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California Energy Alliance (CEA) - 2025 Energy Code Measure Proposal - Multilevel Lighting Controls Expansion

CEA appreciates the opportunity to submit a measure proposal to the CEC for consideration in the 2025 Energy Code pre-rulemaking. This proposal would expand current requirements for nonresidential Multilevel Lighting Controls and meets the CEC cost-effectiveness criteria.

Additional submitted attachment is included below.

2025 California Energy Code

Measure Proposal to the

California Energy Commission

Multilevel Lighting controls expansion

Nonresidential Lighting

Prepared by: California Energy Alliance

August 2023

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Document Information

Keywords: Energy Code, Building Energy Efficiency Standards, Statewide Codes and Standards, Title 24, 2025, efficiency, multilevel lighting controls, Lighting control hierarchy, Zoning and dimming, Occupancy sensing, Task lighting control, Scene control, Lighting presets, Light level tuning, Centralized lighting control, Decentralized lighting control, Lighting control protocols (e.g., DALI, DMX), Lighting control panels, Lighting control software, Individual fixture control, Energy management system, Light-emitting diodes (LED) control, Wireless lighting control, User interface, and control devices

EXECUTIVE SUMMARY

Introduction

The California Energy Alliance sponsored this effort. This report proposes specific energy efficiency actions that could result in further reductions of wasteful, uneconomic, inefficient, or unnecessary consumption of energy in the state of California. The code change proposal, or "measure", described in this report is provided to the California Energy Commission (CEC) for consideration and possible inclusion in the California Energy Code (also known as the Energy Code, or Building Energy Efficiency Standards, or Title 24 Part 6). This measure will be considered, may be modified, and could be assembled as part of a comprehensive regulatory package proposed and adopted by the CEC. Measures proposed for inclusion in the Energy Code must be found to be cost-effective and technically feasible.

The California Energy Alliance's mission is to bring beneficial, equitable change to energy standards, policies, and programs by developing consensus among diverse and engaged stakeholders. By collaborating with various stakeholders such as manufacturers, contractors, and commissioning providers, we propose measures that will achieve energy savings, cost reduction, and support the state's energy and environmental objectives. The CEA partnered with stakeholders to develop code changes, incorporating analyses and compliance insights. Technical viability and market readiness were confirmed through working group sessions, surveys, interviews, and targeted industry feedback. Manufacturers and sales reps provided control solution insights and cost data, shaping cost estimates. Engagement spanned manufacturers, designers, engineers, advocates, standard developers, associations, installers, contractors, distributors, and working group participants.

The CEA has developed proposals for the upcoming 2025 edition of California's Building Energy Efficiency Standards. These proposals focus on maximizing energy savings with minimal additional investment by:

- Enhancing current code measures by expanding requirements.
- Broadening the scope of code measures to include additional spaces and building types.
- Streamlining existing code measures to simplify compliance.
- Facilitating access to valuable data to improve visibility and maximize energy savings.

Code Change Description

This proposed code amendment aims to enhance and provide clearer guidelines for multilevel lighting controls that improve the overall impact of multilevel lighting controls.

The proposal involves adjusting the connected lighting load requirement to enforce multilevel lighting controls in more spaces. It extends the multilevel control mandate to encompass additional spaces including those measuring less than 100 square feet, while also removing some prior exceptions.

Additionally, the measure seeks to simplify the code language by consolidating similar requirements and directly integrating control criteria into the code structure.

This measure proposal aligns with findings and recommendations from the 2025 Title 24 Lighting Language Cleanup Initiative which was led by the California Lighting Technology Center in collaboration with Southern California Energy, RMS Energy Consulting, and the California Energy Alliance. The recommendations from the Cleanup Initiative have been discussed with the CEC and at CASE Team workshops as proposals that involve cleanup of the code language in lighting and controls sections.

Per the details in the CEC Docket 22-BSTD-01, TN#250676 submitted in June of 2023, 62% of stakeholders at the February 24th CASE Team Workshop supported the removal of Table 130.1-A Multilevel Lighting Controls and Uniformity Requirements and to add 'and maintain illuminance uniformity by providing continuous dimming from 10-100 percent power' to the language of Section 130.1(b)(California Energy Commission, 2022).

The Cleanup Initiative has recommendations to incorporate the same language simplification and the removal of the Table 130.1-A just as this measure proposal.

Justification

In order to further augment benefits of multilevel lighting controls in accordance with Title 24 regulations, an expansion of the requirement to encompass a wider array of spaces is warranted. Expanding the thresholds for multilevel lighting controls is justified for several reasons:

Energy Savings Validation: The LBNL meta-analysis (LBNL, 2011) provides robust evidence of significant energy savings achieved through personal tuning. With an average energy savings of 34% demonstrated across various lighting control strategies, this research underscores the effectiveness of multilevel lighting controls in achieving substantial reductions in energy consumption.

Inherent Dimmability: The widespread availability of inherently dimmable LED luminaires at no additional cost simplifies the integration of multilevel lighting controls. Given that most LED luminaires in the market possess dimming

capabilities without incurring extra expenses, implementing such controls becomes cost-effective and feasible for a broader range of projects.

Market Transformation: Continuous dimmability is now a requirement for all DesignLights Consortium (DLC) listed lighting products. This regulatory shift demonstrates the market's growing emphasis on adaptable lighting systems that can be effectively controlled. Expanding multilevel lighting controls aligns with this industry transformation, ensuring compliance with modern lighting standards.

Incorporating these factors into the decision to adjust the multilevel lighting controls threshold not only harnesses proven energy savings potential but also leverages the industry's momentum toward energy-efficient lighting solutions. This approach aligns with both research-driven evidence and market trends, ultimately leading to enhanced energy efficiency, reduced operational costs, and sustainable lighting practices.

Background Information

Multilevel lighting controls have been an evolving aspect of the Title 24 energy efficiency standards in California. Multilevel lighting controls are energy efficient because they allow for the adjustment of lighting levels based on specific needs, ensuring that only the required amount of light is utilized, thereby reducing energy consumption and waste.

Over the years, the Title 24 Part 6 standards have evolved and expanded to include various measures for lighting control, including multilevel controls. The 2019 version of Title 24 continued the trend of enhancing lighting control measures. It expanded the application of multilevel lighting controls, daylight harvesting, and occupancy sensing requirements to a broader range of spaces. The standards also introduced stricter guidelines for lighting control system commissioning and testing to ensure proper functionality and compliance.

With each subsequent code update, California continues to refine its approach to multilevel lighting controls. This proposal aims to enhance and provide clearer guidelines for multilevel lighting controls and updates that have occurred during these code updates.

Scope of Work

Multilevel Lighting Controls Expansion will modify the following Energy Code sections, reference appendices and supporting documents listed in Table 1.

Table 1: Code Change Scope of Work

Energy Code Section(s)	Regulation Type(s): M, Ps, or Pm	Reference Appendices	Modeling Tools	Forms	Other Supporting Documents
Section 130.1(b) of Title 24 Part 6	M	N/A	N/A	N/A	Table 130.1-A multilevel lighting Controls and Uniformity

An (M) indicates mandatory requirements, (Ps) Prescriptive, (Pm) Performance.

Compliance and Enforcement

Multilevel controls have seamlessly integrated into lighting control systems due to the inherent dimmability of LED luminaires. This feature facilitates easy support for multilevel controls across various building types and room sizes, thereby enhancing compliance with expanded code measures.

Since this is not a new section being added to code and is just an expansion, current compliance and enforcement practices for multilevel controls will still be applicable.

The proposed simplification of code language through requirement consolidation also improves compliance by aiding practitioner and stakeholder understanding, aligning with sustainable practices and minimizing energy use as per Title 24 guidelines.

The expansion of compliance efforts to additional spaces affected by the proposal demonstrates a proactive approach without major altering of the existing compliance processes. Although this might slightly increase the workload of acceptance test technicians, no specific issues regarding enforcement have been identified. See Section 2.3 for more details.

Market Assessment

Multilevel lighting controls have seen a significant increase in availability and adoption within the market in recent years due to a combination of factors such as industry standards, technology advancements, and energy efficiency requirements.

Integration into Lighting Systems: Multilevel controls have become an integral part of many lighting systems available in the market. Lighting control manufacturers commonly include these capabilities in their product offerings. These controls allow users to adjust lighting levels based on various factors, such as occupancy, time of day, and available natural light.

Industry Standards and Regulations: Energy efficiency standards and regulations, such as those outlined in building codes like Title 24, have played a crucial role in driving the availability of multilevel controls. Compliance with these regulations has prompted manufacturers to develop products that meet or exceed the required control functionalities.

LED Technology Advancements: The widespread adoption of LED technology has facilitated the integration of multilevel controls. Many LED luminaires are inherently dimmable, allowing for seamless integration with multilevel control systems. Notably, any lighting products approved by the DesignLights Consortium (DLC) necessitate continuous dimming functionality, serving as a testament to the ongoing market transformation in this domain.

Scalability and Customization: Multilevel controls come in various forms, ranging from simple dimmers to advanced networked systems. This variety caters to the diverse needs of different spaces and applications that can be scaled and customized to suit specific requirements.

Energy Efficiency Benefits: The energy-saving potential of multilevel controls and the requirements in current code has garnered attention from both consumers and industry professionals. As businesses and individuals seek ways to reduce energy consumption and operating costs, the availability of multilevel controls has become an appealing solution.

Cost-effectiveness

This proposal includes an expansion to existing controls requirements, and as such, cost-effectiveness considerations should be considered cost-effective. Requirements pertaining to mandatory installation of multilevel lighting controls have already been deemed cost-effective under previous multilevel controls development activities.

According to public documents and studies, lighting controls in California have been shown to provide significant energy savings. Here are the savings estimates with references to relevant public documents:

- Title 24 Compliance: The California Energy Commission (CEC) estimates that compliance with Title 24, the state's energy efficiency standards, can result in lighting energy savings of approximately 30-40% compared to baseline practices. (California Energy Commission, n.d.)
- LBNL Meta-Analysis: The Lawrence Berkeley National Laboratory (LBNL) conducted a meta-analysis of energy savings from lighting controls in commercial buildings. The study found that lighting controls, such as occupancy sensors, dimming systems, and daylight harvesting, can achieve average energy savings of around 35-45% in commercial buildings. (LBNL, 2011)

- CLTC Case Studies: The California Lighting Technology Center (CLTC) has conducted various case studies on lighting retrofits and energy savings in California buildings. These studies have reported energy savings ranging from 20% to over 50% through the implementation of lighting controls, including occupancy sensors, daylighting controls, and task tuning. (California Lighting Technology Center, n.d.)
- Utility Programs: California's investor-owned utilities, such as Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E), offer energy efficiency programs that promote the adoption of lighting controls. These programs estimate energy savings based on specific projects and have reported substantial savings achieved through the implementation of lighting controls. (PG&E, SCE, SDG&E, n.d.)

The Lighting Controls Association offers a collection of industry research that showcases proven, projected, or possible energy savings related to different control strategies and settings. Table 2 highlights this research from the Lighting Controls Association (DiLouie, 2013).

Table 2: Industry Research

Space Type	Controls Type	Lighting Energy Savings Demonstrated in Research or Estimated as Potential	Study Reference
Private Office	Occupancy sensor	38%	An Analysis of the Energy and Cost Savings Potential of Occupancy Sensors for Commercial Lighting Systems, Lighting Research Center/EPA, August 2000.
	Multilevel switching	**22%**	**Lighting Controls Effectiveness Assessment, ADM Associates for Heschong Mahone Group, May 2002.**
	Manual dimming	**6-9%**	**Occupant Use of Manual Lighting Controls in Private Offices, IESNA Paper #34, Lighting Research Center.**
Open Office	Occupancy sensors	35%	National Research Council study on integrated lighting controls in open office, 2007.
	Multilevel switching	**16%**	**Lighting Controls Effectiveness Assessment, ADM Associates for Heschong Mahone Group, May 2002.**

	Personal dimming control	**11%**	**National Research Council study on integrated lighting controls in open office, 2007.**
Classroom	Occupancy sensor	55%	An Analysis of the Energy and Cost Savings Potential of Occupancy Sensors for Commercial Lighting Systems, Lighting Research Center/EPA, August 2000.
	Multilevel switching	**8%**	**Lighting Controls Effectiveness Assessment, ADM Associates for Heschong Mahone Group, May 2002.**

The proposed measure impacts more than one building prototype, however, Small School was chosen as it this prototype incorporates many of the new spaces that are gained by the proposed measure (e.g., classroom and dining spaces). As incremental costs and energy savings are similar across all newly gained space types, CEA only focused on schools in order to show cost effectiveness. Per conversations with CEC staff, there were concerns about incremental costs for schools. This analysis shows cost effectiveness for the new spaces in schools that would require multilevel lighting controls where they were not required in the 2022 Title 24 Part 6.

Table 3 summarizes the estimated benefits, costs and resulting Benefit-Cost Ratios (BCR) by California climate zone for the proposed measures.

Table 3: Cost-effectiveness Summary Per Square Foot

Climate Zone	Benefit: Total Incremental LSC Savings and Other Savings (PV$)	Cost: Total Incremental First Costs and Maintenance Costs (PV$)	Benefit-Cost Ratio (BCR)
Climate Zone 1	$ 5	$ 0.16	1.7
Climate Zone 2	$ 5	$ 0.16	1.6
Climate Zone 3	$ 5	$ 0.16	1.6
Climate Zone 4	$ 5	$ 0.16	1.6
Climate Zone 5	$ 5	$ 0.16	1.6
Climate Zone 6	$ 5	$ 0.16	1.5
Climate Zone 7	$ 5	$ 0.16	1.6
Climate Zone 8	$ 5	$ 0.16	1.6
Climate Zone 9	$ 5	$ 0.16	1.6
Climate Zone 10	$ 5	$ 0.16	1.6
Climate Zone 11	$ 5	$ 0.16	1.6
Climate Zone 12	$ 5	$ 0.16	1.6
Climate Zone 13	$ 5	$ 0.16	1.6
Climate Zone 14	$ 5	$ 0.16	1.6
Climate Zone 15	$ 5	$ 0.16	1.5
Climate Zone 16	$ 5	$ 0.16	1.6

Statewide Energy Impacts

CEA evaluated the year one statewide energy and cost savings that will be realized in 2026 by calculating the product of the per unit savings by the newly constructed buildings forecast. Additionally, CEA evaluated the year one statewide greenhouse gas emission savings that will be realized in 2026 by calculating the product of the per unit savings by the newly constructed buildings forecast.

Again, the proposed measure impacts more than one building prototype, however, Small School was chosen as it this prototype incorporates many of the new spaces that are gained by the proposed measure (e.g., classroom and dining spaces). As incremental costs and energy savings are similar across all newly gained space types, CEA only focused on schools in order to show cost effectiveness and the following tables reflect the one building prototype.

Table 4 and Table 5 summarize the estimated statewide energy and greenhouse gas (GHG) emissions savings for the first year that the proposed measure is implemented.

Table 4: Estimated Statewide Energy Savings

	First Year Statewide Electricity Savings (GWh)	First Year Statewide Power Demand Reduction (MW)	First Year Statewide Natural Gas Savings (Million Therms)	First Year Statewide Electricity LSC Savings (PV$ Mill)	First Year Statewide Natural Gas LSC Savings (PV$)
Multilevel Lighting Controls	35.17	0	0	$0.91	$0
Total	35.17	0	0	$0.91	$0

Table 5: Estimated Statewide Greenhouse Gas Emission Savings

	First Year Statewide GHG Emission Savings (MT CO_2e/year)	First Year Statewide GHG Emissions Savings (PV$)
Multilevel Lighting Controls	11.74	$1445
TOTAL	**11.74**	**$1445**

ACRONYMS

Acronym	Definition
ACM	Alternate Calculation Method
AP-42	USEPA's Compilation of Air Pollutant Emission Factors
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BCR	Benefit-Cost Ratio
BCZ	Building Climate Zone
BEM	Building Energy Modeling
BTU	British Thermal Units
Cal/OSHA	California Department of Occupational Safety and Public Health
CAMX	Western Electricity Coordinating Council California & Mexico Subregion
CARB	California Air Resources Board
CBECC	California Building Energy Code Compliance software
CBECC-Res	California Building Energy Code Compliance software for single-family buildings
CEA	California Energy Alliance
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CPUC	California Public Utilities Commission
CZ	California Climate Zone
EIR	Environmental Impact Report
FCZ	Forecast Climate Zone

GHG	Greenhouse Gas
GWh	Gigawatt-Hour
IECC	International Energy Conservation Code
IOU	Investor Owned Utility
KBTU	Thousands of British Thermal Units
kWh	Kilowatt-Hour
kWh/year	Kilowatt-Hour Per Year
LED	Light-emitting diode
MG	Million Gallons of Water
MMT CO2e	Million Metric Tons of Carbon Dioxide Equivalent
MTCO2e	Metric Tons of Carbon Dioxide Equivalent
MW	Megawatt
NAICS	North American Industry Classification System
PV$	Present Value Dollars
RPS	Renewable Portfolio Standard
SDD	Standards Data Dictionary
SOC	Standard Occupational Classification
LSC	Long-term System Cost (30-year $)
W/sq.ft.	Watt per square foot
WECC	Western Electricity Coordinating Council

1. INTRODUCTION

This report proposes specific energy efficiency actions that could result in further reductions of wasteful, uneconomic, inefficient, or unnecessary consumption of energy in the state of California. The code change proposal, or "measure", described in this report is provided to the California Energy Commission (CEC) for consideration and possible inclusion in the California Energy Code (also known as the Energy Code, or Building Energy Efficiency Standards, or Title 24 Part 6). This measure will be considered, may be modified, and could be assembled as part of a comprehensive regulatory package proposed and adopted by the CEC. Measures proposed for inclusion in the Energy Code must be found to be cost-effective and technically feasible.

Consistent with California Law (Public Resources Code 25000), an energy efficiency measure is cost-effective if the Benefit-Cost Ratio (BCR) is 1.0 or greater, when amortized over the economic life of the structure. BCR is calculated by dividing the total dollar benefit of the measure by the total dollar cost of the measure, over a period of analysis of 30 years.

To calculate benefit, Long-term System Cost (LSC) is used to determine the dollar value of energy efficiency measures in the Energy Code. LSC hourly factors help the state account for long-term benefits associated with policies needed to meet the statewide climate actions goals – such as 100% renewable generation, proliferation of electric transportation, and drastic reductions in fossil fuel combustion occurring in buildings. Today's energy costs do not adequately account for these long-term values to California's energy system. LSC hourly factors weigh the long-term value of each hour differently, where times of peak demand are more valuable, and times off-peak demand are less valuable. LSC hourly factors are not utility rates or energy rate forecasts. LSC is not a predicted utility bill.

LSC hourly conversion factors are developed and published by the CEC for each code cycle. These LSC hourly factors are used to convert predicted site energy use – an output common to building energy modeling (BEM) software – to 30-year present value to California's energy system.

Energy savings for proposed measures are estimated using both LSC hourly factors and CEC-established model prototypes. Large sets of survey data are used to create prototypes that act as averaged representations of common building types in California. These prototypes are created for use in BEM software to provide accuracy and consistency amongst energy models that are used to determine energy savings for the state. CEC-developed prototypes and LSC hourly factors are published by the CEC ahead of each code cycle integral to research versions of CEC's reference Energy Code compliance software (CBECC-Res and CBECC). For this reason, CBECC-Res

and CBECC are the CEC-recommended BEM software tool when assessing energy savings of proposed measures.

To calculate cost, first costs and ongoing maintenance costs must be assessed for proposed measures and accounted for over a period of analysis of 30 years. In the BCR, both the benefits and the costs are assessed incrementally, meaning in comparison to the latest adopted version of the Energy Code.

Similar to LSC hourly factors, the CEC develops and publishes conversion factors for Source Energy, and for GHG Emissions for each code cycle. These three sets of hourly factors are published on CEC's website and formatted to be accessible and usable in combination with broadly available BEM tools.

2. MEASURE DESCRIPTION

This proposal entails modifying Section 130.1(b) Multilevel Lighting Controls of Title 24 Part 6. This section applies to a wide range of building types and systems. The measure is applicable to nonresidential buildings, including commercial, industrial, government, federal and institutional facilities such as offices, retail spaces, schools, healthcare facilities, and more. It encompasses both new construction and retrofit projects in the state of California. The measure does not disallow the installation of federally covered products.

The proposal reduces the existing requirement of 0.5 watts per square foot (W/sq.ft.) connected lighting load requirement to mandate the implementation of multilevel lighting controls for spaces with a connected lighting load exceeding 0.4 W/sq.ft.

The proposal also expands the multilevel lighting control requirement to classrooms and spaces below 100 square feet. Some Exceptions, previously applicable, shall be omitted.

Table 6: Spaces Gained by Measure Proposal

Spaces gained *(not currently required to have multi-level lighting controls but would with the current proposal)*	**Spaces exempted currently will continue to be exempt going forward.**
Audience seating area	Laundry area
Dining areas for bar/leisure/fine dining/fast food/cafeteria	Locker room
Gymnasium, Exercise/Fitness Center	Copy room
Motion picture theater	Restrooms
Transportation ticketing area	Healthcare facilities
Classrooms	Warehouse storage
Spaces using more than 0.4 W/sf and with only one luminaire using 20W or more lighting power (conference rooms, private offices…)	Electrical, mechanical, telephone rooms
Small spaces less than 100 sf using more than 0.4 W/sf of lighting power	

By broadening the scope of these controls to include additional areas, the overall energy efficiency and lighting quality of more existing and new building environments can be significantly improved. The proposal cost-effectively

increases the stringency of the Energy Code, thereby minimizing the energy use of commercial buildings lighting loads, which in turn improves the state's economic and environmental health.

This proposal adds language that will allow occupants to manually adjust the illuminance level up to full light output (or a high-end trimmed level) and down to 10% of full light output or lower, and separately allow the occupants to turn the lighting OFF.

The proposed measure will also remove Table 130.1-A "Multilevel Lighting Controls and Uniformity Requirements" and simplify code language by combining similar requirements and include control requirements in code language rather than in a table. This measure proposal aligns with findings and recommendations from the 2025 Title 24 Lighting Language Cleanup Initiative which was led by the California Lighting Technology Center in collaboration with Southern California Energy, RMS Energy Consulting, and the California Energy Alliance. The recommendations from the Cleanup Initiative have been discussed with the CEC and at CASE Team workshops as proposals that involve cleanup of the code language in lighting and controls sections. The Cleanup Initiative has recommendations to incorporate the same language simplification and the removal of the Table 130.1-A as this measure proposal.

According to the information provided in docket 22-BSTD-01 TN# 250676, which was submitted in June 2023, the majority (62%) of the attendees at the February 24th CASE Team Workshop supported the removal of Table 130.1-A Multilevel Lighting Controls and Uniformity Requirements. Additionally, they agreed with the proposed inclusion of the phrase 'and maintain illuminance uniformity by providing continuous dimming from 10-100 percent power' into the wording of Section 130.1(b)(California Energy Commission, 2022).

This approach offers notable benefits as it aims to streamline the code language by consolidating comparable requirements and seamlessly integrating control criteria into the code's structure. By doing so, the code becomes clearer, more coherent, and easier to understand, ultimately enhancing its usability and effectiveness for both practitioners and stakeholders.

2.1 Measure Modifications to Energy Code Documents

The following sections provide a summary of how the proposed change would impact the standards, Reference Appendices, Alternative Calculation Method (ACM) Reference Manuals, and compliance documents. Full markup of code language and listed updates are in Section 6.

2.1.1 Energy Code Change Summary

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

Subsection 130.1(b): The proposed regulations amend this subsection by reducing the threshold of connected lighting load to require additional spaces to incorporated multilevel lighting controls as well as removing exceptions to this subsection. This reduces the energy use of nonresidential building spaces where multilevel lighting controls were not previously required. This requirement cost-effectively increases the stringency of the Energy Code, thereby minimizing the energy use of nonresidential buildings, which in turn improves the state's economic and environmental health. Additionally, this proposed regulation will remove Table 130.1-A Multilevel Lighting Controls and Uniformity Requirements. The requirements found in Table130.1-A have been incorporated in the amended language of Subsection 130.1(b).

2.1.2 Reference Appendices Change Summary

No change to the reference appendices.

2.1.3 Compliance Manuals Change Summary

To align with the measure, language in the compliance manual Section 5.4.2 Multilevel Lighting Controls needs to be modified and Table 130.1-A needs to be removed. References to Table 130.1-A will need to be removed in various subsections in Section 5.4 Mandatory Lighting Controls.

2.1.4 ACM Reference Manuals Change Summary

No change to the Alternative Calculation Methods (ACM) Reference Manuals.

2.1.5 Compliance Forms Change Summary

The proposed code change mandates a lower default value for "regulated lighting" W/sq.ft. in additional spaces where multilevel lighting is made mandatory by this measure.

2.2 Measure Context

2.2.1 Comparable Model Code or Standard

The proposed code change aligns with the most recent revision to the controls requirements to Section 9.4 of ASHRAE 90.1-2019. Both American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and 2022 Title 24 Part 6 currently have requirements related to multilevel lighting controls, although they have different scopes and applicability.

ASHRAE 90.1 provides guidance on energy efficiency measures for commercial and high-rise residential buildings. It includes mandatory requirements that spaces have for lighting controls, including multilevel controls, occupancy sensors, and daylight harvesting. Section 9.4.1.1 (d) states (ASHRAE, n.d.):

d. Multilevel lighting control: The *general lighting* in the *space* shall be *manually* controlled with *continuous dimming* to 10% or less of full lighting power in addition to full ON and full OFF.

Table 9.3.1-2 Simplified Building Method for Retail Buildings

Interior Space Type	Controls
All *spaces* in retail *buildings* other than parking garages The total *LPA* for the *building* other than parking garages shall not exceed 0.70 W/ft^2.	All lighting shall be *automatically* controlled to turn off when individual *spaces* are either unoccupied or scheduled to be unoccupied. (**Exception:** Lighting load not exceeding 0.02 W/ft^2 multiplied by the gross lighted area of the *space* shall be permitted to operate at all times.) Each *space* shall have a *manual control device* that allows the occupant to reduce lighting power by a minimum of 50% and to turn the lighting off.

ASHRAE Table 9.5.2.1 below also aligns with the current proposal that removes the exception for classrooms as this table requires multilevel lighting controls in all classrooms (ASHRAE, n.d.).

Common Space Types[a]	LPD, W/ft^2	RCR	Local Control 9.4.1.1(a)	Manual ON 9.4.1.1(b)	Partial Auto ON 9.4.1.1(c)	Multilevel Lighting Control 9.4.1.1(d)
Atrium						
<20 ft in height	0.32	NA	REQ	ADD1	ADD1	
≥20 ft and ≤40 ft in height	0.41	NA	REQ	ADD1	ADD1	
>40 ft in height	0.51	11	REQ	ADD1	ADD1	
Audience Seating Area						
Auditorium	0.57	6	REQ	ADD1	ADD1	REQ
Gymnasium	0.23	6	REQ	ADD1	ADD1	REQ
Motion picture theater	0.27	4	REQ	ADD1	ADD1	REQ
Performing arts theater	1.10	8	REQ	ADD1	ADD1	REQ
Sports arena	0.27	4	REQ	ADD1	ADD1	REQ
All other audience seating areas	0.23	4	REQ	ADD1	ADD1	
Banking Activity Area	0.56	6	REQ	ADD1	ADD1	REQ
Classroom/Lecture Hall/Training Room						
Shop classroom	1.17	6	REQ	ADD1	ADD1	
All other classrooms/lecture halls/training rooms	0.72	4	REQ	ADD1	ADD1	REQ

2.2.2 Conflicts with Other Regulations or Certifications

The proposed measure for multilevel controls expansion should not be duplicative of or in conflict with applicable federal, state, or local regulations. Since it is already included in current code the proposal should complement and enhance the existing regulatory framework by providing additional and clearer guidance or more expansive requirements for multilevel lighting controls.

2.3 Compliance and Enforcement

Multilevel lighting controls are included in the current Title 24 Part 6, and they have become a customary feature in various lighting control systems and building designs. Since the majority of LED luminaires are inherently dimmable, there is seamless support and integration for multilevel controls regardless of building type, room dimensions, or connected lighting load. This improves the likelihood of compliance to the expanded code measure.

The proposed simplification of the code language via the consolidation of similar requirements also promotes improved compliance, as it facilitates better understanding and implementation for practitioners and stakeholders, ultimately leading to more effective and efficient adherence to the regulations.

This proactive approach aligns with the ongoing commitment to sustainable practices, enhancing occupant comfort, and minimizing energy consumption across a broader range of spaces subject to Title 24 regulations.

Since this requirement is only an expansion, the process of compliance and enforcement does not need to be modified, only expanded to ensure compliance for the additional spaces affected. This should add limited burden and minimal additional inspection challenges to building officials to ensure compliance. There were no specific issues related to compliance and enforcement that the proposed code change would introduce.

The proposed code change does not alter the existing field verification and acceptance testing requirements or process. The only difference would be the number of spaces within a building that need to undergo field verification and acceptance testing increases because multilevel controls are required in more spaces. Consequently, the time and effort required from the acceptance test technician may increase.

3. MARKET AND ECONOMIC ANALYSIS

CEA conducted a market analysis aimed at identifying existing technology and product availability, along with market trends. Subsequently, the team assessed the potential market impact of the proposed standard on both the broader industry and individual market participants. Data concerning the incremental cost associated with adhering to the proposed measure was collected via surveys and interviews. The CEA also estimated market size and measured applicability through engagement with stakeholders and recognized industry resources.

3.1 Market Structure and Availability

For multilevel lighting controls, there are multiple manufacturers, suppliers, and installers involved in providing the necessary equipment. These include manufacturers specializing in lighting control systems, electrical equipment suppliers, lighting fixture manufacturers, and contractors or electricians responsible for the installation.

The Table 7 below highlights a short list of the many manufacturers and products of multilevel lighting controls: Please note that this table provides just a few examples of manufacturers and their respective multilevel lighting control products. The market offers a wide range of options.

Table 7: Manufacturers and Products

Manufacturer	Product
Leviton	Lumina Gateway
Lutron	Quantum
Acuity Brands	nLight
Crestron	Green Light Systems
Legrand	Wattstopper Lighting Control Systems
Schneider Electric	Powerlink, SpaceLYNK
Eaton	iLumin

Philips Lighting	Dynalite,
Envision Manager	LightMaster
Hubbell Control Solutions	NX Distributed Intelligence

The systems used in multilevel lighting controls can be manufactured, supplied, and installed by more than one party. Different manufacturers may produce lighting control systems or components, while suppliers can distribute these products to various market players. Installers, such as contractors or electricians, are available and well versed in integrating and installing the lighting control systems in buildings since it is already included in the current code.

The existing market has effectively adapted to the demand for multilevel lighting control systems in compliance with the current Energy code. Therefore, there shouldn't be any challenges in the market's response to the proposed Energy Code alterations. Many manufacturers already offer a range of products and solutions that meet or exceed the requirements for multilevel lighting controls. The market has experienced growth and advancements in lighting control technologies, making these systems more readily available.

Competing products in the market may include different brands or models of lighting control systems that offer multilevel functionality. While there may be competition among manufacturers, it fosters innovation and improves the availability and diversity of products.

Regarding patent restrictions, it is possible that certain lighting control technologies or specific features may be protected by patents held by particular manufacturers. However, the market typically offers a variety of alternatives that provide similar functionality, ensuring competition and options for consumers.

When looking into Lighting Control suppliers, the current 2023 GlobalSpec database includes 61,827 manufacturers and 16,209 distributors headquartered in the United States. The international database contains 42,669 manufacturers and 4,697 distributors headquartered throughout the rest of the world.

3.2 Design and Construction Practices

The current best practices for designing and constructing multilevel lighting controls involve several key considerations:

- System Design: Designing an effective multilevel lighting control system involves a comprehensive analysis of lighting needs and requirements specific to the building or space. This includes identifying appropriate

lighting levels for different tasks or areas, considering daylight availability, and integrating occupancy sensors and other control devices.

- Space Planning: Multilevel lighting controls may impact the physical space, particularly in terms of control device placement and wiring requirements. Proper space planning and coordination with other building systems are important to ensure seamless integration and minimize disruptions.
- Electrical Service Needs: Multilevel lighting control systems may require additional electrical circuits, wiring, and control panels. Designers and installers need to ensure that the electrical service capacity is adequate to support the lighting control system and meet code requirements.
- Aesthetics: Multilevel lighting controls should be integrated in a manner that maintains or enhances the overall aesthetic appeal of the space. Consideration should be given to control switch locations, user interface design, and coordination with architectural elements.
- Occupant Comfort: Multilevel lighting controls should be designed to enhance occupant comfort by providing appropriate lighting levels for different tasks and activities. The control system should be user-friendly, allowing occupants to easily adjust lighting levels as needed.

In terms of potential impacts, multilevel lighting controls generally have positive effects on energy efficiency and occupant comfort.

With regards to structural and seismic design, indoor air quality, moisture management, and fire-resistance ratings, the proposed measure has no effect on these aspects of building elements.

It is important to note that specific impacts may vary depending on the design, construction practices, and building characteristics. Therefore, comprehensive planning, adherence to applicable codes and standards, and collaboration among designers, contractors, and regulatory authorities are crucial to ensure that the proposed measure is implemented without adverse effects on health, safety, or other design and construction best practices.

3.3 Impacts on Market Actors

The proposed measure for multilevel lighting controls will have varied impacts on builders, developers, building designers, building owners, and occupants. However, the proposed measures would not significantly impact any market actors in a negative way. This impact is limited since this proposal is only an expansion on current energy code requirements.

The suggested code modification maintains alignment with established federal, state, and local safety and health regulations, including those enforced by the California Division of Occupational Safety and Health (DOSH). Preexisting health and safety standards will remain unaffected. The adoption

of the proposed code change is not foreseen to yield any detrimental effects on the well-being or safety of occupants, as well as individuals engaged in the building's construction, commissioning, and upkeep.

Most market actors have already proactively participated in ongoing education and training, aligning themselves with evolving design practices and building codes. This commitment ensures compliance and reflects the dedication of stakeholders to maintaining industry standards.

Presented below is a summary of the potential outcomes, with emphasis on their limited magnitude due to the existing requirement of multilevel controls in the current Title 24 Part 6:

- Commercial Builders and Developers: Given that the requirement is presently part of the existing code and represents an expansion rather than an entirely new provision, its impact will be confined to buildings that encompass the newly added spaces. For those buildings incorporating these spaces, the anticipated financial impact is minimal, supported by the cost analysis and constitutes a minor proportion of the overall building budget. This measure presents an opportunity for builders and developers to enhance the energy efficiency and marketability of their buildings. Since it is common for builders to update their practices according to new code regulations, updating to this new measure would be minimal and a part of common code cycle practices.
- Commercial Building Designers: Building designers will need to integrate additional multilevel lighting controls into their design plans based on the added spaces and reduced threshold. This includes allocating space for control devices, coordinating wiring requirements, and ensuring compliance with updated codes and standards. Designers may need to update their knowledge and skills to incorporate effective lighting control strategies into their designs, especially the new spaces identified in the proposal. Buildings that integrate these spaces can expect a minimal financial repercussion, substantiated by cost evaluations, and making up only a small portion of the overall building budget.
- Commercial Building Owners: Building owners will benefit from the proposed measure through increased energy savings and improved lighting control capabilities from the added spaces. Multilevel lighting controls allow for better customization of lighting levels, resulting in enhanced comfort for occupants and reduced energy consumption in these additional spaces.
- Occupants: The measure will positively impact occupants by providing a more comfortable and adaptable lighting environment. Multilevel lighting controls allow occupants to adjust lighting levels to suit their specific needs and preferences. This can enhance productivity, visual comfort, and overall satisfaction with the lighting conditions in the building. The

inclusion of these spaces in buildings leads to a marginal financial impact, corroborated by cost analyses, and accounting for a minor percentage of the overall building budget.

- Manufacturers, Distributors, and Retailers: The implementation of this measure would lead to a broader application of multilevel controls in various spaces. As a result, manufacturers and distributors would experience increased sales of essential components and controls products especially for spaces where controls were previously excluded such as classrooms and spaces less than 100 square feet.

It is important to consider potential effects on low-income communities, disadvantaged communities, or tribal communities. The measure may introduce additional costs, which could pose challenges for these communities with limited financial resources. The integration of controls into these additional spaces may result in a marginal financial effect and should have minimal impact to these communities.

To mitigate potential negative impacts, the following measures can be considered:

- Incentives and Financial Support: Providing financial incentives, rebates, or grants can help offset the costs of implementing multilevel lighting controls. This can make the measure more accessible and affordable for low-income communities.
- Education and Assistance: Offering educational resources and technical assistance to builders, developers, and building owners in low-income or disadvantaged communities can help them understand the benefits of multilevel lighting controls and navigate the implementation process effectively.
- Collaboration and Partnerships: Collaborating with community organizations, local governments, and advocacy groups can help identify specific challenges and develop targeted solutions for implementing the measure in low-income or disadvantaged communities.

By implementing these mitigation measures, the potential negative impacts of the proposed multilevel lighting control measure can be minimized, ensuring that all communities can benefit from improved energy efficiency and lighting quality.

3.4 Impacts on Jobs and Businesses

CEA foresees no notable employment or financial disruptions within specific sectors of California's economy with this measure proposal since it is already incorporated into current energy code.

CEA does not anticipate the creation of any new job functions being created due to this proposed measure, only a minor impact to the jobs currently

associated with multilevel controls. We do not anticipate that any businesses will be created or eliminated with the introduction of this code proposal. It will also likely not result in the elimination of jobs since it is only an expansion of the current energy code. Small businesses, regional entities, and industry-specific sectors will not experience any distinct effects.

3.5 Economic and Fiscal Impacts

Incorporating this proposed code change would bring about minor economic effects, primarily from increased direct spending by stakeholders in the commercial building sector, including architects, energy consultants, and building inspectors. CEA projects that the cost savings experienced by commercial building owners or other impacted organizations due to the proposed expansion of the current energy code would offset the minimal increased spending by building owners and other stakeholders.

Cost Impacts:

- Initial Investment: Since multilevel lighting controls are already a part of building designs and budgets, the initial Investment may experience a small increase if the spaces that were previously excluded are part of the project.
- Operational Savings: Adding multilevel lighting controls to additional spaces can result in increased long-term energy savings and reduced operational costs. These savings can offset the initial investment over time.
- Energy Cost Reductions: Energy cost savings are a significant benefit of multilevel lighting controls. By reducing energy consumption in more spaces in a building, businesses and building owners can experience lower electricity bills and operational expenses. The magnitude of these savings depends on factors such as the energy efficiency of the lighting systems, the control strategies employed, and the utilization patterns of the building and if the previously excluded spaces are included in the building.
- Environmental Benefits: Incorporating multilevel lighting controls into added spaces enhances the existing code, promoting energy conservation and decreasing greenhouse gas emissions. By reducing energy demand, the measure helps mitigate the environmental impact associated with electricity generation. This can lead to positive societal benefits and align with sustainability goals.
- Market Opportunities: The implementation of multilevel lighting controls can create more market opportunities for manufacturers, suppliers, and installers of lighting control systems. The increased demand for energy-efficient solutions can stimulate the growth of these industries, potentially leading to job creation and economic development.

3.6 Cost of Compliance and Enforcement

Adding the inspection of additional spaces to the current inspection scope for multilevel controls should add limited burden and minimal additional inspection costs to building officials to ensure compliance. Multilevel lighting controls are already mandatory requirements in Title 24 Part 6, and this proposed change would only add new spaces to be verified for compliance.

In a scenario where state and local government staffing is unavailable to enforce compliance with multilevel lighting control measures it would necessitate alternative approaches and potential costs. Here are some considerations regarding the likely costs involved:

Compliance Enforcement:

- Third-Party Inspection Services: The state may need to engage third-party inspection services to ensure compliance with the measures. These services could include qualified inspectors or private firms responsible for conducting inspections on behalf of the state. The costs associated with hiring and contracting these services would depend on the number and complexity of inspections required.
- Monitoring and Reporting Systems: Developing and implementing monitoring and reporting systems can help track compliance remotely. This may involve investing in technology solutions, software development, and data management systems. The costs would depend on the scale of implementation and the complexity of the systems required.

Training Costs:

State and local governments have already allocated a budget for the development, education, and enforcement of current codes. These resources will be utilized to update the Title 24, Part 6 Standards, which may encompass minor revising educational and compliance materials and addressing inquiries about the revised requirements. These activities are well within the scope of existing state and local budgets. In comparison to the overall cost savings and policy advantages tied to the code change proposal, the expenses for the state and local government are relatively minor.

Since most stakeholders have already implemented multilevel lighting controls, training updates and budget this for new code proposal should not cause additional costs for training. In a scenario where state and local government staffing is unavailable to deliver training, it would necessitate alternative approaches and potential costs.

Here are some considerations regarding the likely costs involved:

- Outsourced Training Providers: To deliver broadly available training, the state may need to engage external training providers, such as industry associations, educational institutions, or private training companies. These

providers can develop and deliver training programs, materials, and resources. Costs would depend on the scope and duration of the training programs, as well as the rates charged by the external providers.

- Online Training Platforms: Investing in online training platforms and e-learning resources can be a cost-effective approach to reaching a broad audience. Costs would include platform development or licensing fees, content creation or adaptation, and ongoing maintenance and support.
- Tools and Resources: Most stakeholders have access to a range of resources aimed at facilitating compliance training, which can effectively mitigate the expenses associated with retraining. These resources encompass tools, training programs, and various other supportive materials provided by manufacturers as well as organizations like the CEA.

4. COST-EFFECTIVENESS

This section provides a summary of energy savings estimates, costs, and overall cost-effectiveness analysis for the proposed measure. Energy savings, costs, and cost effectiveness of proposed measures are assessed incrementally, meaning in comparison to the latest adopted version of the Energy Code. Best available data is used and references to those data sources are provided to clearly substantiate energy savings, costs, and cost effectiveness.

4.1 Energy Savings Methodology

Consistent with California Law (Public Resources Code 25000), an energy efficiency measure is cost-effective if the Benefit-Cost Ratio (BCR) is 1.0 or greater, when amortized over the economic life of the structure. BCR is calculated by dividing the total dollar benefit of the measure by the total dollar cost of the measure, over a period of analysis of 30 years.

To calculate benefit, Long-term System Cost (LSC) is used to determine the dollar value of energy efficiency measures in the Energy Code. LSC hourly factors help the state account for long-term benefits associated with policies needed to meet the statewide climate actions goals – such as 100% renewable generation, proliferation of electric transportation, and drastic reductions in fossil fuel combustion occurring in buildings. Today's energy costs do not adequately account for these long-term values to California's energy system. LSC hourly factors weigh the long-term value of each hour differently, where times of peak demand are more valuable, and times off-peak demand are less valuable. LSC hourly factors are not utility rates or energy rate forecasts. LSC is not a predicted utility bill.

LSC hourly conversion factors are developed and published by the CEC for each code cycle. These LSC hourly factors are used to convert predicted site energy use – an output common to building energy modeling (BEM) software – to 30-year present value to California's energy system.

Energy savings for proposed measures are estimated using both LSC hourly factors and CEC-established model prototypes. Large sets of survey data are used to create prototypes that act as averaged representations of common building types in California. These prototypes are created for use in BEM software to provide accuracy and consistency amongst energy models that are used to determine energy savings for the state. CEC-developed prototypes and LSC hourly factors are published by the CEC ahead of each code cycle integral to research versions of CEC's reference Energy Code compliance software (CBECC-Res and CBECC). For this reason, CBECC-Res and CBECC are the CEC-recommended BEM software tool when assessing energy savings of proposed measures.

To calculate cost, first costs and ongoing maintenance costs must be assessed for proposed measures and accounted for over a period of analysis of 30 years. In the BCR, both the benefits and the costs are assessed incrementally, meaning in comparison to the latest adopted version of the Energy Code.

Similar to LSC hourly factors, the CEC develops and publishes conversion factors for Source Energy, and for GHG Emissions for each code cycle. These three sets of hourly factors are published on CEC's website and formatted to be accessible and usable in combination with broadly available BEM tools.

Multilevel lighting controls enhance facility energy efficiency. Occupants gain direct control, turning off lights in unoccupied rooms, and these controls utilize strategies such as dimming and daylighting to reduce watts used. This proposal increases energy savings by lowering the mandatory installation of multilevel lighting controls threshold for connected lighting loads to 0.4 W/sq.ft. for new space types, comparing energy savings to Title 24 2022 baseline. The methodology of this measure compares the energy saved between the Title 24 2022 code baseline condition and the proposed condition, where the threshold for installing multilevel controls is reduced from 0.5 W/sq.ft. to 0.4 W/sq.ft.

4.2 Energy Savings Results

CEA measured electric energy savings via multilevel lighting controls using CBECC-COM software and the Small School prototypical building model for all 16 climate zones. The prototypical model is representative of typical building geometries for the specified building type. Savings were estimated by adjusting W/sq.ft. based on assumed personal tuning savings from the LBNL Lighting Controls in Commercial Buildings study (6% average) (LBNL, 2011). This approximated the measure's increased impact on facility energy savings. To assess the measure's effect on source energy and long-term systemwide cost (LSC) savings, CEC's hourly source energy and energy cost metrics were employed, with LSC savings projected over the building's 30-year lifespan.

CEA estimated electric energy, source energy, and LSC savings through a combined use of CBECC-COM 2022.3.0, EnergyPlus modeling software, and Microsoft Excel. The code proposal change was simulated in CBECC-COM to create a baseline condition aligned with 2022 Title 24 code and the proposed condition to be compliant with existing code and aligned with the CEA's proposal. CBECC-COM produces two distinct models based on user inputs: the Standard Design and the Proposed Design. The Standard Design depicts a prototypical building's geometry and incorporates features that meet the minimal 2022 Title 24. The Proposed Design maintains the same geometry and meets the minimal 2022 Title 24 code but contains alterations from the software user's input. Both models must "pass" the Time Dependent Valuation and Source Energy Use compliance margins to be accepted for use in this study. In the CEA's evaluation of the proposal measure a baseline condition Standard

Design, and a proposed condition Proposed Design were utilized to estimate savings for each climate zone.

Comparing energy impacts between the models highlights the effects of the proposed code changes in relation to industry standards. The difference in W/sq.ft. between these models represents the electrical energy savings achieved. Extracted outputs from the CBECC-COM energy models are processed through EnergyPlus to compute source energy and LSC savings.

These outputs, combined with the 2022 and 2025 source energy and LSC metrics, are input into an Excel spreadsheet to calculate savings for both source energy and LSC between the baseline and proposed conditions. To project the potential statewide impact of this proposed measure using the construction forecast, these savings are normalized per unit metrics per square foot.

Table 8: Prototype(s) Used for Energy, Cost, and Environmental Analysis

Prototype ID	Occupancy Type (Residential, Retail, Office, etc.)	Floor Area (ft^2)	Number of Stories	Statewide Floor Area (Million ft^2)
Prototype 1	Small School	24,413	1	4.5

The proposed measure impacts more than one building prototype, however, Small School was chosen as it this prototype incorporates many of the new spaces that are gained by the proposed measure (e.g., classroom and dining spaces). As incremental costs and energy savings are similar across space types, CEA only focused on schools in order to show cost effectiveness. Per conversations with CEC staff, there were concerns about incremental costs for schools. This analysis shows cost effectiveness for the new spaces in schools that would require multilevel lighting controls where they were not required in the 2022 Title 24 Part 6. The per unit LSC energy cost savings over the 30-year period of analysis are presented in the table below.

Table 9: LSC Savings Over 30-Year Period of Analysis

Climate Zone	30-Year Electricity LSC Savings (PV$)	30-Year Natural Gas LSC Savings (PV$)	30-Year Total Energy LSC Savings (PV$)
1	$5	$0	$5
2	$5	$0	$5
3	$5	$0	$5
4	$5	$0	$5
5	$5	$0	$5
6	$5	$0	$5
7	$5	$0	$5
8	$5	$0	$5
9	$5	$0	$5
10	$5	$0	$5
11	$5	$0	$5
12	$5	$0	$5
13	$5	$0	$5
14	$5	$0	$5
15	$5	$0	$5
16	$5	$0	$5

4.3 Incremental First Cost

Data concerning the incremental cost associated with adhering to the proposed measure was collected via online retails, surveys, and interviews. Stakeholders representing the various stakeholders were interviewed and submitted cost information. The CEA also performed a literature review of published research studies that quantified the cost information on use of multilevel lighting controls in commercial spaces. The review focused on studies that included cost and energy estimates for spaces required to install multilevel controls. The review resulted in a collection of studies spanning the years 2013 to 2022, which were consistent in methodology, peer-reviewed, and applicable to these commercial spaces. These studies contained different estimates related to cost.

The CEA estimated the current incremental construction costs and post-adoption incremental construction costs. The current incremental construction cost represents the incremental cost of the measure if a building meeting the proposed standard were built today. The post-adoption incremental construction cost represents the anticipated cost assuming full market

penetration of the measure as a result of the new Standards, resulting in possible reduction in unit costs as manufacturing practices improve over time and with increased production volume of qualifying products the year the Standard becomes effective. Per Energy Commission's guidance, design costs are not included in the incremental first cost.

Device costs and labor rates were anonymized and averaged across the various stakeholder's input. The average bill of materials, per unit including installation, commissioning, sales tax, and 15 percent profit/market is $90.46.

4.4 Incremental Maintenance Costs

The incremental maintenance cost is the incremental cost of replacing the equipment or parts of the equipment, as well as periodic maintenance required to keep the equipment operating relative to current practices over the period of analysis of 30 years. The present value of equipment and maintenance costs or savings is calculated using the following equation:

$$\text{Present Value of Maintenance Cost} = \text{Maintenance Cost} \times \left[\frac{1}{1+\text{d}}\right]^{\text{n}}$$

Where:
d = the discount rate of 3%
n = the number of periods of 30 years

The multilevel lighting control devices are expected to last over the entire life of the measure, 30 years. No maintenance is required once the unit is added to a space and initial commissioning occurs. Energy savings are expected to persist for the duration of the life of the unit.

4.5 Cost Effectiveness

Cost-effectiveness analysis is required to determine the economic impact of proposed measures over a 30-year period of analysis. This analysis must consider and include incremental energy savings for all impacted energy sources (electricity and natural gas), incremental first costs, and incremental maintenance costs over a 30-year period of analysis. Design costs and incremental costs associated with code compliance are not included in this analysis.

For purposes of the California Energy Code, a measure is cost-effective if the Benefit-Cost Ratio (BCR) is equal to or greater than 1.0. BCR is calculated by dividing the total present value cost benefits by the total present value costs.

The proposed measure was found to be cost-effective in every climate zone for the building type modeled. Table 10 shows the cost-effectiveness summary for this measure by climate zone.

Table 10: Cost-effectiveness Summary

Climate Zone	Benefit: Total Incremental LSC Savings and Other Savings (PV$)	Cost: Total Incremental First Costs and Maintenance Costs (PV$)	Benefit-Cost Ratio (BCR)
CZ 1	$ 0.26	$ 0.16	1.7
CZ 2	$ 0.25	$ 0.16	1.6
CZ 3	$ 0.25	$ 0.16	1.6
CZ 4	$ 0.25	$ 0.16	1.6
CZ 5	$ 0.25	$ 0.16	1.6
CZ 6	$ 0.24	$ 0.16	1.5
CZ 7	$ 0.25	$ 0.16	1.6
CZ 8	$ 0.25	$ 0.16	1.6
CZ 9	$ 0.25	$ 0.16	1.6
CZ 10	$ 0.25	$ 0.16	1.6
CZ 11	$ 0.25	$ 0.16	1.6
CZ 12	$ 0.25	$ 0.16	1.6
CZ 13	$ 0.25	$ 0.16	1.6
CZ 14	$ 0.25	$ 0.16	1.6
CZ 15	$ 0.24	$ 0.16	1.5
CZ 16	$ 0.25	$ 0.16	1.6

5. STATEWIDE ENERGY IMPACTS

This section provides the first-year statewide savings of the proposed measure. This analysis is to help determine overall value of the proposed measure to the State of California, and not used to determine cost effectiveness of the proposed measure. To assist with this analysis a statewide new construction forecast was developed by the CEC for 2026, which is presented in more detail in *Appendix A: Statewide Savings Methodology*. The first year energy impacts represent the first year annual savings from all buildings forecasted to be completed in 2026.

5.1 Statewide Energy and Energy Cost Savings

The CEA evaluated the year one statewide energy and cost savings that will be realized in 2026 by calculating the product of the per unit savings by the newly constructed buildings forecast (Appendix A). The estimated statewide energy savings are below in Table 11.

Table 11: Estimated Statewide Energy Savings

	First Year Statewide Electricity Savings (GWh)	First Year Statewide Power Demand Reduction (MW)	First Year Statewide Natural Gas Savings (Million Therms)	First Year Statewide Electricity LSC Savings (PV$ million)	First Year Statewide Natural Gas LSC Savings (PV$)
Multilevel Lighting Controls	35.17	0	0	$0.91	0
TOTAL	35.17	0	0	$0.91	0

5.2 Statewide Greenhouse Gas Emissions Savings

The CEA evaluated the year one statewide greenhouse gas emission savings that will be realized in 2026 by calculating the product of the per unit savings by the newly constructed buildings forecast (Appendix A) for the prototype modeled. The first year statewide GHG emissions savings were calculated based on the California cap-and trade program value of $123.14 per MT CO_2e/year (Wen, 2023). The estimated statewide greenhouse gas emissions savings are in Table 12.

Table 12: Estimated Statewide Greenhouse Gas Emissions Savings

	First Year Statewide GHG Emission Savings (MT CO_2e/year)	First Year Statewide GHG Emissions Savings (PV$)
Multilevel Lighting Controls	11.74	$1445
TOTAL	**11.74**	**$1445**

5.3 Statewide Water Savings

No water savings are achieved by installing this measure.

5.4 Other Non-Energy Impacts

Multilevel lighting controls offer a range of benefits beyond energy savings, impacting various aspects of indoor environments and human well-being. Several non-energy impacts associated with multilevel lighting controls include:

Pollutants Reduction: Implementing multilevel lighting controls can lead to reduced energy consumption, which in turn lowers emissions from power generation.

Human Productivity and Occupant Comfort: Proper lighting levels greatly influence human productivity, mood, and overall comfort. A study conducted by the Heschong Mahone Group for the California Energy Commission found that improved lighting quality through daylighting and responsive lighting controls could lead to increased worker productivity, potentially contributing to economic gains. The study is titled "Windows and Offices: A Study of Office Worker Performance and the Indoor Environment (Heschong et al. 2003).

Occupant Comfort and Well-being: Adaptive lighting systems, made possible by multilevel controls, can help create more comfortable and visually pleasant indoor environments. lighting quality affects occupants' mood, stress levels, and cognitive performance. The Lawrence Berkeley National Laboratory's Lighting Systems Research Group also offers research reports and resources on lighting controls and their non-energy impacts. These studies and resources highlight the potential of lighting controls to positively influence occupants' psychological well-being.

Increased Property Valuation: Quality lighting is a desirable feature in commercial spaces. Implementing multilevel lighting controls can enhance the aesthetics and functionality of spaces, positively impacting property valuation. A research report by the Royal Institution of Chartered Surveyors (RICS) titled "Value through Sustainability" emphasizes the correlation between

sustainable features, including lighting controls, and increased property value (RICS, 2021).

These examples demonstrate how multilevel lighting controls have far-reaching effects beyond energy conservation. By reducing criteria pollutants, enhancing human productivity, increasing property values, and improving occupant comfort and well-being, these controls play a vital role in creating healthier and more sustainable indoor environments.

6. PROPOSED CODE LANGUAGE

The proposed changes to the standards, Reference Appendices, and the ACM Reference Manuals are provided below. Changes are to the language from the latest relevant 2022 Energy Code document(s) and use underlines (new language) and ~~strikethroughs~~ (deletions) to show edits to code language.

6.1 Energy Code (Title 24, Part 6)

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

…

(b) **Multilevel lighting controls.** The general lighting of any enclosed ~~area 100 square feet or larger~~ space with a connected lighting load that exceeds 0.~~5~~4 watts per square foot shall provide multilevel manual lighting controls that allow the occupants to adjust the illuminance level ~~of lighting to be adjusted~~ up to full light output (or a high-end trimmed level) and down to 10% of full light output or lower, and separately allow the occupants to turn the lighting OFF. ~~The multilevel controls shall:~~

~~1. Provide the number of control steps specified in Table 130.1-A; and~~

~~**Exception to Section 130.1(b)1:** Classrooms with a connected general lighting load of 0.6 watts per square foot or less shall have a minimum of one control step between 30 and 70 percent of full rated power, regardless of luminaire type.~~

~~2. Meet the uniformity requirements specified in Table 130.1-A.~~

Exception 1 to Section 130.1(b): An area enclosed by ceiling-height partitions that has only one luminaire with no more than two lamps or has only one inseparable SSL luminaire with a maximum labelled rated wattage of less than 20 watts.

Exception 2 to Section 130.1(b): Restrooms, laundry area, locker room, and copy room.

Exception 3 to Section 130.1**(b):** Healthcare facilities

TABLE 130.1-A MULTILEVEL LIGHTING CONTROLS AND UNIFORMITY REQUIREMENTS

Luminaire Type	**Minimum Required Control Steps (percent of full rated power[1])**	**Uniform level of illuminance shall be achieved by:**
LED luminaires and LED light source systems	Continuous dimming 10-100 percent	Continuous dimming 10-100 percent
Line voltage sockets except GU-24	Continuous dimming 10-100 percent	Continuous dimming 10-100 percent
Low-voltage incandescent systems	Continuous dimming 10-100 percent	Continuous dimming 10-100 percent
Fluorescent luminaires	Continuous dimming 10-100 percent	Continuous dimming 10-100 percent
GU-24 sockets rated for fluorescent ≤ 20 watts; Pin-based compact fluorescent ≤ 20 watts[2] Linear fluorescent and U-bent fluorescent ≤ 13 watts	Minimum one step between 30-70 percent	Continuous dimming; or Stepped dimming; or Switching alternate lamps in a luminaire.
Track Lighting	Minimum one step between 30-70 percent	Continuous dimming; or Stepped dimming; or Separately switching circuits in multi- circuit track with a minimum of two circuits.
Linear fluorescent and U-bent fluorescent > 13 watts	Minimum one step in each range: 20 - 40 percent 50 - 70 percent 75 - 85 percent 100 percent	Stepped dimming; or Continuous dimming; or Switching alternate lamps in each luminaire, having a minimum of 4 lamps per luminaire illuminating the same area and in the same manner
Other light sources, including HID and Induction	Minimum one step between 50 - 70 percent	Stepped dimming; or Continuous dimming; or Switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire, illuminating the same area and in the same manner.

1. Full rated input power of driver, ballast and lamp, corresponding to maximum ballast factor

2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps

6.2 Reference Appendices

There are no proposed changes to the Reference Appendices.

6.3 Compliance Manuals

To align with the measure proposal, language in the Compliance Manual Section 5.4.2 needs to be modified and Table 130.1-A also needs to be removed where referenced throughout the Manual.

5.4.2 Multilevel Lighting Controls

§130.1(b) ~~& Table 130.1-A~~

Multilevel lighting control requirements allow the lighting level to be adjusted to accommodate the activities of a room.

This requirement applies to general lighting in enclosed spaces ~~100 sq. ft. or larger and~~ with a connected general lighting load greater than 0.4~~5~~ W/sq. ft.

General lighting does not include task lights, display, or ornamental lighting. The lighting also must ~~have the required number of control steps and meet the uniformity requirements in accordance with Table 130.1-A.~~ allow the occupants to adjust the illuminance level ~~of lighting to be adjusted~~ up to full light output (or a high-end trimmed level) and down to 10% of full light output or lower, and separately allow the occupants to turn the lighting OFF.

~~Dimming can be implemented in steps or over a continuous range. Continuous dimming provides a smoother transition of light levels in comparison to stepped dimming and is one factor to consider when choosing one dimming technology over another.~~

EXCEPTION: The following applications are not required to comply with the multilevel lighting control requirements.

1. An area enclosed by ceiling height partitions with only one luminaire containing no more than two lamps or has only one inseparable SSL luminaire with a maximum labeled rated wattage of less than 20 watts.

2. Restrooms, laundry area, locker room, and copy room.

3. Healthcare facilities.

~~Note that there are two exceptions to part of the requirements of Table 130.1-A for classrooms and other space types.~~

~~Refer to end of Table 5-1 appeared on next two pages.~~

~~Table 5-2 (From Table 130.1-A): Multilevel Lighting Controls and Uniformity Requirements~~

~~Luminaire Type~~	~~Minimum Required Control Steps (percent of full rated power[1])~~	~~Uniform level of illuminance shall be achieved by:~~
~~LED luminaires and LED light source systems~~	~~Continuous dimming 10-100 percent~~	~~Continuous dimming 10-100 percent~~
~~Line-voltage sockets except GU-24~~	~~Continuous dimming 10-100 percent~~	~~Continuous dimming 10-100 percent~~
~~Low-voltage incandescent systems~~	~~Continuous dimming 10-100 percent~~	~~Continuous dimming 10-100 percent~~
~~Fluorescent luminaires~~	~~Continuous dimming 10-100 percent~~	~~Continuous dimming 10-100 percent~~
~~GU-24 sockets rated for fluorescent ≤ 20 watts;~~ ~~Pin-based compact fluorescent ≤ 20 watts[2]~~ ~~Linear fluorescent and U-bent fluorescent ≤ 13 watts~~	~~Minimum one step between 30-70 percent~~	~~Continuous dimming; or Stepped dimming; or~~ ~~Switching alternate lamps in a luminaire.~~
~~Track Lighting~~	~~Minimum one step between 30-70 percent~~	~~Continuous dimming; or Stepped dimming; or~~ ~~Separately switching circuits in multi- circuit track with a minimum of two circuits.~~
~~Linear fluorescent and U-bent fluorescent > 13 watts~~	~~Minimum one step in each range:~~ ~~20 - 40 percent~~ ~~50 - 70 percent~~ ~~75 - 85 percent~~ ~~100 percent~~	~~Stepped dimming; or Continuous dimming; or~~ ~~Switching alternate lamps in each luminaire, having a minimum of 4 lamps per luminaire illuminating the same area and in the same manner~~
~~Other light sources, including HID and Induction~~	~~Minimum one step between 50 - 70 percent~~	~~Stepped dimming; or~~ ~~Continuous dimming; or~~ ~~Switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire, illuminating the same area and in the same manner.~~

6.4 ACM Reference Manuals

There are no proposed changes to the ACM Reference Manuals.

6.5 Compliance Software Change Summary

The proposed code change mandates a lower default value for "regulated lighting" W/sq.ft. in additional spaces where multilevel lighting is made mandatory by this measure.

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APPENDICES

Appendix A: Statewide Savings Methodology

Estimated statewide energy savings for the first year that the Energy Code becomes in effect (2026) can be generated by multiplying the proposed measure's per unit savings by the provided statewide construction forecasts in this appendix.

The CEC has provided residential and nonresidential new construction forecasts for 2026, broken out by building type and forecast climate zones (FCZ). This data can be converted from FCZ to building climate zones (BCZ) using the weighting factors presented in Table 13: . The CEC provided prototypes for all forecasted building types except for Controlled Environmental Horticulture, Grocery, Refrigerated Warehouse, Vehicle Service, Manufacturing and Miscellaneous. The Enclosed Parking Garage is included in the multifamily prototypes. Additionally, Table 14 provides more complete definitions of the various space types used in the forecast.

Updates to Appendix A, including updates to building start data, will be located on the 2025 Energy Code Pre-Rulemaking Docket 22-BSTD-01, https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-BSTD-01

Table 13: FCZ to BCZ Conversion Factors

Forecast zones (FCZ) along X-axis, building climate zones (BCZ) along Y-axis

Climate Zone	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	17.90%	0.00%	13.51%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	80.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	0.00%	52.43%	6.28%	0.00%	3.64%	0.00%	52.26%	0.00%	0.00%	0.00%	0.00%
4	0.00%	30.39%	0.00%	0.00%	0.00%	0.00%	15.39%	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	32.33%	0.00%	0.18%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	18.89%	61.19%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	43.99%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	32.29%	37.22%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.19%
11	0.42%	0.00%	0.00%	84.77%	22.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
12	0.00%	17.18%	0.00%	0.00%	72.61%	4.55%	0.00%	0.00%	0.00%	0.00%	0.00%
13	0.00%	0.00%	0.00%	0.00%	0.00%	94.81%	0.00%	0.00%	0.00%	78.49%	0.00%
14	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.51%	0.00%	12.10%	24.17%
15	3.18%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.10%
16	78.50%	0.00%	0.01%	15.23%	1.68%	0.64%	0.00%	0.33%	1.41%	9.41%	4.55%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Table 13 (continued)

Climate Zone	11	12	13	14	15	16	17	18	19	20
1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%	0.19%	0.00%	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	0.00%	6.60%	0.00%	0.00%	0.00%	17.18%	0.00%	0.00%	0.00%	0.00%
7	0.00%	62.81%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	0.00%	1.94%	0.00%	0.00%	0.00%	27.90%	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%	0.00%	54.92%	99.35%	100.00%	0.00%	0.00%
10	86.11%	27.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
11	0.00%	0.00%	0.42%	0.00%	44.55%	0.00%	0.00%	0.00%	0.00%	0.00%
12	0.00%	0.00%	99.58%	100.00%	52.65%	0.00%	0.00%	0.00%	0.00%	0.00%
13	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14	0.00%	0.66%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
15	13.33%	0.12%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.98%	0.00%
16	0.56%	0.00%	0.00%	0.00%	2.61%	0.00%	0.65%	0.00%	0.00%	100.00%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Table 14: Statewide Nonresidential New Construction Building Types

Forecast Building Types	Uses	Number of Stories	Floor Area (sf)
Assembly	Gatherings including, but not limited to: Arenas, Coliseums, Auditoriums, Transportation Terminals, Clubs and Lodges, Exhibition Halls, Funeral or Internment Facilities, Religious Buildings, Libraries, Museums, Theaters, Recreational and Exercise Facilities.	Any	Any
Controlled-environment Horticulture	Buildings with indoor conditioned spaces used for agriculture.	Any	Any
Hospital	Hospitals, Clinics, and Nursing Convalescent Facilities	Any	Any
Hotel	Hotels and Motels	Any	Any
Laboratory	Laboratories	Any	Any
Large Office	Offices, Banks and Financial Institutions, Government Services Buildings, Post Offices	≥ 5	Any
Medium Office	Offices, Banks and Financial Institutions, Government Services Buildings, Post Offices	2 - 4	Any
Small Office	Offices, Banks and Financial Institutions, Government Services Buildings, Post Offices	1	Any
Restaurant	Food and/or Beverage Service	Any	Any
Large Retail	Stores and Other Mercantile Buildings	Any	≥ 50k

Medium Retail	Stores and Other Mercantile Buildings	Any	< 50k
Grocery	Stores and Other Mercantile Buildings used for the sale of food items	Any	Any
Strip Mall Retail	Shopping Centers	Any	Any
Large School	Schools and Educational Facilities	Any	≥ 50k
Small School	Schools and Educational Facilities	Any	< 50k
Warehouse	Warehouses and Freight Terminals	Any	Any
Forecast Building Types	**Uses**	**Number of Stories**	**Floor Area (sf)**
Refrigerated Warehouse	Refrigerated Warehouses	Any	Any
Vehicle Service	Auto, Aircraft, Bus, Truck, Railroad, Boat, or any other Vehicle Servicing Facility	Any	Any
Manufacturing	Manufacturing Facilities	Any	Any
Enclosed Parking Garage	Parking Garages enclosed by walls and a roof with rooftop parking.	Any	Any
Open Parking Garage	Parking Garages that are open to the ambient environment. Parking lots with canopies are not considered Parking Garages.	Any	Any
Miscellaneous	Miscellaneous Non-Residential Buildings.	Any	Any

Table 15: Statewide Nonresidential New Construction (2026 in Million ft²)

Source: CEC

Space Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Large Office	0	0	2.900898	1.415466	0	1.275534	0.740025	2.052336	3.724344	0.351265	0.097594	0.515506	0	0.179579	0.011688	0.044805
Medium Office	0.1302	0.4761	1.372	0.7442	0.3705	1.201	0.8046	1.646	3.184	1.174	0.2685	2.799	0.5859	0.3482	0.2629	0.102
Small Office	0.012942	0.432968	0.185218	0.020008	0.063652	0.146767	0.231795	0.157965	0.35676	0.41295	0.09246	0.539401	0.381733	0.043644	0.104154	0.032832
Large Retail	0	0	1.097	0.5497	0.1491	0.6978	0.3746	0.8316	1.664	0.6327	0.2997	1.303	0.3564	0.1442	0.1803	0.05547
Medium Retail	0.08421	0.348	0.7947	0.4459	0.08574	0.6027	0.2856	0.8641	1.424	0.8224	0.142	0.6274	0.379	0.18	0.1242	0.08122
Strip Mall	0.001146	0.1543	0.504	0.2256	0.007439	0.5629	0.4878	0.9855	1.065	1.345	0.07164	0.5928	0.3253	0.3206	0.1001	0.0602
Mixed-use Retail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large School	0.005705	0.112151	0.771844	0.389226	0.032033	0.523402	0.536	0.797481	1.251901	0.751934	0.312315	1.014912	0.541727	0.146334	0.075528	0.059996
Small School	0.0665	0.2698	0.4566	0.2294	0.1395	0.3155	0.2944	0.3516	0.6581	0.3481	0.09881	0.7763	0.3025	0.107	0.03728	0.04489
Non-refrigerated Warehouse	0.06177	0.3672	2.16	1.118	0.1776	1.363	0.7108	1.948	3.01	1.36	0.6315	2.844	0.8203	0.3618	0.3673	0.1381
Hotel	0.03627	0.2154	1.033	0.5306	0.1095	0.5527	0.4822	0.7835	1.183	0.5716	0.1534	0.8029	0.2557	0.1375	0.1248	0.04395
Assembly	0.01028	0.3935	1.583	0.5574	0.05869	0.7868	0.7991	1.431	1.824	1.144	0.1669	1.414	0.3043	0.2453	0.118	0.08429
Hospital	0.028414	0.168804	0.813661	0.421333	0.077073	0.317595	0.530775	0.426553	0.763194	0.785817	0.141056	0.797902	0.26384	0.136996	0.111182	0.046532
Laboratory	0.007379	0.191864	1.291984	0.713294	0.072714	0.416391	0.268179	0.461164	0.842601	0.349305	0.127797	0.434039	0.116013	0.080647	0.039607	0.031283
Restaurant	0.0139	0.08256	0.3269	0.1667	0.03403	0.3365	0.2036	0.4933	0.8189	0.4129	0.07099	0.3135	0.1414	0.1015	0.04739	0.0296
Enclosed Parking Garage	0.000176	0.009137	1.83	1.245	0.004558	2.585	0.7059	2.265	1.527	0.05053	0.001585	0.04116	0.002972	0.0152	0.003691	0.007247
Open Parking Garage	0.002272	0.1182	2.474	1.682	0.05894	3.648	1.201	3.197	2.155	0.6535	0.0205	0.5323	0.03843	0.1965	0.04773	0.09372

Table 15: (Continued, Non-Prototype Building Types)

Building Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Grocery	0.006871	0.04512	0.1048	0.06175	0.01187	0.04649	0.01716	0.0519	0.09145	0.0494	0.00891	0.03876	0.02276	0.01081	0.007629	0.006042
Refrigerated Warehouse	0	0	0.06098	0.05067	0.01431	0.02204	0	0.00683	0.01322	0.03874	0	0.06849	0.1181	0.007633	0.007893	0.00517
Controlled-environment Horticulture	0.09265	0.07749	0.3197	0.03986	0.2021	0.2578	0.001464	0.02342	0.02606	0.278	0.3027	0.3053	0.09011	0.01079	0.04796	0.004662
Vehicle Service	0.001921	0.07746	0.5473	0.3582	0.02914	0.5513	0.3416	0.7989	1.809	0.5735	0.02149	0.3892	0.2476	0.1954	0.05667	0.04908
Manufacturing	0.000943	0.019013	0.209795	0.071063	0.015468	0.014681	0.051026	0.1075	0	0	0	0	0	0	0.000162	0
Miscellaneous	0	0	0.000253	0.4212	0	0	0	0	0	0	0	0.000774	0	0	0	0

Table 16: Statewide Nonresidential Construction (2026 in Million ft²)

Source: CEC

Space Type	1	2	3		4	5	6	7	8	9	10	11	12	13	14	15	16
Large Office	0.1275	3.102	139.8	72.35	1.832	99.54	72.71	162.6	303.1	58.48	2.608	78.61	9.264	20.27	4.434	4.663	3.102
Medium Office	3.379	30.99	78.79	42.28	13.32	47.81	43.87	59.11	86.34	66.69	16.94	101.7	25.18	13.33	10.25	4.063	30.99
Small Office	4.178	12.75	22.19	11.33	7.504	13.22	8.516	13.28	20.88	24.43	10.6	43.94	21.47	4.987	6.181	2.676	12.75
Large Retail	1.002	8.665	58.68	26.9	4.2	31.96	25.34	43.46	66.53	53.31	11.4	58.16	22.51	10.91	9.402	3.207	8.665
Medium Retail	1.176	13.11	44.52	25.74	5.433	44.27	34.66	66.72	108.2	66.89	10.37	60.5	24.15	15.53	8.769	5.17	13.11
Strip Mall	3.336	9.842	37.42	18.43	5.095	40.23	28.29	55.76	83.7	66.92	12.25	48.37	24.18	15.27	8.696	4.591	9.842
Mixed-use Retail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large School	0.7589	8.02	34.83	13.95	2.071	28.37	22.54	42.91	73.58	56.01	10.13	53.38	26.41	12.06	7.621	3.589	8.02
Small School	2.23	11.13	25.57	9.979	6.06	25.69	14.96	34.44	54.31	33.03	13.5	42.08	23.44	8.72	4.251	3.645	11.13
Non-refrigerated Warehouse	3.33	20.22	108.3	53.43	9.802	89.98	51.48	128.4	207.3	182.7	33.73	148.3	51.08	38.87	29.05	11.63	20.22
Hotel	1.771	10.52	48.1	24.73	5.011	30.49	32.66	41.97	66.01	37.09	7.218	40.53	13.08	8.006	5.876	2.439	10.52
Assembly	4.328	18.18	91.34	45.06	6.594	57.25	40.9	89.14	120.2	91.75	16.35	69.72	30.13	18.95	11.83	6.439	18.18
Hospital	1.866	11.09	48.33	24.67	5.055	28.25	27.15	40.77	69.88	39.6	11.11	53.18	22.49	8.802	5.034	3.234	11.09
Laboratory	0.1782	4.01	36.93	28.06	1.531	12.21	17.19	15.61	19.31	10.81	0.679	12.14	4.396	1.723	0.387	0.5716	4.01
Restaurant	0.6087	3.616	14.72	7.494	1.546	16.46	10.73	23.78	40	32.41	3.515	16.95	7.742	6.859	3.453	1.897	3.616
Enclosed Parking Garage	0.01696	0.5432	40.71	30.94	0.2988	29.15	20.67	58.41	72.53	2.673	0.345	3.09	0.4883	0.8543	0.1666	0.4343	0.5432
Open Parking Garage	0.2193	7.024	55.03	41.82	3.864	41.14	35.17	82.44	102.4	34.57	4.461	39.96	6.314	11.05	2.155	5.616	7.024

Table 16: (Continued, Non-Prototype Building Types)

Building Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Grocery	0.09598	1.7	5.869	3.564	0.7523	3.415	2.082	4.008	6.951	4.018	0.6502	3.737	1.45	0.9323	0.5386	0.3846
Refrigerated Warehouse	0.004721	0.4556	0.9104	0.2123	0.3863	0.4566	0.02334	0.4213	0.7865	0.6521	0.2629	2.146	3.907	0.1842	0.1939	0.1444
Controlled-environment Horticulture	0.6988	0.4569	2.62	1.072	6.327	8.264	1.072	0.7413	1.599	3.609	2.513	4.533	5.36	0.4681	0.6443	0.2349
Vehicle Service	0.9073	6.184	33.65	15.98	2.971	33.73	23.08	49.52	81.78	56.54	6.296	38.32	18.24	15.09	6.18	3.543
Manufacturing	4.105	16.89	61.93	79.55	5.59	73.33	33.27	122.7	168.1	49.58	12.86	57.01	25.97	16.98	5.146	9.273
Miscellaneous	0.3582	6.575	9.025	6.318	0.2196	2.575	0.7716	3.778	7.868	2.551	3.367	14.35	2.935	0.7699	0.4029	1.026

Appendix B: Embedded Electricity in Water Methodology

There are no on-site water savings associated with the proposed measure.

Appendix C: Environmental Impacts Methodology

Greenhouse Gas Emissions Impacts Methodology

Multilevel lighting controls contribute to the reduction of greenhouse gas (GHG) emissions by optimizing energy consumption in lighting systems. These controls allow for the adjustment of light output based on actual needs, preventing over-illumination and wastage. By dimming or turning off lights when they're not required at full brightness, energy consumption is lowered, leading to a decrease in electricity usage. As a significant portion of electricity is often generated from fossil fuels, the reduced energy demand from efficient lighting controls translates to fewer GHG emissions released into the atmosphere. The GHG impacts incorporate the latest applicable GHG emissions hourly factors published by the CEC.

Water Use and Water Quality Impacts Methodology

There are no on-site water savings associated with the proposed measure.

Potential Significant Environmental Effect of Proposal

The CEC is the lead agency under the California Environmental Quality Act (CEQA) for the 2025 Energy Code and must evaluate any potential significant environmental effects resulting from the proposed Energy Code. A "significant effect on the environment" is "a substantial adverse change in the physical conditions which exist in the area affected by the proposed project." (Cal. Code Regs., tit. 14, § 15002(g).)

This measure is expected to have no "significant effect on the environment".

Direct Environmental Impacts

Direct Environmental Benefits

Based on the modeled energy savings, this measure is expected to reduce GHG emissions by 0.77 metric tons CO_2e per year.

Direct Adverse Environmental Impacts

No direct adverse environmental impacts were identified.

Indirect Environmental Impacts

Indirect Environmental Benefits

No indirect environmental impacts were identified.

Direct Adverse Environmental Impacts

No direct adverse environmental impacts were identified.

Mitigation Measures

No mitigation is proposed because there is no "significant effect on the environment" associated with this measure.

Reasonable Alternatives to Proposal

No alternatives are proposed because there is no "significant effect on the environment" associated with this measure.

Appendix D: CBECC Software Specification

The proposed code change mandates a lower default value for "regulated lighting" W/sq.ft. in additional spaces where multilevel lighting is made mandatory by this measure. This change should be incorporated into the simulation inputs for the next software version. No updates are required for output variables, compliance report, or the ACM Reference Manual.

The image shows a screenshot of the user input for simulating proposed code change in regulated lighting load.