance forms include NRCA-MCH-19-A Occupied Standby and NRCA-PRC14b-F Lab Exhaust – Test and Balance.

4.1.5 Measure Context

4.1.5.1 Comparable Model Codes or Standards

ANSI/ASHRAE/IES 90.1-2022 addendum bd and IECC proposal CE101-24 both propose decreasing the delay time to 15 minutes to achieve energy savings. The ASHRAE committees confirmed with manufacturers that this is a common delay in time setting and would not add cost. ASHRAE 90.1-2022 addendum bd states: "Change the occupancy sensor delay time from 20 minutes to 15 minutes in base prescriptive requirements utilizing occupancy sensor technologies to regulate lighting. This provides an additional 2 percent to 5 percent lighting energy savings for spaces required to use occupancy sensor control without additional costs" (ASHRAE 90.1 Addendum bd 2025).

In New York State, a minimum of 80 percent of all lighting must be automatically turned off within 15 minutes of all occupants leaving the space, for open office plans, cafeteria, and fast-food dining areas greater or equal to 300 square feet (NYC Buildings 2020).

4.1.5.2 Interactions with Other Regulations

The proposed measure is not duplicative of, and not in conflict with, applicable federal, state, or local regulations. There are no known federal, state, or local regulatory requirements that address or conflict with the proposed measure.

4.2 Reduce Occupant Sensing Control Delay time – Compliance and Enforcement

4.2.1 Compliance Considerations

The Statewide CASE Team worked with stakeholders to develop a recommended compliance and enforcement process and to identify how this process would affect various market actors.

While developing this proposal, the Statewide CASE Team considered ways to streamline the compliance and enforcement process and how to reduce negative impacts on market actors involved in it.

Below are the activities that need to occur during each phase of the project:

- **Design Phase:** Designers would need to specify occupancy sensors that can comply with the proposed delay time requirement.
- **Permit Application Phase**: No changes.

- **Construction Phase:** No changes, except programming the occupancy sensor delay time to 15 minutes or less instead of 20 minutes or less, and acceptance testing would confirm the revised delay time.
- **Inspection Phase:** No changes, except verifying the occupancy sensor delay time is 15 minutes or less instead of 20 minutes or less.

The Statewide CASE Team does not anticipate significant changes to the compliance process because of this proposed measure. This proposed measure does not modify the spaces that require an occupancy sensor, and no changes to the occupancy sensor delay time verification process other than the change in the delay time. If the Energy Code adopts the same modifications to delay times for HVAC occupied standby, there would be similar minor changes to the compliance process for those controls to reflect the change.

4.2.2 Impact on Market Actors

The proposed measure would slightly change the process for market actors to implement and verify the correct occupancy sensor delay time but would not create additional work compared to the existing compliance processes. Designers would need to specify occupancy sensors capable of meeting the updated delay time requirement. Installers and ATTs would need to program and test that the controls meet the delay time requirement, but the processes themselves remain unchanged.

Table 50 summarizes impacts on market actors and suggests outreach and education that might be helpful to support market actors as they prepare for the effective date of the requirements.

Table 50: Impacts on Market Actors and Suggested Training and Education Opportunities

Market Actor	Impact(s)	Suggested Outreach and Education
Owner/Developer[a]	Need to specify occupancy sensors capable of a delay time of 15 minutes or less.	Provide educational materials to increase awareness of delay time requirement.
Design Professionals[b]	Need to specify occupancy sensors capable of a delay time of 15 minutes or less.	Provide educational materials to raise awareness of the time-delay requirement and highlight products capable of meeting the required delay time.
Construction Team[c]	Program occupancy sensors delay time to 15 minutes or less.	None identified.
Building Departments[d]	The workflow remains the same and the occupancy sensor delay	None identified. The proposed changes do not require inspectors to acquire new information/knowledge

	time will be set to 15 minutes or less instead of 20 minutes or less.	or modify their practice if the required controls are clearly specified in the design documents.
Verification Testers[e]	• The general workflow remains unchanged by the proposed changes. • For the occupant sensing control functional test, the ATT will now have to verify the delay time to be 15 minutes or less, instead of 20 minutes or less.	Revised educational materials and training will be required as is supported by the Acceptance Test Technician Certification Providers.
Building Owners, Managers, and Occupants	Reduced energy bills.	None identified.
Manufacturers and Distributors	Occupancy sensors must be capable of a delay time of 15 minutes or less.	Provide educational materials to increase awareness of delay time requirement.

a. Owner/Developer is funding the project and is the primary decision-maker.

b. Design professionals include architects, engineers (mechanical, electrical, plumbing, structural), specification writers, cost estimators, commissioning agents, lighting designers, and energy consultants.

c. Construction team includes general contractors, design-build contractors, installation contractors (e.g., HVAC, plumbing, electrical), commissioning agents, and tradespeople.

d. Building departments include plans reviewers, building inspectors, specialty inspectors, permit counter technicians, and third-party plan review and inspection.

e. Verification testers include commissioning agents, ECC-Raters, and ATTs.

The 2028 CASE Methodology Report presents a quantitative assessment of how changes to the California building code impact builders, building designers and energy consultants, and building owners and occupants. While the analysis in the methodology report is not specific to the code changes presented in this report, this measure focuses on verification testers, since these market actors are expected to experience the most direct impacts from reducing the occupancy sensor time delay. The following provides a qualitative description of how this specific code change affects various market actors and additional quantitative analyses of its potential impacts on building industry subsectors.

The proposed change would affect commercial projects with associated market actors; however, it would likely not impact firms focused on the construction or retrofitting of industrial buildings, utility systems, public infrastructure, or other heavy construction. The proposed change would not affect all firms and workers in the commercial building industries equally; instead, it would primarily affect specific subsectors within the industry. Table 51 lists the commercial building subsectors the Statewide CASE Team expects would be impacted by the changes proposed in this report.

Building occupants (owners and tenants). The proposed code change would have no incremental cost and would reduce building owners' utility bills throughout the measure lifetime. See the [2028 CASE Methodology Report] for a description of how LSC savings relate to occupant utility bill savings.

The proposed measure primarily impacts nonresidential electrical contractors, who would be responsible for installing control systems that comply with the updated occupancy delay time.

Table 51: Specific Subsectors of the California Commercial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2025 (Estimated)

Construction Subsector	Establishments*	Employment	Annual Payroll (Billions $)
Commercial Building Construction	5,491	87,450	$10.6
Nonresidential Poured F oundation Contractors	497	15,884	$1.4
Nonresidential Structural Steel Contractors	365	11,899	$1.1
Nonresidential Framing Contractors	137	3,037	$0.2
Nonresidential Masonry Contractors	217	4,028	$0.3
Nonresidential Glass and Glazing Contractors	307	5,079	$0.5
Nonresidential Roofing Contractors	385	11,413	$1.0
Nonresidential Siding Contractors	32	735	$0.1
Other Nonresidential Exterior Contractors	234	2,259	$0.1
Nonresidential Electrical Contractors	3,245	72,794	$7.8
Nonresidential Plumbing and HVAC Contractors	2,270	55,182	$5.8
Other Nonresidential Equipmen t Contractors	580	9,749	$1.1
Nonresidential Drywall Contractors	593	19,328	$1.8

Nonresidential Painting Contractors	501	9,225	$0.7
Nonresidential Flooring Contractors	286	4,011	$0.4
Nonresidential Tile and Terrazzo Contractors	151	2,223	$0.2
Nonresidential Finish Carpentry Contractors	313	3,697	$0.3
Other Nonresidential Finishing Contractors	492	7,241	$0.6
Nonresidential Site Preparation Contractors	1,147	19,273	$1.9
All Other Nonresidential Trade Contractors	948	17,084	$1.7

Source: Analysis by the Title 24 CASE Team of QCEW data from the California Employment Development Department https://labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=industry

*An establishment is a single economic unit, typically at one physical location, that engages in one, or predominantly one, type of economic activity for which a single industrial classification may be applied. Many businesses are composed of multiple establishments. U.S. Bureau of Labor Statistics, Handbook of Methods. https://www.bls.gov/opub/hom/cew/concepts.htm

The current code requires nonresidential buildings to install occupancy sensors. Since this is already a requirement, the proposed measure would have no impact on manufacturers.

4.2.3 Compliance Software Updates

The proposed measure would require a minor update to the CBECC ruleset to change the occupancy sensor delay time from 20 minutes to 15 minutes in the standard design.

4.2.4 Cost of Enforcement

The Statewide CASE Team acknowledges that changes to the code will impact enforcement costs. This report is an evaluation of specific measures, and the collective impact of all proposed changes for the 2028 Title 24, Part 6 may represent an increase in training and/or workload for enforcement personnel. The Statewide CASE Team believes there would be no additional cost to ensure compliance with or enforce the proposed measure in the field. The commissioning and verification procedure would remain the same, except the occupancy sensors would be set with a 15-minute delay time instead of a 20-minute delay time. There would be minor additional costs for training on the new measure. There may be a minimal associated cost with updating CBECC to the proposed 15-minute sensor delay time.

4.3 Reduce Occupant Sensing Control Delay Time – Market and Economic Analysis

4.3.1 Market Structure and Availability

4.3.1.1 Current Market Structure and Availability

The Statewide CASE Team's market research into existing sensor time setpoint capabilities indicates that the proposed measure would not cause any designer or manufacturer challenges due to reducing the sensor delay time to 15 minutes. Available products are capable of meeting the sensor delay time decrease to 15 minutes.

4.3.1.2 Market Challenges and Solutions

There are not any anticipated market challenges for this proposed measure.

4.3.2 Design and Construction Practices

4.3.2.1 Current Design and Construction Practices

Setting or confirming the occupancy sensor delay time is a standard part of current lighting system initial commissioning at installation. The proposed measure would not require a change to the overall installation process, only a change to the delay time the installer selects. Manufacturers ship occupancy sensor and lighting controls products with default delay times. Default time delays for occupancy controls vary between 15 and 30 minutes. For sensors with a default of 15 minutes, the controls would meet the requirements out of the box and would need no further adjustments to meet the proposed requirements.

4.3.2.2 Health and Safety Considerations

The proposed code change does not alter any existing federal, state, or local regulations pertaining to safety and health, including rules enforced by the California DOSH. All existing health and safety rules would remain in place. The Statewide CASE Team does not anticipate that complying with the proposed code change would have adverse impacts on the safety or health of occupants or those involved with the construction, commissioning, and maintenance of the building.

If the Energy Code adopts the same modifications to delay times for HVAC occupied standby, the Statewide CASE Team does not anticipate any negative impacts on indoor air quality, because HVAC occupied standby is only required for space types that the Energy Code allows to have ventilation air reduced to zero. Similarly, the laboratory and factory exhaust system unoccupied minimum exhaust airflow requirements established minimum criteria to protect indoor air quality. The Statewide CASE Team reviewed this measure with HVAC design engineers and confirmed that there are no known impacts to health and safety associated with shortening the delay time for the signal to activate the occupied standby setting in the HVAC system for the impacted room.

4.3.2.3 Design and Construction Challenges and Solutions

The Statewide CASE Team is not aware of any significant barriers to implementing this measure within the construction industry, as it represents an incremental reduction to an existing occupancy sensor requirement.

Prior to the use of LEDs in commercial buildings, the main light source technology employed in nonresidential construction was linear fluorescent. That technology was sensitive to cycling ON and OFF, and doing so would result in degradation of the cathode and anode, leading to decreased performance and shorter lamp life. This led to favoring longer sensor delay time settings to avoid these problems. Since LEDs are now the standard light source technology for interior lighting in California nonresidential buildings, this is no longer a concern because LED technology is not susceptible to frequent switching.

4.3.3 Energy Equity and Environmental Justice

Each measure in this CASE Report was evaluated for ESJ impacts using 4 criteria: cost, health, resiliency, and comfort. The details of that evaluation can be found in Section 1.4 and the 2028 CASE Methodology Report.

Based on a preliminary review, the measures in this proposal are unlikely to have significant impacts on ESJ outside of any impacts mentioned in the 2028 CASE Methodology Report, therefore reducing the impacts of disparities on ESJ communities.

The Statewide CASE Team does not expect any impacts on the health, safety, or disaster preparedness of ESJ communities. The comfort of ESJ communities is unlikely to be impacted by the proposed code changes. The Statewide CASE Team does not expect negative economic or cost impacts to ESJ communities.

4.3.4 Impacts on Jobs and Businesses

The Statewide CASE Team does not anticipate significant employment or financial impacts on any particular sector of the California economy. However, the proposed change may have modest impacts on employment in California. The Statewide CASE Team estimates the proposed change would affect statewide employment and economic output directly and indirectly through its impact on builders, designers, energy consultants, and building inspectors. For more information on the Statewide CASE Team's economic impacts methodology, see the 2028 CASE Methodology Report.

The Statewide CASE Team does not anticipate that the proposed changes would lead to the creation of new types of jobs or the elimination of existing types of jobs. In other words, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. Because the proposed measure has no incremental cost, it would not lead to changes in the employment of existing jobs. The adoption of the proposed measure is estimated to have no impact on the California commercial construction sector, California building designers and energy consultant sectors, or California building inspectors.

The proposed change represents no adjustment, which is not expected to excessively burden or competitively disadvantage California businesses, nor is it expected to lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not expect the proposed code changes to result in the creation of new businesses or the elimination of existing ones.

The proposed code changes would apply to all businesses operating in California, regardless of whether the business is incorporated inside or outside of the state.[15] Therefore, the Statewide CASE Team does not anticipate that the proposed changes would have advantageous or an adverse effect on the competitiveness of California businesses.

The Statewide CASE Team derived a reasonable estimate of the change in investment by California businesses based on the estimated change in economic activity associated with the proposed measure and its expected effect on business income. The Statewide CASE Team's IMPLAN modeling resulted in an estimated $0 increase in California business income due to the proposed code change. The Statewide CASE Team assumed that net business investment is positively correlated with business income and that a portion of business income will be allocated to net business investment.[16]

To estimate the portion of business income that would be allocated to net investment, the Statewide CASE Team analyzed national data on corporate profits and net capital investment by businesses that expand a firm's capital stock, or NPDI).[17] As Table 52 shows, between 2020 and 2024, NPDI as a percentage of corporate profits ranged from a low of 18 percent in 2020 due to the worldwide economic slowdowns associated with the COVID-19 pandemic to a high of 28 percent in 2022, with an average of 23 percent. While only an approximation of the proportion of business income used for net capital investment, it provides a reasonable estimate of the proportion of proprietor income that business owners would reinvest into expanding

[15] Gov. Code, §§ 11346.3(c)(1)(C), 11346.3(a)(2); 1 CCR § 2003(a)(3) Competitive advantages or disadvantages for California businesses currently doing business in the state.

[16] 26 percent of proprietor income was assumed to be allocated to net business investment; see Table 11.

[17] Net private domestic investment is the total amount of investment in capital by the business sector that is used to expand the capital stock, rather than maintain or replace due to depreciation. Corporate profit is the money left after a corporation pays its expenses.

their capital stock.

Table 52: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2020	389	2,212	18
2021	545	2,888	19
2022	825	2,951	28
2023	836	3,069	27
2024	885	3,441	26
5-Year Average	Intentionally blank	Intentionally blank	23

Source: (Federal Reserve Economic Data (FRED) n.d.)

Given the estimated total increase in California business income and net business investment ratio described above, the Statewide CASE Team estimates the proposed code change would result in a $0 increase in net private investment by California businesses.

4.3.5 Economic and Fiscal Impacts

The Statewide CASE Team does not anticipate that the economic impacts associated with the proposed measure would lead to a significant change (increase or decrease) in investment, directly or indirectly, in any affected sectors of California's economy. The proposed change would not result in economic disruption to any sector of the California economy. For more information on the Statewide CASE Team's economic and fiscal impacts methodology, see the 2028 CASE Methodology Report.

Adoption of this code change proposal would result in relatively modest economic impacts through the additional direct spending by those in the commercial building industry, architects, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2028 code cycle regulations would result in additional spending by those businesses.

4.3.5.1 Effects on the State General Fund, State Special Funds, and Local Governments

The Statewide CASE Team does not expect the proposed code changes to have a measurable impact on California's General Fund, any state special funds, or local government funds.

Cost to State: The state government already has a budget for code development, education, and compliance enforcement. While the state government would be allocating resources to update the Title 24, Part 6 Standards, including updating education and compliance materials and responding to questions about the revised requirements, these activities are already covered by existing state budgets. The costs for the state government are small when compared to the overall cost savings and policy benefits associated with the code change proposals. The proposed code change would impact lighting controls in state buildings, including new construction, additions, and alterations. However, the proposed code changes have been found to be cost effective.

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this retraining is an expense to local governments, it is not a new cost associated with the 2025 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training, and resources provided by the IOU Codes and Standards program, such as Energy Code Ace. As noted in Section , the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

4.3.5.2 Mandates on Local Agencies or School Districts

There are no relevant mandates to local agencies or school districts. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

4.3.5.3 Costs to Local Agencies or School Districts

There are no costs to local agencies or school districts. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

4.3.5.4 Costs or Savings to Any State Agency

There are no costs or savings to any state agencies. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

4.3.5.5 Other Non-Discretionary Cost or Savings Imposed on Local Agencies

There are no added non-discretionary costs or savings to local agencies. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

4.3.5.6 Costs or Savings in Federal Funding to the State

There are no costs or savings in federal funding to the state. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

4.4 Reduce Occupant Sensing Control Delay Time – Cost Effectiveness

Cost-effectiveness results in the section only consider the proposed changes to the lighting controls requirements. Energy savings and cost effectiveness in the following sections are specific to the lighting controls portion of the measure. The Statewide CASE Team expects that reducing the HVAC occupied standby delay time to align with lighting controls change would result in additional energy savings beyond what is detailed below, but the Statewide CASE Team has not determined the exact savings. Because the reduced occupied standby delay time would result in energy savings, but has no incremental cost, the Statewide CASE Team assumes the cost effectiveness to be infinite.

4.4.1 Cost-Effectiveness Methodology

The Statewide CASE Team collaborated with the CEC staff to confirm that the cost-effectiveness methodology aligns with the CEC guidelines, including cost inclusion parameters. The 2028 CASE Methodology Report and Appendix A provide reproducibility details.

Per California Law (Public Resources Code 25000), a measure is considered cost effective if its BCR is 1.0 or greater, amortized over the economic life of the structure. The Statewide CASE Team calculates BCR by dividing total dollar benefits by total dollar costs over a 30-year analysis period.

Benefits are based on LSC, which assigns an hourly dollar value to energy use. LSC hourly factors weigh the long-term value of each hour differently, with peak demand hours valued more than off-peak hours. These factors are not utility rates, forecasts, or bill estimates. The CEC develops and publishes LSC hourly conversion factors for each code cycle.

Costs include first costs and ongoing maintenance costs assessed over the 30-year period. Benefits and costs are evaluated incrementally, relative to the most recently adopted Energy Code. The analysis excludes design costs and incremental code compliance verification costs.

4.4.2 Energy and Energy Cost Savings Results

The Statewide CASE Team created spreadsheet models to assess the potential reduction in energy and energy costs resulting from the proposed measure. These models simulated space vacancy patterns and identified the typical number of savings events occurring within a 24-hour period in the space types where the proposed measure would apply.

Savings events represent the frequency with which the space becomes unoccupied for more than 15 minutes, presenting an opportunity to save energy by transitioning from a 20-minute occupancy sensor to a 15-minute occupancy sensor. For example, in a private office, there may be five savings events (trigger points) per day, such as when the space becomes unoccupied during lunch, breaks, and at the end of the workday. The model distributes these events throughout each weekday and similarly through weekend days to create a simulated occupancy profile for the weekdays (Monday through Friday, excluding major holidays) and weekends (including holidays) when sparsely occupied.

The Statewide CASE Team used the Equinox, with 12 hours of sunlight and 12 hours of night, as the representative day to model the weekday and weekend day, so the simulation includes a representative amount of daylight dimming to reduce the potential savings opportunity during times when daylighting is abundant.

The space types that the Statewide CASE Team chose to model represent the spectrum of occupancy patterns that are likely to occur in most building types in the state, including:

- Office – represents typical private and open office spaces.
- Entry/Lobby – represents entries, corridors, restrooms, and other spaces that have a high transient occupancy pattern.
- Warehouse – represents typical non-refrigerated warehouse space occupancy patterns, considering the “aisle” lighting controls approach employed in most of these spaces.
- Classroom – represents typical classroom conditions, with lower annual hours of occupancy and much more vacancy during the summer months.
- Parking garage – represents the high annual hours of occupancy and very low lighting power allowance found in parking garage spaces.

The Statewide CASE Team created a yearly energy consumption model that projects the daily values into an 8,760-hour profile to incorporate 365 days per year. In all cases, the Statewide CASE Team adjusted the 8,760 hours of operation of the lighting system to reflect the full-load-equivalent (FLE) hours of operation of the lighting system, considering the occupancy patterns and the daylight-dimming potential.

The Statewide CASE Team simulation developed calculations on a per-square-foot basis to scale the savings potential up to building-construction prototype forecasts and to perform calculations for several representative space types that cover the spectrum of potential occupancy patterns and lighting power allowances. With the space-type simulations completed, the Statewide CASE Team collected information on the building prototypes in the CBECC calculations to simulate statewide climate zone impacts of various measures. Lighting systems are not inherently climate zone dependent for the direct energy savings related to the measure, but the LSC value and building construction forecasts are dependent on climate zone, so the results that the Statewide CASE Team compiled were then scaled up through area weighted projections from the individual spaces to the building prototypes and then imported into the MeasureSET calculation tool to derive the first year and other savings outputs.

Table 53 through Table 55 present energy savings (electricity, natural gas, and source energy) and peak demand reductions per unit. The expected per-unit savings for the first year range from 0.01 to 0.08 kWh/yr. The proposed measure would not result in any gas savings.

Table 56 presents total energy cost savings per unit for newly constructed buildings and additions in terms of LSC savings realized over a 30-year period, in 2029 PV$. The LSC methodology values peak electricity savings more than electricity savings during non-peak periods. Peak electricity savings depend on the occupancy patterns of the space and building types.

Occupancy shifts throughout the day and differs between weekdays and weekends, while non-occupancy periods occur at various times. For example, in an office building, weekday lunch periods around noon to 1:00 PM are assumed to be unoccupied. In most buildings with higher daytime use and lower nighttime use, a portion of energy savings which occurs as the occupancy decreases, and this reduction often aligns with peak evening hours.

Table 53: First Year Electricity Savings (kWh) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Medium Office	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Small Office	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Large Retail	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Medium Retail	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Strip Mall	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mixed-use Retail	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Large School	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Small School	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Non-refrigerated Warehouse	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Hotel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Assembly	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Hospital	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Laboratory	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Restaurant	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Enclosed Parking Garage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Open Parking Garage	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Grocery	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Refrigerated Warehouse	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Controlled Environment Horticulture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle Service	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Manufacturing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 54: First Year Peak Demand Reduction (kW) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Office	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Office	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Retail	0.00	0.00	5.91	1.17	0.27	2.90	3.32	3.94	6.28	3.13	1.19	2.81	0.00	0.26	0.39	0.23
Medium Retail	0.25	1.40	2.02	1.68	0.25	1.87	1.07	2.53	5.09	4.91	0.60	5.55	3.08	1.05	0.79	0.35
Strip Mall	0.00	0.00	0.32	0.99	0.30	1.83	0.00	3.03	2.29	2.23	0.00	0.29	0.24	1.01	0.17	0.14
Mixed-use Retail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large School	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small School	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-refrigerated Warehouse	0.93	6.43	28.88	14.87	2.56	21.32	10.01	30.73	45.31	32.58	7.38	38.52	11.88	7.45	5.85	2.39
Hotel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Assembly	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hospital	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Laboratory	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Restaurant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Enclosed Parking Garage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Open Parking Garage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grocery	0.03	0.31	0.37	0.39	0.06	0.20	0.11	0.25	0.52	0.49	0.06	0.56	0.31	0.10	0.08	0.04
Refrigerated Warehouse	0.07	0.42	2.04	1.03	0.23	0.56	0.09	0.81	1.34	0.72	0.00	0.42	1.32	0.22	0.11	0.14
Controlled Environment Horticulture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle Service	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 55: First Year Source Energy Savings (kBtu) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Medium Office	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Small Office	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Large Retail	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Medium Retail	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Strip Mall	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Mixed-use Retail	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Large School	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Small School	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Non-refrigerated Warehouse	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Hotel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Assembly	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Hospital	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Laboratory	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Restaurant	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Enclosed Parking Garage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Open Parking Garage	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Grocery	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Refrigerated Warehouse	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Controlled Environment Horticulture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle Service	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Manufacturing	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Table 56: Total 30-Year LSC Savings (2029 PV$) Per Square Foot – Occupancy Sensor

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Large Office	4.61	4.59	4.58	4.59	4.61	4.47	4.55	4.64	4.64	4.65	4.59	4.62	4.59	4.60	4.56	4.64
Medium Office	4.61	4.59	4.58	4.59	4.61	4.47	4.55	4.64	4.64	4.65	4.59	4.62	4.59	4.60	4.56	4.64
Small Office	4.61	4.59	4.58	4.59	4.61	4.47	4.55	4.64	4.64	4.65	4.59	4.62	4.59	4.60	4.56	4.64
Large Retail	1.03	1.03	1.02	1.02	1.03	1.00	1.01	1.03	1.03	1.03	1.02	1.03	1.02	1.02	1.02	1.03
Medium Retail	1.37	1.36	1.36	1.36	1.37	1.33	1.35	1.37	1.37	1.38	1.36	1.37	1.36	1.36	1.35	1.37
Strip Mall	1.28	1.28	1.28	1.28	1.29	1.25	1.26	1.28	1.29	1.29	1.28	1.29	1.28	1.27	1.27	1.29
Mixed-use Retail	1.37	1.36	1.36	1.36	1.37	1.33	1.35	1.37	1.37	1.38	1.36	1.37	1.36	1.36	1.35	1.37
Large School	3.38	3.37	3.37	3.36	3.35	3.28	3.33	3.38	3.34	3.39	3.35	3.36	3.34	3.38	3.33	3.35
Small School	3.83	3.81	3.82	3.80	3.79	3.71	3.77	3.83	3.79	3.84	3.79	3.80	3.79	3.82	3.77	3.80
Non-refrigerated Warehouse	3.00	2.98	2.98	2.97	3.01	2.90	2.94	2.97	3.00	2.99	2.97	3.00	2.97	2.93	2.96	2.99
Hotel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Assembly	4.22	4.22	4.20	4.21	4.22	4.10	4.18	4.28	4.26	4.29	4.22	4.24	4.22	4.26	4.18	4.28
Hospital	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Laboratory	4.10	4.08	4.07	4.08	4.10	3.98	4.05	4.13	4.13	4.14	4.09	4.11	4.08	4.09	4.06	4.13
Restaurant	0.44	0.44	0.44	0.44	0.44	0.43	0.44	0.45	0.45	0.45	0.44	0.45	0.44	0.45	0.44	0.45
Enclosed Parking Garage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Open Parking Garage	1.79	1.79	1.80	1.79	1.79	1.80	1.78	1.76	1.78	1.76	1.78	1.79	1.78	1.75	1.81	1.77
Grocery	1.42	1.42	1.41	1.41	1.43	1.38	1.40	1.42	1.43	1.43	1.41	1.43	1.41	1.40	1.41	1.42
Refrigerated Warehouse	2.86	2.84	2.84	2.84	2.87	2.77	2.81	2.85	2.86	2.86	2.83	2.86	2.83	2.81	2.82	2.86
Controlled Environment Horticulture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle Service	0.73	0.73	0.73	0.73	0.73	0.71	0.72	0.74	0.74	0.74	0.73	0.73	0.73	0.73	0.72	0.74
Manufacturing	0.70	0.70	0.69	0.70	0.70	0.68	0.69	0.71	0.70	0.71	0.70	0.70	0.70	0.70	0.69	0.71

4.4.3 Incremental First Cost

The proposed measure has no incremental first costs. The proposed case does not require different equipment or materials, nor different installation procedures than the base case. This is an incremental improvement to the existing lighting controls requirement in the code. Verification testing costs could decrease as ATTs spend time on acceptance testing overall; instead of waiting 20 minutes to confirm performance for functional tests, they now only need to wait 15 minutes per test.

4.4.4 Incremental Maintenance and Replacement Costs

There are no associated incremental maintenance and replacement costs for the proposed measure because the measure is an incremental improvement (reduction) in the existing lighting controls requirements in the code.

The Statewide CASE Team feels that since the proposed measure is likely to very slightly reduce actual operating hours for the lighting system (by approximately four percent of FLE hours), there is a chance that the lighting system life will be slightly lengthened, but since this is a no-cost code change, the calculations do not include this.

4.4.5 Cost Effectiveness

Results of the per-unit cost-effectiveness analyses are presented in Table 57 and Table 58 for new construction and additions, and alterations, respectively.

In the tables below, all values are presented in 2029 PV$. Benefits represent 15-year LSC savings and other savings, including incremental first-cost savings if the proposed first cost is less than the current first cost, incremental maintenance cost savings if the proposed maintenance costs are less than the current maintenance costs, and incremental residual value if proposed residual value is greater than current residual value at the end of the 15-year period of analysis. Costs represent the total incremental PV cost, including incremental equipment, replacement, and maintenance costs over the period of analysis. The analysis treats a negative incremental maintenance cost as a positive benefit. If total incremental costs are zero, the BCR is considered infinite. Costs and other savings are discounted at a real (inflation-adjusted) three percent rate. If there are no total incremental PV costs, the BCR is infinite.

Table 57: 15-Year Cost-Effectiveness Summary Per Square Foot – New Construction and Additions

Building Prototype	Benefits LSC Savings + Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
Large Office	$4.60	$0	Infinite
Medium Office	$4.60	$0	Infinite
Small Office	$4.60	$0	Infinite
Large Retail	$1.02	$0	Infinite
Medium Retail	$1.36	$0	Infinite
Strip Mall	$1.28	$0	Infinite
Mixed-use Retail	$0	$0	0
Large School	$3.35	$0	Infinite
Small School	$3.80	$0	Infinite
Non-refrigerated Warehouse	$2.98	$0	Infinite
Hotel	N/A	N/A	N/A
Assembly	$4.23	$0	Infinite
Hospital	N/A	N/A	N/A
Laboratory	$4.09	$0	Infinite
Restaurant	$0.45	$0	Infinite
Enclosed Parking Garage	N/A	N/A	N/A
Open Parking Garage	$1.78	$0	Infinite
Grocery	$1.41	$0	Infinite
Refrigerated Warehouse	$2.84	$0	Infinite
Controlled Environment Horticulture	N/A	N/A	N/A
Vehicle Service	$0.73	$0	Infinite
Manufacturing	$0	$0	0

Table 58: 15-Year Cost-Effectiveness Summary Per Square Foot – Alterations

Building Prototype	Benefits LSC Savings + Other PV Savings (2029 PV$)	Costs Total Incremental PV Costs (2029 PV$)	Benefit-to-Cost Ratio
Large Office	$4.60	$0	Infinite
Medium Office	$4.60	$0	Infinite
Small Office	$4.60	$0	Infinite
Large Retail	$1.02	$0	Infinite
Medium Retail	$1.36	$0	Infinite
Strip Mall	$1.28	$0	Infinite
Mixed-use Retail	$0	$0	0
Large School	$3.35	$0	Infinite
Small School	$3.80	$0	Infinite
Non-refrigerated Warehouse	$2.98	$0	Infinite
Hotel	N/A	N/A	N/A
Assembly	$4.23	$0	Infinite
Hospital	N/A	N/A	N/A
Laboratory	$4.09	$0	Infinite
Restaurant	$0.45	$0	Infinite
Enclosed Parking Garage	N/A	N/A	N/A
Open Parking Garage	$1.78	$0	Infinite
Grocery	$1.41	$0	Infinite
Refrigerated Warehouse	$2.84	$0	Infinite
Controlled Environment Horticulture	N/A	N/A	N/A
Vehicle Service	$0.73	$0	Infinite
Manufacturing	$0	$0	0

4.5 Reduce Occupant Sensing Control Delay Time – Statewide Impacts

Statewide impacts results in the section only consider the proposed changes to the lighting controls requirements. Statewide impacts in the following sections are specific to the lighting controls portion of the measure. As noted above, the Statewide CASE

Team expects that reducing the HVAC occupied standby delay time to align with lighting controls change would result in additional energy savings beyond what is detailed below, but the Statewide CASE Team has not determined the exact savings.

4.5.1 Statewide Energy and Energy Cost Savings

See the 2028 CASE Methodology Report for details on how statewide savings are calculated. Appendix C presents the assumptions on the percentage of the total construction forecast that the proposed measure would impact.

For more details on the methodology and context of estimating the current market share rate, as well as statewide energy and energy cost savings, see the 2028 CASE Methodology Report.

The tables below present the first-year statewide energy and LSC savings from newly constructed buildings and additions (Table 59) and alterations (Table 60) by climate zone. Table 61 presents first-year statewide savings from new construction, additions, and alterations.

The proposed measure incrementally reduces the time unoccupied spaces remain illuminated, resulting in small statewide energy and LSC savings.

Table 59: Statewide Energy and LSC Impacts – New Construction and Additions

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026 (Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	531,986	0.03	0.00	-	0.05	$1.78
2	3,498,167	0.21	0.01	-	0.33	$10.78
3	16,083,876	0.98	0.04	-	1.55	$50.61
4	10,619,723	0.61	0.02	-	0.99	$29.00
5	1,450,368	0.08	0.00	-	0.13	$4.69
6	10,946,994	0.61	0.03	-	0.97	$31.09
7	8,293,979	0.53	0.01	-	0.85	$24.63
8	16,628,109	0.96	0.04	-	1.54	$47.86
9	24,982,662	1.47	0.06	-	2.32	$77.45
10	13,515,940	0.70	0.04	-	1.11	$37.09
11	3,308,949	0.17	0.01	-	0.28	$8.56
12	16,289,765	0.89	0.05	-	1.40	$49.63
13	5,392,474	0.27	0.02	-	0.42	$15.77
14	2,993,578	0.15	0.01	-	0.24	$8.11
15	1,884,190	0.09	0.01	-	0.15	$5.37
16	1,097,213	0.06	0.00	-	0.10	$3.02
Total	**137,517,975**	**7.82**	**0.36**	**-**	**12.43**	**$405.41**

Table 60: Statewide Energy and LSC Impacts – Alterations

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026 (Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	1,756,114	0.09	0.00	-	0.15	$5.52
2	10,753,852	0.59	0.03	-	0.93	$33.38
3	52,282,415	2.99	0.14	-	4.69	$162.66
4	28,326,537	1.66	0.07	-	2.61	$87.32
5	4,816,828	0.26	0.01	-	0.41	$14.80
6	40,941,582	2.22	0.12	-	3.47	$119.24
7	29,746,916	1.69	0.07	-	2.66	$89.18
8	61,252,500	3.41	0.17	-	5.37	$183.47
9	92,379,615	5.08	0.27	-	7.96	$279.84
10	59,280,947	2.85	0.24	-	4.44	$167.29
11	10,535,993	0.53	0.04	-	0.82	$30.86
12	55,540,749	2.95	0.18	-	4.60	$168.53
13	20,911,202	1.01	0.07	-	1.57	$60.07
14	13,580,564	0.67	0.05	-	1.04	$37.78
15	8,051,770	0.37	0.04	-	0.58	$22.65
16	4,327,993	0.22	0.02	-	0.35	$12.10
Total	**494,485,576**	**26.60**	**1.53**	**-**	**41.64**	**$1,474.69**

Table 61: Statewide Energy and LSC Impacts – New Construction, Additions, and Alterations

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
New Construction & Additions	7.8	0.4	-	12.4	405
Alterations	26.6	1.5	-	41.6	1,475
Total	**34.4**	**1.9**	**-**	**54.1**	**1,880**

4.5.2 Statewide Greenhouse Gas Emissions Reductions

Table 62 presents the estimated first-year reduction in GHG emissions resulting from the proposed code change. In this initial year, the Statewide CASE Team expects to avoid 49,105 metric tons of CO_2e emissions. These reductions, along with their associated monetary value, were calculated using hourly GHG emissions factors published alongside the LSC hourly factors and source energy hourly factors in the research versions of CBECC, as well as data from the CEC's 2028 Metrics Report. See the 2028 CASE Methodology Report for additional information.

Table 62: First-Year Statewide GHG Emissions Impacts

Construction Type	Reduced GHG Emissions from Electricity Savings (Metric Tons CO_2e)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO_2e)	Total Reduced GHG Emissions (Metric Ton CO_2e)	Total Monetary Value of Reduced GHG Emissions ($)
New Construction & Additions	658	0	658	$80,975
Alterations	2,203	0	2,203	$271,291
Total	**2,861**	**0**	**2,861**	**$352,266**

4.5.3 Statewide Water Use Impacts

The proposed code change would not result in water use impacts.

4.5.4 Statewide Material Impacts

The proposed measure would not result in any material impacts.

4.5.5 Environmental Impacts

The proposed measure would not have any significant environmental impacts.

4.5.6 Other Non-Energy Impacts

The proposed measure would not have other non-energy impacts.

4.6 Reduce Occupant Sensing Control Delay Time – Proposed Language Code

The proposed code language in this section includes only changes relevant to this measure. The intent is to clearly illustrate the scope of this measure. The proposed code language that encompasses the changes resulting from all the measures in this CASE Report can be found in Appendix I.

4.6.1 Guide to Markup Language

The proposed changes to the standards, Reference Appendices, and the ACM Reference Manuals are provided below. Changes to the 2025 documents should be marked with dark blue underlining (new language) and ~~strikethroughs~~ (deletions). New to the 2028 energy code is to italicize defined terms when the terms are being used in their defined context. In-line comments that are not part of the proposed code language but are used to help describe the purpose of what is proposed are included with grey highlight and italics.

Markups are provided to the restructured 2025 Energy Code that the CEC developed in response to feedback that aligning the structure of Title 24, Part 6 with other parts of the California Building Standards Code (Title 24) would improve readability, usability, and navigation. New section numbers are shown in bold followed by square brackets that document the section in the 2025 Title 24, Part 6 section numbers prior to the restructuring. For example, “Section 601.1 [Section 130.0(a)] General” contains the content that is in the current Section 130.0(a).

Posting the proposed code language in this format is useful, as it helps describe how the Energy Code changes proposed for nonresidential occupancies are isolated from the requirements for residential occupancies which are prohibited from being changed until the 2031 code cycle by Assembly Bill 130.

4.6.2 Administrative Code (Title 24, Part 1)

There are no proposed changes to Title 24, Part 1.

4.6.3 Energy Code (Title 24, Part 6)

4.6.3.1 Proposed Lighting Controls Code Language

601.2.2.3 *[Section 130.1(c)]* **Shut-OFF lighting controls.**

All installed indoor *lighting* shall be equipped with controls able to automatically reduce *lighting* power when the space is typically unoccupied.

Exception 1 to Section 601.2.2.3: *Healthcare facilities*.

Exception 2 to Section 601.2.2.3: Continuous *illumination* of up to 0.1 watts per square foot in any area designated for egress within a *building* is allowed, provided that the area is designated for means of egress on the plans and specifications submitted to the *enforcement agency* under Section 10-103(a)2 of *Part 1*. The *lighting* providing for means of egress *illumination*, as defined in the California Building Code, must be configured to provide no less than the *illumination* required by California Building Code Section 1008 while in the partial-off mode.

601.2.2.3.1 *[Section 130.1(c)1]* **General.**

All installed indoor *lighting* shall be equipped with controls that meet the requirements of Sections 601.2.2.3.1.1 through 601.2.2.3.1.3.

..

601.2.2.3.1.1- Shall be controlled with an *occupant sensing control* set to no more than a ~~20~~15-minute time delay, automatic time-switch control, or other control capable of automatically shutting OFF all of the *lighting* when the space is typically unoccupied; and

Exception to Section 601.2.2.3.1.1: *Occupant Sensing controls* in *hotel/motel* buildings and *nonresidential* buildings with Group R occupancies shall be set to no more than a 20-minute time delay, automatic time-switch control, or other control capable of automatically shutting OFF all of the *lighting* when the space is typically unoccupied; and

..

601.2.2.3.5 *[Section 130.1(c)5]* **Occupant Sensing controls.**

1. In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms, conference rooms, and restrooms, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in ~~20~~15 minutes or less after the control zone is unoccupied.

Exception to Section 601.2.2.3.5.1: *Occupant Sensing controls* in *hotel/motel* buildings and *nonresidential* buildings with Group R occupancies, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in 20 minutes or less after the control zone is unoccupied.

..

601.2.2.3.6 *[Section 130.1(c)6]* **Full or partial-OFF occupant sensing controls.**

..

601.2.2.3.6.4- Office spaces greater than 250 square feet. In office spaces greater than 250 square feet, *general lighting* shall be controlled with *occupant sensing controls* that meet all of the following:

..

2. In ~~20~~15 minutes or less after the control zone is unoccupied, the *occupant sensing controls* shall uniformly reduce *lighting* power in the control zone to no more than 20 percent of full power. Control functions that switch control zone *lights* completely off when the zone is vacant meet this requirement; and
3. In ~~20~~15 minutes or less after the entire office space is unoccupied, the *occupant sensing controls* shall automatically turn off *lighting* in all control zones in the space; and

Exception to Section 601.2.2.3.6.4: *Occupant Sensing controls* in *hotel/motel* buildings and *nonresidential* buildings with Group R occupancies shall be set to no more than a 20-minute time delay.

4.6.3.2 Potential HVAC Controls Code Language for Alignment with Proposed Lighting Controls Code Language

SUBCHAPTER 4 SPACE-CONDITIONING AND VENTILATION

401.2.1 *[Section 120.1]* **Ventilation and Indoor Air Quality**

401.2.1.2.5 *[Section 120.1(d)5]* **Occupied standby zone controls.**

..

401.2.1.2.5.1 *[Section 120.1(d)5B]* **Control functionality.**

Occupied-standby zone controls shall comply with the following:

1. Occupant sensors shall have suitable coverage and placement to detect occupants in the entire space. In ~~20~~15 minutes or less after no occupancy is detected by any sensors covering the room, *occupant sensing controls* shall indicate a room is vacant.

Exception to Section 401.2.1.2.5.1.1: Occupant sensors in hotel/motel buildings and nonresidential buildings with Group R occupancies shall indicate a room is vacant in 20 minutes or less after no occupancy is detected by any sensors covering the room.

..

SUBCHAPTER 9 PROCESS SYSTEMS AND EQUIPMENT

SECTION 912

LABORATORY AND FACTORY EXHAUST SYSTEMS

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

912.2.1 *[Section 140.9(c)1]* **Airflow reduction requirements.**

..

2. **Unoccupied minimum exhaust airflow.** Within ~~20~~15 minutes of no occupancy being detected by any occupant sensors covering the space, the minimum exhaust and makeup airflow rates shall be the greater of:

1. User-defined airflow not to exceed 0.67 cfm/ft^2 (equivalent to 4 air changes per hours for a 10-foot high ceiling), or
2. The regulated minimum unoccupied circulation rate documented to comply with code, accreditation, or facility environmental health and safety department requirements, or
3. The minimum needed to maintain unoccupied pressurization.

4.6.4 Reference Appendices

4.6.4.1 Proposed Modifications to Reference Appendices for HVAC Controls

NA7.5.17.2 Functional Testing

…

Step 7: For space conditioning systems that also provide ventilation to the zone, confirm that within 5 minutes of occupant sensing controls indicating that the zone is unoccupied the setpoint is setup or setback and the zone is within the occupied standby deadband. Occupant Sensing controls may have a time delay of up to ~~20~~15 minutes before indicating the space is unoccupied and occupant sensing zone controls may allow up to an additional 5 minute time delay after occupant sensing controls have indicated all rooms served by the zone are unoccupied before resetting zone temperature setpoints and shutting off zone ventilation air).

…

NA7.16.2 Functional Testing for VAV Lab Exhaust System with Occupancy Controls

…

Step 3: Simulate minimum flowrate under unoccupied conditions by adjusting fume hoods and other exhaust devices and vacate all lab spaces served by the exhaust fan system for at least ~~20~~<u>15</u> minutes so occupant control treats lab spaces as unoccupied. Adjust the thermostatic control so that the space temperature is within the dead band.

…

4.6.5 Compliance Manuals

The Statewide CASE Team will provide the CEC with recommended revisions to compliance manuals after the 45-Day Language is published.

4.6.6 ACM Reference Manual

There are no proposed changes to the ACM Reference Manual. Since this measure applies to the mandatory lighting controls sections, there is no alternate pathway for the controls in the modeling software.

4.6.7 Compliance Forms

As discussed in Section 4.1.4.5, the proposed measure would require updates to the SHUT-OFF LIGHTING CONTROL 2025-CEC-NRCA-LTI-02-A compliance form to reflect the updated sensor delay time. The Statewide CASE Team can support the CEC in implementing these updates if the proposed change is adopted.

Any modifications to HVAC occupied standby delay time would require revisions to the associated compliance forms to reflect the change in delay time from 20 minutes to 15 minutes. Associated compliance forms include NRCA-MCH-19-A Occupied Standby and NRCA-PRC14b-F Lab Exhaust – Test and Balance.

5. Update Multilevel Lighting Controls Requirements

5.1 Update Multilevel Lighting Controls Requirements

5.1.1 Proposed Code Change

The proposed code change aims to clarify the current code requirements on multilevel lighting controls and update the trigger to the requirement. The proposal would improve the code language by specifying manual dimmer requirements and the continuous dimming capability required for other control strategies, such as daylight responsive controls and demand responsive lighting controls. The proposal would also revise the trigger to the requirements, which were previously determined based on traditional light sources, to reflect LED lighting technologies, as well as align the trigger specification with other mandatory control requirements.

The proposal would result in the following changes:

- Requirements that pertain to manual dimmers would be moved to the Manual Controls section, Section 601.2.2.1 [Section 130.1(a)]. In addition to the original ON/OFF switching requirements, Section 601.2.2.1 would have additional requirements specifying spaces and conditions where manual dimmers are required. The functional requirements for manual dimmers would also be specified in this section.
- The trigger for requiring manual dimmers would be specified in wattage of the connected general lighting load, instead of in LPD for the current multilevel lighting controls requirements.
- Any reference to multilevel lighting controls in other mandatory control sections, including occupant sensing controls in Section 601.2.2.3 [Section 130.1(c)], daylight responsive controls in Section 601.2.2.4 [Section 130.1(d)], and demand responsive lighting controls in Section 600.4.2 [Section 110.12(c)], would be removed. The dimming capability required for those control strategies would be directly specified in each respective section.

As a result, the current multilevel lighting controls section, Section 601.2.2.2 *[Section 130.1(b)],* would be removed, except for Group R occupancies. References to multilevel lighting controls in both mandatory and prescriptive requirements sections would be updated accordingly. Table 63 summarizes the scope of the proposed code change.

Table 63: Scope of Proposed Code Change

A ☑ indicates the proposed code change is relevant.

Building Type(s)	Construction Type(s)	Type of Change
☐ Single Family	☑ New Construction	☑ Mandatory
☐ Multifamily	☑ Additions	☐ Prescriptive
☑ Nonresidential (Not Group R uses)	☑ Alterations	☐ Performance

Application Climate Zones	Energy Code Sections	Compliance Forms	Sections of ACM Reference Manuals
Climate Zones 1-16	Part 6, Section 601.2.2.1 [*Section 130.1*]	NRCC-LTI-E LMCC-LTI-E NRCC-PRF-E NRCI-LTI-E LMCI-LTI-E NRCA-LTI-03-A	N/A

Third Party Verification	Updates to Compliance Software
☑ No changes to third party verification	☐ No updates
☐ Update existing verification requirements	☑ Update existing feature
☐ Add new verification requirements	☐ Add new feature

5.1.2 Benefits of Proposed Change

The proposed code changes aim to clarify when manual dimmers are required, using dedicated and clear language. They also explicitly describe when continuous dimming is required for each mandatory control requirement, without cross-referencing between code sections. Specifying the requirement trigger in general lighting wattage also aligns the trigger specification with other mandatory lighting controls requirements, avoiding multiple metrics for determining the required controls.

In addition, the proposed changes align with industry best practices to increase occupant satisfaction and avoid lighting control actions (e.g., sudden switching OFF from full-power level due to daylighting controls) that could confuse and potentially upset occupants.

5.1.3 Background Information

The 0.5 watts per square foot and a minimum of 100 square feet thresholds for requiring multilevel lighting controls have been in place since the pre-LED era and were based on legacy light sources such as fluorescent and incandescent. Since the code transitioned to the LED baseline during the 2019 code cycle, these thresholds have not been updated accordingly. With LEDs' high efficacy and being continuously dimmable with no or minimal additional cost, these thresholds should be recalibrated and revised based on current technologies. At the beginning of this code cycle, the California Energy Alliance (CEA) also recommended revising the current 0.5 watts per square foot threshold. Rather than creating a second CASE Report, the topic was absorbed into this effort, and the CEA remained engaged in the process.

Furthermore, the code language does not clearly stipulate the intent of multilevel lighting controls. It could be interpreted as requiring the capability of continuous dimming that other controls can utilize, or as a physical dimmer for manual dimming. The Compliance Manual also does not elaborate on the requirements. This ambiguity can cascade and needs clarification, as several other mandatory control sections, including demand responsive lighting controls, occupant sensing controls, and daylight responsive controls reference multilevel lighting controls since the 2025 code cycle. For example, if interpreted as requiring manual dimmers, referencing multilevel lighting controls in daylight responsive controls could be interpreted as allowing the use of manual dimmers as a means for daylighting controls. The 0.5 watts per square foot trigger for multilevel lighting controls could also result in daylit spaces having to implement daylight responsive controls (i.e., with a connected lighting load of 75 watts or greater) without multilevel lighting controls (i.e., with a LPD of 0.5 watts per square foot or less). In this case, daylight responsive controls may be implemented with stepped switching (ON/OFF switching); the lights would stay at full power until daylight illuminance exceeds 150 percent of the design illuminance, at which the lights would be turned off. This sudden change in electric light level would be noticeable and could cause confusion and frustration for occupants.

Specifying the trigger for multilevel lighting controls based on LPD results in multiple metrics being used to determine the required lighting controls, complicating the workflow for market actors. For example, the triggers for requiring daylight responsive controls and demand responsive lighting controls are both specified in wattages, leading to the need for separately evaluating LPD to determine whether multilevel lighting controls are required.

5.1.4 Modifications to Energy Code Documents

This section provides descriptions of how the proposed code change will affect each Energy Code document. See Section 5.6 of this report for detailed revisions to code language.

5.1.4.1 Energy Code Change Summary

The changes to the code sections are summarized in order of significance and interrelationship with other code sections, instead of in sequential order. The proposed changes apply to all nonresidential occupancies, except hotel/motel and Group R occupancies. The requirements would remain unchanged from 2025 Title 24, Part 6, for hotel/motel and Group R occupancies.

SECTION 601.2.2 *[SECTION 130.1]* – MANDATORY INDOOR LIGHTING CONTROLS

Section 601.2.2.2 *[Subsection 130.1(b)]:* For all spaces in nonresidential buildings, the proposed regulations remove reference to section 601.2.2.2 Multilevel Lighting Controls and move the requirements related to manual dimmers and continuous dimming into other mandatory controls subsections for clarity. For hotel/motel and Group R occupancies, section 601.2.2.2 remains applicable.

Section 601.2.2.1 *[Subsection 130.1(a)]:* For all spaces in nonresidential buildings, the proposed regulations move the manual dimmer requirements in section 601.2.2.2 *[subsection 130.1(b)]* Multilevel Lighting Controls to this section as part of the Manual Controls requirements. The proposed regulations also specify the trigger for requiring manual dimmers based on general lighting wattage, replacing the LPD trigger used for multilevel lighting controls. The proposed changes to this section do not affect hotel/motel and Group R occupancies.

Section 601.2.2.4 *[Subsection 130.1(d)]:* For all spaces in nonresidential buildings, the proposed regulations remove references to section 601.2.2.2 *[subsection 130.1(b)]* Multilevel Lighting Controls in this subsection and directly require continuous dimming for daylight responsive controls. For most space types in nonresidential buildings, this removes the ability to use ON/OFF switching to meet the daylight responsive controls requirements if the space is exempt from multilevel lighting controls. The proposed regulations also mandate that daylight responsive controls regain control of the light level after being overridden by the manual dimmer to temporarily raise the electric light level. The proposed changes to this section do not alter any language or requirement applicable to hotel/motel and Group R occupancies.

Section 601.2.2.3 *[Subsection 130.1(c)]:* The proposed regulations remove references to section 601.2.2.2 *[subsection 130.1(b)]* Multilevel Lighting Controls in this subsection and directly specify the criteria for meeting the partial-ON requirement.

SECTION 600.4 *[SECTION 110.12]* – MANDATORY REQUIREMENTS FOR DEMAND MANAGEMENT

Section 600.4.2 *[Subsection 110.12(c)]:* For all spaces in nonresidential buildings, the proposed regulations remove references to section 601.2.2.2 *[subsection 130.1(b)]* Multilevel Lighting Controls and directly require continuous dimming for demand responsive lighting controls in a newly created subsection 600.4.2.1. For hotel/motel buildings and nonresidential buildings with Group R occupancies, the 2025 requirements, originally in Section 600.4.2, remain applicable, but are moved to a newly created subsection 600.4.2.2.

SECTION 908 *[SECTION 120.6]* – MANDATORY REQUIREMENTS FOR CONTROLLED ENVIRONMENT HORTICULTURE (CEH) SPACES

Section 908.1 *[Subsection 120.6(h)]:* The proposed regulations remove references to section 601.2.2.2 *[subsection 130.1(b)]* Multilevel Lighting Controls and directly require manual dimmers for horticultural lighting that meets the original criteria.

SECTION 601.3.1 *[SECTION 140.6]* – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

Section 601.3.1.1 *[Subsection 140.6(a)]:* For all spaces in nonresidential buildings, the proposed regulations remove references to section 601.2.2.2 *[subsection 130.1(b)]* Multilevel Lighting Controls and directly require continuous dimming for utilizing the PAF related to demand responsive lighting controls. The proposed changes to this section do not affect hotel/motel and Group R occupancies.

Section 601.3.1.3 *[Subsection 140.6(c)]:* For all spaces in nonresidential buildings, the proposed regulations remove references to section 601.2.2.2 *[subsection 130.1(b)]* Multilevel Lighting Controls and directly require manual dimmers for controlling additional lighting in videoconferencing studios. The proposed changes to this section do not affect hotel/motel and Group R occupancies.

SECTION 601.5 *[SECTION 141.0]* – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINAIRED SIGNS

Table 601.5-A *[Table 141.0-F]:* The proposed regulations specifies the conditions, under which Section 601.2.2.1.4 Manual Dimming Controls would be required for alteration projects in nonresidential buildings.

5.1.4.2 Reference Appendices Change Summary

The proposed code changes do not necessitate any updates to the Reference Appendices.

5.1.4.3 Compliance Manuals Change Summary

The section on Mandatory Lighting Controls would be updated to remove the Multilevel Lighting Controls subsection as well as any reference to multilevel lighting controls and its code section number, 130.1(b). Manual dimmer requirements would be added to the Manual Controls subsection. The partial-OFF and partial-ON requirements in the Shut-OFF Controls subsection would be explained without referencing multilevel lighting controls. The Daylight Responsive Controls and Demand Responsive Lighting Controls subsections would be updated to remove any reference to multilevel lighting controls and explain the continuous dimming requirements for these controls.

The subsection on Lighting Control Interactions – Considerations for Spaces with Daylight Responsive Controls and Multilevel Lighting Controls would be updated to remove any references to ON/OFF stepped switching controls for daylight responsive controls in spaces exempted from multilevel lighting controls requirements.

Overall, references to Code Section 130.1(b) will be removed throughout the compliance manuals, and appropriate edits will be made to ensure the document's coherence and accurate interpretation of the code.

5.1.4.4 Alternative Calculation Method Reference Manual Change Summary

The proposed change does not modify any modeling assumptions or parameters in the ACM Reference Manual.

5.1.4.5 Compliance Forms Change Summary

The Certificates of Compliance (NRCC-LTI-E, LMCC-LTI-E and NRCC-PRF-E) forms would need to be updated to remove the fields related to multilevel lighting controls and mentions of the 130.1(b) code section.

The Certificates of Installation (NRCI-LTI-E and LMCI-LTI-E) form would need to be updated to remove the fields related to multilevel lighting controls.

The Certificates of Acceptance (NRCA-LTI-03-A) form would need to be updated to remove the test and verification steps for controls that have zero dimming step between on and off, i.e., daylight responsive controls using ON/OFF switching.

5.1.5 Measure Context

5.1.5.1 Comparable Model Codes or Standards

ASHRAE 90.1-2022 has multilevel lighting control requirements (Section 9.4.1.1.d). However, unlike Title 24 code language, the section is clear about its intention of requiring manual dimmers by stipulating that general lighting be manually controlled with continuous dimming to ten percent or less of full lighting power. Determining whether multilevel lighting control is required is based on space type, and no other exceptions were provided.

ASHRAE 90.1-2022 (Sections 9.4.1.1.e and 9.4.1.1.f) requires photocontrols to reduce electric lighting power in response to available daylight using continuous dimming for both sidelighting and toplighting areas. It does not provide any exceptions to allow the use of ON/OFF switching, stepped switching, or stepped dimming with automatic daylight responsive controls.

IECC-2024 (Section C405.2.5.3) required dimming controls in a list of space types. Dimming control is a manual dimmer requirement, as it clearly stipulates that the controls must be manual controls allowing lights to be dimmed from full output to 10 percent of full power or lower with continuous dimming.

IECC-2024 (Section C405.2.4.1) requires daylight responsive controls to dim the lights continuously and does not provide any exceptions for the use of ON/OFF switching, stepped switching, or stepped dimming.

The proposed change brings the Title 24 requirements more in line with the national standards and model codes.

5.1.5.2 Interactions with Other Regulations

The proposed code change is not duplicative of or in conflict with any applicable federal, state, or local regulations.

5.2 Update Multilevel Lighting Controls Requirements – Compliance and Enforcement

5.2.1 Compliance Considerations

The proposed code change would slightly modify and simplify the compliance process. For nonresidential buildings, multilevel lighting controls are no longer required to be separately identified on the compliance forms. Instead, manual dimmers, where required or specified, would need to be identified on the plans and compliance forms. Identifying manual dimmers on the plans has been a common practice, and the proposed change codifies the manual dimmer requirement in a dedicated subsection.

The proposed code change would require the use of continuous dimming for daylight responsive controls, unless explicitly exempted by space type. This eliminates the decision-making complication for specifiers—including designers, engineers, energy consultants, electrical contractors/installers, commissioning providers, and ATTs—who previously had to determine between ON/OFF switching and continuous dimming for daylight responsive controls, depending on whether multilevel lighting controls exceptions were met. The proposed code change would not alter the enforcement workflow or modify the existing testing and verification procedures. The number of tests and verifications may increase slightly due to increased continuous dimming for daylight responsive controls.

5.2.2 Impact on Market Actors

Table 64 summarizes impacts on market actors and suggests outreach and education that might be helpful to support market actors as they prepare for the effective date of the requirements.

Table 64: Impacts on Market Actors and Suggested Training and Education Opportunities

Market Actor	Impact(s)	Suggested Outreach and Education
Owner/Developer[a]	Minimal impact, if any.	
Design Professional[b]	Lighting designers and electrical engineers would need to: Specify manual dimmers and continuously dimmable lighting in the impacted spaces and correctly reflect the manual dimmers on the drawings. Specify continuously dimmable lighting in daylit zones where daylight responsive controls are required. Energy consultants would need to advise and confirm with the design team that the impacted spaces have manual dimmers and continuous dimmable lighting.	Provide informational references to help identify spaces that require manual dimmers. Provide informational references to highlight that continuous dimming is required in all daylit zones where daylight responsive controls are required. Include the code changes in any compliance tool to better support the updated requirements. Included the code changes in the NRCC forms that support the impacted control requirements.
Construction Team[c]	Electrical contractors and installers would need to expect that: The total number of manual dimmers would increase due to the code change. Photocontrols will need to be wired and programmed with continuous dimming due to the code change. The overall time required to install, wire, and program the lighting control systems may increase. Commissioning providers would need to expect that: More spaces will have manual dimmers, which will need to be programmed appropriately to allow continuous dimming of the lights. In daylit spaces where manual dimmers are not required,	Provide materials to educate electrical contractors and installers on the updated control requirements and their impacts on the control products used on the jobs. Provide informational references to help clearly identify spaces where manual dimmers are required. Provide informational references to increase awareness that continuous dimming is required for daylight responsive controls in daylit zones, with the exception of high intensity discharge (HID) and induction light sources, where step dimming is still allowed. Confirm the NRCC forms support the required acceptance testing

	continuous dimming still needs to be programmed for daylight responsive controls.	triggers for the commissioning providers to coordinate with.
Building Departments[d]	Plans examiners would need to confirm: Manual dimmers are reflected on the drawings for spaces required by code. Luminaires in daylit zones, where daylight responsive controls are required, are capable of continuous dimming. Building inspectors would need to: Expect more spaces will now have manual dimmers. Verify that daylight responsive controls are implemented with continuous dimming, except for HID and induction light sources.	Provide training and reference materials to help clearly identify the spaces where manual dimmers are required. Update the NRCC forms to clearly support the updated control requirements. Update the NRCI forms to clearly support the updated control requirements so they can be used as an inspection tool for building inspectors to follow and educate the contractors on how to comply with these new requirements.
Verification Tester [e]	Commissioning providers would need to: Program the manual dimmers in the impacted spaces to allow continuous dimming of the lights. Program daylight responsive controls with continuous dimming in daylit zones where daylight responsive controls are required. ATTs would need to: Only perform the Stepped Switching or Stepped Dimming Control System Functional Test on HID and induction light sources and perform Continuous Dimming Control System Functional Test on all other light sources. Expect an increase in overall time for the acceptance test, as it typically takes longer to perform the Continuous Dimming Control System Functional Test than the Stepped Switching or Stepped Dimming Control System Functional Test.	Provide informational references to help clearly identify spaces where manual dimmers are required. Provide informational references to increase awareness that continuous dimming is required for daylight responsive controls in daylit zones, with the exception of HID and induction light sources, where step dimming is still allowed. Confirm the NRCC forms support the required acceptance testing triggers for the commissioning providers to coordinate with. Confirm the NRCA forms are updated to clearly specify the use of the Continuous Dimming Control System Function Test, except for HID and induction light sources.
Manufacturers and Distributors	Sell more continuous dimming products.	Provide references that highlight the impacts of the code change on the products used on the job, so

		manufacturers and distributors can recommend appropriate products and solutions to their customers.

a. Owner/Developer is funding the project and is the primary decision-maker.
b. Design professionals include architects, engineers (mechanical, electrical, plumbing, structural), specification writers, cost estimators, commissioning agents, lighting designers, and energy consultants.
c. Construction team includes general contractors, home builders, design-build contractors, installation contractors (e.g., HVAC, plumbing, electrical), commissioning agents, and tradespeople.
d. Building departments include plans reviewers, building inspectors, specialty inspectors, permit counter technicians, and third-party plan review and inspection.
e. Verification testers include commissioning agents, ECC-Raters, and ATTs.

The 2028 CASE Methodology Report presents a quantitative assessment of how changes to the California building code impact builders, building designers and energy consultants, and building owners and occupants. The analysis in the methodology report is not specific to the code changes presented in this report. The following provides a qualitative description of how this specific code change affects various market actors and additional quantitative analyses of its potential impacts on building industry subsectors.

Builders. The proposed change would likely affect firms engaged in the construction or retrofitting of commercial or industrial buildings, utility systems, public infrastructure, or other heavy construction. The proposed change would not affect all firms and workers equally; instead, it would primarily affect specific subsectors within the industry. Table 65 shows the commercial building subsectors that the Statewide CASE Team expects to be impacted by the changes proposed in this report.

Building occupants (owners and tenants). The proposed code change would have incremental costs and would reduce building owners' utility bills throughout the measure lifetime. See the 2028 CASE Methodology Report for a description of how LSC savings relate to occupant utility bill savings.

Table 65: Specific Subsectors of the California Commercial and Industrial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2025 (Estimated)

Construction Subsector	Establishments*	Employment	Annual Payroll (Billions $)
Commercial Building Construction	5,491	87,450	$10.6
Nonresidential Poured Foundation Contractors	497	15,884	$1.4
Nonresidential Structural Steel Contractors	365	11,899	$1.1

Nonresidential Framing Contractors	137	3,037	$0.2
Nonresidential Masonry Contractors	217	4,028	$0.3
Nonresidential Glass and Glazing Contractors	307	5,079	$0.5
Nonresidential Roofing Contractors	385	11,413	$1.0
Nonresidential Siding Contractors	32	735	$0.1
Other Nonresidential Exterior Contractors	234	2,259	$0.1
Nonresidential Electrical Contractors	3,245	72,794	$7.8
Nonresidential Plumbing & HVAC Contractors	2,270	55,182	$5.8
Other Nonresidential Equipment Contractors	580	9,749	$1.1
Nonresidential Drywall Contractors	593	19,328	$1.8
Nonresidential Painting Contractors	501	9,225	$0.7
Nonresidential Flooring Contractors	286	4,011	$0.4
Nonresidential Tile and Terrazzo Contractors	151	2,223	$0.2
Nonresidential Finish Carpentry Contractors	313	3,697	$0.3
Other Nonresidential Finishing Contractors	492	7,241	$0.6
Nonresidential Site Preparation Contractors	1,147	19,273	$1.9
All Other Nonresidential Trade Contractors	948	17,084	$1.7
Industrial Building Construction	278	4,095	$0.5
Water and Sewer System Construction	1,007	22,926	$2.3
Oil and Gas Pipeline Construction	218	10,047	$1.1
Power and communication system construction	635	20,858	$2.7
Land Subdivision	809	4,701	$0.8
Highway, Street, and Bridge Construction	854	29,959	$3.7
Other Heavy Construction	504	12,125	$1.7

Source: Analysis by the Title 24 CASE Team of QCEW data from the California Employment Development Department https://labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=industry

*An establishment is single economic unit, typically at one physical location, that engages in one, or predominantly one, type of economic activity for which a single industrial classification may be applied. Many businesses are composed of multiple establishments. U.S. Bureau of Labor Statistics, Handbook of Methods. https://www.bls.gov/opub/hom/cew/concepts.htm

Manufacturers. Manufacturers would sell different types of equipment as a result of this proposed code change. Specifically, for the impacted spaces, they would sell dimmer keypads instead of switch keypads. Similarly, they would sell lamps and luminaires with continuously dimmable drivers rather than non-dimmable drivers. These shifts are not expected to necessitate the creation of new products, as manufacturers already have these products for meeting existing code requirements. Many of these manufacturers maintain distribution centers and technical support staff within California. Other manufacturers maintain their presence in California through independent sales representative agencies that provide technical, engineering, and commissioning expertise on behalf of the manufacturers to serve California customers.

5.2.3 Compliance Software Updates

The compliance software would need to be updated to support the proposed changes to the mandatory controls.

5.2.4 Cost of Enforcement

The Statewide CASE Team acknowledges that changes to the code will impact enforcement costs. This report is an evaluation of specific measures, and the collective impact of all proposed changes for the 2028 Title 24, Part 6 may represent an increase in training and/or workload for enforcement personnel. The proposed code change is not expected to impact the state's cost of enforcement. The increased number of manual dimmers resulting from this code change would be identified on the plans, but they would just replace the ON/OFF switches shown on the plans. Continuous dimming, now required for all daylight responsive controls, would replace ON/OFF or stepped switching that was previously allowed for implementing daylight responsive controls when meeting the multilevel lighting controls exceptions.

Plan review function would consist of reviewing NRCC-LTI-E and ensuring that it meets the new code requirement and is consistent with the drawings and specifications.

Inspection review would consist of reviewing NRCI-LTI-E and NRCA-LTI-03-A and ensuring that the information on the forms is consistent with the approved NRCI-LTI-E forms and with what is actually installed.

5.3 Update Multilevel Lighting Controls Requirements – Market and Economic Analysis

5.3.1 Market Structure and Availability

5.3.1.1 Current Market Structure and Availability

Dimming drivers are widely available and are typically the default option for lamps and luminaires, especially those used in commercial applications. The most common dimming protocol for commercial applications in the U.S. is 0–10V dimming. Other dimming protocols include phase dimming, Digitally Addressable Lighting Interface (DALI), and DMX. With 0–10V dimming, two additional low-voltage control wires will need to be wired to the controller for continuous dimming controls. The controller may be a room controller, power pack, sensor, or wall control panel. Therefore, installers can still forego wiring the dimming control wires and treat the lamps and luminaires with dimming drivers as non-dimmable if the space is exempt from multilevel lighting controls. For systems using other dimming protocols, the wall keypads may still be programmed to provide only ON/OFF switching rather than functioning as manual dimmers. Similarly, daylight responsive controls, if currently exempted from multilevel lighting controls, may still be programmed to only turn ON/OFF the electric lights in response to the available daylight instead of using continuous dimming.

5.3.1.2 Market Challenges and Solutions

The Statewide CASE Team does not expect market challenges with the proposed change. Manual dimmers are already available in lighting control systems of all designs and configurations. Requiring manual dimmers in more spaces is not expected to introduce additional concerns; instead, it could empower occupants to adjust the light level to better meet their task needs. Daylight Responsive controls are a mandatory lighting control requirement for many code cycles. In most cases, daylight responsive controls are already required by code to be implemented with continuous dimming. Removing the ability to meet daylight responsive controls requirements with ON/OFF or stepped switching would not cause implementation issues. It would potentially eliminate confusion and frustration as occupants are less familiar with the expected daylighting control behavior when implemented with ON/OFF or stepped switching.

See Section 5.2.2 for a description of workforce training that may be needed to ensure effective design, installation, and commissioning.

5.3.2 Design and Construction Practices

5.3.2.1 Current Design and Construction Practices

Whether the manual controls should provide ON/OFF switching, manual dimming, or scene selection (and if so, the number of scenes needed) is typically specified in the design documents, specifically, the control intent narrative (CIN). The expected behavior of the manual controls and scene settings is prescribed in the sequence of operation (SOO). Similarly, if daylight responsive controls are implemented using continuous dimming, ON/OFF switching, stepped switching, or stepped dimming (based on code requirements, exceptions, and the space's functional needs) it is specified in the CIN and SOO. The electrical contractors would procure the lighting control system from lighting or electrical distributors in accordance with the design documents and install and start up the system. Depending on the lighting control systems and the system purchase agreement, system startup and programming may be performed by the manufacturers or the manufacturer's sales representative agency's field engineers. The commissioning providers would then review the design documents and confirm that manual controls and daylight responsive controls are programmed as intended. The ATTs would test and verify that the performance of daylight responsive controls meets code requirements.

5.3.2.2 Health and Safety Considerations

There are no known health and safety considerations.

5.3.2.3 Design and Construction Challenges and Solutions

The proposed code change would require more spaces to use manual dimmers, rather than ON/OFF switches. Continuous dimming has been required and used for both multilevel lighting controls and daylight responsive controls for many code cycles. The multilevel lighting controls requirement mandates the use of manual dimmers, which use the continuous dimming capability to manually adjust the light level. The availability and implementation of dimmer technologies are well-established. Additionally, the proposed code change would require spaces with lower general lighting power to use continuous dimming for daylight responsive controls, which would be implemented in the exact same way as spaces that already need to meet the requirement. Design and construction challenges are not expected for the proposed code change.

See Table 64 in Section 5.2.2 for a description of workforce training that could support effective design, installation, and commissioning.

5.3.3 Energy Equity and Environmental Justice

Each measure in this CASE Report was evaluated for ESJ impacts using 4 criteria: cost, health, resiliency, and comfort. The details of that evaluation can be found in Section 1.4 and the 2028 CASE Methodology Report.

Based on a preliminary review, the measures in this proposal are unlikely to have significant impacts on ESJ outside of any impacts mentioned in the 2028 CASE Methodology Report, therefore reducing the impacts of disparities on ESJ communities.

The Statewide CASE Team does not expect any impacts on the health, safety, or disaster preparedness of ESJ communities. The comfort of ESJ communities is unlikely to be impacted by the proposed code changes. The Statewide CASE Team does not expect negative economic or cost impacts to ESJ communities.

5.3.4 Impacts on Jobs and Businesses

The Statewide CASE Team does not anticipate significant employment or financial impacts on any particular sector of the California economy. However, the proposed change may have modest impacts on employment in California. The Statewide CASE Team estimates the proposed change would affect statewide employment and economic output directly and indirectly through its impact on builders, designers, energy consultants, and building inspectors. Table 66, Table 67, and Table 68 outline the statewide implications for these job categories. For more information on the Statewide CASE Team's economic impacts methodology, see the 2028 CASE Methodology Report.

The Statewide CASE Team does not anticipate that the proposed changes would lead to the creation of new types of jobs or the elimination of existing types of jobs. The proposed change would not result in economic disruption to any sector of the California economy. Rather, it would lead to modest changes in the employment of existing jobs.

Table 66: Estimated Impact that Adoption of the Proposed Measure would have on the California Nonresidential Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income (Millions)	Total Value Added (Millions)	Output (Millions)
Direct Effects (Additional spending by Commercial Builders)	77	$6.07	$8.53	$17.54
Indirect Effect (Additional spending by firms supporting Commercial Builders)	37	$2.98	$5.05	$8.9
Total Economic Impacts	**114**	**$9.05**	**$13.58**	**$26.45**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[18]

Table 67: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultant Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building designers and energy consultants)	3	$0.33	$0.33	$0.52
Indirect Effect (Additional spending by firms supporting building designers and energy consultants)	1	$0.10	$0.14	$0.22
Total Economic Impacts	**4.0**	**$0.43**	**$0.47**	**$0.74**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

Table 68: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building inspectors)	2	$0.26	$0.31	$0.37
Indirect Effect (Additional spending by firms supporting building inspectors)	1	$0.02	$0.04	$0.06
Total Economic Impacts	**3**	**$0.28**	**$0.34**	**$0.44**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

The proposed change represents a modest adjustment, which is not expected to excessively burden or competitively disadvantage California businesses, nor is it expected to lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not expect the proposed code changes to result in the creation of new businesses or the elimination of existing ones.

The proposed code changes would apply to all businesses operating in California, regardless of whether the business is incorporated inside or outside of the state.[19] Therefore, the Statewide CASE Team does not anticipate that the proposed changes

[18] IMPLAN® model, 2020 Data, IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078 www.IMPLAN.com

[19] Gov. Code, §§ 11346.3(c)(1)(C), 11346.3(a)(2); 1 CCR § 2003(a)(3) Competitive advantages or disadvantages for California businesses currently doing business in the state.

would have advantageous or an adverse effect on the competitiveness of California businesses.

The Statewide CASE Team derived a reasonable estimate of the change in investment by California businesses based on the estimated change in economic activity associated with the proposed measure and its expected effect on business income. The Statewide CASE Team's IMPLAN modeling resulted in an estimated $2,104,153 increase in California business income due to the proposed code change. The Statewide CASE Team assumed that net business investment is positively correlated with business income and that a portion of business income will be allocated to net business investment.[20]

To estimate the portion of business income that would be allocated to net investment, the Statewide CASE Team analyzed national data on corporate profits and net capital investment by businesses that expand a firm's capital stock, or NPDI.[21] As Table 69 shows, between 2020 and 2024, NPDI as a percentage of corporate profits ranged from a low of 18 percent in 2020 due to the worldwide economic slowdowns associated with the COVID-19 pandemic to a high of 28 percent in 2022, with an average of 23 percent. While only an approximation of the proportion of business income used for net capital investment, it provides a reasonable estimate of the proportion of incremental income that business owners would reinvest into expanding their capital stock.

Table 69: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2020	$389	$2,212	18%
2021	$545	$2,888	19%
2022	$825	$2,951	28%
2023	$836	$3,069	27%
2024	$885	$3,441	26%
5-Year Average	**Intentionally blank**	**Intentionally blank**	**23%**

Source: (Federal Reserve Economic Data (FRED) n.d.)

[20] 23 percent of proprietor income was assumed to be allocated to net business investment (investment that expands the capital stock, rather than updates or replaces existing capital stock); see Table 11.

[21] Net private domestic investment is the total amount of investment in capital by the business sector that is used to expand the capital stock, rather than maintain or replace due to depreciation. Corporate profit is the money left after a corporation pays its expenses.

Given the estimated total increase in California business income and net business investment ratio described above, the Statewide CASE Team estimates the proposed code change would result in a $493,927 increase in net private investment by California businesses.

5.3.5 Economic and Fiscal Impacts

The Statewide CASE Team does not anticipate that the economic impacts associated with the proposed measure would lead to a significant change (increase or decrease) in investment, directly or indirectly, in any affected sectors of California's economy. The proposed change would not result in economic disruption to any sector of the California economy.

Adoption of this code change proposal would result in relatively modest economic impacts through the additional direct spending by those in the commercial building industry, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2028 code cycle regulations would result in additional spending by those businesses.

5.3.5.1 Effects on the State General Fund, State Special Funds, and Local Governments

The Statewide CASE Team does not expect the proposed code changes to have a measurable impact on California's General Fund, any state special funds, or local government funds.

Cost to State: The state government already has a budget for code development, education, and compliance enforcement. While the state government would be allocating resources to update the Title 24, Part 6 Standards, including updating education and compliance materials and responding to questions about the revised requirements, these activities are already covered by existing state budgets. The costs for the state government are small when compared to the overall cost savings and policy benefits associated with the code change proposals. The proposed code change would impact lighting controls in state buildings, for new construction, additions, and alterations; however, the changes have been found to be cost effective.

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this retraining is an expense to local governments, it is not a new cost associated with the 2028 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training, and resources provided by the IOU Codes and Standards program, such as Energy Code Ace. As noted in Section 5.2, the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

5.3.5.2 Mandates on Local Agencies or School Districts

There are no relevant mandates to local agencies or school districts. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

5.3.5.3 Costs to Local Agencies or School Districts

There are no costs to local agencies or school districts. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies or school districts.

5.3.5.4 Costs or Savings to Any State Agency

There are no costs or savings to any state agencies. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for any state agency.

5.3.5.5 Other Non-Discretionary Cost or Savings Imposed on Local Agencies

There are no added non-discretionary costs or savings to local agencies. The proposed code change would not result in the creation, elimination, increase, or decrease of jobs or revenue for local agencies.

5.3.5.6 Costs or Savings in Federal Funding to the State

There are no costs or savings in federal funding to the state. The proposed code change is not related to and would not impact federal funding to the state.

5.4 Update Multilevel Lighting Controls Requirements – Cost Effectiveness

5.4.1 Cost-Effectiveness Methodology

The Statewide CASE Team collaborated with the CEC staff to confirm that the cost-effectiveness methodology aligns with the CEC guidelines, including cost inclusion parameters. The 2028 CASE Methodology Report and Appendix A provide reproducibility details.

Per California Law (Public Resources Code 25000), a measure is considered cost effective if its BCR is 1.0 or greater, amortized over the economic life of the structure. The Statewide CASE Team calculates BCR by dividing total dollar benefits by total dollar costs over a 30-year analysis period.

Benefits are based on LSC, which assigns an hourly dollar value to energy use. LSC hourly factors weigh the long-term value of each hour differently, where times of peak demand are valued more than off-peak hours. These factors are not utility rates, forecasts, or bill estimates. The CEC develops and publishes LSC hourly conversion factors for each code cycle.

Costs include first costs and ongoing maintenance costs assessed over the 30-year period. Benefits and costs are evaluated incrementally, relative to the most recently adopted Energy Code. The analysis excludes design costs and incremental code compliance verification costs.

5.4.2 Energy and Energy Cost Savings Results

5.4.2.1 Convert to Wattage-Based Trigger

The Statewide CASE Team proposes to specify the trigger for the requirements to be based on general lighting wattage, instead of general LPD currently specified for multilevel lighting controls. This change is intended to unify the metric used to determine the required controls, so that all mandatory lighting control requirements are triggered by wattage, improving ease of compliance. The change will impact spaces in nonresidential buildings exclusively. Due to Assembly Bill 130, Group R occupancies would continue to use LPD to evaluate whether multilevel lighting controls are required.

An equivalent wattage-based trigger, with the same stringency as the current LPD trigger (greater than 0.5 watts per square foot in spaces 100 square feet or larger), was first derived. This wattage trigger was determined to be 75 watts. The equivalency is established based on equal LSC between the LPD trigger and the converted wattage trigger for spaces impacted by the current multilevel lighting controls requirement. A detailed description of the methodology is provided in Appendix G.

For spaces in all nonresidential buildings excluding Group R occupancies, the Statewide CASE Team proposes a lower wattage trigger for requiring manual dimmers to better reflect the current LED technology.

5.4.2.2 Energy Savings from Space in Nonresidential Buildings

Energy savings are expected from spaces for nonresidential occupancies through the following two distinct components of the proposed code change:

- Requiring manual dimmers in spaces with a general lighting load greater than 50 watts.
- Requiring continuous dimming for all daylight responsive controls.

Energy Savings from Requiring Manual Dimmers

The current requirement for multilevel lighting controls applies to spaces 100 square feet or larger and with an LPD greater than 0.5 watts per square foot. Based on section 5.4.2.1, this is equivalent to a general lighting load greater than 75 watts. The proposed code changes require manual dimmers in spaces with a general lighting load greater than 50 watts. Therefore, for spaces with a general lighting load greater than 50 watts and less than or equal to 75 watts, energy savings from manual dimmers are expected, as shown in Table 70. Under the current code requirements, multilevel lighting controls are already required in many spaces listed in Table 70. However, lowering the threshold to 50 watts would trigger additional spaces, typically smaller ones, to require manual dimmers, and the per-unit savings in Table 70 would still apply. Per-unit savings from manual dimmers, presented in per-watt controlled by manual dimmers, for the first year are expected to range from 0.091 to 0.583 kWh/yr, depending on the space type. Demand reductions are expected to range from 0.006 to 0.066 W, depending on the space type. The measure applies to new construction, additions, and alterations, with no difference in the per-unit savings expected . Electricity and source energy savings, as well as peak demand reductions per unit (per-watt controlled by manual dimmers) from requiring manual dimmers, are presented in Table 70 through Table 71 by space type. There are no natural gas savings from this proposed change. Table 72 presents total per-unit (per-watt controlled by manual dimmers) energy cost savings by space type for new construction, additions, or alterations in terms of LSC savings realized over a 30-year period, in 2029 PV$. The LSC methodology allows peak electricity savings to be valued more than electricity savings during non-peak periods.

Table 70: First Year Electricity Savings (kWh) and Demand Reductions Per Watt Controlled – Requiring Manual Dimmers

Space Type (Area Category)	First Year Electricity Savings (kWh/W)	First Year Peak Demand Reduction (W/W)
Aging Eye/Low-vision: Dining	0.388	0.038
Aging Eye/Low-vision: Main Entry Lobby	0.145	0.013
Aging Eye/Low-vision: Lounge/Waiting Area	0.583	0.066
Aging Eye/Low-vision: Multipurpose Room	0.583	0.066
Aging Eye/Low-vision: Religious Worship Area	0.261	0.024
Audience Seating Area	0.261	0.024

Auditorium Area	0.261	0.024
Auto Repair / Maintenance Area	0.115	0.008
Barber, Beauty Salon, and Spa Area	0.211	0.016
Civic Meeting Place Area	0.203	0.019
Classroom, Lecture, Training, Vocational Area	0.145	0.011
Concourse and Atria Area	0.151	0.011
Convention, Conference, Multipurpose and Meeting Area	0.261	0.024
Dining Area: Bar/Lounge and Fine Dining	0.388	0.038
Dining Area: Cafeteria/Fast Food	0.216	0.021
Exercise/Fitness Center and Gymnasium Area	0.211	0.016
Financial Transaction Area	0.091	0.006
Library: Reading Area	0.091	0.006
Library: Stacks Area	0.091	0.006
Main Entry Lobby	0.145	0.013
Lounge, Breakroom, or Waiting Area	0.261	0.024
Museum Area: Exhibition/Display	0.203	0.019
Museum Area: Restoration Room	0.203	0.019
Office Area: > 250 square feet	0.091	0.006
Office Area: ≤ 250 square feet	0.163	0.011
Pharmacy Area	0.151	0.011
Retail Sales Area: Grocery Sales	0.151	0.011
Retail Sales Area: Retail Merchandise Sales	0.211	0.016
Retail Sales Area: Fitting Room	0.151	0.011
Religious Worship Area	0.261	0.024
Sports Arena – Playing Area: Class I Facility	0.151	0.011
Sports Arena – Playing Area: Class II Facility	0.151	0.011
Sports Arena – Playing Area: Class III Facility	0.151	0.011
Sports Arena – Playing Area: Class IV Facility	0.151	0.011
Theater Area: Motion picture	0.261	0.024
Theater Area: Performance	0.261	0.024
Videoconferencing Studio	0.091	0.006

Table 71: First Year Source Energy Savings (kBtu) Per Watt Controlled – Requiring Manual Dimmers

Space Type (Area Category)	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Aging Eye/Low-vision: Dining	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529
Aging Eye/Low-vision: Main Entry Lobby	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181
Aging Eye/Low-vision: Lounge/Waiting Area	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992
Aging Eye/Low-vision: Multipurpose Room	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992
Aging Eye/Low-vision: Religious Worship Area	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Audience Seating Area	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Auditorium Area	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Auto Repair / Maintenance Area	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
Barber, Beauty Salon, and Spa Area	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185
Civic Meeting Place Area	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254
Classroom, Lecture, Training, Vocational Area	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135

Concourse and Atria Area	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
Convention, Conference, Multipurpose and Meeting Area	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Dining Area: Bar/Lounge and Fine Dining	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529	0.529
Dining Area: Cafeteria/Fast Food	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294
Exercise/Fitness Center and Gymnasium Area	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185
Financial Transaction Area	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Library: Reading Area	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Library: Stacks Area	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Main Entry Lobby	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181
Lounge, Breakroom, or Waiting Area	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Museum Area: Exhibition/Display	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254
Museum Area: Restoration Room	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254
Office Area: > 250 square feet	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Office Area: ≤ 250 square feet	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139	0.139
Pharmacy Area	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132

Retail Sales Area: Grocery Sales	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
Retail Sales Area: Retail Merchandise Sales	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185
Retail Sales Area: Fitting Room	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
Religious Worship Area	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Sports Arena – Playing Area: Class I Facility	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
Sports Arena – Playing Area: Class II Facility	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
Sports Arena – Playing Area: Class III Facility	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
Sports Arena – Playing Area: Class IV Facility	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
Theater Area: Motion picture	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Theater Area: Performance	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327	0.327
Videoconferencing Studio	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077

Table 72: Total 30-Year LSC Savings (2029 PV$) Per Watt Controlled – Requiring Manual Dimmers

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Aging Eye/Low-vision: Dining	$3.15	$3.16	$3.16	$3.16	$3.18	$3.09	$3.12	$3.18	$3.21	$3.19	$3.16	$3.18	$3.16	$3.13	$3.15	$3.20
Aging Eye/Low-vision: Main Entry Lobby	$1.15	$1.15	$1.15	$1.15	$1.16	$1.11	$1.13	$1.16	$1.18	$1.16	$1.15	$1.16	$1.15	$1.13	$1.15	$1.17
Aging Eye/Low-vision: Lounge/Waiting Area	$5.09	$5.08	$5.09	$5.08	$5.07	$5.11	$5.08	$5.07	$5.07	$5.07	$5.08	$5.07	$5.08	$5.08	$5.09	$5.07
Aging Eye/Low-vision: Multipurpose Room	$5.09	$5.08	$5.09	$5.08	$5.07	$5.11	$5.08	$5.07	$5.07	$5.07	$5.08	$5.07	$5.08	$5.08	$5.09	$5.07
Aging Eye/Low-vision: Religious Worship Area	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Audience Seating Area	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Auditorium Area	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Auto Repair / Maintenance Area	$0.81	$0.80	$0.80	$0.79	$0.80	$0.78	$0.79	$0.78	$0.79	$0.78	$0.79	$0.80	$0.79	$0.77	$0.79	$0.78
Barber, Beauty Salon, and Spa Area	$1.50	$1.50	$1.50	$1.49	$1.51	$1.45	$1.47	$1.48	$1.51	$1.48	$1.48	$1.51	$1.49	$1.44	$1.49	$1.49
Civic Meeting Place Area	$1.61	$1.61	$1.61	$1.61	$1.63	$1.56	$1.58	$1.62	$1.65	$1.63	$1.61	$1.62	$1.61	$1.58	$1.60	$1.64
Classroom, Lecture, Training, Vocational Area	$1.07	$1.06	$1.06	$1.05	$1.06	$1.02	$1.04	$1.05	$1.06	$1.05	$1.05	$1.06	$1.05	$1.02	$1.04	$1.05

Concourse and Atria Area	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06
Convention, Conference, Multipurpose and Meeting Area	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Dining Area: Bar/Lounge and Fine Dining	$3.15	$3.16	$3.16	$3.16	$3.18	$3.09	$3.12	$3.18	$3.21	$3.19	$3.16	$3.18	$3.16	$3.13	$3.15	$3.20
Dining Area: Cafeteria/Fast Food	$1.75	$1.76	$1.75	$1.75	$1.77	$1.72	$1.73	$1.77	$1.78	$1.77	$1.75	$1.77	$1.76	$1.74	$1.75	$1.78
Exercise/Fitness Center and Gymnasium Area	$1.50	$1.50	$1.50	$1.49	$1.51	$1.45	$1.47	$1.48	$1.51	$1.48	$1.48	$1.51	$1.49	$1.44	$1.49	$1.49
Financial Transaction Area	$0.65	$0.64	$0.64	$0.64	$0.64	$0.62	$0.63	$0.63	$0.63	$0.63	$0.63	$0.64	$0.63	$0.62	$0.63	$0.63
Library: Reading Area	$0.65	$0.64	$0.64	$0.64	$0.64	$0.62	$0.63	$0.63	$0.63	$0.63	$0.63	$0.64	$0.63	$0.62	$0.63	$0.63
Library: Stacks Area	$0.65	$0.64	$0.64	$0.64	$0.64	$0.62	$0.63	$0.63	$0.63	$0.63	$0.63	$0.64	$0.63	$0.62	$0.63	$0.63
Main Entry Lobby	$1.15	$1.15	$1.15	$1.15	$1.16	$1.11	$1.13	$1.16	$1.18	$1.16	$1.15	$1.16	$1.15	$1.13	$1.15	$1.17
Lounge, Breakroom, or Waiting Area	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Museum Area: Exhibition/Display	$1.61	$1.61	$1.61	$1.61	$1.63	$1.56	$1.58	$1.62	$1.65	$1.63	$1.61	$1.62	$1.61	$1.58	$1.60	$1.64
Museum Area: Restoration Room	$1.61	$1.61	$1.61	$1.61	$1.63	$1.56	$1.58	$1.62	$1.65	$1.63	$1.61	$1.62	$1.61	$1.58	$1.60	$1.64
Office Area: > 250 square feet	$0.65	$0.64	$0.64	$0.64	$0.64	$0.62	$0.63	$0.63	$0.63	$0.63	$0.63	$0.64	$0.63	$0.62	$0.63	$0.63
Office Area: ≤ 250 square feet	$1.17	$1.15	$1.16	$1.15	$1.15	$1.12	$1.14	$1.13	$1.14	$1.13	$1.14	$1.15	$1.14	$1.11	$1.14	$1.13
Pharmacy Area	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06

Retail Sales Area: Grocery Sales	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06
Retail Sales Area: Retail Merchandise Sales	$1.50	$1.50	$1.50	$1.49	$1.51	$1.45	$1.47	$1.48	$1.51	$1.48	$1.48	$1.51	$1.49	$1.44	$1.49	$1.49
Retail Sales Area: Fitting Room	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06
Religious Worship Area	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Sports Arena – Playing Area: Class I Facility	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06
Sports Arena – Playing Area: Class II Facility	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06
Sports Arena – Playing Area: Class III Facility	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06
Sports Arena – Playing Area: Class IV Facility	$1.07	$1.07	$1.07	$1.07	$1.08	$1.03	$1.05	$1.06	$1.08	$1.06	$1.06	$1.08	$1.06	$1.03	$1.06	$1.06
Theater Area: Motion picture	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Theater Area: Performance	$2.07	$2.07	$2.07	$2.07	$2.10	$2.00	$2.04	$2.09	$2.12	$2.09	$2.07	$2.09	$2.07	$2.03	$2.06	$2.11
Videoconferencing Studio	$0.65	$0.64	$0.64	$0.64	$0.64	$0.62	$0.63	$0.63	$0.63	$0.63	$0.63	$0.64	$0.63	$0.62	$0.63	$0.63

5.4.2.3 Energy Savings from Daylight Responsive Controls with Continuous Dimming

The current requirement for multilevel lighting controls applies to spaces with an LPD greater than 0.5 watts per square foot, and the current daylight responsive controls only require continuous dimming in daylit zones where multilevel lighting controls are required. As a result, requiring continuous dimming for all daylight responsive controls would result in additional energy savings in daylit zones with an LPD of 0.5 watts per square foot or less and where daylight responsive controls are required, i.e., the general lighting load in the daylit zone is 75 watts or more (60 watts or more of the total general lighting load in parking garage areas). Table 73 shows the areas that will be impacted and the estimated likelihood of being skylit or sidelit. The detailed energy modeling and analysis are documented in Appendix H.

Table 73: Spaces Impacted by Requiring Daylight Responsive Controls with Continuous Dimming

Space Type	Maximum LPD (W/ft^2)	Likelihood of Exceeding Daylight Responsive Controls Threshold	Likelihood of Skylit	Likelihood of Sidelit
Audience Seating Area	0.50	High	Unlikely	Unlikely
Copy Room	0.50	Low	Unlikely	Unlikely
Corridor Area	0.40	High	Low	Medium
Bar/Lounge and Fine Dining Area	0.45	High	Low	Medium
Cafeteria/Fast Food Dining Area	0.45	High	Low	Medium
Family and Leisure Dining Area	0.40	High	Low	Medium
Electrical, Mechanical, Telephone Room	0.40	Low	Unlikely	Unlikely
Exercise/Fitness Center and Gymnasium Area	0.50	High	Medium	Medium
Laundry Area	0.45	Medium	Unlikely	Unlikely
Locker Room	0.45	High	Low	Low
Parking Zone and Ramps in Parking Garage Area	0.10	High	Unlikely	Low
Warehouse Storage Area	0.40	High	High	Low
Theater Area	0.50	High	Unlikely	Unlikely
Transportation Baggage Area	0.40	High	Low	Medium
Transportation Ticketing Area	0.45	High	Medium	High

The Statewide CASE Team estimated first-year electricity savings and demand reduction for space types that are likely to be daylit and will be cost-effective when requiring daylight responsive controls to be implemented with continuous dimming. Per-unit electricity savings for the first year, as presented in per-watt controlled by daylight responsive controls with continuous dimming in Table 74, are estimated to range from 0.414 to 1.814 kWh per year, depending on the space type, daylit zone, and climate zone. Demand reductions, as presented in Table 75, are expected to range from 0.029 to 0.092 W per watt controlled by continuous-dimming daylight responsive controls, also varying by space type, daylit zone, and climate zone. The estimates apply to new construction, additions, and alterations, with no difference in the per-unit savings expected.

Space types listed in Table 73 but omitted in Table 74 are spaces that are unlikely to be daylit or spaces where continuous dimming for daylight responsive controls would not generate meaningful energy savings. For these space types, requirements for daylight responsive controls would remain the same as the 2025 code, and stepped switching may be used in place of continuous dimming. For spaces that are allowed to use stepped switching for daylight responsive controls, electric lights can remain at full power until daylight illuminance exceeds 150 percent of the design illuminance, at which point the electric lights are turned OFF. On the other hand, to minimally comply with the daylight responsive controls requirements with continuous dimming, electric lights are only required to be reduced to 10 percent of power when daylight illuminance exceeds 150 percent of the design illuminance. Daylit spaces, particularly sidelit spaces with lower design illuminance such as corridor areas, are more easily saturated with daylight, and the electric lights would spend more time at 10 percent power when daylight responsive controls are implemented using continuous dimming, as opposed to 0 percent power (lights are turned OFF) using stepped switching. For these spaces, daylight responsive controls implemented with continuous dimming would result in more energy use than stepped switching, and therefore would not be cost-effective. As a result, these spaces were not included in the energy savings analysis and cost-effectiveness evaluation in the later section.

Source energy savings per unit (per-watt controlled by daylight responsive controls) are presented in Table 76 by space type and daylit zone. There are no natural gas savings from this proposed change. Table 77 presents total per-unit (per-watt controlled by daylight responsive controls) energy cost savings by space type and daylit zone for newly constructed buildings and additions, as well as alterations to existing buildings in terms of LSC savings realized over a 30-year period, in 2029 PV$. The LSC methodology allows peak electricity savings to be valued more than electricity savings during non-peak periods.

Table 74: First Year Electricity Savings (kWh) Per Watt Controlled – Requiring Continuous Dimming for Daylight Responsive Controls

Space Type (Area Category): Daylit Zone Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Corridor Area: Skylit	0.876	0.949	0.914	0.910	0.973	0.991	0.967	0.950	0.900	0.961	0.881	0.901	0.950	0.837	1.047	0.829
Bar/Lounge and Fine Dining Area: Skylit	1.026	1.214	1.205	1.228	1.197	1.211	1.081	1.192	1.168	1.228	1.147	1.208	1.246	1.137	1.286	1.077
Cafeteria/Fast Food Dining Area: Skylit	0.771	0.788	0.779	0.724	0.818	0.836	0.926	0.782	0.708	0.780	0.730	0.707	0.774	0.677	0.858	0.708
Family and Leisure Dining Area: Skylit	0.995	1.049	1.039	1.015	1.088	1.093	1.052	1.051	0.992	1.063	0.978	1.008	1.065	0.931	1.139	0.934
Exercise/Fitness Center and Gymnasium Area: Skylit	1.248	1.166	1.170	1.112	1.226	1.241	1.374	1.245	1.175	1.181	1.073	1.099	1.138	1.153	1.238	1.037
Exercise/Fitness Center and Gymnasium Area: Primary Sidelit	0.677	0.612	0.579	0.518	0.538	0.481	0.477	0.503	0.503	0.496	0.609	0.609	0.536	0.449	0.414	0.663
Exercise/Fitness Center and Gymnasium Area: Secondary Sidelit	1.570	1.630	1.662	1.676	1.674	1.690	1.748	1.664	1.681	1.671	1.606	1.647	1.649	1.693	1.672	1.602
Warehouse Storage Area: Skylit	1.529	1.616	1.593	1.576	1.689	1.728	1.690	1.666	1.568	1.682	1.515	1.558	1.664	1.450	1.814	1.451
Locker Room: Skylit	0.867	0.771	0.832	0.782	0.850	0.833	0.937	0.825	0.805	0.813	0.735	0.739	0.796	0.773	0.820	0.699
Transportation Baggage Area: Skylit	1.462	1.542	1.520	1.507	1.621	1.649	1.613	1.588	1.495	1.607	1.442	1.495	1.589	1.386	1.726	1.376
Transportation Ticketing Area: Skylit	1.504	1.565	1.539	1.541	1.604	1.630	1.639	1.628	1.565	1.598	1.465	1.536	1.562	1.595	1.658	1.365

Table 75: First Year Demand Reductions (W) Per Watt Controlled – Requiring Continuous Dimming for Daylight Responsive Controls

Space Type (Area Category): Daylit Zone Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Corridor Area: Skylit	0.041	0.046	0.045	0.042	0.042	0.049	0.054	0.046	0.042	0.042	0.040	0.042	0.043	0.041	0.052	0.040
Bar/Lounge and Fine Dining Area: Skylit	0.055	0.065	0.065	0.063	0.060	0.067	0.062	0.064	0.060	0.061	0.055	0.061	0.061	0.060	0.066	0.057
Cafeteria/Fast Food Dining Area: Skylit	0.033	0.034	0.035	0.032	0.033	0.037	0.040	0.034	0.030	0.032	0.030	0.032	0.035	0.032	0.041	0.032
Family and Leisure Dining Area: Skylit	0.046	0.051	0.051	0.047	0.048	0.054	0.059	0.050	0.045	0.046	0.045	0.047	0.050	0.046	0.057	0.047
Exercise/Fitness Center and Gymnasium Area: Skylit	0.050	0.047	0.048	0.046	0.047	0.052	0.056	0.050	0.048	0.046	0.042	0.049	0.046	0.050	0.055	0.044
Exercise/Fitness Center and Gymnasium Area: Primary Sidelit	0.062	0.065	0.065	0.069	0.067	0.056	0.060	0.061	0.068	0.065	0.067	0.068	0.065	0.062	0.056	0.072
Exercise/Fitness Center and Gymnasium Area: Secondary Sidelit	0.075	0.081	0.078	0.073	0.072	0.076	0.078	0.075	0.077	0.074	0.071	0.082	0.076	0.075	0.075	0.073
Warehouse Storage Area: Skylit	0.067	0.077	0.076	0.072	0.073	0.084	0.092	0.078	0.071	0.073	0.066	0.072	0.077	0.072	0.090	0.072
Locker Room: Skylit	0.038	0.033	0.035	0.033	0.032	0.036	0.043	0.035	0.034	0.032	0.029	0.031	0.033	0.032	0.037	0.030
Transportation Baggage Area: Skylit	0.061	0.070	0.069	0.066	0.066	0.077	0.085	0.071	0.064	0.066	0.059	0.066	0.070	0.066	0.081	0.065
Transportation Ticketing Area: Skylit	0.067	0.070	0.069	0.069	0.069	0.076	0.082	0.074	0.072	0.067	0.062	0.071	0.065	0.074	0.077	0.064

Table 76: First Year Source Energy Savings (kBtu) Per Watt Controlled – Requiring Continuous Dimming for Daylight Responsive Control

Space Type (Area Category): Daylit Zone Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Corridor Area: Skylit	0.271	0.350	0.333	0.329	0.359	0.376	0.401	0.340	0.312	0.337	0.294	0.300	0.346	0.321	0.396	0.309
Bar/Lounge and Fine Dining Area: Skylit	0.400	0.521	0.503	0.502	0.502	0.533	0.510	0.493	0.461	0.486	0.452	0.457	0.522	0.462	0.546	0.470
Cafeteria/Fast Food Dining Area: Skylit	0.228	0.270	0.267	0.255	0.276	0.280	0.294	0.258	0.235	0.255	0.231	0.233	0.272	0.241	0.302	0.245
Family and Leisure Dining Area: Skylit	0.331	0.403	0.393	0.382	0.406	0.417	0.433	0.385	0.352	0.375	0.344	0.348	0.400	0.358	0.434	0.365
Exercise/Fitness Center and Gymnasium Area: Skylit	0.343	0.379	0.388	0.380	0.416	0.405	0.447	0.393	0.384	0.387	0.334	0.372	0.378	0.413	0.433	0.345
Exercise/Fitness Center and Gymnasium Area: Primary Sidelit	0.745	0.775	0.740	0.728	0.738	0.722	0.682	0.739	0.723	0.736	0.732	0.778	0.785	0.727	0.667	0.757
Exercise/Fitness Center and Gymnasium Area: Secondary Sidelit	0.660	0.737	0.752	0.778	0.727	0.716	0.790	0.725	0.747	0.728	0.696	0.759	0.747	0.733	0.751	0.728
Warehouse Storage Area: Skylit	0.517	0.647	0.630	0.632	0.672	0.729	0.768	0.677	0.618	0.664	0.559	0.572	0.671	0.619	0.783	0.611
Locker Room: Skylit	0.269	0.260	0.288	0.269	0.294	0.279	0.348	0.276	0.287	0.283	0.225	0.241	0.277	0.272	0.287	0.239
Transportation Baggage Area: Skylit	0.434	0.554	0.538	0.542	0.580	0.617	0.657	0.567	0.520	0.561	0.468	0.493	0.573	0.530	0.656	0.511
Transportation Ticketing Area: Skylit	0.486	0.565	0.574	0.569	0.611	0.605	0.665	0.582	0.572	0.573	0.496	0.554	0.557	0.614	0.631	0.512

Table 77: Total 30-Year LSC Savings (2029 PV$) Per Watt Controlled – Requiring Continuous Dimming for Daylight Responsive Controls

Space Type (Area Category): Daylit Zone Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Corridor Area: Skylit	$5.27	$5.77	$5.59	$5.49	$5.90	$5.99	$6.00	$5.64	$5.38	$5.66	$5.25	$5.44	$5.71	$4.97	$6.40	$4.96
Bar/Lounge and Fine Dining Area: Skylit	$6.42	$7.71	$7.59	$7.67	$7.62	$7.56	$6.89	$7.38	$7.39	$7.52	$7.15	$7.61	$7.78	$6.83	$8.17	$6.90
Cafeteria/Fast Food Dining Area: Skylit	$4.61	$4.76	$4.72	$4.39	$4.96	$4.97	$5.54	$4.64	$4.32	$4.61	$4.36	$4.32	$4.69	$3.99	$5.29	$4.31
Family and Leisure Dining Area: Skylit	$6.05	$6.49	$6.41	$6.23	$6.73	$6.65	$6.56	$6.36	$6.13	$6.36	$5.96	$6.23	$6.52	$5.55	$7.13	$5.84
Exercise/Fitness Center and Gymnasium Area: Skylit	$7.41	$6.97	$7.04	$6.66	$7.37	$7.34	$8.21	$7.26	$7.01	$6.91	$6.32	$6.65	$6.77	$6.78	$7.53	$6.12
Exercise/Fitness Center and Gymnasium Area: Primary Sidelit	$5.55	$5.15	$4.90	$4.45	$4.66	$4.12	$3.99	$4.09	$4.34	$4.08	$4.96	$5.12	$4.53	$3.77	$3.71	$5.37
Exercise/Fitness Center and Gymnasium Area: Secondary Sidelit	$9.97	$10.33	$10.51	$10.47	$10.40	$10.46	$10.92	$10.09	$10.37	$10.17	$9.97	$10.38	$10.23	$10.26	$10.44	$9.92
Warehouse Storage Area: Skylit	$9.36	$10.09	$9.91	$9.76	$10.52	$10.68	$10.69	$10.19	$9.78	$10.20	$9.29	$9.68	$10.29	$8.77	$11.50	$9.13
Locker Room: Skylit	$5.21	$4.60	$5.04	$4.65	$5.06	$4.92	$5.68	$4.81	$4.76	$4.74	$4.28	$4.40	$4.71	$4.53	$4.94	$4.07
Transportation Baggage Area: Skylit	$8.78	$9.41	$9.27	$9.11	$9.84	$9.97	$10.00	$9.46	$9.02	$9.50	$8.58	$9.06	$9.58	$8.24	$10.68	$8.30
Transportation Ticketing Area: Skylit	$9.15	$9.56	$9.44	$9.37	$9.84	$9.85	$10.13	$9.70	$9.54	$9.49	$8.77	$9.42	$9.36	$9.50	$10.23	$8.24

5.4.3 Incremental First Cost

5.4.3.1 Cost Estimate Methodology

The Statewide CASE Team obtained first costs in the current dollar at the time of writing this CASE Report and projected them to the 2029 PV$ for the cost-effectiveness analyses, assuming a three percent year-over-year inflation rate.

For the material costs, the Statewide CASE Team obtained the distributor net price quotes, primarily from independent manufacturers' sales representative agencies between February 1 and February 19, 2026. To arrive at the total incremental material cost, state and local sales tax, freight charge, and supply chain markup were applied to the net distributor price quotes. The Statewide CASE Team applied the average sales tax rates of 8.84 percent across the state, effective October 1, 2025, to estimate the after-tax incremental cost.

The additional effort required to implement the proposed code change, including installation and system programming, was based on practitioner estimates in labor hours surveyed between February 1 and February 19, 2026. The incremental labor costs were estimated as a product of the incremental labor hours and the hourly labor rate. The Statewide CASE Team assumed an electrician's rate for labor. Two sources were consulted to estimate the labor rates: RSMeans and the prevailing wage published by the California Department of Industrial Relations (DIR) (State of California Department of Industrial Relations 2025).

The 2025 RSMeans national average electrician rate is $85.95/hr and $109.10/hr, including overhead and profit, for non-union and union laborers, respectively. The Statewide CASE Team used the 2025 RSMeans City Cost Index of 132.6 percent for California as the scaling factor to arrive at the average California labor rates, as shown in Table 78. Applying the 132.6 percent scaling factor resulted in a labor rate of $113.97/hr and $144.67/hr for non-union and union California laborers, respectively. The prevailing wages for workers employed on public works projects are published by the county on the DIR website. The prevailing wages for the inside wireman classification under the electrician craft were used to estimate the labor rates. The average rate across all counties and climate zones, weighted by the CEC 2029 construction forecast, is $98.02/hr. The Statewide CASE Team used the average of the three labor rate categories to represent the 2025 labor rate in estimating labor costs. This average 2025 hourly rate was projected to 2029 PV$, assuming the same three percent year-over-year inflation rate. The labor hours estimated in the later sections were then converted into labor costs using the hourly rate in Table 78.

Table 78: Estimated Labor Rates

Labor Rate Category/Source	Estimated Average Labor Rate
RSMeans Non-Unionized (2025$/hr)	$113.97
RSMeans Unionized (2025$/hr)	$144.67
DIR Prevailing Wage (2025$/hr)	$98.02
Average (2025$/hr)	$118.89
Average (2029$/hr)	$133.80

The labor required for implementing the proposed code change typically does not involve the full skillset of a licensed electrician and may be largely performed by an electrician's apprentice. Therefore, the estimated labor cost using exclusively the electrician's rates would be on the conservative side.

The proposed code change has two major incremental first cost components: (1) the incremental cost of implementing manual dimmers and (2) the incremental cost of implementing daylight responsive controls with continuous dimming in daylit zones. They are separately discussed in the following sections.

5.4.3.2 Incremental First Cost of Manual Dimmers

The four control solution configurations in Table 79 were considered to represent the variety of possible implementations and the associated costs.

Table 79: Control Solutions Considered for Requiring Manual Dimmers

Control Solution Type	Control Solution Description	Base Case Configuration	Proposed Case Configuration
Wired, Line-Voltage	The manual control is powered by the line voltage for on/off switching and dimming control commands are communicated to the luminaires or controllers through low-voltage wires, most commonly, 0 –10V.	The manual control is a wall switch keypad that switches the line voltage for on/off controls. No low-voltage control wires.	The manual control is a wall dimmer keypad that switches the line voltage for on/off controls. Low-voltage dimming control wires between the keypad and the luminaire or controller.
Wired, Low-Voltage	The manual control is powered by low voltage, and on/off switching and dimming control commands are also communicated to the luminaires or controllers through low-voltage wires. The most common configuration is that both power and control signals are carried on a multi-conductor	The manual control is a wall switch keypad wired to the luminaire or controller with a multi-conductor cable. It is programmed for only on/off switching.	The manual control is a wall dimmer keypad wired to the luminaire or controller with a multi-conductor cable. It is programmed for both on/off switching and continuous dimming.

	cable, such as Cat5 or Cat6 cables.		
Wireless, Line Powered	The manual control is powered by the line voltage but switching and dimming control commands are communicated to the luminaires or controllers wirelessly.	The manual control is a wall switch keypad wired to the line voltage. It is programmed for only on/off switching.	The manual control is a wall dimmer keypad wired to the line voltage. It is programmed for both on/off switching and continuous dimming.
Wireless, Self Powered	The manual control is powered by batteries or kinetic energy and switching and dimming control commands are communicated to the luminaires or controllers wirelessly.	The manual control is a wall switch keypad with no wiring. It is programmed for only on/off switching.	The manual control is a wall dimmer keypad with no wiring. It is programmed for both on/off switching and continuous dimming.

The first costs of materials and labor associated with the four control solution configurations are listed in Table 80.

Table 80: Incremental First Cost Components Estimated for Requiring Manual Dimmers

Control Solution Type	Base Case Material	Proposed Case Material	Proposed Case Incremental Labor
Wired, Line-Voltage	High-voltage wall switch keypad	High-voltage wall dimmer keypad Low-voltage dimming control wires Wire nuts	Additional wiring of low-voltage dimming control wires between the keypad and the luminaire or controller.
Wired, Low-Voltage	Low-voltage wall switch keypad	Low-voltage wall dimmer keypad	No wiring difference Additional programming for the dimmer
Wireless, Line Powered	Wireless line-powered wall switch keypad	Wireless line-powered wall dimmer keypad	No wiring difference Additional programming for the dimmer
Wireless, Self Powered	Wireless self-powered wall switch keypad	Wireless self-powered wall dimmer keypad	No wiring needed Additional programming for the dimmer

For battery-powered wireless keypads, the Statewide CASE Team assumes that batteries are included in the product package, which is largely the case for most products researched. For the low-voltage dimming control wires, the Statewide CASE Team assumes an average length of 16 feet between the keypad and the luminaire or controller, consistent with the assumption used in the 2025 Daylighting Final CASE

Report. Other necessary components, including controllers, power packs, and networking devices, are assumed to be in place due to other mandatory control requirements, and requiring manual dimmers would not incur additional related hardware costs.

To arrive at the total incremental material cost, state and local sales tax, delivery charge, and supply chain markup would be applied to the net distributor price quotes. A 50 percent markup throughout the supply chain, including the delivery (shipping and freight) charges, was assumed for the dimmer keypads. The second to fourth columns in Table 82 show the pre-tax base case, proposed case, and incremental material cost in current dollars, respectively. These represent the cost per dimmer keypad installation averaged across multiple pricing data points of different makes, models, and systems within each control solution type. The fifth column shows the average incremental material cost after tax and supply chain markup. The additional efforts required to implement the manual dimmer, including installation and system programming, were based on practitioner estimates, and presented in labor hours as shown in Table 81. The estimate only includes the differences in installation and programming of a wall switch keypad versus a wall dimmer keypad for each control solution type. For simplicity, the Statewide CASE Team used conservative estimates for the hours that would cover the average time required to perform installation and programming in both new construction and alteration. This would avoid the need to separately evaluate cost and cost-effectiveness for new construction and alterations, although, in general, such an approach would likely be too conservative for new constructions. Applying the average California labor rates discussed in Section 5.4.3.1, the incremental installation and programming costs per control solution type are shown in the third and fourth columns in Table 83. The values for each control solution type are the average labor costs across all systems that fall under that control solution type. The total first cost, in both 2025 dollars and 2029 PV$ are shown in the last two columns of the table.

For control solution types where the material or labor costs for implementing the proposed case are less than the base case, the assumed incremental costs are zero.

Table 81: Labor Hours Estimated for Requiring Manual Dimmers

Control Solution Type	Incremental Installation Hours (hr)	Incremental Programming Hours (hr)
Wired, Line-Voltage	0	0
Wired, Low-Voltage	0	0
Wireless, Line Powered	0	0.03
Wireless, Self Powered	0	0.03

Table 82: Incremental Material Costs Estimated for Requiring Manual Dimmers

Control Solution Type	Pre-Tax Base Case Material Cost	Pre-Tax Proposed Case Material Cost	Pre-Tax Incremental Material Cost	Incremental Material Cost after Tax and Supply Chain Markup
Wired, Line-Voltage	$97.71	$110.00	$12.29	$20.06
Wired, Low-Voltage	$146.20	$97.75	$-	$-
Wireless, Line Powered	$88.97	$85.00	$-	$-
Wireless, Self Powered	$76.18	$90.00	$13.82	$22.56

Table 83: Incremental First Costs Estimated for Requiring Manual Dimmers

Control Solution Type	Incremental Material Cost after Tax and Supply Chain Markup	Incremental Installation Labor Cost	Incremental Programming Labor Cost	Total First Cost (2025$)	Total First Cost (2029$)
Wired, Line-Voltage	$20.06	$-	$-	$20.06	$22.58
Wired, Low-Voltage	$-	$-	$-	$-	$-
Wireless, Line Powered	$-	$-	$3.96	$3.96	$4.46
Wireless, Self Powered	$22.56	$-	$3.96	$26.52	$29.85
Average	$10.65	$-	$1.98	$12.64	$14.22

5.4.3.3 Incremental First Cost of Daylight Responsive Controls with Continuous Dimming

The five control solution configurations in Table 84 were considered to represent the variety of possible implementations and the associated costs.

For the base case that complies with the current code requirements, the control solutions are assumed to switch the lights OFF when daylight illuminance exceeds 150 percent of the design illuminance; otherwise, the lights remain on at 100 percent of full power. For the proposed case, the control solutions are assumed to continuously adjust the electric light level based on the available daylight and keep the lights at 10 percent of full power when daylight illuminance exceeds 150 percent of the design illuminance.

The first costs of materials and labor associated with the four control solution configurations are listed in Table 85.

Table 84: Control Solution Types Considered for Requiring Daylight Responsive Controls with Continuous Dimming

Control Solution Type	Control Solution Description	Base Case Configuration	Proposed Case Configuration
Analog Line-Voltage Daylight Sensor	Daylight sensor is powered by line voltage and directly switches the power to the loads, i.e., LED drivers.	Daylight sensor directly switches the loads.	Daylight sensor dims the light through low-voltage dimming signals, e.g., 0–10V.
Analog Low-Voltage Daylight Sensor	Daylight sensor is powered by low voltage provided by the power pack or controller. It switches the power to the loads, i.e., LED drivers, by signaling the power pack or controller, and dims the light through low-voltage signals wired directly to the loads.	Daylight sensor is wired to the power pack or controller and switches the power to the loads by signaling the power pack or controller.	Daylight sensor is wired to the power pack or controller. Additionally, low-voltage control wires, e.g., 0–10V, are directly connected to the loads for dimming.
Digital Wired Daylight Sensor	Daylight sensor is wired to the controller. The cable connecting the sensor and controller serves both to power the sensor and to carry the control commands. The controller controls the loads, i.e., LED drivers, in accordance with commands from the sensor.	Daylight sensor is wired to the controller. The controller switches the lights ON and OFF based on the control commands from the daylight sensor.	Daylight sensor is wired to the controller. The controller adjusts the light level in response to control commands from the daylight sensor.
Digital Wireless Daylight Sensor	Daylight sensor is either wired to the controller for power or powered by batteries. The controller is wired to the loads, i.e., LED drivers. Control signals are transmitted between the daylight sensor and the controller via wireless communication, such as Bluetooth.	Daylight sensor sends wireless control commands to the controller based on the daylight level it sees. The controller switches the power to the drivers accordingly.	Daylight sensor sends wireless control commands to the controller based on the daylight level it sees. The controller dims the lights accordingly through the control wires between the controller and the drivers.
Luminaire-Integrated Daylighting Controls	Daylight sensors and controllers are built into the luminaire and directly connected to the LED driver.	The controller switches the lights ON or OFF based on the daylight level the daylight sensor sees.	The controller dims the lights in response to the daylight level the daylight sensor sees.

Table 85: Incremental First Cost Components for Requiring Daylight Responsive Controls with Continuous Dimming

Control Solution Type	Base Case Material	Proposed Case Material	Proposed Case Incremental Labor
Analog Line-Voltage Daylight Sensor	Line-voltage daylight sensor, ON/OFF control only Non-dimmable driver	Line-voltage daylight sensor, ON/OFF control with dimming Dimmable driver Low-voltage dimming control wires Wire nuts	Additional wiring of low-voltage dimming control wires between the sensor and the driver
Analog Low-Voltage Daylight Sensor	Line-voltage daylight sensor, ON/OFF control only Non-dimmable driver	Low-voltage daylight sensor, ON/OFF control with dimming Dimmable driver Low-voltage dimming control wires Wire nuts	Additional wiring of low-voltage dimming control wires between the sensor and the driver
Digital Wired Daylight Sensor	Digital wired daylight sensor Non-dimmable driver	Digital wired daylight sensor Dimmable driver Dimming control wires (if 0–10V) Wire nuts, as needed	Additional wiring of dimming control wires between the controller/power pack and the driver Differences in programming daylight responsive controls with continuous dimming vs. ON/OFF switching
Digital Wireless Daylight Sensor	Digital wired daylight sensor (low voltage or battery powered) Non-dimmable driver	Digital wired daylight sensor (low voltage or battery powered) Dimmable driver	Additional wiring of dimming control wires between the controller and the driver Differences in programming daylight responsive controls with continuous dimming vs. ON/OFF switching
Luminaire-Integrated Daylighting Controls	Non-dimmable driver with associated wiring to the sensor/control module	Dimmable driver with associated wiring to the sensor/control module	Differences in programming daylight responsive controls with continuous dimming vs. ON/OFF switching

For battery-powered wireless daylight sensors, the Statewide CASE Team assumes that batteries are included in the product package, which is largely the case for most products researched. For low-voltage dimming control wires, the Statewide CASE Team assumes an average length of 18 feet between the LED driver and the daylight sensor, power pack, or controller, depending on the control solution type. This assumption is consistent with that used in the 2025 Daylighting Final CASE Report. Other necessary components, including controllers, power packs, and networking devices, are assumed to be in place due to other mandatory control requirements and would not incur additional related hardware cost.

To arrive at the total incremental material cost, state and local sales tax, delivery charge, and supply chain markup would be applied to the net distributor price quotes. A 50 percent markup throughout the supply chain, including the delivery (shipping and freight) charges, was assumed for the sensors. The second to fourth columns in Table 88 show the pre-tax base case, proposed case, and incremental material cost in current dollars, respectively. These represent the cost-per-sensor installation averaged across multiple pricing data points of different makes, models, and systems within each control solution type. The fifth column shows the average incremental material cost after tax and supply chain markup.

The additional effort required to implement daylight responsive controls with continuous dimming, including installation and system programming, was based on practitioner estimates and presented in labor hours as shown in Table 86. The estimate only includes the differences in installation and programming between ON/OFF switching and continuous dimming daylight responsive controls. The installation efforts ranged from 0.02 to 0.50 hours, depending on the control solution type. The Statewide CASE Team's survey found no increase in programming efforts between daylight responsive controls with ON/OFF switching and with continuous dimming.

Table 86: Labor Hours Estimated for Requiring Daylight Responsive Controls with Continuous Dimming

Control Solution Type	Incremental Installation Hours (hr)	Incremental Programming Hours (hr)
Analog Line-Voltage Daylight Sensor	0.50	0.00
Analog Low-Voltage Daylight Sensor	0.50	0.00
Digital Wired Daylight Sensor	0.50	0.00
Digital Wireless Daylight Sensor	0.34	0.00
Luminaire-Integrated Daylighting Controls	0.02	0.00

Applying the average California labor rates discussed in Section 5.4.3.1, the incremental installation and programming costs per control solution type are shown in the third and fourth columns in Table 89.

Additionally, acceptance testing would need to be performed on the daylight responsive controls installed in the impacted spaces, and therefore, the cost of the acceptance test was included as one of the components in the incremental first cost. The Statewide CASE Team conducted a survey of ATTs from April 9 to April 29, 2026, which included a question about their hourly rates. Out of a total of 88 responses, 55 were valid. The reported hourly rates ranged from $50 to $500, with the majority falling within the $125 to $150 range (38 percent). Following that, 19 percent reported rates of $150 to $175, and another 19 percent reported rates of $175 to $200. To determine the incremental cost of acceptance testing, the Statewide CASE Team used the midpoint of all reported hourly rates, which was $154.95. The research documented in the 2025 Daylighting CASE Report shows that the time required to perform daylight responsive controls functional test was estimated at 1 hour per photocontrol per daylit zone. This time was estimated for Continuous Dimming Control Systems Functional Testing per the test method provided in Title 24, Reference Appendices NA7.6.1.4. The time required to perform Continuous Dimming Control Systems Functional Testing is about twice that of Stepped Switching or Stepped Dimming Control Systems Functional Testing method in NA7.6.1.5, based on insights provided by state-certified ATTs. Therefore, performing Stepped Switching or Stepped Dimming Control Systems Functional Testing was estimated at 0.5 hours per photocontrol per daylit zone.

The code permits sampling of a group of up to five photocontrols when performing daylight responsive controls functional test, as long as all photocontrols within the same sample group have the same characteristics, including cardinal direction and luminaire layout; if the photocontrol passes the test, all photocontrols within the same sample group pass. Using the sampling approach, not every additional photocontrol would incur acceptance testing cost. In the best-case scenario, only one out of every five photocontrols (20 percent of photocontrols across all daylit zones) needs to be tested when the ATT is able to identify and test the photocontrols in groups of five photocontrols. In this case, one-fifth of the cost of the acceptance test would be attributed to each photocontrol. Similarly, the Statewide CASE Team estimated the worst-case scenario where only one out of two photocontrols on average can be grouped for testing (50 percent of photocontrols across all daylit zones), and therefore, half of the cost of the acceptance test would be attributed to each photocontrol. An ATT is expected to encounter a variety of sampling scenarios spanning from the best case to the worst case, so the midpoint between the best and worst case (35 percent) was used to represent the typical number of photocontrols needed to undergo acceptance testing. To take the sampling approach, the ATT also needs to spend time planning how to sample the photocontrols. The Statewide CASE Team conservatively assumed a planning time of 0.1 to 0.5 hours per photocontrol, with the average of 0.3 hours, given that the overall project-level planning time is distributed to each photocontrol. Table 87 shows the average values of each cost component considered in estimating the cost associated with acceptance test. In addition, the values in the parentheses represent the range between the worst- and best-case estimates. The Statewide CASE Team used the average cost estimate and projected it to 2029 PV$ as the incremental cost on acceptance testing, as summarized in the last row in Table 87 for each control solution type.

Table 87: Incremental Costs for Acceptance Testing

ATT Tasks Average (Surveyed Range)	Base Case: Stepped Switch or Stepped Dimming Testing	Proposed Case: Continuous Dimming Testing
ATT Labor Rate (2025$/hr) [A]	$154.95	$154.95
Sampling Planning Time (hr) [B]	0.3 (0.1-0.5)	0.3 (0.1-0.5)
Test Time per Photocontrol per Daylit Zone (hr) [C]	0.5	1.0
Groupable Photocontrols (Fraction of Photocontrols Tested Per Daylit Zone) [D]	0.35 (0.2-0.5)	0.35 (0.2-0.5)
Average Acceptance Test Cost per Photocontrol (2025 $) [A]x([B]+[C]x[D])	$73.60 ($30.99-$116.22)	$100.72 ($46.49-154.95)
Average Incremental Acceptance Test Cost per Photocontrol (2025$)	N/A	$27.12 ($15.50-$38.74)
Average Incremental Acceptance Test Cost per Photocontrol (2029$)	N/A	$30.52 ($17.44-$43.60)

Table 88: Incremental Material Costs Estimated for Requiring Daylight Responsive Controls with Continuous Dimming

Control Solution Type	Pre-Tax Base Case Material Cost	Pre-Tax Proposed Case Material Cost	Pre-Tax Incremental Material Cost	Incremental Material Cost after Tax and Supply Chain Markup
Analog Line-Voltage Daylight Sensor	$136.00	$244.67	$108.67	$177.41
Analog Low-Voltage Daylight Sensor	$229.50	$229.50	$-	$-
Digital Wired Daylight Sensor	$174.50	$176.25	$1.75	$2.86
Digital Wireless Daylight Sensor	$158.00	$143.18	$-	$-
Luminaire-Integrated Daylighting Controls	$94.00	$85.36	$-	$-

Table 89: Incremental First Costs Estimated for Requiring Daylight Responsive Controls with Continuous Dimming

Control Solution Type	Incremental Material Cost after Tax and Supply Chain Markup	Incremental Installation Labor Cost	Incremental Programming Labor Cost	Incremental Acceptance Test Labor Cost	Total First Cost (2025$)	Total First Cost (2029$)
Analog Line-Voltage Daylight Sensor	$177.41	$59.45	$-	$27.12	$263.97	$297.10
Analog Low-Voltage Daylight Sensor	$-	$59.45	$-	$27.12	$86.56	$97.43
Digital Wired Daylight Sensor	$2.86	$59.45	$-	$27.12	$89.43	$100.65
Digital Wireless Daylight Sensor	$-	$40.62	$-	$27.12	$67.74	$76.24
Luminaire-Integrated Daylighting Controls	$-	$1.98	$-	$27.12	$29.10	$32.75
Average	$36.05	$44.19	$-	$27.12	$107.36	$120.83

5.4.4 Incremental Maintenance and Replacement Costs

A description of the incremental maintenance and replacement costs, as well as estimation of the present value of maintenance and replacement costs, are provided in the 2028 CASE Methodology Report.

The Statewide CASE Team obtained replacement and maintenance costs in the current dollar at the time of writing this CASE Report and projected them to the 2029 PV$ for the cost-effectiveness analyses, assuming a three percent year-over-year inflation rate.

5.4.4.1 Cost Estimate Methodology

The maintenance and replacement costs over the 30-year analysis period were obtained in current dollars at the time of writing this CASE Report and projected to 2029 PV$, assuming a three percent year-over-year inflation rate. The present values of these costs were then calculated using a three percent discount rate for the years in which maintenance and replacement take place.

For control hardware, the Statewide CASE Team did not find any documented lifetime information in the product literature. The manufacturers that the Statewide CASE Team consulted also did not observe or estimate any systematic time-dependent failure patterns for control hardware in indoor applications. As an alternative, the Statewide CASE Team used the estimated luminaire lifetime as a proxy for the lifetime of control hardware. This is likely a conservative assumption since control hardware typically outlasts luminaires. According to the lighting schedule provided in the 2025 ACM, the annual lighting operating hours range from 1,687 hours (warehouse) to 4,754 hours (restaurant). Assuming a 50,000-hour nominal rated lifetime for commercial-grade LED luminaires, the luminaire would last 10.5 to 29.7 years, based on the annual lighting operating hours in the ACM. The average lifetime, weighted by the square footage of different non-residential building types estimated in the CEC's 2029 construction forecast, is 20.3 years. This estimate excludes parking garage lighting, which, although treated as an indoor application in Title 24, Part 6, is considered to operate in a harsher environment exposed to outdoor conditions and to have significantly longer operating hours. Also, parking garages are not expected to be impacted by this proposed code change. The Statewide CASE Team conservatively assumed a 15-year lifetime for luminaire and control hardware, resulting in one replacement during the 30-year analysis period.

For battery-powered devices, including keypads and daylight sensors, used in some of the control solution configurations in the cost analysis, the batteries would need to be replaced every five to ten years, according to the product data sheets. However, no incremental cost would be incurred since battery replacement costs, both material and labor, would be the same for the base case and the proposed case. For requiring manual dimmers, the batteries and associated replacement efforts for the battery-powered switch keypads in the base case and the battery-powered dimmer keypads in the proposed case would be identical. Similarly, for requiring continuous dimming for daylight responsive controls, the batteries and corresponding replacement efforts would be the same for battery-powered daylight sensors operating ON/OFF switching in the base case and continuous dimming in the proposed case. The incremental maintenance and replacement cost is estimated for each control system using the following methodology:

- Estimate the incremental material and labor costs for each maintenance and replacement occurrence.
- Calculate the present value cost for the same type of maintenance and replacement over the 30-year analysis period.
- Add the present value cost of all types of maintenance and replacement for the system.
- Calculate the average present value cost across all systems of the same control solution type.

5.4.4.2 Incremental Maintenance and Replacement Cost of Manual Dimmers

The average incremental present value cost of maintenance and replacement costs for each manual dimmer control solution type is shown in Table 90. It was assumed that the device being replaced at the 15-year mark of the estimated end of life includes only the keypad and does not include wires and cables connecting the keypads to other system components. For control solution types where the replacement costs in the proposed case are lower than the base case, the assumed incremental replacement costs are zero.

Table 90: Incremental Maintenance and Replacement Cost for Requiring Manual Dimmers

Control Solution Type	30-Year Present Value Maintenance and Replacement Cost
Wired, Line-Voltage	$14.49
Wired, Low-Voltage	$-
Wireless, Line Powered	$2.86
Wireless, Self Powered	$19.16
Average	$9.13

5.4.4.3 Incremental Maintenance and Replacement Cost of Daylight Responsive Controls with Continuous Dimming

The average incremental present value cost of maintenance and replacement costs for each daylight responsive control solution type is shown in Table 91. Except for luminaire-level lighting controls (LLLCs), it was assumed that the device being replaced at the 15-year mark of the estimated end of life includes only the daylight sensor and does not include wires and cables connecting the sensor to other system components. For LLLCs, the entire luminaire, including the luminaire-integrated sensor, would be replaced at the 15-year end-of-life mark. The incremental replacement cost also includes the cost for ATTs to perform acceptance testing when the replacement daylight sensors and luminaires are installed.

Table 91: Incremental First Costs Estimated for Requiring Daylight Responsive Controls with Continuous Dimming

Control Solution Type	30-Year Present Value Maintenance and Replacement Cost
Analog Line-Voltage Daylight Sensor	$190.70
Analog Low-Voltage Daylight Sensor	$62.53
Digital Wired Daylight Sensor	$64.60
Digital Wireless Daylight Sensor	$48.94
Luminaire-Integrated Daylighting Controls	$21.02
Average	$77.56

5.4.5 Cost Effectiveness

Cost effectiveness is assessed separately for the two major savings and cost components of the proposed code change: requiring manual dimmers and requiring all daylighting responsive controls to be implemented with continuous dimming.

In the tables in this section, all values are presented in 2029 PV$. Benefits represent 30-year LSC savings and other savings, including incremental first-cost savings if the proposed first cost is less than the current first cost, incremental maintenance cost savings if the proposed maintenance costs are less than the current maintenance costs, and incremental residual value if the proposed residual value is greater than the current residual value at the end of the 30-year period of analysis. Costs represent the total incremental PV cost, including incremental equipment, replacement, and maintenance costs over the period of analysis. The analysis treats a negative incremental maintenance cost as a positive benefit. If total incremental costs are zero, the BCR is considered infinite. Costs and other savings are discounted at a real (inflation-adjusted) three percent rate. If there are no total incremental PV costs, the BCR is infinite.

5.4.5.1 Cost Effectiveness for Requiring Manual Dimmers

The incremental present value costs for each of the control solution types are summarized in Table 92. The average present value incremental cost across all control solution types is $23.35 per dimmer keypad. Since manual dimmers are only required if the connected general lighting load exceeds 50 watts, the Statewide CASE Team applied $23.35 as the average present value incremental cost for a manual dimmer controlling 50 watts of lighting load. In most cases, when the manual dimmer requirement is triggered, a single dimmer typically controls the entire space, which may have a general lighting load far exceeding 50 watts. Therefore, this assumption would result in the most conservative cost-effectiveness evaluations.

Table 92: Incremental Cost Components for Requiring Manual Dimmers

Control Solution Type	Incremental First Cost per Dimmer at 50 watts	30-Year PV Incremental Maintenance and Replacement Cost per Dimmer at 50 watts	30-Year PV Incremental Cost Total per Dimmer at 50 watts
Wired, Line-Voltage	$22.58	$14.49	$37.07
Wired, Low-Voltage	$-	$-	$-
Wireless, Line Powered	$4.46	$2.86	$7.32
Wireless, Self Powered	$29.85	$19.16	$49.01
Average	$14.22	$9.13	$23.35

Table 93 shows the BCR for each of the impacted space types evaluated at 50 watts of lighting load. The benefits are the per-unit (per-watt controlled) total 30-year LSC savings per impacted space type per climate zone, as listed in Table 72, multiplied by 50 watts. The total incremental costs in 2029 PV$ do not vary by climate zone or space type, and the average 30-year present value incremental cost at 50 watts in Table 92 (the value in the last row of the last column in the table) is used to determine the BCRs. The BCRs are all greater than 1.0, ranging from 1.32 to 10.93, depending on the space type and climate zone, with space type being the dominant factor.

Table 93: 30-Year Cost-Effectiveness Summary for Requiring Manual Dimmers– New Construction, Additions, and Alterations

Space Type (Area Category)	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Aging Eye/Low-Vision: Dining	6.74	6.77	6.76	6.76	6.81	6.62	6.68	6.81	6.87	6.83	6.76	6.80	6.78	6.70	6.75	6.85
Aging Eye/Low-Vision: Main Entry Lobby	2.46	2.47	2.46	2.46	2.49	2.38	2.42	2.48	2.52	2.49	2.46	2.48	2.47	2.42	2.45	2.51
Aging Eye/Low-Vision: Lounge/Waiting Area	10.89	10.88	10.89	10.88	10.86	10.93	10.87	10.86	10.85	10.85	10.87	10.86	10.87	10.88	10.90	10.85
Aging Eye/Low-Vision: Multipurpose Room	10.89	10.88	10.89	10.88	10.86	10.93	10.87	10.86	10.85	10.85	10.87	10.86	10.87	10.88	10.90	10.85
Aging Eye/Low-Vision: Religious Worship Area	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Audience Seating Area	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Auditorium Area	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Auto Repair/Maintenance Area	1.73	1.71	1.72	1.70	1.71	1.66	1.68	1.67	1.68	1.67	1.68	1.70	1.68	1.65	1.69	1.67
Barber, Beauty Salon, and Spa Area	3.22	3.21	3.22	3.20	3.24	3.10	3.15	3.17	3.23	3.17	3.18	3.23	3.19	3.09	3.19	3.19
Civic Meeting Place Area	3.44	3.45	3.45	3.44	3.49	3.34	3.39	3.48	3.53	3.49	3.44	3.47	3.45	3.39	3.43	3.51
Classroom, Lecture, Training, Vocational Area	2.29	2.27	2.27	2.25	2.28	2.19	2.22	2.24	2.26	2.25	2.24	2.26	2.25	2.19	2.22	2.25
Concourse and Atria Area	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28
Convention, Conference, Multipurpose and Meeting Area	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Dining Area: Bar/Lounge and Fine Dining	6.74	6.77	6.76	6.76	6.81	6.62	6.68	6.81	6.87	6.83	6.76	6.80	6.78	6.70	6.75	6.85
Dining Area: Cafeteria/Fast Food	3.75	3.76	3.75	3.75	3.79	3.68	3.71	3.79	3.82	3.79	3.76	3.78	3.76	3.72	3.75	3.81

Space Type (Area Category)	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Dining Area: Family and Leisure	6.74	6.77	6.76	6.76	6.81	6.62	6.68	6.81	6.87	6.83	6.76	6.80	6.78	6.70	6.75	6.85
Exercise/Fitness Center and Gymnasium Area	3.22	3.21	3.22	3.20	3.24	3.10	3.15	3.17	3.23	3.17	3.18	3.23	3.19	3.09	3.19	3.19
Financial Transaction Area	1.39	1.37	1.38	1.36	1.37	1.34	1.35	1.34	1.36	1.35	1.35	1.37	1.35	1.32	1.35	1.35
Library: Reading Area	1.39	1.37	1.38	1.36	1.37	1.34	1.35	1.34	1.36	1.35	1.35	1.37	1.35	1.32	1.35	1.35
Library: Stacks Area	1.39	1.37	1.38	1.36	1.37	1.34	1.35	1.34	1.36	1.35	1.35	1.37	1.35	1.32	1.35	1.35
Main Entry Lobby	2.46	2.47	2.46	2.46	2.49	2.38	2.42	2.48	2.52	2.49	2.46	2.48	2.47	2.42	2.45	2.51
Lounge, Breakroom, or Waiting Area	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Museum Area: Exhibition/Display	3.44	3.45	3.45	3.44	3.49	3.34	3.39	3.48	3.53	3.49	3.44	3.47	3.45	3.39	3.43	3.51
Museum Area: Restoration Room	3.44	3.45	3.45	3.44	3.49	3.34	3.39	3.48	3.53	3.49	3.44	3.47	3.45	3.39	3.43	3.51
Office Area: > 250 square feet	1.39	1.37	1.38	1.36	1.37	1.34	1.35	1.34	1.36	1.35	1.35	1.37	1.35	1.32	1.35	1.35
Office Area: ≤ 250 square feet	2.50	2.47	2.48	2.45	2.47	2.40	2.43	2.42	2.44	2.42	2.44	2.46	2.44	2.38	2.43	2.43
Pharmacy Area	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28
Retail Sales Area: Grocery Sales	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28
Retail Sales Area: Retail Merchandise Sales	3.22	3.21	3.22	3.20	3.24	3.10	3.15	3.17	3.23	3.17	3.18	3.23	3.19	3.09	3.19	3.19
Retail Sales Area: Fitting Room	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28
Religious Worship Area	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Sports Arena – Playing Area: Class I Facility	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28

Space Type (Area Category)	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Sports Arena – Playing Area: Class II Facility	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28
Sports Arena – Playing Area: Class III Facility	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28
Sports Arena – Playing Area: Class IV Facility	2.30	2.29	2.30	2.28	2.32	2.22	2.25	2.26	2.31	2.26	2.27	2.31	2.28	2.21	2.28	2.28
Theater Area: Motion picture	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Theater Area: Performance	4.42	4.44	4.43	4.43	4.49	4.29	4.36	4.47	4.53	4.48	4.42	4.47	4.44	4.35	4.42	4.51
Videoconferencing Studio	1.39	1.37	1.38	1.36	1.37	1.34	1.35	1.34	1.36	1.35	1.35	1.37	1.35	1.32	1.35	1.35

5.4.5.2 Cost Effectiveness for Requiring Continuous Dimming for All Daylight Responsive Controls

The incremental present value costs for each of the control solution types are summarized in Table 94. The average present value incremental cost across all control solution types is $198.39 per daylight responsive control. Since daylight responsive controls are only required in daylit zones with a general lighting of 75 watts or greater, the Statewide CASE Team applied $198.39 as the average present value incremental cost for controlling 75 watts of lighting load. This is the most conservative assumption since each daylit zone is likely to have more than 75 watts of general lighting load.

Table 94: Incremental Cost Components for Requiring Daylight Responsive Controls with Continuous Dimming

Control Solution Type	Incremental First Cost per Continuous Dimming Daylight Responsive Control at 75 watts	30-Year PV Incremental Maintenance and Replacement Cost per Continuous Dimming Daylight Responsive Control at 75 watts	30-Year PV Incremental Cost Total per Continuous Dimming Daylight Responsive Control at 75 watts
Analog Line-Voltage Daylight Sensor	$297.10	$190.70	$487.80
Analog Low-Voltage Daylight Sensor	$97.43	$62.53	$159.96
Digital Wired Daylight Sensor	$100.65	$64.60	$165.25
Digital Wireless Daylight Sensor	$76.24	$48.94	$125.17
Luminaire-Integrated Daylighting Controls	$32.75	$21.02	$53.77
Average	**$120.83**	**$77.56**	**$198.39**

Table 95 shows the BCR for the impacted space types evaluated at 75 watts of lighting load. The benefits are the per-unit (per-watt controlled) total 30-year LSC savings per impacted space type per climate zone, as listed in Table 77, multiplied by 75 watts. The total incremental costs in 2029 PV$ do not vary by climate zone or space type, and the average 30-year present value incremental cost at 75 watts in Table 94 (the value in the last row of the last column in the table) is used to determine the BCRs.

As discussed in Section 5.4.2.2, spaces with low design illuminance in climate zones where the sky condition would more easily saturate the space with daylight may not produce meaningful energy savings and, in some cases, use more energy. This would result in those spaces not being cost effective when the BCR for this requirement is evaluated independently. Therefore, only spaces showing a BCR greater than 1 were included in the cost-effectiveness evaluation. An exception was created to allow other impacted spaces to continue to use stepped switching for daylight responsive controls.

The BCRs for spaces showing cost-effectiveness range from 1.40 to 4.68, depending on space type, daylit zone type, and climate zone, with space type being the dominant factor.

Table 95: 30-Year Cost-Effectiveness Summary for Requiring Continuous Dimming for Daylight Responsive Controls – New Construction, Additions, and Alterations

Space Type (Area Category): Daylit Zone Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Corridor Area: Skylit	1.99	2.18	2.11	2.08	2.23	2.26	2.27	2.13	2.03	2.14	1.98	2.06	2.16	1.88	2.42	1.87
Bar/Lounge and Fine Dining Area: Skylit	2.43	2.91	2.87	2.90	2.88	2.86	2.60	2.79	2.79	2.84	2.70	2.88	2.94	2.58	3.09	2.61
Cafeteria/Fast Food Dining Area: Skylit	1.74	1.80	1.78	1.66	1.88	1.88	2.09	1.75	1.63	1.74	1.65	1.63	1.77	1.51	2.00	1.63
Family and Leisure Dining Area: Skylit	2.29	2.45	2.42	2.36	2.54	2.51	2.48	2.40	2.32	2.40	2.25	2.36	2.47	2.10	2.69	2.21
Exercise/Fitness Center and Gymnasium Area: Skylit	2.80	2.63	2.66	2.52	2.79	2.77	3.10	2.74	2.65	2.61	2.39	2.51	2.56	2.56	2.85	2.31
Exercise/Fitness Center and Gymnasium Area: Primary Sidelit	2.10	1.95	1.85	1.68	1.76	1.56	1.51	1.55	1.64	1.54	1.88	1.94	1.71	1.43	1.40	2.03
Exercise/Fitness Center and Gymnasium Area: Secondary Sidelit	4.27	4.43	4.50	4.49	4.46	4.48	4.68	4.32	4.44	4.36	4.27	4.45	4.38	4.40	4.47	4.25
Exercise/Fitness Center and Gymnasium Area: Primary and Secondary Sidelit	2.93	2.93	2.91	2.82	2.85	2.76	2.82	2.68	2.78	2.69	2.82	2.93	2.79	2.65	2.67	2.89
Warehouse Storage Area: Skylit	3.54	3.81	3.75	3.69	3.98	4.04	4.04	3.85	3.70	3.86	3.51	3.66	3.89	3.32	4.35	3.45
Locker Room: Skylit	1.97	1.74	1.90	1.76	1.91	1.86	2.15	1.82	1.80	1.79	1.62	1.66	1.78	1.71	1.87	1.54
Transportation Baggage Area: Skylit	3.32	3.56	3.51	3.44	3.72	3.77	3.78	3.58	3.41	3.59	3.24	3.43	3.62	3.11	4.04	3.14
Transportation Ticketing Area: Skylit	3.46	3.61	3.57	3.54	3.72	3.72	3.83	3.67	3.61	3.59	3.31	3.56	3.54	3.59	3.87	3.12

5.5 Update Multilevel Lighting Controls Requirements – Statewide Impacts

5.5.1 Statewide Energy and Energy Cost Savings

See the 2028 CASE Methodology Report for details on how statewide savings are calculated. Appendix C presents the assumptions on the percentage of the total construction forecast that the proposed measure would impact.

For more details on the methodology and context of estimating the current market share rate, as well as statewide energy and energy cost savings, see the 2028 CASE Methodology Report.

The Statewide CASE Team first made assumptions on the percentage of nonresidential occupancy space types within each building type included in the CEC construction forecast. Hotel/motel and Group R occupancies were excluded from the assumptions and the subsequent analysis. The Statewide CASE Team then estimated, within each space type, the percentage of space that would be impacted by the proposed code changes. Spaces that would be impacted were separately estimated for the two components of the proposed code change: requiring manual dimmers in spaces with a general lighting load greater than 50 watts and requiring continuous dimming for all daylight responsive controls. The first-year statewide savings for new construction and additions were calculated by multiplying the per-unit savings, presented in Section 5.4.2, by the estimated percentage of spaces within newly constructed buildings that would be impacted. The statewide savings for the two components of the proposed changes were added together to represent the total statewide savings.

For alterations, the Statewide CASE Team followed the same approach as for new construction and additions and additionally assumed that the existing building stock would be impacted by the proposed code changes over the span of 15 years. In other words, one-fifteenth of the existing building stock would be impacted in the first year and each year thereafter. The statewide savings from alterations are thus determined by multiplying the per-unit savings by the estimated existing building stock and by the estimated percentage of spaces within each building type that would be impacted.

The tables below present the first-year statewide energy and LSC savings from newly constructed buildings and additions (Table 96) and alterations (Table 97) by climate zone. Table 98 presents first-year statewide savings from new construction, additions, and alterations.

While the proposed change excludes hotel/motel and Group R occupancies due to Assembly Bill 130, the Statewide CASE Team documented the overall potential statewide impacts in Table 99 to Table 101 if hotel/motel and Group R occupancies were to voluntarily implement the proposed change.

Table 96: Statewide Energy and LSC Impacts – New Construction and Additions

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2029 (Million Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	0.100	0.024	0.001	0.009	$0.13
2	0.535	0.124	0.007	0.049	$0.67
3	2.239	0.553	0.029	0.222	$3.16
4	1.223	0.283	0.015	0.114	$1.56
5	0.211	0.054	0.003	0.021	$0.30
6	1.596	0.386	0.021	0.150	$2.10
7	1.045	0.266	0.015	0.110	$1.48
8	2.322	0.557	0.030	0.216	$3.00
9	3.733	0.863	0.048	0.348	$4.67
10	2.007	0.494	0.025	0.191	$2.67
11	0.433	0.099	0.005	0.036	$0.53
12	2.398	0.549	0.029	0.211	$3.05
13	0.833	0.205	0.011	0.080	$1.12
14	0.439	0.105	0.005	0.041	$0.57
15	0.309	0.078	0.004	0.030	$0.43
16	0.152	0.034	0.002	0.013	$0.18
Total	**19.574**	**4.675**	**0.251**	**1.843**	**$25.61**

Table 97: Statewide Energy and LSC Impacts – Alterations

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2026 (Million Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	0.312	0.077	0.004	0.028	$0.43
2	1.729	0.403	0.022	0.159	$2.21
3	8.221	2.008	0.107	0.802	$11.29
4	4.348	1.028	0.054	0.416	$5.75
5	0.758	0.190	0.009	0.075	$1.06
6	6.717	1.665	0.088	0.648	$9.14
7	4.325	1.126	0.062	0.467	$6.33
8	9.720	2.377	0.126	0.924	$12.94
9	14.805	3.538	0.189	1.428	$19.57
10	10.173	2.535	0.128	0.977	$13.73
11	1.796	0.422	0.022	0.151	$2.28
12	8.855	2.052	0.109	0.785	$11.40
13	3.471	0.856	0.044	0.334	$4.69
14	2.261	0.538	0.028	0.213	$2.91
15	1.407	0.364	0.019	0.140	$2.05
16	0.722	0.162	0.009	0.063	$0.88
Total	**79.620**	**19.343**	**1.022**	**7.612**	**$106.69**

Table 98: Statewide Energy and LSC Impacts – New Construction, Additions, and Alterations

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
New Construction & Additions	4.675	0.251	1.843	$25.61
Alterations	19.343	1.022	7.612	$106.69
Total	**24.018**	**1.273**	**9.455**	**$132.30**

Table 99: Statewide Energy and LSC Impacts Including Hotel/motel and Group R Occupancies – New Construction and Additions

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2029 (Million Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	0.108	0.025	0.001	0.009	$0.13
2	0.575	0.130	0.007	0.051	$0.69
3	2.381	0.573	0.030	0.229	$3.23
4	1.304	0.294	0.016	0.118	$1.60
5	0.226	0.056	0.003	0.022	$0.31
6	1.707	0.402	0.022	0.156	$2.15
7	1.129	0.278	0.016	0.115	$1.52
8	2.485	0.580	0.032	0.225	$3.08
9	3.995	0.899	0.051	0.361	$4.80
10	2.135	0.512	0.027	0.198	$2.73
11	0.461	0.103	0.005	0.038	$0.55
12	2.542	0.569	0.031	0.219	$3.12
13	0.888	0.212	0.011	0.083	$1.15
14	0.467	0.109	0.006	0.043	$0.58

15	0.328	0.081	0.004	0.031	$0.45
16	0.162	0.035	0.002	0.014	$0.19
Total	**20.892**	**4.859**	**0.265**	**1.910**	**$26.28**

Table 100: Statewide Energy and LSC Impacts Including Hotel/motel and Group R Occupancies – Alterations

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2026 (Million Square Feet)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1	0.335	0.080	0.004	0.029	$0.44
2	1.849	0.420	0.023	0.165	$2.27
3	8.761	2.085	0.113	0.829	$11.57
4	4.614	1.066	0.057	0.430	$5.89
5	0.810	0.198	0.010	0.07	$1.09
6	7.143	1.725	0.093	0.671	$9.36
7	4.644	1.175	0.066	0.485	$6.52
8	10.319	2.460	0.133	0.956	$13.25
9	15.712	3.664	0.199	1.476	$20.04
10	10.786	2.619	0.135	1.009	$14.04
11	1.901	0.436	0.023	0.156	$2.33
12	9.379	2.124	0.115	0.811	$11.66
13	3.678	0.884	0.047	0.344	$4.79
14	2.392	0.556	0.030	0.220	$2.98
15	1.485	0.375	0.020	0.144	$2.10
16	0.764	0.168	0.009	0.065	$0.90
Total	**84.573**	**20.037**	**1.077**	**7.868**	**$109.23**

Table 101: Statewide Energy and LSC Impacts Including Hotel/motel and Group R Occupancies – New Construction, Additions, and Alterations

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
New Construction & Additions	4.859	0.265	1.910	$26.28
Alterations	20.037	1.077	7.868	$109.23
Total	**24.895**	**1.342**	**9.778**	**$135.50**

5.5.2 Statewide Greenhouse Gas Emissions Reductions

Table 102 presents the estimated first-year reduction in GHG emissions resulting from the proposed code change. In this initial year, the Statewide CASE Team expects to avoid 875.85 metric tons of CO_2e emissions. These reductions, along with their associated monetary value, were calculated using hourly GHG emissions factors published alongside the LSC hourly factors and source energy hourly factors in the research versions of CBECC, as well as data from the CEC's 2028 Metrics Report. See the 2028 CASE Methodology Report for additional information.

While the proposed change excludes hotel/motel and Group R occupancies due to Assembly Bill 130, the Statewide CASE Team documented the overall potential statewide GHG emission impacts in Table 103 if hotel/motel and Group R occupancies were to voluntarily implement the proposed change.

Table 102: First-Year Statewide GHG Emissions Impacts

Construction Type	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2e)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO2e)	Total Reduced GHG Emissions (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions ($)
New Construction & Additions	97.52	N/A	97.52	$15,842.86
Alterations	402.73	N/A	402.73	$65,427.09
Total	**500.25**	**N/A**	**500.25**	**$81,269.95**

Table 103: First-Year Statewide GHG Emissions Impacts Including Hotel/motel and Group R Occupancies

Construction Type	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2 e)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO 2e)	Total Reduced GHG Emissions (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions ($)
New Construction & Additions	101.07	N/A	101.07	$16,419.61
Alterations	416.30	N/A	416.30	$67,632.60
Total	**517.37**	**N/A**	**517.37**	**$84,052.21**

5.5.3 Statewide Water Use Impacts

The proposed code change would not result in water use impacts.

5.5.4 Statewide Material Impacts

The proposed mandatory code change would require the use of slightly different devices in the impacted spaces. Instead of wall switch keypads and non-dimmable lamps and luminaires, the wall dimmer keypads and continuously dimmable lamps and luminaires would be used. Similarly, instead of photocontrols that switch lights ON and OFF in response to available daylight, photocontrols capable of continuously dimming the lights based on the daylight level would be required. These changes would result in minimal, if any, increases in material use in the control hardware. The Statewide CASE Team also expects that many lamps, luminaires, and photocontrols are already capable of continuous dimming but are not wired and configured to do so; in these cases, the proposed change would not result in any incremental material use. The use of additional cables and wires, and the associated materials, would increase for certain wired control solutions to connect between hardware for continuous dimming signals.

The Statewide CASE Team collected control device material composition data primarily from manufacturers' product environmental profile declaration documents. There were only very limited data points available, and most were from European manufacturers since publishing product environmental profile data is not yet a common practice in the U.S. The limited data point did not provide sufficient granularity for deriving the incremental material use between non-dimmable (e.g., wall switch keypads, non-dimmable lamps and drivers) and continuously dimmable devices (e.g., wall dimmer keypads, dimmable lamps and drivers). The Statewide CASE Team assumed that devices capable of continuous dimming controls use five percent more materials than their non-dimmable counterparts. Table 104 summarizes the first-year statewide impacts on material use across requiring manual dimmers and daylight responsive controls with continuous dimming.

Table 104: First-Year Statewide Impacts on Material Use

Material	Impact	Per-Unit Impacts (Pounds per Square Foot)	First-Year Statewide Impacts (Pounds)	Embodied GHG Emissions Saved (Metric Tons CO2e)
Mercury	No Change	0.0000000	0	0.000
Lead	Increase	0.0000001	3	-0.002
Copper	Increase	0.0011946	60,398	-76.705
Steel	Increase	0.0000265	1,347	-0.094
Plastic	Increase	0.0002526	12,745	-7.010
Aluminum	Increase	0.0000018	89	-0.099
Brass	Increase	0.0000003	12	-0.002
Ferrites	Increase	0.0000031	157	-0.132
Silicon	Increase	0.0000115	587	-428.892
Tin	Increase	0.0000022	110	-80.655
Zinc	Increase	0.0000003	16	-0.010
Total	**N/A**	**0.0014929**	**75,464**	**-593.601**

5.5.5 Environmental Impacts

The proposed measure is not expected to have any significant environmental impacts.

5.5.6 Other Non-Energy Impacts

The proposed measure is not expected to have any quantifiable positive or negative non-energy impacts.

5.6 Update Multilevel Lighting Controls Requirements – Proposed Code Language

The proposed code language in this section includes only changes relevant to this measure. The intent is to clearly illustrate the scope of this measure. The proposed code language that encompasses the changes resulting from all the measures in this CASE Report can be found in Appendix I.

5.6.1 Guide to Markup Language

The proposed changes to the standards, Reference Appendices, and the ACM Reference Manuals are provided below. Changes to the 2025 documents should be marked with dark blue underlining (new language) and ~~strikethroughs~~ (deletions). Defined terms are italicized when the terms are being used in their defined context. In-line comments that are not part of the proposed code language but are used to help describe the purpose of what is proposed are included with grey highlight and italics.

Markups are provided to the restructured 2025 Energy Code that the CEC developed in response to feedback that aligning the structure of Title 24, Part 6 with other parts of the California Building Standards Code (Title 24) would improve readability, usability, and navigation. New section numbers are shown in bold followed by square brackets that document the section in the 2025 Title 24, Part 6 section numbers prior to the restructuring. For example, "Section 601.1 [Section 130.0(a)] General" contains the content that is in the current Section 130.0(a).

Posting the proposed code language in this format is useful as it helps describe how the Energy Code changes proposed for nonresidential occupancies are isolated from the requirements for residential occupancies, which are prohibited from being changed until the 2031 code cycle by Assembly Bill 130.

5.6.2 Administrative Code (Title 24, Part 1)

There are no proposed changes to the Administrative Code (Title 24, Part 1).

5.6.3 Energy Code (Title 24, Part 6)

SECTION 201

DEFINITIONS

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…

LIGHTING definitions:

…

Countdown Timer Switch turns lighting or other loads ON when activated using one or more selectable countdown time periods and then automatically turns lighting or other loads OFF when the selected time period has elapsed.

Daylight Continuous Dimming Controls are a continuous dimming controls that vary the luminous flux of the electric lighting system continuously between 100 percent and 10 percent of lower of lighting power in response to available daylight.

Daylight Stepped Switching Controls vary the luminous flux of the electric lighting system in two discrete steps, the 100 percent lighting power and OFF, in response to available daylight.

Daylight Responsive Control adjusts the luminous flux of the electric lighting system in either a series of steps or by continuous dimming in response to available daylight.

This kind of control uses one or more photosensors to detect changes in daylight illumination and then automatically adjusts the electric lighting levels in response.

…

Luminous Maintenance (often referred to as "lumen flux maintenance" or "lumen maintenance") is the remaining luminous flux output, typically expressed as a percentage of initial luminous flux output, at any selected elapsed operating time. Luminous maintenance is the converse of luminous flux depreciation (or "lumen depreciation").

Manual Dimming Control provides a means for occupants to vary the luminous flux of the electric lighting system over a continuous range from 100 percent to 10 percent or lower of the lighting power.

Marquee Lighting is a permanent lighting system consisting of one or more rows of many small lamps, including light emitting diodes (LEDs) lamps, tungsten lamps, low pressure discharge lamps or fiber optic lighting, attached to a canopy.

…

SECTION 908

CONTROLLED ENVIRONMENTAL HORTICULTURE (CEH)

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

908.1 *[Section 120.6(h)]* **Mandatory requirements (Newly Constructed, Additions, Alterations).**

…

908.1.5 *[Section 120.6(h)5]* **Horticultural lighting.**

In a *building* with CEH spaces or a greenhouse with more than 40 kW of aggregate horticultural lighting load, the electric lighting system used for plant growth and plant maintenance shall meet the following requirements:

…

3. ~~*Multilevel lighting controls*~~Manual dimming controls shall be installed and comply with Section 60~~1.2.2.2~~601.2.2.1.4 *[Section ~~130.1(b)~~130.1(a)4]*.

SUBCHAPTER 6 ELECTRICAL AND LIGHTING

SECTION 600

MANDATORY REQUIREMENTS FOR ALL OCCUPANCIES

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

600.4 *[Section 110.12]* **Demand management.**

Buildings, other than *healthcare facilities and single-family occupancies*, that install or are required to install *demand responsive controls* shall comply with the applicable *demand responsive control* requirements of this section.

…

600.4.2 *[Section 110.12(c)]* **Demand responsive lighting controls.**

600.4.2.1 Nonresidential buildings excluding hotel/motel and buildings with Group R occupancies.

Buildings with *nonresidential lighting* systems having a total installed lighting power of 4,000 watts or greater that are subject to the requirements of Section 601.2.2.1.4 *[New section]* shall install controls that are capable of automatically reducing *lighting* power in response to a *demand response signal*.

For compliance testing, the *lighting* controls shall demonstrate a 15-percent or greater reduction in *lighting* power as described in NA7.6.3. The controls may provide additional demand responsive functions or abilities.

For *buildings* where *demand response controls* are required, *demand responsive controls* shall control the *general lighting* in the spaces required to meet Section 601.2.2.1.4 *[New section]* .

General lighting power shall be reduced by continuous dimming.

Exception to Section 600.4.2.1: Spaces where a health or life safety statute, ordinance, or regulation does not permit the general lighting to be reduced are not required to install *demand responsive controls* and do not count toward the 4,000-watt threshold.

600.4.2.2 Hotel/motel buildings and nonresidential buildings with Group R occupancies.

Buildings with nonresidential *lighting* systems having a total installed lighting power of 4,000 watts or greater that are subject to the requirements of Section 601.2.2.2 *[Section 130.1(b)]* or *Section 160.5(b)4B]* shall install controls that are capable of automatically reducing *lighting* power in response to a *demand response signal*.

For compliance testing, the *lighting* controls shall demonstrate a 15-percent or greater reduction in *lighting* power as described in NA7.6.3. The controls may provide additional demand responsive functions or abilities.

For *buildings* where *demand response controls* are required, *demand responsive controls* shall control the *general lighting* in the spaces required to meet Section 601.2.2.2 *[Section 130.1(b) or Section 160.5(b)4B].*

General lighting shall be reduced in a manner consistent with the requirements of Section 601.2.2.2 *[Section 130.1(b) or Section 160.5(b)4B].*

Exception to Section 600.4.2.~~1~~2: Spaces where a health or life safety statute, ordinance, or regulation does not permit the general lighting to be reduced are not required to install *demand responsive controls* and do not count toward the 4,000-watt threshold.

601.2 Mandatory requirements (Newly Constructed, Additions, Alterations).

…

601.2.2 *[Section 130.0(d) and (e)]* Indoor lighting controls.

…

601.2.2.1 *[Section 130.1(a)]* Manual controls.

Each space shall be provided with *lighting* controls that allow the *lighting* in that space to be manually turned on and off. The *manual* control shall comply with Sections 601.2.2.1.1 through 601.2.2.1.3 *[Sections 130.1(a)1-130.1(a)3]*.

Exception to Section 601.2.2.1: Up to 0.1 watts per square foot of indoor *lighting* may be continuously illuminated to allow for means of egress *illumination* consistent with California Building Code Section 1008. Egress *lighting* complying with this wattage limitation is not required to comply with *manual* control requirements if:

1. The space is designated for means of egress on the plans and specifications submitted to the *enforcement agency* under Section 10-103(a)2 of *Part 1*; and
2. The egress *lighting* controls shall not be controllable by unauthorized personnel during a normal power failure.

601.2.2.1.1 *[Section 130.1(a)1]* Accessibility.

Be *readily accessible*; and

Exception to Section 601.2.2.1.1: *Restrooms* having two or more stalls, parking areas, *stairwells*, corridors and spaces of the *building* intended for access or use by the public may use a manual control not *accessible* to unauthorized personnel.

601.2.2.1.2 *[Section 130.1(a)2]* Viewable when operating controls.

Be located in the same space, or be located such that the controlled *lighting* or the status of the controlled *lighting* can be seen when operating the controls; and

Exception to Section 601.2.2.1.2: In *healthcare facilities*, for *restrooms* and bathing rooms intended for a single occupant, the *lighting* control may be located outside the enclosed area but directly adjacent to the door.

601.2.2.1.3 *[Section 130.1(a)3]* **Separate controls.**

Provide separate control of general, floor display, wall display, *window* display, case display, ornamental, and *special effects lighting*, such that each type of *lighting* can be turned on or off without turning on or off other types of *lighting*. Scene controllers may comply with this requirement provided that at least one scene turns on *general lighting* only, and the control provides a means to manually turn off all *lighting*.

601.2.2.1.4 *[New section]* **Manual dimming controls.**

In spaces in nonresidential buildings, where the connected *general lighting* exceeds 50 watts, controls shall be capable of continuous manual dimming to 10 percent or less of full *lighting* power in addition to full ON and OFF control.

Scene controllers may comply with this requirement provided that at least one scene sets the *general lighting* power to a level between 10 and 100 percent of full power.

Exception 1 to Section 601.2.2.1.4: *Lighting* in commercial/industrial shipping and receiving areas, copy rooms, corridors, electrical/mechanical/telephone rooms, kitchen/food preparation areas, laboratories, laundry rooms, locker rooms, manufacturing/commercial/industrial work areas, parking garages, restrooms, stairwells, and transportation concourse/baggage/ticketing areas.

Exception 2 to Section 601.2.2.1.4: HID (high intensity discharge) and induction lighting with manual controls that have a minimum of one control step between 30 and 70 percent of full rated power in addition to full ON and full OFF.

Exception 3 to Section 601.2.2.1.4: *Healthcare Facilities*.

Exception 4 to Section 601.2.2.1.4: Spaces in hotels/motel buildings and nonresidential buildings with Group R occupancies shall comply with the requirements in Section 601.2.2.2.

601.2.2.2 *[Section 130.1(b)]* **Multilevel lighting controls.**

In hotel/motel buildings and nonresidential buildings with Group R occupancies, the *general lighting* of any space with a size of 100 square feet or larger and with a connected *lighting* load greater than 0.5 watts per square foot shall be provided with *multilevel lighting controls*.

The *multilevel lighting controls* shall provide and enable continuous dimming from 100 percent to 10 percent or lower of *lighting* power.

Exception 1 to Section 601.2.2.2: An indoor space that has only one *luminaire*.

Exception 2 to Section 601.2.2.2: *Restrooms*.

Exception 3 to Section 601.2.2.2: *Healthcare facilities*.

Exception 4 to Section 601.2.2.2: The *general lighting* with *light source* of HID and induction shall have a minimum of one control step between 30 and 70 percent of full rated power.

601.2.2.3 *[Section 130.1(c)]* **Shut-OFF lighting controls.**

All installed indoor *lighting* shall be equipped with controls able to automatically reduce *lighting* power when the space is typically unoccupied.

…

601.2.2.3.5 *[Section 130.1(c)5]* **Occupant Sensing controls.**

1. In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms, conference rooms, and restrooms, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in 20 minutes or less after the control zone is unoccupied.
2. ~~In areas required by Section 601.2.2.2 *[Section 130.1(b)]* to have multi-level lighting controls, the~~The occupant sensing controls shall function either as a:
   - 2.1. Partial-ON occupant sensing controls capable of automatically activating between 50 and 70 percent of controlled lighting power, or
   - 2.2. Vacancy sensing controls, where all lighting responds to a manual ON input only.
3. ~~In areas not required by Section 601.2.2.2 *[Section 130.1(b)]* to have multilevel lighting controls, the occupant sensing controls shall function either as:~~
   - ~~3.1. Automatic full-on occupant sensing controls; or~~
   - ~~3.2. Partial-ON occupant sensing controls, or~~
   - ~~3.3. Vacancy sensing controls, where all lighting responds to a manual ON input only.~~

43. In addition, controls shall be provided that allow the lights to be manually shut OFF in accordance with Section 601.2.2.1 *[Section 130.1(a)]* regardless of the sensor status.

Exception to Section 601.2.2.3.5: Lighting systems not required to comply with the manual dimming controls requirement in Section 601.2.2.1.4 or Section 601.2.2.2 may comply with this section with automatic full-on occupant sensing controls.

…

601.2.2.4 *[Section 130.1(d)]* **Daylight Responsive Controls.**

Daylight Responsive controls shall be installed in the locations listed in this section as applicable and shall comply with Sections 601.2.2.4.1 through 601.2.2.4.6.

…

601.2.2.4.3 *[Section 130.1(d)2C]* **Daylight Responsive control requirements.**

The *daylight responsive controls* shall meet the following:

~~1. For spaces where the installation of *multilevel lighting controls* is required under Section 601.2.2.2 *[Section 130.1(b)]*, allow the multilevel lighting controls to adjust the light level with continuous dimming;~~

12. For each space, ensure the combined illuminance from the controlled lighting and daylight is not less than the illuminance from controlled lighting when no daylight is available;

23. For areas other than parking garages, ensure that, when the daylight illuminance is greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power in that daylight zone shall be reduced by a minimum of 90 percent; and

34. For parking garages, ensure that when daylight illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing or opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power in the combined primary and secondary sidelit daylit zones shall be reduced by 100 percent; and

4. Skylit and sidelit daylit zones in audience seating areas, copy rooms, electrical, mechanical, and telephone rooms, laundry areas, parking zones and ramps in parking garages, and theater areas in nonresidential buildings shall implement Daylight Continuous dimming Controls or Daylight Stepped Switching Controls;

   Sidelit daylit zones in corridor areas, locker rooms, dining areas, warehouse storage areas, and transportation baggage and ticketing areas shall implement Daylight Continuous dimming Controls or Daylight Stepped Switching Controls;

All daylit zones in all other spaces in nonresidential buildings where the installation of manual dimming controls is required under Section 601.2.2.1.4 *[New section]* shall implement Daylight Continuous dimming Controls; and

5. For *Group R occupancies* where the installation of *multilevel lighting controls* is required under Section 601.2.2.2 *[Section 130.1(b)]*, allow the multilevel lighting controls to adjust the light level with continuous dimming; and

…

601.2.2.4.6 *[Section 130.1(d)2F]* **Multilevel lighting and manual dimming control interaction.**

In hotel/motel buildings and nonresidential buildings with Group R occupancies, daylight responsive controls~~The *automatic* daylighting control~~ shall permit the *multilevel lighting control* to adjust the level of *lighting*.

In buildings where *manual dimming controls* are required, the *manual dimming controls* shall be capable of turning off or decreasing light levels below the light level set by the *daylight responsive controls*. When *manual dimming controls* are capable of temporarily increasing electric lighting above the light level set by the *daylight responsive controls*, the controls shall be configured to reset electric *lighting* controls back to the Section 601.2.2.4.3 *[Section 130.1(d)2C]* defaults after electric lighting has been turned off or reduced by a *manual dimming control*, *occupant sensing control*, or timeclock.

601.3 Prescriptive requirements (Newly Constructed).

601.3.1 *[Section 140.6]* Indoor Lighting.

…

601.3.1.1 *[Section 140.6(a)]* Calculation of adjusted indoor lighting power.

The adjusted indoor *lighting* power of all proposed *building* areas is the total watts of all planned permanent and *portable lighting* systems in all areas of the proposed *building*; subject to the applicable adjustments under Sections 601.3.1.1.1 through 601.3.1.1.4, and the requirements of Section 601.3.1.1.4.

…

601.3.1.1.2 *[Section 140.6(a)2]* Reduction of wattage through controls.

In calculating adjusted indoor *lighting* power, the installed watts of a *luminaire* providing *general lighting* in an area *listed* in Table 601.3-A *[Table 140.6-A]* may be reduced by the product of (i) the number of watts controlled as described in

Table 601.3-A *[Table 140.6-A]*, times (ii) the applicable power adjustment factor (PAF), if all of the following conditions are met:

…

11. **Demand responsive control PAF.** To qualify for the PAF for a *demand responsive control* in Table 601.3-A *[Table 140.6-A]*, the *general lighting* wattage receiving the PAF shall not be within the scope of Section 600.4.2 *[Section 110.12(c)]* and a *demand responsive control* shall meet all of the following requirements:

    11.1. The controlled *lighting* shall be capable of being automatically reduced in response to a *demand response signal*; and

    11.2. *General lighting* power in hotel/motel buildings and nonresidential buildings with Group R occupancies shall be reduced in a manner consistent with the requirements of Section 601.2.2.2 *[Section 130.1(b)]*. *General lighting* power in spaces in other nonresidential buildings shall be reduced by continuous dimming.

…

601.3.1.3 *[Section 140.6(c)]* **Calculation of allowed indoor lighting power: specific methodologies.**

The allowed indoor lighting power for each *building* type, or each primary function area shall be calculated using only one of the methods in Section 601.3.1.3.1 or Section 601.3.1.3.2 below as applicable.

…

601.3.1.3.3 *[Section 140.6(c)2G]* **Area Category Method - Additional lighting power allowances for qualifying lighting systems.**

In addition to the allowed indoor lighting power calculated according to Section 601.3.1.3.2 *[Sections 140.6(c)2A through F]*, the *building* may add additional lighting power allowances for qualifying lighting systems as specified in the Qualifying Lighting Systems column in Table 601.3-C *[Table 140.6-C]* under the following conditions:

…

7. **Videoconferencing studios.** Additional lighting power for videoconferencing as specified in Table 601.3-C *[Table 140.6-C]* shall be allowed in a *videoconferencing studio*, as defined in Section 200 *[Section 100.1]*, provided the following conditions are met:

   …

7.3. General lighting in hotel/motel buildings and nonresidential buildings with Group R occupancies is switched in accordance with the requirements of Section 601.2.2.2 *[Section 130.1(b)]*. General lighting in other nonresidential buildings is switched in accordance with the requirements of Section 601.2.2.1.4 *[Section 130.1(a)4]*; and

…

601.5 *[Section 141.0]* **Additions and alterations to existing buildings.**

TABLE 601.5-A [Table 141.0-F] – CONTROL REQUIREMENTS FOR INDOOR LIGHTING SYSTEM ALTERATIONS

Control Specifications	Coded Section	Projects complying with Section 601.5.2.2.4 item 1	Projects complying with 601.5.2.2.4. item 2 or 3
Manual Area Controls	601.2.2.1.1 *[130.1(a)1]*	Required	Required
Manual Area Controls	601.2.2.1.2 *[130.1(a)2]*	Required	Required
Manual Area Controls	601.2.2.1.3 *[130.1(a)3]*	Only required for new or completely replaced circuits	Only required for new or completely replaced circuits
Manual Area Controls	601.2.2.1.4 *[New section]*	Required	Not Required
Multilevel Controls	601.2.2.2 *[130.1(b)]*	Required	Not Required
Automatic Shut-Off Controls	601.2.2.3.1 *[130.1(c)1]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.2 *[130.1(c)2]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.3 *[130.1(c)3]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.4 *[130.1(c)4]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.5 *[130.1(c)5]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.6 *[130.1(c)6]*	Required	Required; except for 601.2.2.3.6.4 *[130.1(c)6D]*
Automatic Shut-Off Controls	601.2.2.3.7 *[130.1(c)8]*	Required	Required
Daylight Responsive Controls	601.2.2.4 *[130.1(d)]*	Required	Not Required
Demand Responsive Controls	600.4.1 *[110.12(a)]* and 600.4.2 *[110.12(c)]*	Required	Not Required

5.6.4 Reference Appendices

There are no proposed changes to the Reference Appendices.

5.6.5 Compliance Manuals

The Statewide CASE Team will provide the CEC with recommended revisions to compliance manuals after the 45-Day Language is published.

5.6.6 ACM Reference Manual

There are no proposed changes to the ACM Reference Manual.

5.6.7 Compliance Forms

As discussed in Section 5.1.4.5, the NRCC-LTI-E, NRCC-PRF-E, NRCI-LTI-E and NRCA-LTI-03-A compliance forms would be updated to reflect the proposed change. The Statewide CASE Team can support the CEC in implementing these updates if the proposed change is adopted.

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Appendix A: Assumptions for Cost-Effectiveness Analysis

Parking Garage Daylight Adaptation Zones Nighttime Controls

Key Assumptions for Energy Savings Analysis

The Statewide CASE Team calculated per-unit impacts and statewide impacts associated with both new construction and alterations by comparing the energy use of lighting that is minimally compliant with the 2025 Title 24, Part 6 Standards to lighting that is minimally compliant with the proposed requirements for the 2028 standards. Savings are based on a comparison between a base case that uses daylight adaptation zone lighting operating 24 hours per day and a building with daylight adaptation zone photocell controls that turn the system off between sunset and sunrise at each garage entrance.

The Statewide CASE Team used a spreadsheet-based analysis approach to determine energy savings. The Statewide CASE Team modeled annual energy consumption per garage entrance based on an average garage entrance size. The Statewide CASE Team used an average garage entrance square footage for energy analysis, as these can vary across different garage entrance styles and significantly affect the annual energy consumption of the associated daylight adaptation system.

The analysis used the following assumptions and methodologies:

- The energy and cost analysis presented in this report used the final 2028 LSC factors.
- Since savings do not vary by climate zone, the Statewide CASE Team used the statewide average LSC hourly factors when calculating energy and energy cost impacts.
- The analysis used the same assumption as the 2025 code cycle, that all lighting would use LED technology or another technology with equivalent performance.
- Based on market research and stakeholder input, the Statewide CASE Team modeled the measure case using on/off photocell controls for daylight adaptation zone lighting.
- For the energy and cost analysis, the Statewide CASE Team used an average garage entrance size of 25 feet by 45 feet to calculate energy savings.
- For the energy and cost analysis, the Statewide CASE Team estimated that parking garages have one entrance per 250 parking spaces to calculate energy savings.

- For the energy and cost analysis, the Statewide CASE Team used the CEBECC Open Parking Garage model to represent the average size of standalone structured parking garages.
- For the energy and cost analysis, the Statewide CASE Team used the size of a single floor of the each analyzed building prototype to estimate the accompanying attached garage size to calculate energy savings.
- For the energy and cost analysis, the Statewide CASE Team used an estimate of the number of new construction commercial buildings that would include attached parking garages to estimate statewide impacts.

Energy Savings Methodology per Prototypical Building

The 2028 CASE Methodology Report provides details on estimating energy savings per prototypical building and unit. The CEC directed the Statewide CASE Team to model energy impacts using specific prototypical building models that represent typical building geometries for different building types. Table 105 presents the prototype buildings used in the analysis.

Table 105: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis[22]

Prototype Name	Number of Stories	Floor Area (Square Feet)	Description
Large Office	12	498,589	12-story + 1 basement. WWR–40%.
Large Retail	1	240,000	Big-box type retail building with WWR–12% and SRR–0.82%
Large School	2	210,866	High school with WWR–35% and SRR–1.4%
Assembly	1	315,339	The main assembly prototype comprises five different assembly buildings i.e., Dodge building types: Religious Worship, Sports & Recreation, Library, Exhibits & Events, and Transportation Terminals.
Hospital	5	241,501	5-story hospital plus basement.
Laboratory	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–33%
Open Parking Garage	3	183,750	Configuration: two-way ramp with one-way floors. 175-foot length and width. 3-story building with 13-foot floor-to-floor height, 5.5-foot wall opening height, 3.5-foot sill height, and 175-foot wall opening width. Concrete wall with 0.30 reflectance. Unconditioned except for 8x5-foot parking attendant space with 8-foot ceiling.
Grocery	1	50,002	6-Zone Grocery Store DEER prototype model provided by Southern California Edison

There is an existing Title 24, Part 6 requirement that covers the building system in question and applies to both new construction/additions and alterations, so the Standard Design is minimally compliant with the 2025 Title 24 requirements, as the previous section describes.

The Proposed Design was identical to the Standard Design in all ways except for the revisions that represent the proposed changes to the code, as the previous section describes. Table 106 presents the parameters modified and the values used in the Standard Design and Proposed Design.

[22] This proposed change applies to Nonresidential Buildings not Including Group R Occupancies and Common Use or Public Use Areas as mandated by California Assembly Bill 130.

Table 106: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change

Prototype ID	Climate Zones	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
Large Office	3, 4, 6-10, 12	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1
Large Retail	3, 4, 6-10, 12	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1
Large School	3, 4, 6-10, 12	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1
Assembly	3, 4, 6-10, 12	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1
Hospital	3, 4, 6-10, 12	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1
Laboratory	3, 4, 6-10, 12	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1
Open Parking Garage	All	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1
Grocery	3, 4, 6-10, 12	Parking Garage daylight adaptation zone lighting	LPD	1.0	0.1

The energy impacts of the proposed code change do not vary by climate zone. Since savings do not vary by climate zone, the Statewide CASE Team used the statewide LSC hourly factors when calculating energy and LSC impacts.

Require Occupant Sensing Controls in More Spaces

Key Assumptions for Energy Savings Analysis

Two methods were utilized for estimating energy savings with one for energy savings analysis for lighting and one for HVAC. For both methods, the construction forecast assumes:

- 100 percent compliance in new construction; and
- Alterations that gradually convert the existing building stock over a 30-year period, where 15 percent of existing buildings are assumed to already have this measure implemented due to naturally occurring market adoption (NOMAD).

The analysis assumes that one-fifteenth (6.7 percent) of the existing stock is impacted in the first year and each year thereafter, based on the EUL of 15 for the control devices required to implement this measure. Energy impacts were simulated in each climate zone. Climate-zone-specific LSC hourly factors were applied to calculate energy and energy cost impacts.

The analysis includes HVAC–lighting interaction effects. The proposed lighting schedules and updated occupancy schedules are applied simultaneously within the CBECC model.

Lighting Energy Savings Analysis

The first method evaluates the benefit of adding full- or partial-off lighting shutoff controls, depending on space type and occupancy needs. This approach uses a spreadsheet-based model with lighting schedules derived from the 2025 CBECC weekday, Saturday, and Sunday schedules, extrapolated to a full-year 8,760-hour profile, excluding holidays.

The proposed building occupancy schedule was developed by subtracting unoccupied time based on each space type's floor area fraction. Savings from occupancy controls are based on Title 24, Part 6, Table 140.6-C, which specifies LPD allowances by Lighting Area Category.

The analysis assumes that occupancy reductions applies when lighting loads exceed five percent. A 25 percent reduction is applied when controls are upgraded to full-off occupancy-based control. This assumption is based on the lesser of[23]:

- The savings identified in an LBNL meta-analysis of 20 peer-reviewed studies, and
- The occupancy sensor reduction defined in ASHRAE 90.1 Table G3.7-1.

When controls are upgraded from manual to partial-off or from partial-off to full-off, the analysis assumes that a 12.5 percent reduction is applied. This is 50 percent less savings change upgrading from manual to full-off occupancy-based control. Occupancy-based controls apply only to general lighting. Connected lighting loads are assumed to match the full LPD permitted under the 2025 Title 24, Part 6 Lighting Area Category method. Floor area distributions for each area category are derived from CPUC DEER data. Electricity savings are assumed to apply consistently across climate zones. Lighting schedules used for modeling are available from the authors upon request.

HVAC Energy Savings Analysis

The HVAC energy savings analysis method evaluates the benefit of adding full-off ventilation controls (occupied-standby mode). This approach also uses a spreadsheet-based model with building occupancy schedules derived from the 2025 CBECC

[23] Breakrooms were assumed to have a 25 percent reduction.

weekday, Saturday, and Sunday schedules, extrapolated to a full-year 8,760-hour profile, excluding holidays.

The proposed occupancy schedule was developed by subtracting unoccupied time based on floor area fraction. The analysis assumes a 25 percent occupancy reduction applied evenly across building operating hours for each area category, consistent with the lighting occupancy reduction assumption described above.

Baseline HVAC energy use is based on CBECC results for each building type under current code assumptions. Proposed HVAC energy use reflects CBECC results generated using the updated building occupancy schedule. HVAC schedules used for modeling are available from the authors upon request.

Energy Savings Methodology per Prototypical Building

The 2028 CASE Methodology Report provides details on estimating energy savings per prototypical building and unit. The CEC directed the Statewide CASE Team to model energy impacts using specific prototypical building models that represent typical building geometries for different building types. Table 107 presents the prototype buildings used in the analysis.

Table 107: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Number of Stories	Floor Area (Square Feet)	Description
Large Office	12	498,589	12-story + 1 basement office building with 5 zones and a ceiling plenum on each floor. WWR–40%. Because CBECC will model single-zone heat pumps in the Large School prototype's Standard Design, results from measures applied to the prototype should be compared to the Proposed Design prototype model, not the Standard Design. For example, as with the Assembly prototype, if a U-factor measure is applied to the Large School windows, that measure should be applied to a copy of the original Proposed Design. The results from that analysis should then be compared to the results of the original prototype's Proposed Design.
Medium Office	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–33%.
Small Office	1	5,502	1-story, 5-zone office building with pitched roof and unconditioned attic. WWR–24%.
Small School	1	24,413	Elementary school with WWR–36%.
Mixed-use Retail	1	9,375	Retail building with WWR–10%. Roof is adiabatic.
Medium Retail	1	24,563	Similar to a Target or Walgreens, 7% WWR on the front façade, none on other sides. SRR–2.1%.
Strip Mall	1	9,375	Strip mall building with WWR–10%.
Large School	2	210,866	High school with WWR–35% and SRR–1.4%.

Reduce Occupant Sensing Controls Delay Time

Key Assumptions for Energy Savings Analysis

To determine the energy savings for this proposal, the Statewide CASE Team compared the proposed code change to a base case with an occupant sensing control delay time set at 20 minutes, which is minimally compliant with the current Energy Code requirements. The proposed measure will set the delay time to 15 minutes. The Statewide CASE Team applied this comparison in several typical building space types with likely traffic patterns to model the amount of time during a typical day that the lighting system is dimmed or turned OFF. The difference between the base case and the proposed measure case represents the typical energy savings in the scenario.

The Statewide CASE Team used a spreadsheet-based analysis approach to determine energy savings. The first step was to develop a prototype scenario that reflects a typical load profile for a seven-day week, with a 40-hour work week in small, medium, and large office building types. Within these building types, the calculation estimates the proportion of space types, such as open office, private office, and reception area. Each space type has a different load shape based on the occupancy of the space. The model uses values per space type based on statewide averages of full load hours and extrapolated to the building level to incorporate multiple space types within the building. The Statewide CASE Team modeled a lighting scenario with the base case of 20-minute delay times and compared it to a model of the proposed 15-minute delay time to determine the reduction of Wh/day. The model multiplied full-load hours by the reduction time (percentage), then multiplied by the LPD.

The Statewide CASE Team is sensitive to the variability in delay times across different activities within buildings and is evaluating where longer delay times may lead to increased safety and security. In industrial building types, for instance, there may be a fall risk factor involved. The Statewide CASE Team also considered occupancy sensors for restrooms, because of the bathroom stalls where the lights may turn off while occupied.

The Statewide CASE Team simulated a 24-hour period in typical spaces and applied the full load equivalent hours based on normal occupancy patterns.

The Statewide CASE Team will use values based on engineering expertise instead of a full dataset to determine potential energy savings. The model assigned energy savings expectations to the prototype building based on the predominant use types. The Statewide CASE Team defined the overall building type allowance in Wh/f^2 using the complete building category method. The model compiles each simulation area use category to determine the energy savings at the complete building level. The Statewide CASE Team then extrapolated across other building types, depending on the space type level to the prototype savings. The full-load hour reduction will result in statewide energy savings.

Since the lighting energy savings do not vary by climate zone, the Statewide CASE Team used the statewide average LSC hourly factors when calculating energy and energy cost impacts.

Energy Savings Methodology per Prototypical Building

The 2028 CASE Methodology Report provides details on estimating energy savings per prototypical building and unit. The CEC directed the Statewide CASE Team to model energy impacts using specific prototypical building models that represent typical building geometries for different building types. Table 108 presents the prototype buildings used in the analysis.

Table 108: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Number of Stories	Floor Area (Square Feet)	Description
Assembly	1	315,339	The main assembly prototype comprises five different assembly buildings i.e., Dodge building types: Religious Worship, Sports & Recreation, Library, Exhibits & Events, and Transportation Terminals. The CBECC model is separated into individual building files before using the Standard design. The CBECC standard design is modeled with SZVAVHP for Library and all other assembly building types are modeled with SZVAVAC systems. Gas hot water system is used as the Standard design SWH.
Non-refrigerated Warehouse	1	52,045	Single story high ceiling warehouse. Includes one office space. WWR–0.7%, SRR–5%
Hospital	5	241,501	5-story hospital plus basement. Source: DOE Standard 90.1 Hospital prototype and scorecard. The prototype contains Title 24, Part 6, minimally compliant envelope features, and lighting. For HVAC systems, the AIA guidelines recommended using VAV systems wherever possible.
Hotel	4	42,554	4-story hotel with 77 guest rooms. WWR–11%
Large Office	12	498,589	12-story + 1 basement office building with 5 zones and a ceiling plenum on each floor. WWR–40%. Because CBECC will model single-zone heat pumps in the Large School prototype's Standard Design, results from measures applied to the prototype should be compared to the Proposed Design prototype model, not the Standard Design. For example, as with the Assembly prototype, if a U-factor measure is applied to the Large School windows, that measure should be applied to a copy of the original Proposed Design. The results from that analysis should then be compared to the results of the original prototype's Proposed Design.
Medium Office	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–33%
Laboratory	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–33%

Small Office	1	5,502	1-story, 5-zone office building with pitched roof and unconditioned attic. WWR–24%
Restaurant	1	2,501	Fast food restaurant with a small kitchen and dining areas. WWR–14%. Pitched roof with an unconditioned attic.
Large Retail	1	240,000	Big-box type retail building with WWR–12% and SRR–0.82%
Data Center	1	9,375	Retail building with WWR–10%. Roof is adiabatic
Medium Retail	1	24,563	Similar to a Target or Walgreens, 7% WWR on the front façade, none on other sides. SRR–2.1%.
Strip Mall	1	9,375	Strip mall building with WWR–10%
Small School	1	24,413	Elementary school with WWR–36%
Large School	2	210,866	High school with WWR–35% and SRR–1.4%
Open Parking Garage	3	183,750	Configuration: two-way ramp with one-way floors. 175-foot length and width. 3-story building with 13-foot floor-to-floor height, 5.5-foot wall opening height, 3.5-foot sill height, and 175-foot wall opening width. Concrete wall with 0.30 reflectance. Unconditioned except for 8x5-foot parking attendant space with 8-foot ceiling.
Enclosed Parking Garage	1	12,540	Part of the Mid- and High-rise Multifamily building prototype models (see UGGarage in the .idf files)
Grocery	1	50,002	6-Zone Grocery Store DEER prototype model provided by Southern California Edison
Refrigerated Warehouse	1	100,000	-
Controlled-environment Horticulture	1	100,000	-
Vehicle Service	1	100,000	-
Manufacturing	1	100,000	-
Unassigned	-	-	-

There is an existing Title 24, Part 6 requirement that covers the building system in question and applies to both new construction/additions and alterations, so the Standard Design is minimally compliant with the 2025 Title 24 requirements. The current occupancy sensor delay time is 15 minutes for relevant space types in both new construction/additions and alterations.

The Proposed Design was identical to the Standard Design in all ways except for the revisions that represent the proposed changes to the code. presents the parameters modified and the values used in the Standard Design and Proposed Design.

Specifically, the proposed conditions assume an occupancy sensor delay time of 15 minutes.

CBECC was not used to model energy impacts. The Statewide CASE Team calculated energy savings using a spreadsheet model that simulates typical hours of a week in certain space types and applies a distribution of full load equivalent hours based on occupancy. The calculation considers the distribution of space types within each prototype and identifies the gaps in occupancy that are long enough to have the lights go off with the proposed code change for the measure's savings opportunity.

The energy impacts of the proposed code change do not vary by CZ. Since savings do not vary by climate zone, the Statewide CASE Team used the statewide LSC hourly factors when calculating energy and LSC impacts.

Update Multilevel Lighting Controls Requirements

Key Assumptions for Energy Savings Analysis

Energy savings are expected from the following two distinct components of the proposed code change:

- Requiring manual dimmers in spaces with a general lighting load greater than 50 watts.
- Requiring continuous dimming for all daylight responsive controls.

Requiring manual dimmers in spaces with a general lighting load greater than 50 watts

The savings from manual dimmers do not vary by climate zone. However, because LSC varies by climate zone, the Statewide CASE Team applied climate-zone-specific LSC hourly factors when calculating energy and energy cost impacts.

The current multilevel lighting controls requirements exempt spaces with an LPD of 0.5 watts per square foot or less, and the proposed change switches the metric used to trigger manual dimmers to wattage and requires manual dimmers in spaces with a general lighting load greater than 50 watts. A wattage trigger equivalent to the original 0.5 watts per square foot trigger for multilevel lighting controls was derived to be 75 watts. Therefore, energy savings for this proposed change are generated in spaces with a general lighting load greater than 50 watts but less than or equal to 75 watts. Consequently, the energy savings analysis focused only on spaces with a general lighting load meeting this criterion. The base case assumes that no manual dimmer is installed in the space. The lights in the space are either full ON when occupied or full OFF when unoccupied. The proposed case assumes the lights are full OFF when unoccupied, same as the base case. However, when occupied, it assumes the lights are manually dimmed from the full ON level by the occupants.

The lighting schedules provided in the 2025 Nonresidential and Multifamily ACM Reference Manual that best match the impacted space types were used as the base case schedules. Based on professional judgement by the practitioners on the Statewide CASE Team staff, each impacted space type was assigned a likelihood of dimmers being used by occupants on a three-point scale: low, medium, or high. The potential savings from manual dimming, reported as percentages in the literature identified as part of the Statewide CASE Team research, were mapped to the three scale points. These percentage savings were applied uniformly to the base case lighting schedules to form the proposed case lighting schedules.

The differences in full-load hours (FLH) between the base case and the proposed case for the full-year 8760 hours were calculated for each impacted space type as FLH per year. The per-unit savings were then determined by multiplying the FLH by the allowed LPD for each impacted space type, presented in kilowatt-hours per square foot.

Requiring continuous dimming for all daylight responsive controls

The savings from requiring continuous dimming for all daylight responsive controls vary by climate zone because daylight availability throughout the day is correlated with climate zones. Therefore, the Statewide CASE Team applied climate-zone-specific LSC hourly factors when calculating energy and energy cost impacts.

Daylight Responsive controls are required in daylit zones with a general lighting load of 75 watts or greater. The current multilevel lighting controls requirements exempt spaces with an LPD of 0.5 watts per square foot or less. In other words, spaces achieving an LPD of 0.5 watts per square foot or less would not need to have continuous dimming, and daylight responsive controls may be implemented using stepped switching. The proposed change requires all daylight responsive controls to be implemented with continuous dimming. Therefore, energy savings for this proposed change are generated in daylit zones with a general lighting load of 75 watts or greater and an LPD of 0.5 watts per square foot or less. Consequently, the energy savings analysis focused only on spaces meeting these two criteria. The base case assumes that daylight responsive controls in the impacted spaces are implemented with stepped switching, where the lights remain on at full power and are turned off only when daylight illuminance exceeds 150 percent of the designed light level. The proposed case assumes continuous dimming for daylight responsive controls in the impacted spaces, minimally compliant with the current code requirements when daylight responsive controls are implemented with continuous dimming. In other words, for the proposed case, the lights are at full power when there is no daylight, proportionally dimmed as daylight illuminance increases, and reach 10 percent of full power when daylight illuminance exceeds 150 percent or more of the designed light level.

The Statewide CASE Team focused the energy savings analysis on the space types with an allowed LPD of 0.5 watts per square foot or less. For sidelit daylit zones, energy savings were estimated using the same methodology documented in the 2025 Daylighting CASE Report. The hourly daylight illuminance values at the far side of the primary and secondary sidelit zones for all hours of the year in a prototypical space were calculated for different climate zones using the ray-tracing technique. The reduction in the fraction of electric light required to supplement the available daylight for each hour of the year was then calculated based on the recommended light level for each space type. When summed up over a year, this represents the reduction in full-load hours (FLH). The per-unit savings were determined by multiplying the FLH by the allowed LPD for each impacted space type, in kilowatts per square foot. For skylit daylit zones, energy savings were estimated using the ray-tracing technique similar to methodology in the 2025 Daylighting CASE Report. Based on professional judgement by practitioners on the Statewide CASE Team, each space was assigned a likelihood of being skylit and daylit on a three-point scale: low, medium, and high. Energy savings for each space were estimated as the average of the savings from the skylit and sidelit scenarios, weighted by their respective assigned likelihoods. Detailed energy modeling for sidelit and skylit daylit zones is documented in Appendix H.

Energy Savings Methodology per Prototypical Building

The 2028 CASE Methodology Report provides details on estimating energy savings per prototypical building and unit. The CEC directed the Statewide CASE Team to model energy impacts using specific prototypical building models that represent typical building geometries for different building types.

Since the prototypical buildings do not model granular space compositions within each building, they were not suitable for use in modeling energy savings for the proposed measure. Consequently, the prototypical building models were not used in estimating energy savings. The per-unit energy savings were calculated for each impacted space type, as described above.

Appendix B: Purpose and Necessity of Proposed Code Changes

Introduction

The sections below provide the purpose and necessity of proposed changes to Title 24, Part 1; Title 24, Part 6; and the reference appendices. This section intends to provide the CEC with the information needed for the Initial Statement of Reasons.

See Section 2.6 of this report for marked-up code language.

Parking Garage Daylight Adaptation Zones Nighttime Controls

Purpose and Necessity of Changes to Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

Purpose and Necessity of Changes to Title 24, Part 6

Section: 601.2.2.3.6.5

Purpose: The purpose of this change is to adjust the exemption for luminaires located in the daylight adaptation zones.

Necessity: The necessity for this change is to apply the measure only to hotel/motel buildings and nonresidential buildings with Group R occupancies.

Section: 601.2.2.7

Purpose: The purpose of this change is to separately control the parking garage daylight adaptation zone lighting to automatically reduce the lighting to no more than the general light level in the parking zone and ramps from sunset to sunrise.

Necessity: The necessity for this change is to increase energy savings in parking garages and ensure proper visual adaptation for drivers entering and exiting parking garages at night.

Purpose and Necessity of Changes to the Reference Appendices

Section: [New section] NA7.6.1.6 Switching or Dimming Control Systems Functional Testing for Parking Garage Daylight Adaptation Zone Applications

Purpose: The purpose of this change is to provide new testing language for one of the proposed control types.

Necessity: The necessity for this change is to provide new testing procedures for one of the proposed control types.

Section: [New section] NA7.6.2.7 Automatic Astronomic Time Switch Lighting Controls Functional Testing for Parking Garage Adaptation Zone Lighting

Purpose: The purpose of this change is to provide new testing language for one of the proposed control types.

Necessity: The necessity for this change is to provide new testing procedures for one of the proposed control types.

Require Occupant Sensing Controls in More Spaces

Purpose and Necessity of Changes to Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

Purpose and Necessity of Changes to Title 24, Part 6

Section: 601.2.2.3.6

Purpose: The purpose of this change is to expand the list of space types required to use partial-OFF or full-OFF occupant sensing controls in spaces that are currently allowed to comply with time-based automatic shut-OFF controls. The change would apply these requirements to additional intermittently occupied nonresidential spaces, including laboratories, lounges, breakrooms, waiting areas, and computer rooms.

Necessity: The necessity for this change is to reduce wasted lighting energy in intermittently occupied spaces where time-based controls cannot respond to actual occupancy patterns. Time-based shut-OFF controls operate on schedules and may leave lighting on when spaces are vacant, whereas occupant sensing controls reduce lighting power based on real-time space use. Expanding occupant sensing requirements to these additional space types improves the responsiveness of lighting controls, captures additional lighting energy savings, and supports related HVAC savings where occupancy status is used to reduce ventilation during unoccupied periods. The change is also necessary to align Title 24, Part 6 more closely with the direction of ASHRAE 90.1-2025 and current industry practice for occupant-responsive controls in a broader range of space types.

Section: 401.2.1 Table 401.2-A

Purpose: The purpose of this change is to make editorial updates to the ventilation requirements for office breakrooms to align with ASHRAE 62.1-2022 Addendum b and the 2028 Air Distribution CASE report recommendations.

Necessity: The necessity for this change is to remove ambiguity caused by duplicative breakroom space types and align Title 24, Part 6 with ASHRAE 62.1. ASHRAE 62.1-2022 Addendum b removes "Breakrooms" from the Office Buildings occupancy category because a related "Breakrooms" space type already exists in the General occupancy category, which allows ventilation air to be reduced to zero when the space is in occupied-standby mode. This clarification supports consistent application of the ventilation requirements and enables energy savings associated with office breakrooms.

Purpose and Necessity of Changes to the Reference Appendices

Section: NA7.6.2.3

Purpose: The purpose of this change is to update the occupancy sensing lighting control functional testing requirements to reflect the additional space types that would now be required to use partial-OFF occupant sensing controls.

Necessity: The necessity for this change is to ensure that acceptance testing requirements remain consistent with the proposed expansion of mandatory occupant sensing controls. As the code would require these controls in additional space types, the Reference Appendices must be updated so that the existing functional testing procedures clearly apply to those spaces and support proper verification of compliance.

Reduce Occupant Sensing Controls Delay time

Purpose and Necessity of Changes to Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

Purpose and Necessity of Changes to Title 24, Part 6

Section: 601.2.2.3

Purpose: The purpose of this change is to reduce the occupancy sensing control delay time from 20 minutes to 15 minutes.

Necessity: The necessary for this change is to increase lighting energy savings.

Section: 401.2.1.2.5.1

Purpose: The purpose of this change is to reduce the occupied-standby control delay time from 20 minutes to 15 minutes.

Necessity: The necessary for this change is to align with the lighting control delay time in section 601.2.2.3.

Section: 912.2.1

Purpose: The purpose of this change is to reduce the unoccupied minimum exhaust airflow control delay time from 20 minutes to 15 minutes.

Necessity: The necessary for this change is to align with the lighting control delay time in section 601.2.2.3.

Purpose and Necessity of Changes to the Reference Appendices

Section: NA7.5.17.2 Functional Testing

Purpose: The purpose of this change is to update references to occupied standby control delay time from 20 minutes to 15 minutes.

Necessity: The necessity for this change is to align the reference appendices with the updated delay time requirement in section 401.2.1.2.5.1.

Section: NA7.16.2 Functional Testing for VAV Lab Exhaust System with Occupancy Controls

Purpose: The purpose of this change is to update references to minimum flowrate under unoccupied conditions control delay time from 20 minutes to 15 minutes.

Necessity: The necessity for this change is to align the reference appendices with the updated delay time requirement in section 912.2.1.

Update Multilevel Lighting Controls Requirements

Purpose and Necessity of Changes to Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

Purpose and Necessity of Changes to Title 24, Part 6

Section: 201

Purpose: The purpose of this change is to add definitions of new terms and revise the definitions of existing terms related to the proposed requirements.

Necessity: The necessity for this change is to ensure clarity and conciseness of the proposed requirements.

Section: 601.2.2.2

Purpose: The purpose of this change is to explicitly specify that this section is only applicable to hotel/motel and Group R occupancies.

Necessity: The necessity for this change is to ensure the proposed requirements do not impact hotel/motel and Group R occupancies due to Assembly Bill 130.

Section: 601.2.2.1

Purpose: The purpose of this change is to specify the manual dimmer requirements that were in 601.2.2.2 multilevel lighting controls and place them as part of the manual controls requirements in the newly created subsection 601.2.2.1.4. The purpose of allowing the use of scene controllers to comply with the manual dimmer requirements, provided that scenes are programmed to achieve lower light levels for general lighting, is to provide compliance flexibility when scene controls are used.

Necessity: The necessity for this change is to clarify the manual dimmer requirement originally specified with confusing code language in the 601.2.2.2 multilevel lighting controls section. Since manual dimmers allow occupants to manually adjust the light level using the lighting system's continuous dimming capability, it is logical to specify the requirements as part of the manual controls requirements in 601.2.2.1. The necessity of allowing the use of scene controllers to comply with the manual dimmer requirements is to ensure cost-effectiveness by avoiding the need for higher-cost scene controllers with integrated means for continuous manual dimming.

Section: 601.2.2.4

Purpose: The purpose of this change is to directly require continuous dimming for all daylight responsive controls and remove the existing reference to the 601.2.2.2 multilevel lighting controls section for continuous dimming. The purpose of this change is also to require continuous dimming for all daylight responsive controls in 601.2.2.4 with the fewest exceptions possible.

Necessity: The necessity for this change is to improve occupant experience with daylight responsive controls and remove the lighting control behaviors that confuse and frustrate occupants when daylight responsive controls are implemented using on/off switching due to the original multilevel lighting controls exception in 601.2.2.2. The change also removes the confusing code intent that references the 601.2.2.2 multilevel lighting controls section for continuous dimming. By directly specifying continuous dimming to be used for all daylight responsive controls, it facilitates correct interpretation of code requirements and improves compliance.

Section: 601.2.2.3

Purpose: The purpose of this change is to remove reference to the 601.2.2.2 multilevel lighting controls section and directly specify the required behaviors for partial-on occupant sensing controls in 601.2.2.3.5.

Necessity: The necessity for this change is to improve the clarity of the code requirements for partial-on occupant sensing controls, depending on whether manual dimmers are required, to avoid confusing references to the 601.2.2.2 multilevel lighting controls section, the use of which is removed for all spaces in nonresidential buildings, and to retain the original intent of this section.

Section: 600.4.2

Purpose: The purpose of this change is to remove reference to the 601.2.2.2 multilevel lighting controls section and directly specify the required behaviors for demand responsive lighting controls in 600.4.2.

Necessity: The necessity for this change is to improve the clarity of the code requirements for demand responsive lighting controls, avoid confusing references to the 601.2.2.2 multilevel lighting controls section, the use of which is removed for all spaces in nonresidential buildings, and retain the original intent of this section.

Section: 908.1

Purpose: The purpose of this change is to remove reference to the 601.2.2.2 multilevel lighting controls section and reference the new 601.2.2.1.4 for horticultural lighting manual dimmer requirements.

Necessity: The necessity for this change is to ensure the requirements in this section no longer reference the 601.2.2.2 multilevel lighting controls section, the use of which is removed for all spaces in nonresidential buildings. Instead, the manual dimmer requirement in the new 601.2.2.1.4 section is referenced to retain the original intent of this section.

Section: 601.3.1.1

Purpose: The purpose of this change is to remove reference to the 601.2.2.2 multilevel lighting controls section and directly require continuous dimming for utilizing the PAF related to demand responsive lighting controls.

Necessity: The necessity for this change is to remove references to the 601.2.2.2 multilevel lighting controls section, which is removed for all spaces in nonresidential buildings, and retain the original intent of this section.

Section: 601.3.1.3

Purpose: The purpose of this change is to remove reference to the 601.2.2.2 multilevel lighting controls section and directly require manual dimmers for controlling additional lighting in videoconference studios.

Necessity: The necessity for this change is to remove references to the 601.2.2.2 multilevel lighting controls section, which is removed for all spaces in nonresidential buildings, and retain the original intent of this section.

Section: Table 601.5-A

Purpose: The purpose of this change is to specify requirements for the new manual dimmer requirements, 601.2.2.1.4, and remove the current multilevel lighting controls requirements, 601.2.2.2, from the table for alteration projects for all spaces in nonresidential buildings.

Necessity: The necessity for this change is to properly reflect the proposed code changes made to the manual controls section, 601.2.2.1.4, and the multilevel lighting controls section,601.2.2.2, in the control requirements for indoor lighting system alterations.

Purpose and Necessity of Changes to the Reference Appendices

There are no proposed changes to the Reference Appendices.

Appendix C: Assumptions for Statewide Savings Estimates

Parking Garage Daylight Adaptation Zones Nighttime Controls

The Statewide CASE Team estimated statewide impacts for the first year by multiplying per-unit savings estimates by statewide construction forecasts provided by the CEC. The 2028 CASE Methodology Report includes additional information about the methodology and assumptions used to calculate statewide energy impacts.

The Statewide CASE Team calculated statewide savings for new construction by multiplying the per-unit savings, detailed in Section 2.4.2, by assumptions about the floor space associated with newly constructed buildings affected by the proposed code.

The Statewide CASE Team used the following assumptions and methodologies in the statewide savings analysis:

- The CBECC building prototype models represent the average square footage of each building type.
    - The Statewide CASE Team used the CBECC building prototype models square footage to convert total statewide square footage into total buildings.
- The number of parking spaces in each parking garage is based on the square footage of a best-practices parking space, and the square footage of the parking garage.
- The number of garage entrances in each building's parking garage is proportional to the number of parking spaces.
- The following building types in the 2029 New Construction Forecast do not include parking garages:
    - Medium Office; Small Office; Medium Retail; Strip Mall; DataCenter; Small School; Non-refrigerated Warehouse; Hotel; Restaurant; Refrigerated Warehouse; Controlled-environment Horticulture; Vehicle Service; Manufacturing; Unassigned
- A portion of the following building types in the 2029 New Construction Forecast includes parking garages:
    - Large Office; Large Retail; Large School; Assembly; Hospital; Laboratory; Grocery

The statewide savings and cost estimates take the current market share rate into account. The current market share rate is estimated based on the Statewide CASE Team's professional judgment and data from the evaluation of past Title 24 code cycles.

Table 109 presents the projected nonresidential new construction that the proposed code change will impact in 2029. Table 110 shows the projected nonresidential existing statewide building stock that the proposed code change would affect through alterations in 2029. The Statewide CASE Team developed these estimates using the methods described in this section.

The Statewide CASE Team estimates that the proposed measure will apply to all new construction open- and enclosed-parking garages. The Statewide CASE Team applied an estimate of 2.1 percent to determine the fraction of other commercial building new construction that represents parking garages. The 2022 Statewide CASE Team developed this estimate for the 2022 Nonresidential Indoor Lighting CASE Report based on the last CBECS survey to include parking garages (The Statewide CASE Team 2020).

The Statewide CASE Team estimated the percentage of newly constructed floorspace that the proposed code change would impact. Table 111 shows the assumed percentage of affected floorspace by building type. If a proposed code change does not apply to a specific building type, the Statewide CASE Team assumes that zero percent of the floorspace would be impacted. If the assumed percentage is non-zero, but less than 100 percent, the proposal is expected to affect some—but not all—buildings. Table 112 represents the assumed percentage of affected floorspace by climate zone.

Table 109: Estimated Nonresidential New Construction and Additions Impacted by Proposed Code Change in 2029, by Climate Zone and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All
Large Office	0.00	0.000	0.007	0.005	0.00	0.002	0.000	0.005	0.009	0.000	0.00	0.002	0.00	0.000	0.00	0.000	0.029
Large Retail	0.00	0.000	0.014	0.005	0.00	0.005	0.000	0.009	0.014	0.000	0.00	0.009	0.00	0.000	0.00	0.000	0.054
Large School	0.00	0.000	0.002	0.002	0.00	0.000	0.000	0.002	0.002	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.009
Assembly	0.00	0.000	0.014	0.005	0.00	0.005	0.000	0.009	0.014	0.000	0.00	0.009	0.00	0.000	0.00	0.000	0.054
Hospital	0.00	0.000	0.005	0.002	0.00	0.002	0.000	0.002	0.005	0.000	0.00	0.005	0.00	0.000	0.00	0.000	0.020
Laboratory	0.00	0.000	0.007	0.003	0.00	0.001	0.000	0.001	0.001	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.014
Open Parking Garage	0.00	0.000	0.007	0.005	0.00	0.002	0.000	0.005	0.009	0.000	0.00	0.002	0.00	0.000	0.00	0.000	0.029
Grocery	0.00	0.000	0.005	0.002	0.00	0.002	0.000	0.005	0.007	0.000	0.00	0.007	0.00	0.000	0.00	0.000	0.027
TOTAL	**0.00**	**0.002**	**0.072**	**0.042**	**0.00**	**0.060**	**0.016**	**0.066**	**0.071**	**0.009**	**0.00**	**0.036**	**0.00**	**0.002**	**0.00**	**0.002**	**0.378**

Table 110: Estimated Existing Nonresidential Floorspace Impacted by Proposed Code Change in 2026 (Alterations), by Climate Zone and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All
Large Office	*0.10*	*2.48*	*111.84*	*57.88*	*1.47*	*79.63*	*58.17*	*130.08*	*242.48*	*46.78*	*2.09*	*62.89*	*7.41*	*16.22*	*3.55*	*3.73*	*826.79*
Large Retail	*0.80*	*6.93*	*46.94*	*21.52*	*3.36*	*25.57*	*20.27*	*34.77*	*53.22*	*42.65*	*9.12*	*46.53*	*18.01*	*8.73*	*7.52*	*2.57*	*348.51*
Large School	*0.61*	*6.42*	*27.86*	*11.16*	*1.66*	*22.70*	*18.03*	*34.33*	*58.86*	*44.81*	*8.10*	*42.70*	*21.13*	*9.65*	*6.10*	*2.87*	*316.98*
Assembly	*3.46*	*14.54*	*73.07*	*36.05*	*5.28*	*45.80*	*32.72*	*71.31*	*96.16*	*73.40*	*13.08*	*55.78*	*24.10*	*15.16*	*9.46*	*5.15*	*574.53*
Hospital	*1.49*	*8.87*	*38.66*	*19.74*	*4.04*	*22.60*	*21.72*	*32.62*	*55.90*	*31.68*	*8.89*	*42.54*	*17.99*	*7.04*	*4.03*	*2.59*	*320.41*
Laboratory	*0.14*	*3.21*	*29.54*	*22.45*	*1.22*	*9.77*	*13.75*	*12.49*	*15.45*	*8.65*	*0.54*	*9.71*	*3.52*	*1.38*	*0.31*	*0.46*	*132.59*
Open Parking Garage	*0.18*	*5.62*	*44.02*	*33.46*	*3.09*	*32.91*	*28.14*	*65.95*	*81.92*	*27.66*	*3.57*	*31.97*	*5.05*	*8.84*	*1.72*	*4.49*	*378.59*
Grocery	*0.08*	*1.36*	*4.70*	*2.85*	*0.60*	*2.73*	*1.67*	*3.21*	*5.56*	*3.21*	*0.52*	*2.99*	*1.16*	*0.75*	*0.43*	*0.31*	*32.12*
TOTAL	**27.7**	**164.1**	**799.4**	**467.1**	**76.4**	**606.2**	**437.7**	**912.0**	**1409.1**	**779.5**	**152.9**	**792.6**	**296.1**	**184.5**	**104.5**	**62.8**	**7,272.55**

Table 111: Percentage of Nonresidential Buildings Impacted by Proposed Code Change in 2029, by Building Type

Building Type	New Construction Impacted (Percent Buildings)	Existing Building Stock (Alterations) Impacted (Percent Buildings)
Large Office	50%	7%
Medium Office	0%	0%
Small Office	0%	0%
Large Retail	50%	7%
Medium Retail	0%	0%
Strip Mall	0%	0%
Data Center	0%	0%
Large School	50%	7%
Small School	0%	0%
Non-refrigerated Warehouse	0%	0%
Hotel	0%	0%
Assembly	50%	7%
Hospital	50%	7%
Laboratory	50%	7%
Restaurant	0%	0%
Enclosed Parking Garage	0%	0%
Open Parking Garage	100%	7%
Grocery	50%	7%
Refrigerated Warehouse	0%	0%
Controlled-Environment Horticulture	0%	0%
Vehicle Service	0%	0%
Manufacturing	0%	0%
Unassigned	0%	0%

Table 112: Percentage of Nonresidential Floorspace Impacted by Proposed Measure, by Climate Zone

Climate Zone	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
1	100%	100%
2	100%	100%
3	100%	100%
4	100%	100%
5	100%	100%
6	100%	100%
7	100%	100%
8	100%	100%
9	100%	100%
10	100%	100%
11	100%	100%
12	100%	100%
13	100%	100%
14	100%	100%
15	100%	100%
16	100%	100%

Require Occupant Sensing Controls in More Spaces

The Statewide CASE Team estimated statewide energy and energy cost impacts for the first year of code adoption using a bottom-up approach consistent with the 2028 CASE Methodology Report. Per-unit energy savings developed from prototype simulations were extrapolated to statewide impacts using the CEC Statewide Construction Forecasts.

Statewide savings were calculated separately for new construction and additions, and for alterations to existing buildings, and then aggregated to estimate total first-year impacts. The 2029 construction forecast represents the first year the 2028 Title 24, Part 6 standards are in effect.

Detailed assumptions related to per-unit energy savings, including prototype modeling, occupancy schedules, HVAC–lighting interactions, and key modeling parameters (e.g., compliance, turnover, and market adoption), are provided in Appendix A.

Statewide Savings Calculation Approach

For new construction and additions, statewide savings were calculated by multiplying per-unit energy savings by the projected 2029 new construction floor area from the CEC forecast. The analysis applies assumptions regarding the fraction of floor area that includes the targeted space types subject to the proposed measure.

For alterations, statewide savings were calculated by applying per-unit savings to the existing building stock forecasted for 2029. Only a portion of the existing stock is assumed to be affected in the first year, consistent with the gradual adoption assumptions described in Appendix A.

Floor Area Scaling

The Statewide CASE Team used the CEC's 2029 construction forecasts to estimate:

- Total statewide new construction and additions
- Total existing building stock subject to alterations

To translate these forecasts into measure impacts, the analysis estimates the percentage of total floor area affected by the proposed code change. Table 113, Table 114, and Table 115 respectively present the assumptions used to determine:

- The fraction of new construction and alterations projects estimated to implement this proposed code measure
- The fraction of floor area containing applicable space types by building type[24]
- The distribution of affected floor area across climate zones

If a building type does not include the targeted space types, the affected floor area is assumed to be zero. For building types that include these space types, less than 100 percent of floor area is assumed to be impacted, reflecting the distribution of these spaces within buildings.

[24] The floor area fraction only accounts for the square footage of the named space type. In practice, depending on the design approach, the thermal zone subject to HVAC occupied standby requirements may extend beyond that named space type. In these cases, all space types within the thermal zone would need to comply with the HVAC occupied standby control requirements for any portion of the zone to qualify.

Table 113: Percentage of Nonresidential Buildings Impacted by Proposed Code Change in 2029, by Building Type

Building Type	New Construction Impacted (Percent Buildings)	Existing Building Stock (Alterations) Impacted (Percent Buildings)
Large Office	100%	7%
Medium Office	100%	7%
Small Office	100%	7%
Large Retail	100%	7%
Medium Retail	100%	7%
Strip Mall	100%	7%
Mixed-Use Retail	0%	0%
Large School	100%	7%
Small School	100%	7%
Non-refrigerated Warehouse	0%	0%
Hotel	0%	0%
Assembly	0%	0%
Hospital	0%	0%
Outpatient Healthcare	0%	0%
Quick Service Restaurant	0%	0%
Full Service Restaurant	0%	0%
Laboratory	0%	0%
Restaurant	0%	0%
Enclosed Parking Garage	0%	0%
Open Parking Garage	0%	0%
Grocery	0%	0%
Refrigerated Warehouse	0%	0%
Controlled-Environment Horticulture	0%	0%
Vehicle Service	0%	0%
Manufacturing	0%	0%
Unassigned	0%	0%

Table 114: Floor Area Scaling – More Occupancy Sensors

Building Type	Floor Area Use Category	Percent of Total Building Floor Space
Small Office	Breakroom	3.69%
	Computer Room	1.30%
Medium Office	Breakroom	3.29%
Large Office	Breakroom	3.29%
Small School	Computer Room	1.39%
Large School	Computer Room	2.45%
	Laboratory	2.00%
Medium Retail	Breakrooms	1.99%
Large Retail	Breakrooms	1.99%
Strip Mall	Breakrooms	2.30%

Table 115: Percentage of Nonresidential Floorspace Impacted by Proposed Measure, by Climate Zone – More Occupancy Sensors

Climate Zone	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
1	100%	100%
2	100%	100%
3	100%	100%
4	100%	100%
5	100%	100%
6	100%	100%
7	100%	100%
8	100%	100%
9	100%	100%
10	100%	100%
11	100%	100%
12	100%	100%
13	100%	100%
14	100%	100%
15	100%	100%
16	100%	100%

Reduce Occupant Sensing Controls Delay time

The Statewide CASE Team estimated statewide impacts for the first year by multiplying per-unit savings estimates by statewide construction forecasts provided by the CEC. The 2028 CASE Methodology Report includes additional information about the methodology and assumptions used to calculate statewide energy impacts.

The statewide savings and cost estimates take the current market share rate into account. The current market share rate is estimated based on the Statewide CASE Team's professional judgment and data from the evaluation of past Title 24 code cycles.

Table 116 presents the projected nonresidential new construction that the proposed code change will impact in 2026.

Table 117 shows the projected nonresidential existing statewide building stock that the proposed code change would affect through alterations in 2026. The Statewide CASE Team developed these estimates using the methods described in this section.

The Statewide CASE Team estimated the percentage of newly constructed floorspace that the proposed code change would impact. Table 118 shows the assumed percentage of affected floorspace by building type. If a proposed code change does not apply to a specific building type, the Statewide CASE Team assumes that zero percent of the floorspace would be impacted. If the assumed percentage is non-zero, but less than 100 percent, the proposal is expected to affect some—but not all—buildings. Table 119 represents the assumed percentage of affected floorspace by climate zone.

To determine the statewide savings, the Statewide CASE Team:

- The occ sensor measure applies to all space types that require occupancy sensors, and for the purposes of evaluation, the Statewide CASE Team grouped them into several different categories of activity:
    - Office
    - Entry/lobby/corridor/restroom/office support, etc.
    - Warehouse
    - Parking garage
    - Classroom
- The Statewide CASE Team then assigned these use types to spaces in all the relevant building types in the construction forecast with an area weighted approach to represent the space in each building type that is likely to have the incremental benefit of the measure.
- That then is scaled up from the prototype space to the statewide through the MeasureSET calculations.
- Occupancy sensors are not driven in every building type, as each space type varies in occupancy patterns.

    - Are they driven by occ sensors? In bars and auditoriums, the assumption is that these occupancy types are not driven by occupancy and if they are, to a small degree.
- Less space-use types match if 60 percent of the building does not have as much savings.

The Statewide CASE Team will focus on large offices which incorporate the following: 30 percent private office, 30 percent open offices, 10 restrooms, and 10 percent entry/lobby) medium and small office building prototype will have the space use type as private office, and open reception.

Table 116: Estimated New Nonresidential Construction Impacted by Proposed Code Change in 2026, by Climate Zone and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All
Large Office	0.00	0.00	2.69	1.31	0.00	1.35	1.01	2.00	4.65	0.65	0.00	3.22	0.00	0.22	0.04	0.03	17.16
Medium Office	0.09	0.68	1.25	0.97	0.38	1.43	0.87	2.06	2.56	1.52	0.39	0.38	0.54	0.32	0.25	0.13	13.83
Small Office	0.05	0.15	0.30	0.05	0.11	0.22	0.03	0.29	0.64	0.19	0.09	0.38	0.33	0.09	0.05	0.04	3.02
Large Retail	0.00	0.00	1.77	0.35	0.08	0.87	1.00	1.18	1.88	0.94	0.36	0.84	0.00	0.08	0.12	0.07	9.54
Medium Retail	0.10	0.56	0.81	0.67	0.10	0.75	0.43	1.01	2.04	1.96	0.24	2.22	1.23	0.42	0.31	0.14	12.99
Strip Mall	0.00	0.00	0.10	0.30	0.09	0.55	0.00	0.91	0.69	0.67	0.00	0.09	0.07	0.30	0.05	0.04	3.84
Data Center	0.00	0.00	0.08	1.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.16	0.00	0.00	0.00	0.00	1.28
Large School	0.08	0.23	1.15	0.46	0.11	0.61	0.56	1.03	1.17	0.40	0.09	0.34	0.17	0.11	0.02	0.02	6.54
Small School	0.01	0.33	1.08	0.66	0.20	0.71	0.68	0.79	1.93	1.37	0.48	1.97	0.99	0.28	0.22	0.13	11.85
Non-refrigerated Warehouse	0.06	0.43	1.93	0.99	0.17	1.42	0.67	2.05	3.02	2.17	0.49	2.57	0.79	0.50	0.39	0.16	17.81
Hotel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Assembly	0.11	0.43	0.48	0.71	0.05	0.77	0.51	1.13	2.09	0.90	0.21	1.26	0.35	0.11	0.21	0.07	9.38
Hospital	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Laboratory	0.00	0.01	2.40	0.27	0.00	0.18	0.67	0.30	0.23	0.50	0.00	0.77	0.34	0.05	0.01	0.02	5.74
Restaurant	0.01	0.08	0.31	0.16	0.03	0.34	0.21	0.51	0.82	0.49	0.08	0.34	0.15	0.11	0.05	0.03	3.74
Enclosed Parking Garage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Open Parking Garage	0.01	0.43	1.91	2.05	0.10	1.26	1.67	2.74	2.71	1.58	0.58	1.05	0.12	0.35	0.09	0.18	16.82
Grocery	0.01	0.07	0.09	0.09	0.01	0.05	0.03	0.06	0.12	0.12	0.01	0.13	0.07	0.03	0.02	0.01	0.93

Refrigerated Warehouse	0.01	0.04	0.17	0.09	0.02	0.05	0.01	0.07	0.12	0.06	0.00	0.04	0.11	0.02	0.01	0.01	0.82
Controlled-Environment Horticulture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle Service	0.00	0.06	0.06	0.49	0.01	0.46	0.05	0.60	0.53	0.26	0.28	0.54	0.15	0.06	0.05	0.02	3.65
Manufacturing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unassigned	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.47	1.18	0.00	0.00	0.01	0.00	0.03	0.00	0.01	2.02
TOTAL	**0.5**	**3.5**	**16.6**	**10.6**	**1.5**	**11.3**	**8.4**	**17.2**	**26.4**	**13.8**	**3.3**	**16.3**	**5.4**	**3.1**	**1.9**	**1.1**	**141.0**

Table 117: Estimated Existing Nonresidential Floorspace Impacted by Proposed Code Change in 2026 (Alterations), by Climate Zone and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All
Large Office	0.00	0.19	8.72	4.37	0.11	7.00	4.91	11.27	19.92	4.12	0.18	5.81	0.57	1.36	0.27	0.30	69.09
Medium Office	0.19	1.93	4.70	2.61	0.84	3.23	2.96	4.03	5.50	4.59	1.12	6.29	1.65	0.88	0.68	0.27	41.47
Small Office	0.29	0.82	1.29	0.60	0.46	0.87	0.56	0.87	1.46	1.63	0.70	2.70	1.50	0.37	0.49	0.19	14.79
Large Retail	0.07	0.63	4.05	1.86	0.30	2.30	1.79	3.12	4.62	3.92	0.83	4.16	1.63	0.79	0.70	0.23	31.01
Medium Retail	0.08	0.88	3.03	1.71	0.35	3.13	2.37	4.69	7.37	4.82	0.71	4.22	1.72	1.11	0.65	0.37	37.23
Strip Mall	0.23	0.67	2.52	1.25	0.34	2.83	1.91	3.95	5.69	4.79	0.82	3.36	1.72	1.10	0.63	0.33	32.12
Data Center	0.00	0.00	0.04	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.62
Large School	0.16	0.43	3.67	1.43	0.33	2.37	1.15	2.04	3.39	1.13	0.31	2.32	0.42	0.20	0.07	0.11	19.53
Small School	0.14	1.37	3.74	2.32	0.43	2.95	3.05	5.54	8.11	6.87	1.54	5.69	3.63	1.58	0.97	0.52	48.45
Non-refrigerated Warehouse	0.23	1.35	7.11	3.55	0.64	6.32	3.35	9.07	13.96	12.83	2.19	9.34	3.68	2.74	2.03	0.82	79.22
Hotel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Assembly	0.21	0.97	4.14	1.72	0.33	3.18	1.96	5.04	6.69	5.27	0.96	4.00	1.70	1.09	0.71	0.36	38.35

Hospital	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Laboratory	0.03	0.28	2.87	2.46	0.06	0.75	1.29	1.05	1.08	1.12	0.06	0.98	0.35	0.15	0.04	0.05	12.62
Restaurant	0.04	0.24	0.96	0.49	0.10	1.12	0.71	1.62	2.62	2.22	0.24	1.14	0.52	0.47	0.24	0.13	12.86
Enclosed Parking Garage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Open Parking Garage	0.02	0.53	3.93	2.92	0.27	2.95	2.69	5.96	7.14	2.67	0.40	2.86	0.43	0.82	0.15	0.40	34.12
Grocery	0.01	0.12	0.33	0.24	0.05	0.20	0.14	0.28	0.45	0.29	0.04	0.26	0.10	0.07	0.04	0.03	2.63
Refrigerated Warehouse	0.00	0.07	0.10	0.04	0.04	0.06	0.00	0.06	0.11	0.09	0.04	0.31	0.32	0.03	0.02	0.02	1.31
Controlled-Environment Horticulture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle Service	0.06	0.37	1.48	0.58	0.18	1.85	1.03	2.78	4.47	3.12	0.42	2.22	1.06	0.87	0.37	0.22	21.09
Manufacturing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unassigned	0.03	0.43	0.75	0.33	0.09	0.57	0.26	0.68	1.28	0.61	0.24	1.12	0.35	0.16	0.09	0.09	7.07
TOTAL	**1.8**	**11.3**	**53.4**	**29.0**	**4.9**	**41.7**	**30.1**	**62.1**	**93.9**	**60.1**	**10.8**	**56.9**	**21.4**	**13.8**	**8.2**	**4.4**	**503.6**

Table 118: Percentage of Nonresidential Floorspace Impacted by Proposed Code Change in 2026, by Building Type

Building Type	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
Large Office	100%	7%
Medium Office	100%	7%
Small Office	100%	7%
Large Retail	100%	7%
Medium Retail	100%	7%
Strip Mall	100%	7%
Data Center	100%	7%
Large School	100%	7%
Small School	100%	7%
Non-refrigerated Warehouse	100%	7%
Hotel	0%	0%
Assembly	100%	7%
Hospital	0%	0%
Laboratory	100%	7%
Restaurant	100%	7%
Enclosed Parking Garage	0%	0%
Open Parking Garage	100%	7%
Grocery	100%	7%
Refrigerated Warehouse	100%	7%
Controlled-Environment Horticulture	0%	0%
Vehicle Service	100%	7%
Manufacturing	0%	0%
Unassigned	100%	7%

Table 119: Percentage of Nonresidential Floorspace Impacted by Proposed Measure, by Climate Zone

Climate Zone	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
1	100%	100%
2	100%	100%
3	100%	100%
4	100%	100%
5	100%	100%
6	100%	100%
7	100%	100%
8	100%	100%
9	100%	100%
10	100%	100%
11	100%	100%
12	100%	100%
13	100%	100%
14	100%	100%
15	100%	100%
16	100%	100%

Update Multilevel Lighting Controls Requirements

The Statewide savings were estimated separately for the two distinct components of the proposed code change and then summed up:

- Requiring manual dimmers in spaces with a general lighting load greater than 50 watts.
- Requiring continuous dimming for all daylight responsive controls.

The Statewide CASE Team estimated the composition of different space types within each building type. For each space type that would be affected by the code change, a percentage was estimated. It was assumed that the percentage of spaces impacted is the same across all climate zones and across new construction and alterations. Additionally, it was assumed that the proposed code change would impact the entire building stock over a period of 15 years. In other words, only one-fifteenth of existing building stock would be impacted in the first year through alterations. These estimates excluded hotel/motel and Group R occupancies. The statewide impacts for the first year were estimated as the product of the per-unit (per-watt controlled) savings for each impacted space type, the associated allowed LPD, the floorspace in the CEC construction forecasts, and the estimated percentage of impacted spaces within each CEC construction building type. The 2028 CASE Methodology Report includes additional information about the methodology and assumptions used to calculate statewide energy impacts.

Table 120 presents the projected nonresidential new construction and existing statewide building stock that the proposed code change to the manual dimmer requirement will impact in 2029. Table 121 shows the projected nonresidential new construction and existing statewide building stock that the proposed code change of requiring continuous dimming for daylight responsive controls would affect in 2029. The Statewide CASE Team developed these estimates using the methods described in this section.

Table 120: Percentage of Nonresidential Floorspace Impacted by Proposed Code Change in 2029 for Requiring Manual Dimmers, by Building Type

Building Type	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
Large Office	7.0%	0.5%
Medium Office	6.8%	0.5%
Small Office	6.4%	0.4%
Large Retail	2.4%	0.2%
Medium Retail	2.4%	0.2%
Strip Mall	2.4%	0.2%
Data Center	0.0%	0.0%
Large School	13.2%	0.9%
Small School	6.4%	0.4%
Non-refrigerated Warehouse	0.9%	0.1%
Hotel	N/A	N/A
Assembly	23.3%	1.6%
Hospital	3.3%	0.2%
Laboratory	6.0%	0.4%
Restaurant	40.9%	2.7%
Enclosed Parking Garage	0.0%	0.0%
Open Parking Garage	0.0%	0.0%
Grocery	0.5%	0.0%
Refrigerated Warehouse	0.9%	0.1%
Controlled-environment Horticulture	0.0%	0.0%
Vehicle Service	6.9%	0.5%
Manufacturing	1.9%	0.1%
Unassigned	5.2%	0.3%

Table 121: Percentage of Nonresidential Floorspace Impacted by Proposed Code Change in 2029 for Requiring Continuous Dimming for Daylight Responsive Controls, by Building Type

Building Type	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
Large Office	4.2%	0.3%
Medium Office	4.0%	0.3%
Small Office	3.5%	0.2%
Large Retail	4.5%	0.3%
Medium Retail	4.5%	0.3%
Strip Mall	4.5%	0.3%
Data Center	0.0%	0.0%
Large School	10.1%	0.7%
Small School	4.1%	0.3%
Non-refrigerated Warehouse	28.2%	1.9%
Hotel	0.0%	0.0%
Assembly	4.2%	0.3%
Hospital	1.3%	0.1%
Laboratory	4.5%	0.3%
Restaurant	4.0%	0.3%
Enclosed Parking Garage	0.0%	0.0%
Open Parking Garage	0.0%	0.0%
Grocery	9.7%	0.6%
Refrigerated Warehouse	28.2%	1.9%
Controlled-environment Horticulture	0.0%	0.0%
Vehicle Service	1.1%	0.1%
Manufacturing	6.1%	0.4%
Unassigned	1.4%	0.1%

Appendix D: Environmental Analysis

Parking Garage Daylight Adaptation Zones Nighttime Controls

Potential Significant Environmental Effect of Proposal

The Statewide CASE Team has considered the environmental benefits and adverse impacts of its proposal, including—but not limited to—an evaluation of factors contained in the California Code of Regulations, Title 14, section 15064, and has determined that the proposal will not result in a significant effect on the environment.

Direct Environmental Impacts

Direct Environmental Benefits

The direct environmental benefits include a positive impact resulting from energy savings and GHG reduction.

Direct Adverse Environmental Impacts

Direct adverse environmental impacts include the slight potential for increased materials use from implementing the required controls, as detailed in section 22.

Indirect Environmental Impacts

Indirect Environmental Benefits

Indirect environmental benefits from the proposed measure include a reduced potential for light pollution and light trespass due to the reduced light levels at parking garage entries at night.

Indirect Adverse Environmental Impacts

The Statewide CASE Team determined this measure would not result in indirect adverse environmental impacts.

Mitigation Measures

The Statewide CASE Team did not determine this measure would result in significant direct or indirect adverse environmental impacts and therefore, did not develop any mitigation measures.

Reasonable Alternatives to Proposal

The Statewide CASE Team has considered alternatives to the proposal and determined that no alternative would achieve its purpose with less environmental effect.

Water Use and Water Quality Impacts Methodology

The Statewide CASE Team determined that there are no impacts to water quality or water use.

Require Occupant Sensing Controls in More Spaces

Potential Significant Environmental Effect of Proposal

The Statewide CASE Team has considered the environmental benefits and adverse impacts of its proposal, including—but not limited to—an evaluation of factors contained in the California Code of Regulations, Title 14, section 15064, and has determined that the proposal will not result in a significant effect on the environment.

Direct Environmental Impacts

Direct Environmental Benefits

Content for this section is still being developed and will be completed before the Final CASE Report is posted for public review.

Direct Adverse Environmental Impacts

Content for this section is still being developed and will be completed before the Final CASE Report is posted for public review.

Indirect Environmental Impacts

Indirect Environmental Benefits

Content for this section is still being developed and will be completed before the Final CASE Report is posted for public review.

Indirect Adverse Environmental Impacts

Content for this section is still being developed and will be completed before the Final CASE Report is posted for public review.

Mitigation Measures

The Statewide CASE Team did not determine that this measure would result in significant direct or indirect adverse environmental impacts and therefore, did not develop any mitigation measures.

Reasonable Alternatives to Proposal

The Statewide CASE Team has considered alternatives to the proposal and determined that no alternative would achieve its purpose with less environmental effect.

Water Use and Water Quality Impacts Methodology

The Statewide CASE Team determined that there are no impacts to water quality or water use.

Reduce Occupant Sensing Controls Delay time

Potential Significant Environmental Effect of Proposal

The Statewide CASE Team has considered the environmental benefits and adverse impacts of its proposal, including—but not limited to—an evaluation of factors contained in the California Code of Regulations, Title 14, section 15064, and has determined that the proposal will not result in a significant effect on the environment.

Direct Environmental Impacts

Direct Environmental Benefits

The direct environmental benefits include a positive impact resulting from energy savings and GHG reduction.

Direct Adverse Environmental Impacts

The Statewide CASE Team determined this measure would not result in direct adverse environmental impacts.

Indirect Environmental Impacts

Indirect Environmental Benefits

The Statewide CASE Team determined this measure would not result in indirect environmental benefits.

Indirect Adverse Environmental Impacts

The Statewide CASE Team determined this measure would not result in indirect adverse environmental impacts.

Mitigation Measures

The Statewide CASE Team did not determine that this measure would result in significant direct or indirect adverse environmental impacts and therefore did not develop any mitigation measures.

Reasonable Alternatives to Proposal

The Statewide CASE Team has considered alternatives to the proposal and determined that no alternative would achieve its purpose with less environmental effect.

Water Use and Water Quality Impacts Methodology

The Statewide CASE Team determined that there are no impacts to water quality or water use.

Update Multilevel Lighting Controls Requirements

Potential Significant Environmental Effect of Proposal

The Statewide CASE Team has considered the environmental benefits and adverse impacts of its proposal, including—but not limited to—an evaluation of factors contained in the California Code of Regulations, Title 14, section 15064, and has determined that the proposal will not result in a significant effect on the environment.

Direct Environmental Impacts

Direct Environmental Benefits

Numbers cited below are based on preliminary estimates and will need to be updated as the Statewide CASE Team continues data collection and refines the statewide impacts. The values will be updated before the Final CASE Report is posted for public review.

As described in Section 5.5, this proposed code change is expected to result in 24.02 GWh statewide energy savings and reduce electrical demand by 1.27 MW annually. The resulting savings and demand reductions would translate to annual reductions in 500.25 metric tons of greenhouse gas emissions.

Direct Adverse Environmental Impacts

The Statewide CASE Team did not find any studies, data or other information suggesting the proposed code change, by installing manual dimmers and continuous dimmable lighting in more spaces, would result in direct adverse environmental impacts.

Indirect Environmental Impacts

Indirect Environmental Benefits

The Statewide CASE Team did not find any studies, data or other information supporting any indirect environmental benefits for the proposed code change.

Indirect Adverse Environmental Impacts

The Statewide CASE Team did not find any studies, data or other information demonstrating that the proposed code change, by installing manual dimmers and continuously dimmable lighting in more spaces, would cause indirect environmental impacts.

Mitigation Measures

The Statewide CASE Team has considered opportunities to minimize the environmental impact of the proposal, including an evaluation of “specific economic, environmental, legal, social, and technological factors” (Cal. Code Regs., tit. 14, § 15021). The Statewide CASE Team did not determine that this measure would result in significant direct or indirect adverse environmental impacts and therefore, did not develop any mitigation measures.

Reasonable Alternatives to Proposal

The Statewide CASE Team has considered alternatives to the proposal and determined that no alternative would achieve its purpose with less environmental effect.

Water Use and Water Quality Impacts Methodology

The proposed code change is not related to water usage, and there are no impacts to water quality or water use.

Appendix E: Summary of Stakeholder Engagement

Introduction to Stakeholder Engagement

Collaborating with stakeholders who may be affected by proposed code changes is a core component of the Statewide CASE Team's process. The Statewide CASE Team engages interested parties to identify and address issues related to the proposals, with the goal of submitting recommendations to the CEC in this Draft CASE Report that reflect broad support. Public stakeholders provide valuable feedback on draft analyses and help identify and address adoption challenges, including cost effectiveness, market and technical barriers, compliance and enforcement, and potential impacts on human health or the environment. Some stakeholders also provide data that the Statewide CASE Team uses to support analyses.

This appendix summarizes the stakeholder engagement conducted by the Statewide CASE Team during the development and refinement of the report's recommendations.

Utility-Sponsored Stakeholder Meetings

Utility-sponsored stakeholder meetings provide an opportunity to learn about the Statewide CASE Team's role in the advocacy effort and to hear about specific code change proposals that the Statewide CASE Team is pursuing for the 2028 code cycle. The goal of these meetings is to solicit input on proposals from stakeholders early enough to ensure the proposals and the supporting analyses are vetted and have as few outstanding issues as possible. To promote transparency in the development of code change proposals, the Statewide CASE Team uses stakeholder meetings to solicit feedback on:

- Proposed code changes
- Draft code language
- Draft assumptions and results of analyses
- Data to support assumptions
- Compliance and enforcement
- Technical and market feasibility

The Statewide CASE Team hosted one stakeholder meeting for Indoor Lighting Controls via webinar and planned the second one in March 2026, as described in Table 122. Please see below for dates and links to event pages on Title24Stakeholders.com. Materials from each meeting, such as slide presentations, proposal summaries with code language, and meeting notes, are included in the bibliography section of this report.

Table 122: Utility-Sponsored Stakeholder Meeting

Meeting Name and Link to Materials	Meeting Date	Summary of Items Discussed
First Round of Indoor Lighting Controls Utility-Sponsored Stakeholder Meeting	Wednesday, September 24, 2025	Introduced the four lighting controls measures and the background of each measure Presented the plan for estimating energy savings and collecting cost data Highlighted specific information that the Statewide CASE Team was requesting from the stakeholders Discuss stakeholder concerns on triggering additional occupied standby requirements Clarify the intent of updating multilevel lighting controls with stakeholders
Second Round of Indoor Lighting Controls Utility-Sponsored Stakeholder Meeting	Friday, March 6, 2026 (planned)	(Planned key topics) Present the updated code change proposals for indoor lighting controls Discuss the rationale of the updates and solicit feedback Present the estimated energy savings for each of the lighting controls measure Highlight information the Statewide CASE Team is still seeking from the stakeholders

The first round of utility-sponsored stakeholder meetings began in September 2025 and served as an early forum to promote transparency and gather stakeholder feedback on measures under consideration by the Statewide CASE Team.

The objectives of the first round of stakeholder meetings were to solicit input on the scope of the 2028 code cycle proposals; request data and feedback on the specific approaches, assumptions, and methodologies for the energy impacts and cost-effectiveness analyses; and understand potential technical and market barriers. The Statewide CASE Team also presented the initial draft code language for stakeholders to review.

The second round of utility-sponsored stakeholder meetings is scheduled from February to March 2026 to provide updated details on proposed code changes. These meetings will introduce early results of energy, cost effectiveness, and incremental cost analyses, and solicit feedback on refined draft code language.

Utility-sponsored stakeholder meetings were open to the public. For each stakeholder meeting, two promotional emails were distributed from info@title24stakeholders.com. One email was sent to the full Title 24 Stakeholders listserv, which includes over 3,000 individuals. A second email targeted specific recipients based on their subscription preferences.

The Title 24 Stakeholders listserv is an opt-in service comprising participants from diverse industries and trades, such as manufacturers, advocacy groups, local government, and building and energy professionals. Each meeting was announced on the Title 24 Stakeholders LinkedIn page and cross-promoted on the CEC LinkedIn page approximately two weeks in advance to engage individuals, organizations, and broader channels beyond the listserv. The Statewide CASE Team conducted extensive personal outreach to stakeholders identified in initial work plans who had not yet opted in to the listserv. Exported webinar meeting data captured attendance numbers, individual comments, and results from live attendee polls to help evaluate stakeholder participation and support.

Statewide CASE Team Communications

The Statewide CASE Team held personal communications over email and phone with numerous stakeholders when developing this report, listed in Table 123.

Table 123: Engaged Stakeholders

Organization/Individual Name	Market Role
Legrand	Manufacturer
Signify	Manufacturer
Lutron	Manufacturer
Current	Manufacturer
National Electrical Manufacturers Association	Industry Association
KW Engineering	Acceptance Test Technician
National Lighting Contractors Association of America (NLCAA)	ATT Training Administrator
CalEnergy Corporation	ATT Training Administrator
California Energy Alliance	Energy Stakeholders
DesignLights Consortium	Energy Efficiency Advocates
Northwest Energy Efficiency Alliance	Energy Efficiency Advocates
Henderson Engineers	Construction and Engineering
Silicon Valley Mechanical	Mechanical Engineering
The Engineering Enterprise	Electrical Engineering
Rudolph and Sletten	Construction
UpAvanti, Inc	Code Enforcement
Villara Building Systems	Code Enforcement

Engagement with ESJ communities

During the measure selection process, the Statewide CASE Team worked with Common Spark, an Environmental Social Justice partner, to evaluate each measure through the lens of four criteria: cost, health, resiliency, and comfort. Impacts identified are noted in the main body of the report. The Statewide CASE Team will continue to build relationships with CBOs and other stakeholders to improve the identification of potential impacts for future code cycles and is open to additional resources that can contribute to this effort.

Appendix F: Code Language Markup (Non-Restructured)

The language below is from the Draft CASE Report and in the non-restructured 2025 Title 24 Part 6 Code Language.

Parking Garage Daylight Adaptation Zones Nighttime Controls

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

(g) **Parking Garage Daylight Adaptation Zone Lighting Controls.** Parking garage daylight adaptation zone lighting shall be separately controlled to automatically reduce the lighting to no more than LPD for general lighting in parking zones and ramps from sunset to sunrise.

EXCEPTION to Section 130.1(g): Group R occupancies and common or public use areas.

EXCEPTION to Section 130.1(c)6E: Luminaires located in a parking garage daylight adaptation zone and dedicated to providing illuminance for daylight adaptation.

Require Occupant Sensing Controls in More Spaces

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

(c) **Shut-OFF Controls.** All installed indoor lighting shall be equipped with controls able to automatically reduce lighting power when the space is typically unoccupied.

…

6. **Full or partial-OFF occupant sensing controls.** For warehouse aisle ways, warehouse open areas, library book stack aisles, corridors, stairwells, offices greater than 250 square feet, parking garages, parking areas, loading areas, and unloading areas, laboratories, lounges, breakrooms, waiting areas, and computer rooms, the installed general lighting shall meet the following requirements:

…

F. **Laboratory spaces.** In laboratory spaces, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power to between 20 percent and 50 percent of full power when the space is unoccupied for no more than 15 minutes during normally occupied hours and shall turn off lighting when the space is unoccupied for an additional 15 minutes during normally unoccupied hours.

Where the lighting system occupant sensors are providing the occupancy status of the laboratory space for airflow reduction control in accordance with Section 140.9(c)1, the occupancy signal shall be independent of daylighting or manual lighting overrides of lighting.

Exception to Section 130.1(c)6F: Laboratory spaces where occupancy sensing control of lighting conflicts with facility environmental health and safety department requirements.

G. **Lounges, breakrooms, and waiting areas.** In lounges, breakrooms, and waiting areas, lighting shall be controlled by occupant sensing controls that automatically turn lighting OFF when the space is unoccupied for no more than 15 minutes. The occupant sensing controls shall be capable of automatically turning the lighting fully ON upon detection of occupancy.

Exception to Section 130.1(c)6G: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

H. **Computer rooms.** In *computer rooms*, *general lighting* shall be controlled by occupant sensing controls that automatically turn lighting OFF when the space is unoccupied for no more than 15 minutes. The occupant sensing controls shall be capable of automatically turning the lighting fully ON upon detection of occupancy. In *server aisles*, the occupant sensing controls shall independently control lighting in each aisle way.

Exception to Section 130.1(c)6F: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

…

Reduce Occupant Sensing Control Delay Time

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

(c) **Shut-OFF Controls.** All installed indoor lighting shall be equipped with controls able to automatically reduce lighting power when the space is typically unoccupied.

1. All installed indoor lighting shall be equipped with controls that meet the following requirements:

A. Shall be controlled with an occupant sensing control set to no more than a ~~20~~15-minute delay time, automatic time-switch control, or other control capable of automatically shutting OFF all of the lighting when the space is typically unoccupied; and

…

5. **Occupant Sensing controls.** In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms of any size, conference rooms, and

restrooms, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in ~~20~~15 minutes or less after the control zone is unoccupied.

SECTION 120.1 – REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

(d) **Operation and control requirements for minimum quantities of outdoor air.**

…

5. **Occupied Standby Zone Controls.**

…

B. Occupied-standby zone controls shall comply with the following:

i. Occupant sensors shall have suitable coverage and placement to detect occupants in the entire space. In ~~20~~15 minutes or less after no occupancy is detected by any sensors covering the room, occupant sensing controls shall indicate a room is vacant.

SECTION 140.9 – REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

(c) **Prescriptive requirements for laboratory and factory exhaust systems.**

…

1. **Airflow reduction requirements.** Building laboratory exhaust systems shall be able to reduce zone exhaust and makeup airflow rates to the occupied and unoccupied minimum exhaust airflow rates based on demand and sensed occupancy as follows:

…

C. Unoccupied minimum exhaust airflow. Within ~~20~~15 minutes of no occupancy being detected by occupant sensors covering the space, the minimum exhaust and makeup airflow rates shall be the greater of:

i. User defined airflow not to exceed 0.67 cfm/ft2 (equivalent to 4 air changes per hours for a 10-foot high ceiling), or

ii. The regulated minimum unoccupied circulation rate documented to comply with code, accreditation, or facility environmental health and safety department requirements, or

iii. The minimum needed to maintain unoccupied pressurization.

…

6. **Full or partial-OFF occupant sensing controls.**

…

D. In office spaces greater than 250 square feet, general lighting shall be controlled with occupant sensing controls that meet all of the following:

…

ii. In ~~20~~15 minutes or less after the control zone is unoccupied, the occupant sensing controls shall uniformly reduce lighting power in the control zone to no more than 20 percent of full power. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement; and

iii. In ~~20~~15 minutes or less after the entire office space is unoccupied, the occupant sensing controls shall automatically turn off lighting in all control zones in the space; and

Update Multilevel Lighting Controls Requirements

SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

Nonresidential and hotel/motel buildings shall comply with the applicable requirements of Sections 120.6(a) through 120.6(k), and the applicable requirements of Sections 110.2(a) and 120.3.

…

(h) **Mandatory requirements for Controlled Environment Horticulture (CEH) spaces.**

…

5. **Horticultural lighting.** In a building with CEH spaces or a greenhouse with more than 40 kW of aggregate horticultural lighting load, the electric lighting system used for plant growth and plant maintenance shall meet the following requirements:

…

C. ~~Multilevel lighting controls~~Manual dimmers shall be installed and comply with Section ~~130.1(b)~~130.1(a)4.

…

SECTION 110.12 – MANDATORY REQUIREMENTS FOR DEMAND MANAGEMENT

Buildings, other than healthcare facilities, that install or are required to install demand responsive controls shall comply with the applicable demand responsive control requirements of Sections 110.12(a) through 110.12(e).

…

(c) **Demand Responsive Lighting Controls.** Buildings with nonresidential lighting systems having a total installed lighting power of 4,000 watts or greater that are subject to the requirements of Section 130.1(a)4 ~~130.1(b)~~ or 160.5(b)4B shall install controls that are capable of automatically reducing lighting power in response to a demand response signal.

1. For compliance testing, the lighting controls shall demonstrate a 15-percent or greater reduction in lighting power as described in NA7.6.3. The controls may provide additional demand responsive functions or abilities.
2. For buildings where demand response controls are required, demand responsive controls shall control the general lighting in the spaces required to meet Section ~~130.1(b)~~ 130.1(a)4 or 160.5(b)4B.
3. General lighting power shall be reduced by continuous dimming ~~in a manner consistent with the requirements of Section 130.1(b)~~ or consistent with the requirements of Section 160.5(b)4B.

Exception to Section 110.12(c): Spaces where a health or life safety statute, ordinance, or regulation does not permit the general lighting to be reduced are not required to install demand responsive controls and do not count toward the 4,000-watt threshold.

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

Nonresidential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.1(a) through 130.1(f), in addition to the applicable requirements of Sections 110.9 and 130.0.

(a) **Manual controls**. Each space shall be provided with lighting controls that allow the lighting in that space to be manually turned on and off. The manual control shall:

…

4. In Group R occupancies, where the connected general lighting exceeds 75 watts, controls shall be capable of continuous manual dimming to 10 percent or less of full lighting power in addition to full ON and OFF control. In spaces in nonresidential buildings, where the connected general lighting exceeds 50 watts, controls shall be

capable of continuous manual dimming to 10 percent or less of full lighting power in addition to full ON and OFF control.

Exception 1 to Section 130.1(a)4: Lighting in commercial/industrial shipping and receiving areas, copy rooms, corridors, electrical/mechanical/telephone rooms, kitchen/food preparation areas, laboratories, laundry rooms, locker rooms, manufacturing/commercial/industrial work areas, parking garages, restrooms, stairwells, and transportation concourse/baggage/ticketing areas.

Exception 2 to Section 130.1(a)4: HID (high intensity discharge) and induction lighting with manual controls that have a minimum of one control step between 30 and 70 percent of full rated power in addition to full ON and full OFF.

Exception 3 to Section 130.1(a)4: Healthcare Facilities.

…

(b) **RESERVED.** ~~**Multilevel lighting controls.** The general lighting of any space with a size of 100 square feet or larger and with a connected lighting load greater than 0.5 watts per square foot shall be provided with multilevel lighting controls. The multilevel lighting controls shall provide and enable continuous dimming from 100 percent to 10 percent or lower of lighting power.~~

…

(c) **Shut-OFF ~~C~~controls.** All installed indoor lighting shall be equipped with controls able to automatically reduce lighting power when the space is unoccupied.

…

5. **Occupant Sensing controls.** In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms, conference rooms, and restrooms, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in 20 minutes or less after the control zone is unoccupied.

   ~~In areas required by Section 130.1(b) to have multi-level lighting controls, the~~The occupant sensing controls shall function either as a:

   A. Partial-ON occupant sensing controls capable of automatically activating between 50 and 70 percent of controlled lighting power, or

   B. Vacancy sensing controls, where all lighting responds to a manual ON input only.

   ~~In areas not required by Section 130.1(b) to have multilevel lighting controls, the occupant sensing controls shall function either as:~~

   ~~A. Automatic full-on occupant sensing controls; or~~

~~B. Partial-ON occupant sensing controls, or~~

~~C. Vacancy sensing controls, where all lighting responds to a manual ON input only.~~

In addition, controls shall be provided that allow the lights to be manually shut OFF in accordance with Section 130.1(a) regardless of the sensor status.

Exception 1 to Section 130.1(c)5: Lighting systems not required to comply with the manual dimmer requirement in Section 130.1(a)4 may comply with this section with automatic full-on occupant sensing controls.

…

(d) **Daylight Responsive controls.**

…

2. All daylight responsive controls shall meet the following requirements:

A. All skylit daylit zones, primary sidelit daylit zones, secondary sidelit daylit zones, and the combined primary and secondary sidelit daylit zones in parking garages shall be shown on the plans"; and

…

C. The daylight responsive controls shall control general lighting as follows ~~meet the following~~:

i. For spaces in Group R occupancies and common or public use areas, where the installation of ~~multilevel lighting controls~~manual dimmer is required under Section ~~130.1(b)~~130.1(a)4, ~~allow the multilevel lighting controls to adjust the light level with continuous dimming~~in response to availability of daylight, the daylighting control shall dim the lighting system continuously between 100 percent to 10 percent or lower of lighting power. For spaces in nonresidential buildings, in response to availability of daylight, the daylighting control shall dim the lighting system continuously between 100 percent to 10 percent or lower of lighting power;

~~**Exception to Section 130.1(d)2Ci:** Where general lighting is provided by HID or induction light sources, a daylight responsive control shall be permitted that has a minimum of one control step between 30 and 70 percent of full rated power in addition to full ON and full OFF.~~

…

F. ~~The automatic daylighting control shall permit the multilevel lighting control to adjust the level of lighting.~~ In spaces where manual controls are required, the manual controls shall be capable of turning off or decreasing light levels below the light level set by the daylight responsive controls. When manual controls are capable of temporarily increasing electric lighting above the light level set by the daylight responsive controls, the controls shall be configured to reset electric lighting controls back to the Section 130.1(d)2C defaults after electric lighting have been turned off or reduced by a manual control, occupancy sensor or timeclock.

SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

(a) **Calculation of adjusted indoor lighting power.** The adjusted indoor lighting power of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through 4 of this subsection, and the requirements of Subdivision 4 of this subsection.

…

2. **Reduction of wattage through controls.** In calculating adjusted indoor lighting power, the installed watts of a luminaire providing general lighting in an area listed in Table 140.6-A may be reduced by the product of (i) the number of watts controlled as described in Table 140.6-A, times (ii) the applicable power adjustment factor (PAF), if all of the following conditions are met:

   …

   K. To qualify for the PAF for a demand responsive control in Table 140.6-A, the general lighting wattage receiving the PAF shall not be within the scope of Section 110.12(c) and a demand responsive control shall meet all of the following requirements:

      i. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal; and

      ii. General lighting power shall be reduced by continuous dimming ~~in a manner consistent with the requirements of Section 130.1(b)~~.

…

(c) **Calculation of allowed indoor lighting power: specific methodologies.** The allowed indoor lighting power for each building type, or each primary function area shall be calculated using only one of the methods in Subsection 1 or 2 below as applicable.

…

2. **Area Category Method.** Requirements for using the Area Category Method include all of the following:

   …

   G. In addition to the allowed indoor lighting power calculated according to Sections 140.6(c)2A through F, the building may add additional lighting power allowances for qualifying lighting systems as specified in the

Qualifying Lighting Systems column in TABLE 140.6-C under the following conditions:

…

vii. In addition to meeting Sections 140.6(c)2Gi through vi, additional lighting power for videoconferencing as specified in Table 140.6-C shall be allowed in a videoconferencing studio, as defined in Section 100.1, provided the following conditions are met:

…

c. General lighting is switched in accordance with the requirements of Section ~~130.1(b)~~130.1(a)4; and

…

SECTION 141.1 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND THE INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

Table 141.0-F – Control Requirements for Indoor Lighting System Alterations

Control Specifications	Coded Section	Projects complying with Section 141.0(b)2Ii	Projects complying with Sections 141.0(b)2Iii or 141.0(b)2Iiii
Manual Area Controls	130.1(a)1	Required	Required
Manual Area Controls	130.1(a)2	Required	Required
Manual Area Controls	130.1(a)3	Only required for new or completely replaced circuits	Only required for new or completely replaced circuits
Manual Area Controls	130.1(a)4	Required	Not Required
~~**Multilevel Controls**~~	~~130.1(b)~~	~~Required~~	~~Not Required~~
Automatic Shut-Off Controls	130.1(c)1	Required	Required
Automatic Shut-Off Controls	130.1(c)2	Required	Required
Automatic Shut-Off Controls	130.1(c)3	Required	Required
Automatic Shut-Off Controls	130.1(c)4	Required	Required
Automatic Shut-Off Controls	130.1(c)5	Required	Required
Automatic Shut-Off Controls	130.1(c)6	Required	Required; except for 130.1(c)6D
Automatic Shut-Off Controls	130.1(c)8	Required	Required

Daylight Responsive Controls	130.1(d)	Required	Not Required
Demand Responsive Controls	110.12(a) and 110.12(c)	Required	Not Required

Appendix G: Methodology of Converting LPD-based Trigger to Wattage-based Trigger for Multilevel Lighting Controls

The methodology for converting the specification of multilevel lighting controls from the current LPD trigger to a wattage trigger is based on the equivalence of the overall long-term system cost (LSC) across impacted spaces.

Per the 2025 Title 24, Part 6, Section 130.1(b), multilevel lighting controls are required for spaces that:

- Have a connected general lighting load (LPD) greater than 0.5 watts per square foot
- Have a size of 100 square feet or larger
- Have more than one luminaire
- Are not restrooms
- Are not healthcare facilities.

The space types considered in the derivation are the Primary Function Areas of different Building Type/Use and their allowed LPD values in 2025 Title 24, Part 6, Table 140.6-C for utilizing the area category method to comply with the LPD requirements.

The Statewide CASE Team first estimated the statewide square footage that will be impacted in the first year. This estimate follows the same methodology for estimating the statewide energy impact as that used in the Indoor Lighting Power Density CASE Report. The estimate is based on both the Complete Building types in Table 140.6-B and the Primary Functional Areas in Table 140.6-C. Each Complete Building is mapped to different Primary Functional Areas with assumed fractions. In other words, it assumes that a Complete Building is composed of different fractions of Primary Functional Areas, and that all fractions of all Primary Functional Areas within each Complete Building add up to 100 percent. The fractions of Primary Functional Areas within each Complete Building were derived from building surveys that were used to develop the U.S. EIA Commercial Building End-Use Survey (CBECS) database and were originally used by PNNL to develop the whole-building weighted LPDs for the Whole Building approach in ASHRAE 90.1.

A fraction of the Complete Building method areas is then assigned to each of the building types included in the CEC 2029 construction forecast. For each CEC construction building type, the fractions add up to 100 percent.

For new construction, the estimated square footage of each Primary Functional Area (in million square feet) was derived from the two mappings above based on CEC 2029 forecast for new construction. For alteration, the same method was applied to CEC 2029 forecast for existing building stock, with an additional assumption that the complete stock turnover would take place over a 15-year period. In other words, only one-fifteenth of the existing building stock would be impacted in the first year.

The CBECC lighting schedule for each prototype building was assigned to each Primary Functional Area to construct an annual 8760-hour lighting usage profile, and it was assumed that five percent of the lighting in all spaces is designated as egress lighting and is uncontrolled. The LSC per watt controlled (PV$/W) for each Primary Functional Area and each climate zone was derived by multiplying the 8760-hour lighting usage profile and the 2028 Energy Code LSC hourly factor for each of the 16 California climate zones provided by CEC.

The overall LSC for each Primary Functional Area was calculated as the sum-product of the allowed LPD values, the per-watt-controlled LSC, and total impacted square footage in 2029 for each Primary Functional Area across all climate zones. The total LSC was the sum of the LSCs of all impacted Primary Functional Areas.

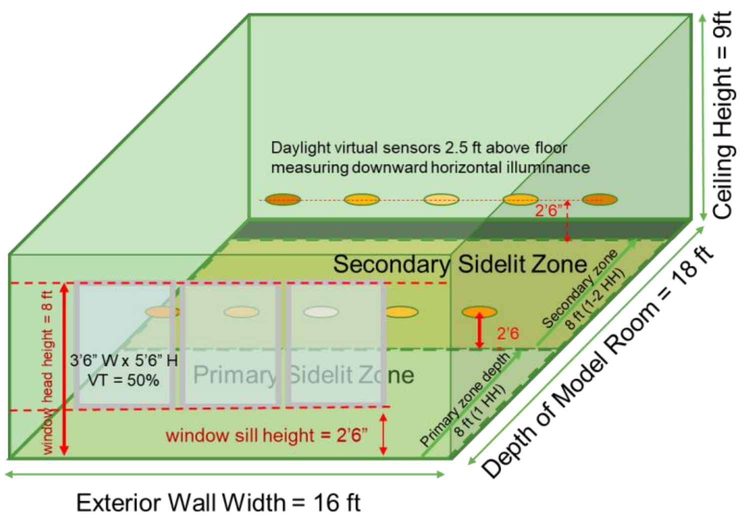
To calculate the equivalent wattage trigger, the triggering criteria (b) through (e) above must remain true for equal stringency. The sum-product of the pre-watt-controlled LSC and the total 2029 impacted square footage for each impacted Primary Functional Area across all climate zones was first calculated. The wattage trigger was derived by dividing the total LSC calculated in the step above by the product of this value and the 100 square-foot minimum square footage.

Appendix H: Modeling of Energy Savings from Daylight Responsive Controls with Continuous Dimming

The daylight availability in the daylit zone was determined by simulating hourly daylight illuminance for all hours of the year in a prototypical space. The simulation of daylight illuminance in the interior of the prototypical space was accomplished using Radiance – a backward ray-tracing technique that is considered to be one of the more accurate ways of simulating daylighting in buildings. The full-year hourly daylight conditions for sidelit spaces and daylit spaces were modeled separately as described below. The models are intended to identify when there is sufficient daylight in each hour of the day so that the electric lighting level can be reduced. The hourly energy savings were determined using a spreadsheet model that calculates the reduction in electric lighting in response to daylight and the corresponding reduction in electrical power usage.

Modeling of the Daylighting Condition for Sidelit Spaces within the Prototypical Buildings

The Statewide CASE Team developed a daylight model to evaluate the illuminance levels within a sidelit space. The space characteristics are typical of those found in an office space, conference room, or medium-sized room. This is the same model used for the analysis in the 2025 Daylighting CASE Report (Statewide CASE Team 2023). The model consisted of a 16-foot-wide by 18-foot-deep space with a 9-foot ceiling height, as depicted in Figure 1. Standard interior reflectance was used for the ceiling (80 percent), walls (50 percent), and floor (20 percent).



- Daylight simulated with LightStanza front-end to Radiance ray tracing
- Daylight illuminance for control
  - Average of 5 sensors at rear of primary and secondary zone
  - 2.5 feet above finished floor
- Model configuration designed for spaces impacted by change from 120 W to 75 W threshold
  - 16' x 18' x 9' (288 ft^2)
- Surface reflectances: Celling 80%, Wall 50%, Floor 20%
- Ground reflectance: 0%
- Windows:
  - Three: 3'-6"W by 5'-6"H
  - Visible transmittance = 50%

Figure 1: The sidelit daylight model for modeling the spaces within the prototypical buildings.

This daylight model includes three windows that are three feet and six inches wide by five feet and six inches tall. The windows are located adjacent to each other at the center of an exterior wall. The window head height is eight feet, and the windowsill height is placed at two feet and six inches. The window placement and dimensions are selected to maintain a 40 percent net window-to-wall ratio (not including wall area exterior to the plenum) to align with a typical office or commercial building envelope.[25]

The windows are assigned a 50 percent visible transmittance, a little higher than the 40 percent minimum prescriptive visible transmittance prescriptively required by Section 301.3 *[Section 140.3]* of Title 24, Part 6. For the purposes of this simulation, blinds were set to 100 percent open each day to minimize potential errors if the blind control interfered with the daylight analysis. Earlier studies have found that blinds are predominantly left open (Heschong Mahone Group 2012, Nezamdoost, Mahic and Van Den Wymelenberg 2018). The ground plane outside of the simulated geometry was given a conservatively low reflectance of zero percent to offset the amount of shading that might occur from surrounding buildings.

[25] With a 12-foot floor to floor height (3-foot plenum height) this design is representative of a 30% window to wall ratio. This analysis is conservative as designs with the prescriptive maximum WWR of 40% would be saving more energy with daylighting controls.

The primary sidelit daylit zone (PSDZ) covered the entire width of the space and extended eight feet into the space from the window. The secondary sidelit daylit zone (SSDZ) also covered the entire width of the space and was located eight feet to 16 feet from the window. The . Two rows of daylight calculation points were located at the back of each daylit zone, with the points two feet and six inches above the floor – typical of a standard work plane – and two feet apart. The simulated daylight availability at these two rows were utilized in the analysis to determine if there was sufficient daylight within the entire PSDZ or SSDZ to dim the electric lighting.

The daylighting condition in the daylight model was simulated with the window oriented in all four cardinal directions in each of the 16 climate zones, totaling 64 different scenarios. The spreadsheet-based energy calculation uses the average hourly illuminance levels at the back of the PSDZ and SSDZ to determine the operation of daylight responsive controls. In the stepped switching base case, it determines when the electric lighting would be switched on or off in response to daylight in each daylit zone. In the proposed continuous dimming case, it determines the percentage by which the electric lighting would be dimmed in response to daylight in each daylit zone.

The daylight model is agnostic to space types; the energy impact of daylight responsive controls for a specific space type can be derived by applying a calculation algorithm that is a function of simulated daylighting values relative to the general lighting design illuminance for the space type. This is multiplied by a lighting schedule that is a function of the occupancy of the space type and the assumed controls of the space (occupancy sensors, manual controls, timeclocks etc.).

Table 124 shows the space types analyzed. Among these space types, only the exercise/fitness center and gymnasium areas were recommended for continuous dimming daylight responsive controls due to cost-effectiveness considerations.

Table 124: Space Types, General Lighting Design Illuminance and Power Density

Space Types	General Lighting Design Illuminance (lux)	General Lighting LPD (W/ft^2)
Corridor Area	50, 100[a]	0.40
Bar/Lounge and Fine Dining Area	75	0.45
Cafeteria/Fast Food Dining Area	150	0.45
Family and Leisure Dining Area	100	0.40
Exercise/Fitness Center and Gymnasium Area	300	0.50
Locker Room	100	0.45
Commercial/Industrial Warehouse Storage Area	100	0.40
Transportation Baggage Area	100	0.40
Transportation Ticketing Area	200	0.45

a. IES recommended illuminance for corridors is 50 lux, but 100 lux was used to minimize adaptation between corridor and other spaces.

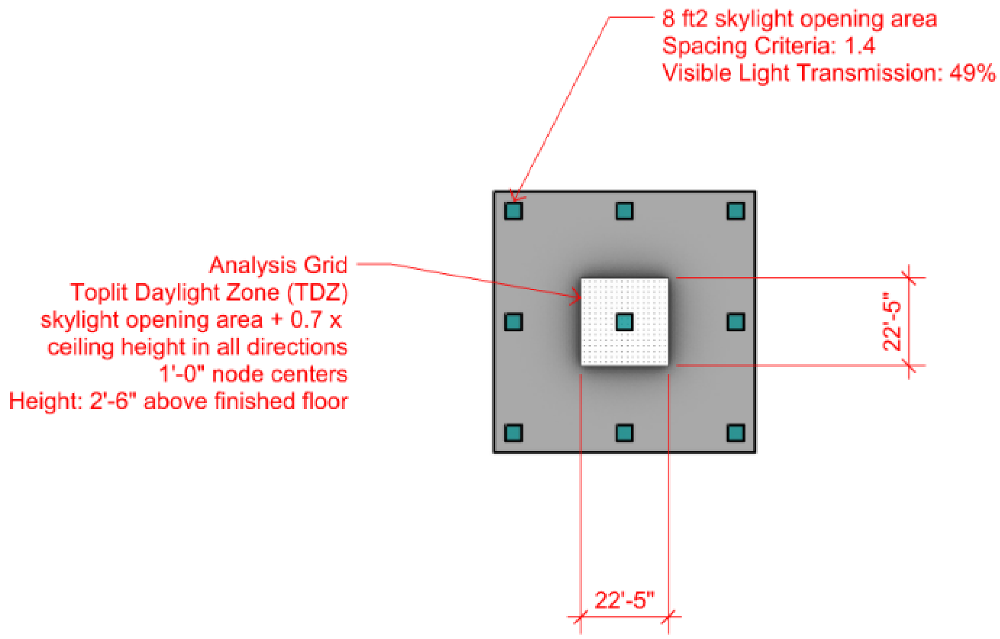
Modeling of the Daylighting Condition for *Skylit Spaces within the Prototypical Buildings*

The Statewide CASE Team developed three daylight models to evaluate illuminance levels in a space from daylight, including a low-ceiling model, a high-ceiling model with open plan, and a high-ceiling model with shelving aisles.

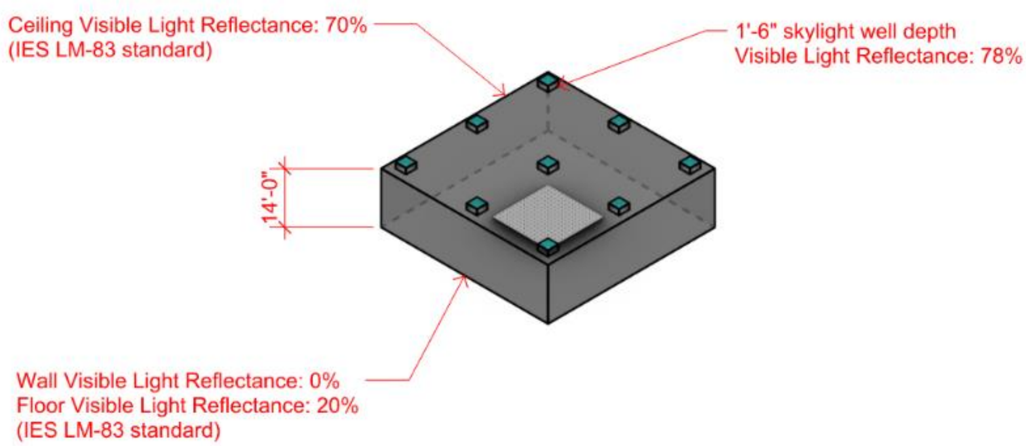
The low-ceiling model, as depicted in Figure 2, is a space with a 14-foot ceiling height and notional 2-foot by 4-foot skylights, representing skylit spaces such as office corridors, dining areas, and transportation baggage areas. Standard interior reflectances were used for the ceiling (70 percent) and floor (20 percent). Opaque model boundary walls were included, and wall reflectance contributions were not considered (0 percent).

The high-ceiling model with open plan, shown in Figure 3, has a 30-foot ceiling height and notional 5-foot-by-6-foot skylights, representing skylit spaces such as exercise/fitness center and gymnasium areas, and transportation ticketing areas. The high-ceiling model with shelving aisles represents warehouse storage areas. In addition to the same ceiling height and skylight configurations as the open plan high-ceiling model, it includes storage stacks with a 20-foot shelving height, 8-foot shelf width, and 12-foot aisle width, as depicted in Figure 4. Standard interior reflectances for high-ceiling spaces were used for the ceiling (30 percent) and floor (20 percent) for both high-ceiling models. Opaque model boundary walls were included, and wall reflectance contributions were not considered (0 percent).

An opaque ground plane outside of the simulated geometry was included in all three models, but ground reflectance contributions were not a factor for skylight performance.

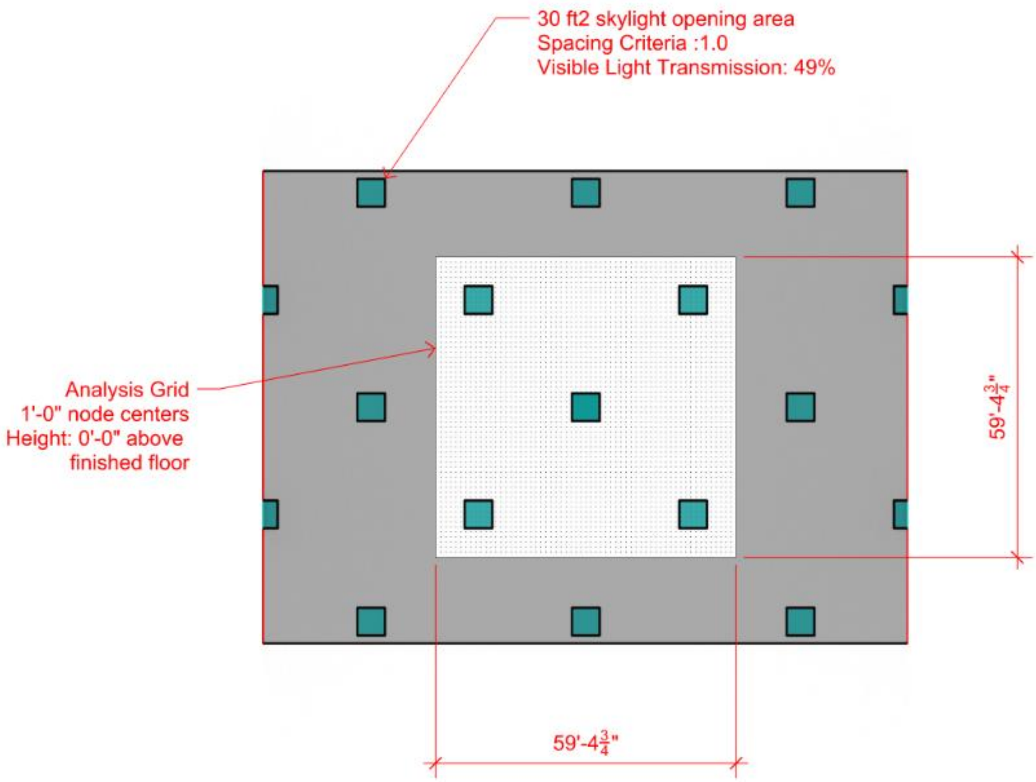


(a) Top View

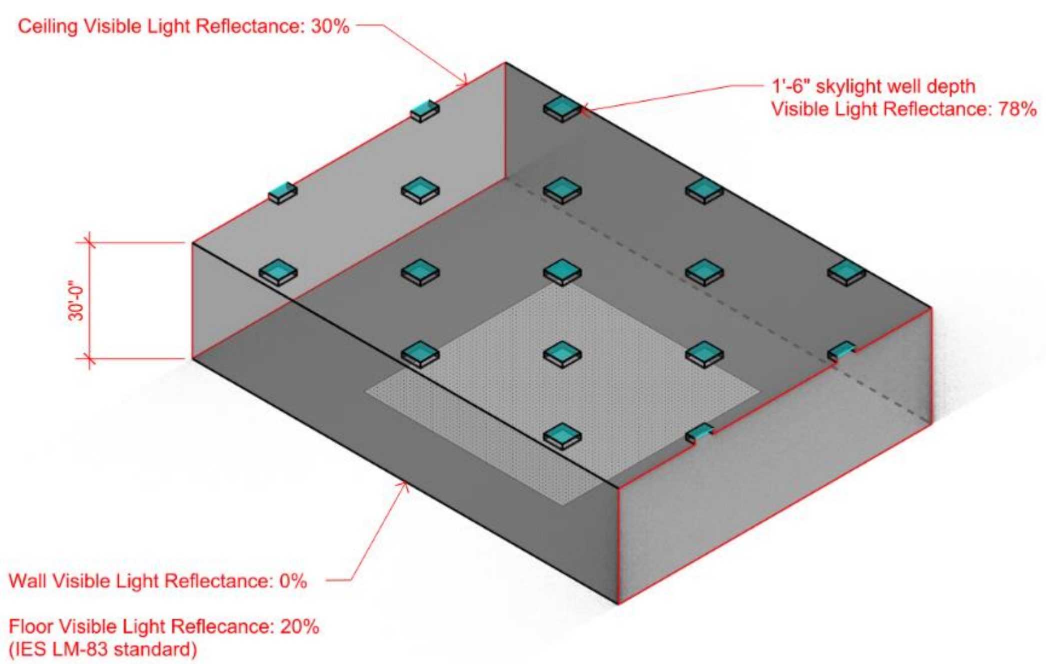


(b) Isometric View

Figure 2: The low-ceiling skylit daylight model for modeling the spaces within the prototypical buildings.

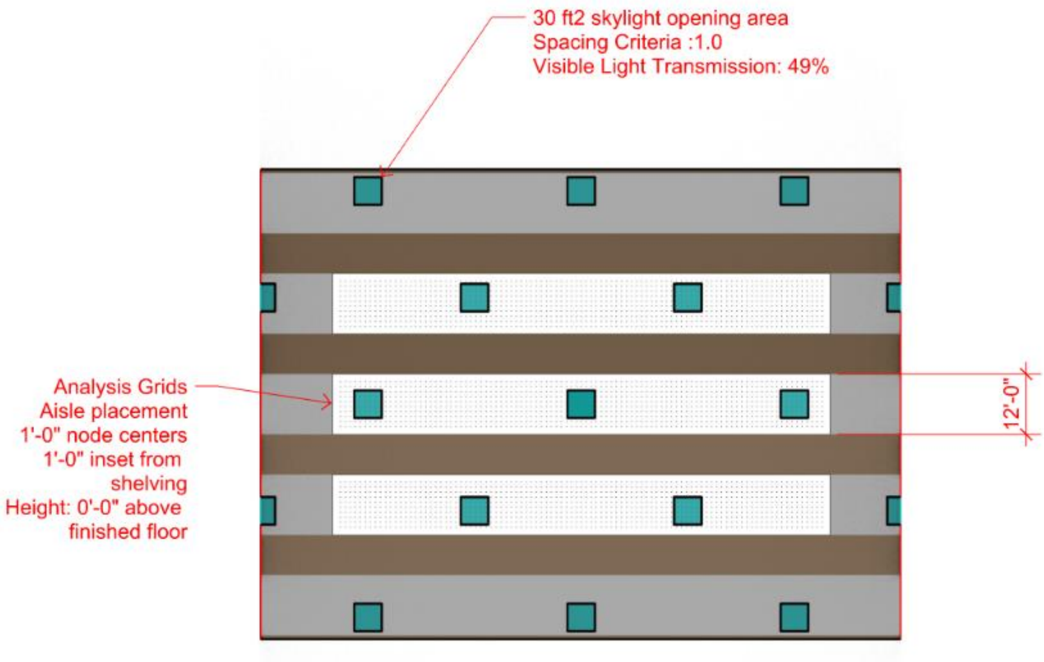


(a) Top View

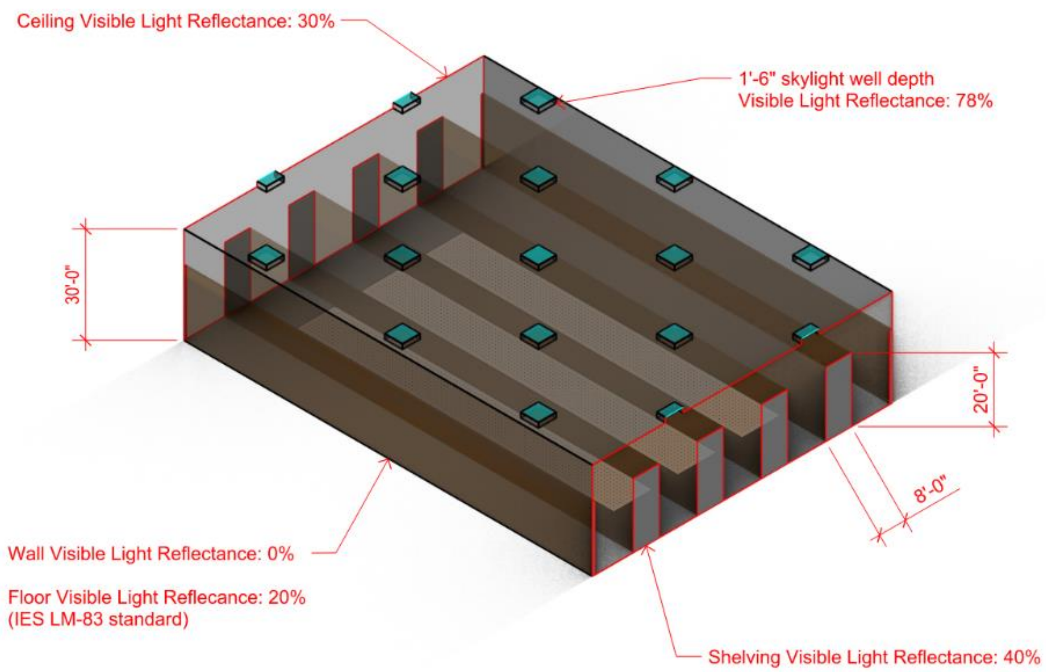


(b) Isometric View

Figure 3: The high-ceiling skylit daylight model for modeling the open plan spaces within the prototypical buildings.



(a) Top View



(b) Isometric View

Figure 4: The high-ceiling skylit daylight model for modeling the spaces with shelving aisles within the prototypical buildings.

For all three skylight models, the skylight geometry was modeled with a combined well depth of 18 inches, including a 1-foot skylight curb and a 6-inch roof thickness. The skylight well material finish was weighted as 78 percent reflectance, assuming 80 percent of statewide installations are at a high-reflectance finish (90 percent reflectance) and 20 percent are unfinished (30 percent reflectance). The skylight model material assignment was intended to capture the daylighting performance characteristics of a typical double-wall, milk-white, and uniformly translucent polycarbonate skylight product. A visible light transmittance of 49 percent was assumed, which includes a code-minimum 64 percent visible light transmittance skylight material, a 15 percent dirt depreciation factor (per IES LM-83 modeling recommendations for horizontal fenestration), and an assumed 10 percent light reduction from a notional burglar guard.

The skylight geometries in the models were reduced to uniformly square aperture areas of 8 square feet (low-ceiling model) and 30 square feet (high-ceiling models), that, when projected to the floor, would establish the skylit daylit zone (SDZ) as defined by the code-established method. Daylight calculation points within the skylit daylit zone were located at floor height (high-ceiling models) and 2-foot-6-inch task height (low-ceiling model) in one-foot intervals.

The Statewide CASE Team simulated the hourly daylight illuminance values within the skylit daylight zonal area at the task level for all 8,760 hours of the year in each of the three daylight models for the 16 California climate zones. The minimum hourly illuminance value across the analysis grid of each daylight model served as the hourly representative illuminance level for the model's skylit daylit zone. The spreadsheet-based energy calculation uses the hourly illuminance levels to determine the operation of daylight responsive controls.

Table 125 summarizes the space types analyzed and the daylight model used for each. The analysis showed that it would be cost-effective to require continuous dimming for daylight responsive controls in all the spaces considered.

Table 125: Space Types, General Lighting Design Illuminance and Power Density

Space Types	Daylight Model	General Lighting Design Illuminance (lux)	General Lighting LPD (W/ft^2)
Corridor Area	Low ceiling	50, 100[a]	0.40
Bar/Lounge and Fine Dining Area	Low ceiling	75	0.45
Cafeteria/Fast Food Dining Area	Low ceiling	150	0.45
Family and Leisure Dining Area	Low ceiling	100	0.40
Exercise/Fitness Center and Gymnasium Area	High ceiling with open plan	300	0.50
Locker Room	Low ceiling	100	0.45
Commercial/Industrial Warehouse Storage Area	High ceiling with shelving aisles	100	0.40
Transportation Baggage Area	Low ceiling	100	0.40
Transportation Ticketing Area	High ceiling with open plan	200	0.45

Electric Lighting Energy Savings Calculation for the Daylight Models

The response of the electric lighting controls to daylight illuminance levels was calculated to be representative of a daylighting control specified and installed in accordance with Section 130.1(d) *"Daylight Responsive Controls"* of Title 24, Part 6, and the settings confirmed as meeting the code intent by successfully passing the Nonresidential Appendix NA7.6.1 *"Daylight Responsive Controls Acceptance Test."*

Title 24, Part 6 Section 130.1(d)3 requires:

B. For each space, ensure the combined illuminance from the controlled lighting and daylight is not less than the illuminance from controlled lighting when no daylight is available;

C. For areas other than parking garages, ensure that, when the daylight illuminance is greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power in that daylight zone shall be reduced by a minimum of 90 percent;

These requirements are reflected in the control plot shown in Figure 5 below. The lighting system is given some leeway to implement daylight responsive controls. The requirements are designed to maintain amenity (light levels do not fall below the design illuminance of the electric lighting system) while saving energy. The leeway indicated by the acceptable range is to ensure the requirements are achievable, as no control works perfectly. So long as the system is not over-dimming and making the space too dark (combined daylight and electric light illuminance is not less than design illuminance) or under-dimming and being fully dimmed to 10 percent or lower when daylight is 150 percent of the design illuminance, the system complies.

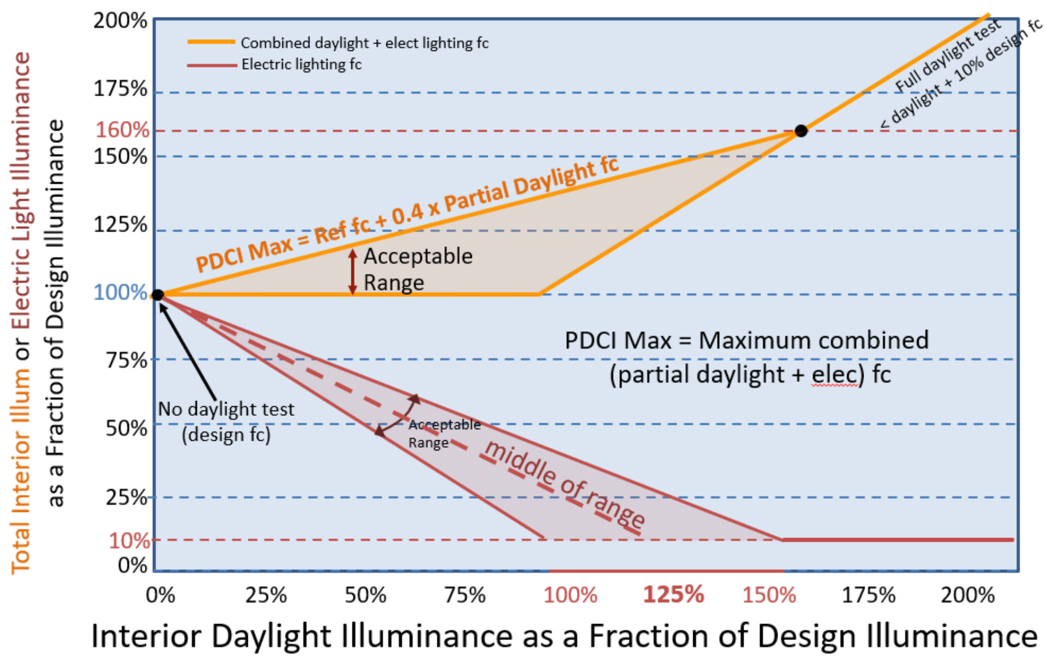


Figure 5: Daylighting control plot showing the relationship between daylighting illuminance and electric lighting illuminance.

The safest approach to implement daylight responsive controls would be to set the control response close to the middle of the acceptable dimming range (i.e., fully dimmed when daylight in the space is 125 percent of design illuminance). This typical control response is shown as the dashed red line in the middle of the red electric lighting control range. In this manner, if the control errs slightly by over- or under-dimming, it will still pass the acceptance tests, as the slight error will not cause it to fall outside the acceptable range.

Thus, the Statewide CASE Team made use of the assumption that the controls would linearly interpolate between 100 percent electric light output at 0 percent daylight contribution and 10 percent electric light output when daylight in the space is 125 percent of the design illuminance. This would reflect customary practice and is halfway between a control that maximizes energy savings while the space does not drop below design illuminance and a minimally compliant control that is fully dimmed when daylight in the space is 150 percent of design illuminance.

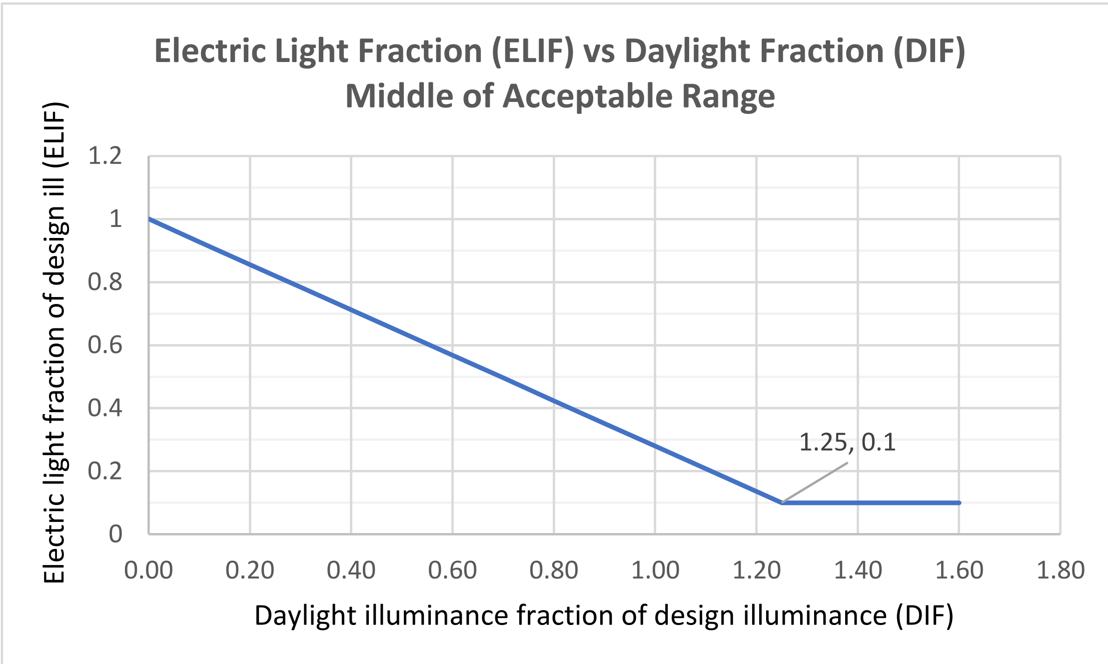


Figure 6: Electric Light Illuminance Fraction (ELIF) in the middle of acceptable range with 10 percent minimum dimming level versus interior daylight illuminance fraction.

Figure 6 illustrates the hourly electric light fraction of design illuminance, $ELIF_h$, with respect to daylight illuminance as a fraction of design illuminance, DIF_h. This relationship can be quantified as follows in **Equation 1.**

$$ELIF_h = max\left(1 - \frac{0.9}{1.25} DIF_h, 0.1\right)$$

Equation 1

Where:

DIF_h is the hourly interior daylight illuminance as a fraction of the design illuminance (**Equation 2**).

The slope of -0.9/1.25 reflects that electric lighting is dimmed by 90 percent when the interior daylight level is 125 percent of the design illuminance level.

The value of this equation never falls below 0.1 as the code requirement is to dim by at least 90 percent, thus when there is full daylight in the space, electric lights can provide up to 10 percent of full light output.

$$DIF_h = \frac{Daylight\ Illuminance_h}{Design\ Illuminance}$$

Equation 2

Where:

Daylight Illuminance_h is the hourly daylight illuminance from the raytracing daylighting simulations.

Design Illuminance is the average illuminance provided by the general lighting system when there is no daylight in the space.

It should be noted that the task illuminance values are used as a proxy for general lighting illuminance. Often the general lighting system is actually providing a mixture of the relatively low light levels needed for circulation lighting and some of the task lighting with the full task illuminance provided by a task lighting system. As a result, this analysis is conservative; actual general lighting design illuminance is often lower than the task illuminance, and a greater fraction of general lighting power will be reduced than calculated here.

The hourly electric light power fraction, $ELPF_h$, is determined based on $ELIF_h$ in **Equation 1**. ELPF represents the fraction or percentage of electric lighting power required to produce electric light level to result in the designed illuminance at the reference. This assumes a linear relationship between electric lighting power and electric light output – between the minimum power and light point when fully dimming, and the 100 percent power and 100 percent light output when the light is operating at its rated power and light.

$$ELPF_h = Min\ Power + (ELIF_h - Min\ Light) \times \frac{(1 - Min\ Power)}{(1 - Min\ Light)}$$

Equation 3

Where:

Min Power is the fraction of rated power at the minimum light output;

Min light is the fraction of rated light output at the minimum light output.

Typically, LEDs are assumed to consume power proportional to their light output. Thus, if a LED is dimmed to 40 percent of light output, it is assumed the LED consumes 40 percent of rated power. In other words, the LED is assumed to have a constant efficacy across its entire dimming range. To be slightly more conservative in calculating savings, the Statewide CASE Team assumed that the minimum fraction of lighting power is 12 percent for an LED luminaire capable of dimming to a minimum of 10 percent of light output. There is not much data available about this key performance characteristic, but the Statewide CASE Team did find a limited amount of data that indicated that there was approximately a two percent offset in lighting power at the minimum light output point for LED luminaires.

$$ELPF_h = 0.12 + (ELIF_h - 0.1) \times \frac{(1 - 0.12)}{(1 - 0.1)}$$

Equation 4

This linear interpolation of fraction of rated power to fraction of rated light is shown in Figure 7.

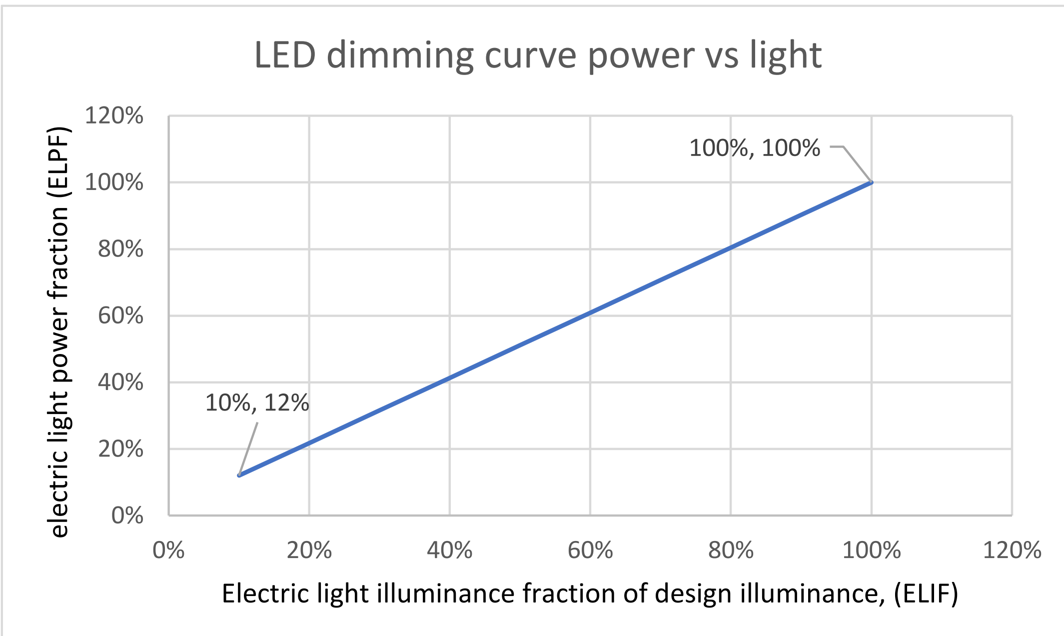


Figure 7: Electric Power Fraction (ELPF) versus Electric Light Fraction (ELIF), 12 percent of rated power when dimmed to 10 percent of rated light output.

By following Equation 1 through Equation 4, the hourly simulated daylight in the modeled space (DIF_h) is the basis of calculating the hourly fraction of light output of electric lighting in the daylight zones ($ELIF_h$) which in turn leads to the hourly fraction of electric power consumed by the controlled lighting ($ELPF_h$). However, electric lighting is not energized every daylit hour of the day. Spaces may be vacated during some portions of daytime hours and lights are turned off manually or by automatic controls. Thus, the savings from daylighting controls are multiplied by the probability that lights are on during that time.

The Statewide CASE Team modeled the effects of occupant sensing controls based on the lighting schedules provided in the ASHRAE 90.1 prototype score cards for the appropriate building prototype. In looking at the schedule, there is a small background value of lighting energy consumed even when the occupancy schedule is zero percent. This is likely representing “night lighting” or egress lighting for the space. As shown in Equation 5, the Statewide CASE Team subtracted the egress lighting from the total lighting schedules to describe the probability of lighting that is controlled, CLS, based on the assumption that the “night lighting” is uncontrolled.

$$CLS_h = ALS_h - NCL$$

Equation 5

Where:

CLS_h is the hourly schedule of controlled lighting as a fraction of full occupancy;

ALS_h is the hourly schedule of all lighting as a fraction of full occupancy, including uncontrolled “night lighting” from ASHRAE prototype score cards;

NCL is the uncontrolled “night lighting”.

After applying these reduced schedules to the lighting reduced by automatic daylighting controls, the night lighting was added back onto each hour’s energy consumption. This total normalized energy consumption is calculated as full load hours. Full load hours have units of Wh/year per watt or hours per year at rated power.

$$FLH = \sum_{h=1}^{8,760} [CLS_h \times ELPF_h + NCL]$$

Equation 6

The base case with stepped switching daylighting controls has an electric lighting power fraction, ELPF in Equation 3, equal to zero for hours where the daylight illuminance exceeds 150 percent of the design illuminance, and one otherwise. The full load hours for the base case are, therefore, can also be calculated using Equation 6, with the modified ELPF.

Since full load hours have units of Wh/year per watt, dividing them by 1,000 will represent energy savings in terms of kWh/year per watt of controlled lighting.

Full load hours of energy savings, and equivalently, annual energy savings per watt of lighting power, from daylight responsive controls are the difference between the two cases above.

Appendix I: Code Language Markup (Restructured)

The proposed markup language in sections 2.6, 3.6, 4.6, and 5.6 are confined to the scope of each individual measure. This section provides the markup language when the scopes of all measures are considered.

Guide to Markup Language

The proposed changes to the standards, Reference Appendices, and the Alternative Calculation Method (ACM) Reference Manuals are provided below. Changes to the 2025 documents should be marked with dark blue underlining (new language) and ~~strikethroughs~~ (deletions). New to the 2028 Energy Code is to italicize defined terms when the terms are being used in their defined context. In-line comments that are not part of the proposed code language but are used to help describe the purpose of what is proposed are included with grey highlight and italics.

Markups are provided to the restructured 2025 Energy Code that the CEC developed in response to feedback that aligning the structure of Title 24, Part 6 with other parts of the California Building Standards Code (Title 24) would improve readability, usability, and navigation. New section numbers are shown in bold, followed by square brackets that document the section in the 2025 Title 24, Part 6 section numbers prior to the restructuring. For example, "**Section 601.1** [Section 130.0(a)] **General**" contains the content that is in the current Section 130.0(a).

Posting the proposed code language in this format is useful, as it helps describe how the Energy Code changes proposed for nonresidential occupancies are isolated from the requirements for residential occupancies, which are prohibited from being changed until the 2031 code cycle by Assembly Bill 130.

Administrative Code (Title 24, Part 1)

There are no proposed changes to Title 24, Part 1.

Energy code (Title 24, Part 6)

SECTION 201

DEFINITIONS

…

L

…

LIGHTING definitions:

…

Countdown Timer Switch turns lighting or other loads ON when activated using one or more selectable countdown time periods and then automatically turns lighting or other loads OFF when the selected time period has elapsed.

Daylight Continuous Dimming Controls are a continuous dimming controls that vary the luminous flux of the electric lighting system continuously between 100 percent and 10 percent of lower of lighting power in response to available daylight.

Daylight Stepped Switching Controls vary the luminous flux of the electric lighting system in two discrete steps, the 100 percent lighting power and OFF, in response to available daylight.

Daylight Responsive Control adjusts the luminous flux of the electric lighting system in either a series of steps or by continuous dimming in response to available daylight. This kind of control uses one or more photosensors to detect changes in daylight illumination and then automatically adjusts the electric lighting levels in response.

…

Luminous Maintenance (often referred to as “lumen flux maintenance” or “lumen maintenance”) is the remaining luminous flux output, typically expressed as a percentage of initial luminous flux output, at any selected elapsed operating time. Luminous maintenance is the converse of luminous flux depreciation (or “lumen depreciation”).

Manual Dimming Control provides a means for occupants to vary the luminous flux of the electric lighting system over a continuous range from 100 percent to 10 percent or lower of the lighting power.

Marquee Lighting is a permanent lighting system consisting of one or more rows of many small lamps, including light emitting diodes (LEDs) lamps, tungsten lamps, low pressure discharge lamps or fiber optic lighting, attached to a canopy.

…

SECTION 908

CONTROLLED ENVIRONMENTAL HORTICULTURE (CEH)

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

908.1 *[Section 120.6(h)]* **Mandatory requirements (Newly Constructed, Additions, Alterations).**

…

908.1.5 *[Section 120.6(h)5]* **Horticultural lighting.**

In a *building* with CEH spaces or a greenhouse with more than 40 kW of aggregate horticultural lighting load, the electric lighting system used for plant growth and plant maintenance shall meet the following requirements:

…

3. ~~*Multilevel lighting controls*~~Manual dimming controls shall be installed and comply with Section ~~601.2.2.2~~601.2.2.1.4 *[Section ~~130.1(b)~~130.1(a)4]*.

SUBCHAPTER 6 ELECTRICAL AND LIGHTING

SECTION 600

MANDATORY REQUIREMENTS FOR ALL OCCUPANCIES

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

600.4 *[Section 110.12]* **Demand management.**

Buildings, other than *healthcare facilities and single-family occupancies*, that install or are required to install *demand responsive controls* shall comply with the applicable *demand responsive control* requirements of this section.

…

600.4.2 *[Section 110.12(c)]* **Demand responsive lighting controls.**

600.4.2.1 Nonresidential buildings excluding Group R occupancies.

Buildings with *nonresidential lighting* systems having a total installed lighting power of 4,000 watts or greater that are subject to the requirements of Section 601.2.2.1.4 *[New section]* shall install controls that are capable of automatically reducing *lighting* power in response to a *demand response signal*.

For compliance testing, the *lighting* controls shall demonstrate a 15-percent or greater reduction in *lighting* power as described in NA7.6.3. The controls may provide additional demand responsive functions or abilities.

For *buildings* where *demand response controls* are required, *demand responsive controls* shall control the *general lighting* in the spaces required to meet Section 601.2.2.1.4 *[New section]* .

General lighting power shall be reduced by continuous dimming.

Exception to Section 600.4.2.1: Spaces where a health or life safety statute, ordinance, or regulation does not permit the general lighting to be reduced are not required to install *demand responsive controls* and do not count toward the 4,000-watt threshold.

600.4.2.2 Hotel/motel buildings and nonresidential buildings with Group R occupancies.

Buildings with nonresidential *lighting* systems having a total installed lighting power of 4,000 watts or greater that are subject to the requirements of Section 601.2.2.2 *[Section 130.1(b)]* or *Section 160.5(b)4B]* shall install controls that are capable of automatically reducing *lighting* power in response to a *demand response signal*.

For compliance testing, the *lighting* controls shall demonstrate a 15-percent or greater reduction in *lighting* power as described in NA7.6.3. The controls may provide additional demand responsive functions or abilities.

For *buildings* where *demand response controls* are required, *demand responsive controls* shall control the *general lighting* in the spaces required to meet Section 601.2.2.2 *[Section 130.1(b) or Section 160.5(b)4B].*

General lighting shall be reduced in a manner consistent with the requirements of Section 601.2.2.2 *[Section 130.1(b) or Section 160.5(b)4B].*

Exception to Section 600.4.2.~~1~~2: Spaces where a health or life safety statute, ordinance, or regulation does not permit the general lighting to be reduced are not required to install *demand responsive controls* and do not count toward the 4,000-watt threshold.

601.2 Mandatory requirements (Newly Constructed, Additions, Alterations).

…

601.2.2 *[Section 130.0(d) and (e)]* **Indoor lighting controls.**

…

601.2.2.1 *[Section 130.1(a)]* **Manual controls.**

Each space shall be provided with *lighting* controls that allow the *lighting* in that space to be manually turned on and off. The *manual* control shall comply with Sections 601.2.2.1.1 through 601.2.2.1.3 *[Sections 130.1(a)1-130.1(a)3]*.

Exception to Section 601.2.2.1: Up to 0.1 watts per square foot of indoor *lighting* may be continuously illuminated to allow for means of egress *illumination* consistent with California Building Code Section 1008. Egress *lighting* complying with this wattage limitation is not required to comply with *manual* control requirements if:

1. The space is designated for means of egress on the plans and specifications submitted to the *enforcement agency* under Section 10-103(a)2 of *Part 1*; and

2. The egress *lighting* controls shall not be controllable by unauthorized personnel during a normal power failure.

601.2.2.1.1 *[Section 130.1(a)1]* **Accessibility.**

Be *readily accessible*; and

Exception to Section 601.2.2.1.1: *Restrooms* having two or more stalls, parking areas, *stairwells*, corridors and spaces of the *building* intended for access or use by the public may use a manual control not *accessible* to unauthorized personnel.

601.2.2.1.2 *[Section 130.1(a)2]* **Viewable when operating controls.**

Be located in the same space, or be located such that the controlled *lighting* or the status of the controlled *lighting* can be seen when operating the controls; and

Exception to Section 601.2.2.1.2: In *healthcare facilities*, for *restrooms* and bathing rooms intended for a single occupant, the *lighting* control may be located outside the enclosed area but directly adjacent to the door.

601.2.2.1.3 *[Section 130.1(a)3]* **Separate controls.**

Provide separate control of general, floor display, wall display, *window* display, case display, ornamental, and *special effects lighting*, such that each type of *lighting* can be turned on or off without turning on or off other types of *lighting*. Scene controllers may comply with this requirement provided that at least one scene turns on *general lighting* only, and the control provides a means to manually turn off all *lighting*.

601.2.2.1.4 *[New section]* **Manual dimming controls.**

In spaces in nonresidential buildings, where the connected *general lighting* exceeds 50 watts, controls shall be capable of continuous manual dimming to 10 percent or less of full *lighting* power in addition to full ON and OFF control.

Scene controllers may comply with this requirement provided that at least one scene sets the *general lighting* power to a level between 10 and 100 percent of full power.

Exception 1 to Section 601.2.2.1.4: *Lighting* in commercial/industrial shipping and receiving areas, copy rooms, corridors, electrical/mechanical/telephone rooms, kitchen/food preparation areas, laboratories, laundry rooms, locker rooms, manufacturing/commercial/industrial work areas, parking garages, restrooms, stairwells, and transportation concourse/baggage/ticketing areas.

Exception 2 to Section 601.2.2.1.4: HID (high intensity discharge) and induction lighting with manual controls that have a minimum of one control step between 30 and 70 percent of full rated power in addition to full ON and full OFF.

Exception 3 to Section 601.2.2.1.4: *Healthcare Facilities*.

Exception 4 to Section 601.2.2.1.4: Spaces in hotels/motel buildings and nonresidential buildings with Group R occupancies shall comply with the requirements in Section 601.2.2.2.

601.2.2.2 *[Section 130.1(b)]* **Multilevel lighting controls.**

In hotel/motel buildings and nonresidential buildings with Group R occupancies, the *general lighting* of any space with a size of 100 square feet or larger and with a connected *lighting* load greater than 0.5 watts per square foot shall be provided with *multilevel lighting controls*.

The *multilevel lighting controls* shall provide and enable continuous dimming from 100 percent to 10 percent or lower of *lighting* power.

Exception 1 to Section 601.2.2.2: An indoor space that has only one *luminaire*.

Exception 2 to Section 601.2.2.2: *Restrooms*.

Exception 3 to Section 601.2.2.2: *Healthcare facilities*.

Exception 4 to Section 601.2.2.2: The *general lighting* with *light source* of HID and induction shall have a minimum of one control step between 30 and 70 percent of full rated power.

601.2.2.3 *[Section 130.1(c)]* **Shut-OFF lighting controls.**

All installed indoor *lighting* shall be equipped with controls able to automatically reduce *lighting* power when the space is typically unoccupied.

…

601.2.2.3.1.1- Shall be controlled with an *occupant sensing control* set to no more than a ~~20~~15-minute time delay, automatic time-switch control, or other control capable of automatically shutting OFF all of the *lighting* when the space is typically unoccupied; and

Exception to Section 601.2.2.3.1.1: *Occupant Sensing controls* in *hotel/motel* buildings and *nonresidential* buildings with Group R occupancies shall be set to no more than a 20-minute time delay, automatic time-switch control, or other control capable of automatically shutting OFF all of the *lighting* when the space is typically unoccupied: and

…

601.2.2.3.5 *[Section 130.1(c)5]* **Occupant Sensing controls.**

1. In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms, conference rooms, and restrooms, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in ~~20~~15 minutes or less after the control zone is unoccupied.

   Exception to Section 601.2.2.3.5.1: *Occupant Sensing controls* in *hotel/motel* buildings and *nonresidential* buildings with Group R occupancies, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in 20 minutes or less after the control zone is unoccupied.

2. ~~In areas required by Section 601.2.2.2 *[Section 130.1(b)]* to have multi-level lighting controls, the~~The occupant sensing controls shall function either as a:

   2.1. Partial-ON occupant sensing controls capable of automatically activating between 50 and 70 percent of controlled lighting power, or

   2.2. Vacancy sensing controls, where all lighting responds to a manual ON input only.

3. ~~In areas not required by Section 601.2.2.2 *[Section 130.1(b)]* to have multilevel lighting controls, the occupant sensing controls shall function either as:~~

   ~~3.1. Automatic full-on occupant sensing controls; or~~

   ~~3.2. Partial-ON occupant sensing controls, or~~

   ~~3.3. Vacancy sensing controls, where all lighting responds to a manual ON input only.~~

~~4~~3. In addition, controls shall be provided that allow the lights to be manually shut OFF in accordance with Section 601.2.2.1 *[Section 130.1(a)]* regardless of the sensor status.

Exception to Section 601.2.2.3.5: Lighting systems not required to comply with the manual dimming controls requirement in Section 601.2.2.1.4 or Section 601.2.2.2 may comply with this section with automatic full-on occupant sensing controls.

…

601.2.2.3.6 *[Section 130.1(c)6]* **Full or partial-OFF occupant sensing controls.**

For *warehouse aisle ways*, *warehouse* open areas, library book stack aisles, corridors, *stairwells*, offices greater than 250 square feet, parking *garages*, parking areas, loading areas, and unloading areas, laboratories, lounges, breakrooms, waiting areas, and computer rooms, the installed *lighting* shall meet the following requirements:

601.2.2.3.6.1 *[Section 130.1(c)6A]* **- Warehouse aisle ways and open areas.** In *warehouse aisle ways* and *warehouse* open areas, *lighting* shall be controlled with *occupant sensing controls* that automatically reduce *lighting* power by at least 50 percent when the areas are unoccupied. The *occupant sensing controls* shall independently control *lighting* in each *warehouse aisle way*, and shall not control *lighting* beyond the *aisle way* being controlled by the sensor.

Exception to Section 601.2.2.3.6.1: When metal halide *lighting* or high pressure sodium *lighting* is installed in *warehouses*, *occupant sensing controls* shall reduce *lighting* power by at least 40 percent.

601.2.2.3.6.2 *[Section 130.1(c)6B]* **- Library book stack aisles.** In library book stack aisles 10 feet or longer that are *accessible* from only one end, and library book stack aisles 20 feet or longer that are *accessible* from both ends, *lighting* shall be controlled with *occupant sensing controls* that automatically reduce *lighting* power by at least 50 percent when the areas are unoccupied. The *occupant sensing controls* shall independently control *lighting* in each *aisle way*, and shall not control *lighting* beyond the *aisle way* being controlled by the sensor.

601.2.2.3.6.3 *[Section 130.1(c)6C]* **- Corridors and stairwells.** In corridors and *stairwells*, *lighting* shall be controlled by *occupant sensing controls* that separately reduce the *lighting* power in each space by at least 50 percent when the space is unoccupied. The *occupant sensing controls* shall be capable of automatically turning the *lighting* fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress. *Lighting* in *stairwells* and common area corridors that provide access to guestrooms of *hotel/motels* shall meet requirements of this section instead of complying with Section 601.2.2.3.1 *[Section 130.1(c)1]*.

601.2.2.3.6.4 *[Section 130.1(c)6D]* **- Office spaces greater than 250 square feet.** In office spaces greater than 250 square feet, *general lighting* shall be controlled with *occupant sensing controls* that meet all of the following:

1. The *occupant sensing controls* shall be configured so that *lighting* shall be controlled separately in control zones not greater than 600 square feet. All control zones in offices greater than 250 square feet shall be shown on the plans; and
2. In ~~20~~15 minutes or less after the control zone is unoccupied, the *occupant sensing controls* shall uniformly reduce *lighting* power in the control zone to no more than 20 percent of full power. Control functions that switch control zone *lights* completely off when the zone is vacant meet this requirement; and
3. In ~~20~~15 minutes or less after the entire office space is unoccupied, the *occupant sensing controls* shall automatically turn off *lighting* in all control zones in the space; and

4. In each control zone, *lighting* shall be allowed to automatically turn on to any level up to full power upon *occupancy* within the control zone. When *occupancy* is detected in any control zone in the space, the *lighting* in other control zones that are unoccupied shall operate at no more than 20 percent of full power.

Exception 1 to Section 601.2.2.3.6.4: Under-shelf or furniture-mounted *task lighting* controlled by a local switch and either a time switch or an *occupancy* sensor.

Exception 2 to Section 601.2.2.3.6.4: *Occupant Sensing controls* in *hotel/motel* buildings and *nonresidential* buildings with Group R occupancies shall be set to no more than a 20-minute time delay.

601.2.2.3.6.5 *[Section 130.1(c)6E]* **- Parking garages, parking areas and loading and unloading areas.** In parking *garages*, parking areas and loading and unloading areas, *general lighting* shall be controlled by *occupant sensing controls* that meet the requirements below instead of complying with Section 601.2.2.3.1 *[Section 130.1(c)1]*:

1. The *occupant sensing controls* shall uniformly reduce *lighting* power in the control zone to between 20 percent and 50 percent of full power and with at least one control step; and
2. No more than 500 watts of rated *lighting* power shall be controlled together as a single zone; and
3. The *occupant sensing controls* shall be capable of automatically turning the *lighting* fully ON only in the separately controlled zone, and shall be automatically activated from all designed paths of egress.

Interior areas of parking *garages* are under the classification of indoor *lighting* and shall comply with Section 601.2.2.3.6.5 *[Section 130.1(c)6E]*.

Parking areas on the *roof* of a parking structure are under the classification of outdoor *hardscape* and shall comply with Section 601.2.3 *[Section 130.2]*.

EXCEPTION to Section 601.2.2.3.6.5: Luminaires located in a parking garage daylight adaptation zone and dedicated to providing illuminance for daylight adaptation.

601.2.2.3.6.6 ***[New section]*** **– Laboratory spaces.** In laboratory spaces, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power to between 20 percent and 50 percent of full power when the space is unoccupied for no more than 15 minutes during normally occupied hours and shall turn off lighting when the space is unoccupied for an additional 15 minutes during normally unoccupied hours.

Where the lighting system occupant sensors are providing the occupancy status of the laboratory space for airflow reduction control in accordance with Section 912.2.1 *[Section 140.9(c)1]*, the occupancy signal shall be independent of daylighting or manual lighting overrides of lighting.

Exception to 601.2.2.3.6.6: Laboratory spaces where occupancy sensing control of lighting conflicts with facility environmental health and safety department requirements.

601.2.2.3.6.7 *[New section]* – Lounges, breakrooms, and waiting areas. In lounges, breakrooms, and waiting areas, lighting shall be controlled by occupant sensing controls that automatically turn lighting OFF when the space is unoccupied for no more than 15 minutes. The occupant sensing controls shall be capable of automatically turning the lighting fully ON upon detection of occupancy.

Exception to 601.2.2.3.6.7: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

601.2.2.3.6.8 *[New section]* – Computer rooms. In *computer rooms*, *general lighting* shall be controlled by occupant sensing controls that automatically turn lighting OFF when the space is unoccupied for no more than 15 minutes. The occupant sensing controls shall be capable of automatically turning the lighting fully ON upon detection of occupancy. In *server aisles*, the occupant sensing controls shall independently control lighting in each aisle way.

Exception to 601.2.2.3.6.8: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

…

601.2.2.4 *[Section 130.1(d)]* **Daylight Responsive Controls.**

Daylight Responsive controls shall be installed in the locations listed in this section as applicable and shall comply with Sections 601.2.2.4.1 through 601.2.2.4.6.

…

601.2.2.4.3 *[Section 130.1(d)2C]* **Daylight Responsive control requirements.**

The *daylight responsive controls* shall meet the following:

~~1. For spaces where the installation of *multilevel lighting controls* is required under Section 601.2.2.2 *[Section 130.1(b)]*, allow the multilevel lighting controls to adjust the light level with continuous dimming;~~

1~~2~~. For each space, ensure the combined illuminance from the controlled lighting and daylight is not less than the illuminance from controlled lighting when no daylight is available;

2~~3~~. For areas other than parking garages, ensure that, when the daylight illuminance is greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power in that daylight zone shall be reduced by a minimum of 90 percent; and

34. For parking garages, ensure that when daylight illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing or opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power in the combined primary and secondary sidelit daylit zones shall be reduced by 100 percent; and

4. Skylit and sidelit daylit zones in audience seating areas, copy rooms, electrical, mechanical, and telephone rooms, laundry areas, parking zones and ramps in parking garages, and theater areas in nonresidential buildings shall implement Daylight Continuous dimming Controls or Daylight Stepped Switching Controls;

   Sidelit daylit zones in corridor areas, locker rooms, dining areas, warehouse storage areas, and transportation baggage and ticketing areas shall implement Daylight Continuous dimming Controls or Daylight Stepped Switching Controls;

   All daylit zones in all other spaces in nonresidential buildings where the installation of manual dimming controls is required under Section 601.2.2.1.4 *[New section]* shall implement Daylight Continuous dimming Controls; and

5. For *Group R occupancies* where the installation of *multilevel lighting controls* is required under Section 601.2.2.2 *[Section 130.1(b)]*, allow the multilevel lighting controls to adjust the light level with continuous dimming; and

…

601.2.2.4.6 *[Section 130.1(d)2F]* **Multilevel lighting and manual dimming control interaction.**

In hotel/motel buildings and nonresidential buildings with Group R occupancies, daylight responsive controls~~The *automatic* daylighting control~~ shall permit the *multilevel lighting control* to adjust the level of *lighting*.

In buildings where *manual dimming controls* are required, the *manual dimming controls* shall be capable of turning off or decreasing light levels below the light level set by the *daylight responsive controls*. When *manual dimming controls* are capable of temporarily increasing electric lighting above the light level set by the *daylight responsive controls*, the controls shall be configured to reset electric *lighting* controls back to the Section 601.2.2.4.3 *[Section 130.1(d)2C]* defaults after electric lighting has been turned off or reduced by a *manual dimming control*, *occupant sensing control*, or timeclock.

…

601.2.2.7 *[New Section]* Parking Garage Daylight Adaptation Zone Lighting Controls.

Parking garage daylight adaptation zone lighting shall be separately controlled to automatically reduce the lighting power density per Table 601.3-C Parking Garage Area - Parking Zone and Ramps from sunset to sunrise and be increased to the lighting power density for Daylight Adaption Zones from sunrise to sunset.

EXCEPTION to Section 601.2.2.7: Hotel/motel buildings and nonresidential buildings with Group R occupancies.

601.3 Prescriptive requirements (Newly Constructed).

601.3.1 *[Section 140.6]* Indoor Lighting.

…

601.3.1.1 *[Section 140.6(a)]* Calculation of adjusted indoor lighting power.

The adjusted indoor *lighting* power of all proposed *building* areas is the total watts of all planned permanent and *portable lighting* systems in all areas of the proposed *building*; subject to the applicable adjustments under Sections 601.3.1.1.1 through 601.3.1.1.4, and the requirements of Section 601.3.1.1.4.

…

601.3.1.1.2 *[Section 140.6(a)2]* Reduction of wattage through controls.

In calculating adjusted indoor *lighting* power, the installed watts of a *luminaire* providing *general lighting* in an area *listed* in Table 601.3-A *[Table 140.6-A]* may be reduced by the product of (i) the number of watts controlled as described in Table 601.3-A *[Table 140.6-A]*, times (ii) the applicable power adjustment factor (PAF), if all of the following conditions are met:

…

11. **Demand responsive control PAF.** To qualify for the PAF for a *demand responsive control* in Table 601.3-A *[Table 140.6-A]*, the *general lighting* wattage receiving the PAF shall not be within the scope of Section 600.4.2 *[Section 110.12(c)]* and a *demand responsive control* shall meet all of the following requirements:

    11.1. The controlled *lighting* shall be capable of being automatically reduced in response to a *demand response signal*; and

    11.2. *General lighting* power in hotel/motel buildings and nonresidential buildings with Group R occupancies shall be reduced in a manner consistent with the requirements of Section 601.2.2.2 *[Section 130.1(b)]*. *General lighting* power in spaces in other nonresidential buildings shall be reduced by continuous dimming.

…

601.3.1.3 *[Section 140.6(c)]* **Calculation of allowed indoor lighting power: specific methodologies.**

The allowed indoor lighting power for each *building* type, or each primary function area shall be calculated using only one of the methods in Section 601.3.1.3.1 or Section 601.3.1.3.2 below as applicable.

…

601.3.1.3.3 *[Section 140.6(c)2G]* **Area Category Method - Additional lighting power allowances for qualifying lighting systems.**

In addition to the allowed indoor lighting power calculated according to Section 601.3.1.3.2 *[Sections 140.6(c)2A through F]*, the *building* may add additional lighting power allowances for qualifying lighting systems as specified in the Qualifying Lighting Systems column in Table 601.3-C *[Table 140.6-C]* under the following conditions:

…

7. **Videoconferencing studios.** Additional lighting power for videoconferencing as specified in Table 601.3-C *[Table 140.6-C]* shall be allowed in a *videoconferencing studio*, as defined in Section 200 *[Section 100.1]*, provided the following conditions are met:

…

7.3. General lighting in hotel/motel buildings and nonresidential buildings with Group R occupancies is switched in accordance with the requirements of Section 601.2.2.2 *[Section 130.1(b)]*. General lighting in other nonresidential buildings is switched in accordance with the requirements of Section 601.2.2.1.4 *[Section 130.1(a)4]*; and

…

601.5 *[Section 141.0]* **Additions and alterations to existing buildings.**

TABLE 601.5-A [Table 141.0-F] – CONTROL REQUIREMENTS FOR INDOOR LIGHTING SYSTEM ALTERATIONS

Control Specifications	Coded Section	Projects complying with Section 601.5.2.2.4 item 1	Projects complying with 601.5.2.2.4. item 2 or 3
Manual Area Controls	601.2.2.1.1 *[130.1(a)1]*	Required	Required
Manual Area Controls	601.2.2.1.2 *[130.1(a)2]*	Required	Required
Manual Area Controls	601.2.2.1.3 *[130.1(a)3]*	Only required for new or completely replaced circuits	Only required for new or completely replaced circuits
Manual Area Controls	601.2.2.1.4 *[New section]*	Required	Not Required
Multilevel Controls	601.2.2.2 *[130.1(b)]*	Required	Not Required
Automatic Shut-Off Controls	601.2.2.3.1 *[130.1(c)1]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.2 *[130.1(c)2]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.3 *[130.1(c)3]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.4 *[130.1(c)4]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.5 *[130.1(c)5]*	Required	Required
Automatic Shut-Off Controls	601.2.2.3.6 *[130.1(c)6]*	Required	Required; except for 601.2.2.3.6.4 *[130.1(c)6D]*
Automatic Shut-Off Controls	601.2.2.3.7 *[130.1(c)8]*	Required	Required
Daylight Responsive Controls	601.2.2.4 *[130.1(d)]*	Required	Not Required
Demand Responsive Controls	600.4.1 *[110.12(a)]* and 600.4.2 *[110.12(c)]*	Required	Not Required

Potential HVAC Controls Code Language for Alignment with Proposed Lighting Controls Code Language

SUBCHAPTER 4 SPACE-CONDITIONING AND VENTILATION

SECTION 401

NONRESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

401.2 Mandatory requirements (Newly Constructed, Additions, Alterations).

401.2.1 *[Section 120.1]* **Ventilation and Indoor Air Quality**

…

401.2.1.2.5 *[Section 120.1(d)5]* **Occupied standby zone controls.**

…

401.2.1.2.5.1 *[Section 120.1(d)5B]* **Control functionality.**

Occupied-standby zone controls shall comply with the following:

1. Occupant sensors shall have suitable coverage and placement to detect occupants in the entire space. In ~~20~~<u>15</u> minutes or less after no occupancy is detected by any sensors covering the room, *occupant sensing controls* shall indicate a room is vacant.

   <u>**Exception to Section 401.2.1.2.5.1.1:** Occupant sensors in hotel/motel buildings and nonresidential buildings with Group R occupancies shall indicate a room is vacant in 20 minutes or less after no occupancy is detected by any sensors covering the room.</u>

…

(CONTINUED): TABLE 401.2-A [TABLE 120.1-A]– MINIMUM VENTILATION RATES

Occupancy Category - *Office Buildings*	**Minimum Occupant Load Density (persons / 1000 ft^2)**	**Area-based Minimum Ventilation R_a (cfm/ft^2)**	**Air Class**	**Notes**
~~Breakrooms~~	~~33~~	~~0.15~~	~~1~~	~~--~~
Main entry lobbies	33	0.15	1	F
Occupiable storage rooms for dry materials	2	0.15	1	--
Office space	5	0.15	1	F

Occupancy Category - *Office Buildings*	Minimum Occupant Load Density (persons / 1000 ft^2)	Area-based Minimum Ventilation R_a (cfm/ft^2)	Air Class	Notes
Reception areas	5	0.15	1	F
Telephone/data entry	33	0.15	1	F

…

SUBCHAPTER 9 PROCESS SYSTEMS AND EQUIPMENT

SECTION 912

LABORATORY AND FACTORY EXHAUST SYSTEMS

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

912.1 Mandatory requirements.

RESERVED.

912.2 *[Section 140.9(c)]* **Prescriptive requirements (Newly Constructed).**

Exception to Section 912.2: Healthcare facilities.

912.2.1 *[Section 140.9(c)1]* **Airflow reduction requirements.**

…

2. **Unoccupied minimum exhaust airflow.** Within ~~20~~15 minutes of no occupancy being detected by any occupant sensors covering the space, the minimum exhaust and makeup airflow rates shall be the greater of:

   2.1. User-defined airflow not to exceed 0.67 cfm/ft^2 (equivalent to 4 air changes per hours for a 10-foot high ceiling), or

   2.2. The regulated minimum unoccupied circulation rate documented to comply with code, accreditation, or facility environmental health and safety department requirements, or

   2.3. The minimum needed to maintain unoccupied pressurization.

…

Reference Appendices

NA7.6 Indoor Lighting Controls Acceptance Tests

NA7.6.1 Daylight Responsive Controls Acceptance Tests

…

NA7.6.1.6 Switching or Dimming Control Systems Functional Testing for Parking Garage Daylight Adaptation Zone Applications

Switching or dimming control systems for daylight adaptation controls are required to manage the adaptation zone lights in a manner that turns OFF the added lighting power allowance in the adaptation zone but is not required to impact the general lighting system if it is separate, or is permitted to maintain an output that is consistent with the general lighting LPA if the systems are combined for the adaptation zone.

1. **Reference location.** The reference location for the adaptation zone lighting system is a location near the photocell that will control the adaptation lighting zone lighting equipment.
2. **Reference illuminance.** A reference illuminance of 10 footcandles should be used for testing the function of the adaptation lighting zone system unless another value is specified by the design engineer in the lighting controls documents. Note that this illuminance value is at the photocell and in the orientation of the photocell receptor and is not an illuminance on the garage deck or ramp.
3. **Nighttime test.** Simulate or provide conditions without daylight on the photocell sensor. Verify and document the following:
    a. *If the adaptation zone lighting is a separate system:* Document that the adaptation zone lighting system is turned OFF when illuminance at the reference location is below the 50 percent intended design illuminance trigger level (or 5 footcandles, if not designated in the design documents).
    b. *If the adaptation zone lighting is part of a combined dimming system:* Document that the combined lighting control system is dimmed to 10 percent of the maximum output when the reference location is below 50 percent of the intended design or reference illuminance. Circuit amperage, a lighting control system reading, or a focused illuminance meter that reads only the

output of the lighting equipment are all suitable methods for verification of this output.

c. Light output is stable with no visible flicker.

4. **Daytime test.** Simulate or provide bright conditions where the illuminance is greater than 150 percent of the intended design illuminance trigger level (or 15 footcandles, if this is not designated in the design documents) at the reference location photocell. Verify and document the following:

    a. The daylight adaptation zone lighting system is operating at the fully intended adaptation lighting output per the specifications of the design engineer.

    No intermediate test is required for dimming systems in a daylight adaptation zone lighting system.

NA7.6.2 Shut-off Controls Acceptance Tests

…

NA7.6.2.3 Occupant Sensing Lighting Controls Functional Testing

This requirement applies to areas where occupant sensing controls are required to comply with Section 130.1(c) with the exception of Section 130.1(c)6D.

For each sensor to be tested do the following:

(a) Unoccupied Test. Simulate an unoccupied condition in the controlled space. Verify and document the following:

1. The occupant sensing control turn the controlled lighting off or partially-off in ~~20~~15 minutes or less from the start of an unoccupied condition. In addition:

    a. For partial-on occupant sensing controls, occupant sensing controls and vacancy sensing controls, the controlled lighting is turned off in unoccupied condition.

    …

NA7.6.2.7 Automatic Astronomic Time Switch Lighting Controls Functional Testing for Parking Garage Adaptation Zone Lighting

1. “Daylight” Test. Simulate a daytime condition in the controlled adaptation zone. Verify and document the following:

a. The automatic time switch control turns the controlled adaptation zone lighting ON.

2. "Nighttime" Test. Simulate a nighttime condition in the controlled space. Verify and document the following:

   a. The automatic time switch control turns OFF or dims the lighting equipment that is designated as adaptation zone lighting. Circuit amperage, a lighting control system output percentage, or a focused illuminance meter that reads only the output of the lighting equipment are all suitable methods for verification of this output.

Potential HVAC Controls Code Language for Alignment with Proposed Lighting Controls Code Language

NA7.5 Mechanical Systems Acceptance Tests

…

NA7.5.17 Occupied Standby

…

NA7.5.17.2 Functional Testing

…

Step 7: For space conditioning systems that also provide ventilation to the zone, confirm that within 5 minutes of occupant sensing controls indicating that the zone is unoccupied the setpoint is setup or setback and the zone is within the occupied standby deadband. Occupant Sensing controls may have a time delay of up to ~~20~~15 minutes before indicating the space is unoccupied and occupant sensing zone controls may allow up to an additional 5 minute time delay after occupant sensing controls have indicated all rooms served by the zone are unoccupied before resetting zone temperature setpoints and shutting off zone ventilation air).

…

NA7.16 Lab Exhaust Ventilation System Acceptance Test

…

NA7.16.2 Functional Testing for VAV Lab Exhaust System with Occupancy Controls

…

Step 3: Simulate minimum flowrate under unoccupied conditions by adjusting fume hoods and other exhaust devices and vacate all lab spaces served by the exhaust fan system for at least ~~20~~15 minutes so occupant control treats lab spaces as unoccupied. Adjust the thermostatic control so that the space temperature is within the dead band.