Codes and Standards Enhancement (CASE) Initiative

2025 California Energy Code

Nonresidential Envelope

Nonresidential Envelope
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Executive Summary

This is a draft report. The Statewide CASE Team encourages readers to provide comments on the proposed code changes and the analyses presented in this draft report. When possible, provide supporting data and justifications in addition to comments. Suggested revisions will be considered when refining proposals and analyses. The Final CASE Report will be submitted to the California Energy Commission in summer 2023.

For this report, the Statewide CASE Team is requesting input on the following:

1. *Incremental cost information for improved insulation, improved windows, and added vestibules.*
2. *Confirmation or corrections to the 2026 Construction Forecast breakdowns for each measure (See Appendix A).*

*Email comments and suggestions to Maureen Guttman (*mguttman@energy-solution.com*) and* info@title24stakeholders.com by July 26, 2023*. Comments will not be released for public review or will be anonymized if shared.*

Introduction

The Codes and Standards Enhancement (CASE) Initiative presents recommendations to support the California Energy Commission's (CEC's) efforts to update the California Energy Code (Title 24, Part 6) to include new requirements or to upgrade existing requirements for various technologies. Three California Investor-Owned Utilities (IOUs) — Pacific Gas and Electric Company, San Diego Gas and Electric, and Southern California Edison – and two Publicly Owned Utilities — Los Angeles Department of Water and Power, and Sacramento Municipal Utility District (herein referred to as the Statewide CASE Team when including the CASE Author) — sponsored this effort. The program goal is to prepare and submit proposals that would result in cost-effective enhancements to improve energy efficiency and energy performance in California buildings. This report and the code change proposals presented herein are a part of the effort to develop technical and cost-effectiveness information for proposed requirements on building energy-efficient design practices and technologies.

The Statewide CASE Team submits code change proposals to the CEC, the state agency that has authority to adopt revisions to Title 24, Part 6. The CEC will evaluate proposals submitted by the Statewide CASE Team and other stakeholders. The CEC may revise or reject proposals. See the CEC's 2025 Title 24 website for information about the rulemaking schedule and how to participate in the process:

https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency.

The Statewide CASE Team gathered input from stakeholders to inform the proposal and associated analyses and justifications. Stakeholders also provided input on the code compliance and enforcement process.

The Statewide CASE Team reached out to 20 individuals and organizations with specific expertise in building envelope design and construction to gather information on costs, market assumptions, and technical feasibility. In response to several of these meetings, the Statewide CASE Team has modified the envelope proposals incrementally, but the stakeholder engagement has generally indicated support for the proposed measures. See Appendix F for a summary of stakeholder engagement.

The goal of this Draft CASE Report is to present a cost-effective code change proposal for nonresidential (NR) opaque assemblies, vestibules, and windows. The report contains pertinent information supporting the code change.

Proposal Description

Proposed Code Change

Opaque Assemblies

This proposal would impose a reduction of the existing U-factor values for most opaque envelope assemblies. Based on the modeling outcomes, some climate zones may be excluded. To justify the feasibility, an energy simulation with all California climate zones will be completed. The exact U-factor values for each assembly will be based on the simulation results and cost-effectiveness analysis.

The Statewide CASE Team also recommends two other measures that would simplify the code while improving energy savings. The first proposal would eliminate the separate prescriptive requirements for hotel/motel guest rooms by incorporating them into the general provisions for nonresidential buildings. The second proposal would consolidate some of the prescriptive U-factors for certain opaque assembly types into fewer values across all sixteen climate zones.

This proposal would not add or modify acceptance tests or require any technology not previously regulated. This proposal would not add new field verification but would make modifications to the processes to address the proposed new measures.

Vestibules

The proposed code change would establish a new mandatory requirement for vestibules in mixed-used and nonresidential buildings with high-traffic main entrances.

These would include colleges, schools, grocery stores, hospitals, multi-storied hotels, offices, restaurants, and retail.

The vestibule requirement would be applicable to new construction and additions that include new main entrances. The measure would not apply to alterations. The climate zones for which this measure would be mandatory, as well as specific building types and sizes, will be determined via modeling. Exceptions to the requirement will be similar to those identified in ASHRAE 90.1 and in IECC where the requirement is not found to be cost effective.

This proposal would not add or modify acceptance tests or require any technology not previously regulated. This proposal would not add new field verification but would make modifications to the processes to address the proposed new measure.

Windows

This proposal would set a new mandatory requirement establishing U-factor and Relative Solar Heat Gain Coefficient (RSGHC) values for window assemblies for most nonresidential buildings. It would affect alterations and new construction, where cost effective, as determined by energy modeling. The proposed mandatory requirements would apply to all vertical fenestration including fixed windows, curtainwall or storefront, and operable windows.

Currently, Title 24, Part 6 includes prescriptive U-factor and RSHGC requirements for exterior vertical fenestration, but these values can be traded away for higher efficiency HVAC equipment or other building systems when a designer uses the performance path to achieve code compliance. This measure, by establishing maximum mandatory U-factor and SHGC values for vertical fenestration, would ensure that there is a backstop to how much window efficiency can be replaced by a non-envelope system that typically has a much shorter lifespan.

Because of the values intended to be used for mandatory requirements, this measure would also require that most vertical fenestration, regardless of materials used, would be thermally broken, adding to the effectiveness of the building's thermal envelope.

This proposal would not add or modify acceptance tests or require any technology not previously regulated. This proposal would not add new field verification but would make modifications to the processes to address the proposed new measures.

Justification

Background Information

Scope of Code Change Proposal

Table summarizes the scope of the proposed changes and which sections of the Energy Code, Reference Appendices, Alternative Calculation Method (ACM) Reference Manuals, and compliance documents that would be modified as a result of the proposed change(s).

Table 1: Scope of Code Change Proposal

Proposal Name	Opaque Assemblies	Vestibules	Windows
Type of Requirement	Prescriptive and Mandatory	Mandatory	Mandatory
Applicable Climate Zones*	All	All	All
Modified Section(s) of Title 24, Part 6	Prescriptive:140.3 Mandatory: 120.7, 141.0	120.7	120.7, 141.0
Modified Title 24, Part 6 Appendices	TBD	TBD	TBD
Would Compliance Software Be Modified	Yes	Yes	Yes
Modified/New Compliance Document(s)	Yes	Yes	Yes

Market Analysis and Regulatory Assessment

The proposed code changes would impact various market actors including designers, architects, component manufacturers, installers, construction companies, and certification/compliance specialists. The proposed measures are similar to previous code cycle changes to U-factor and building component requirements that the market has adjusted and accommodated for in the past. It is within the normal practices for these actors to adjust their building practices to changes in building codes. When necessary, builders engage in continuing education and training in order to remain up-to-date with changes to design practices and building codes. Retailers, manufacturers, and distributors who offer higher performing envelope materials, vestibule products, and fenestration are anticipated to have increased business from proposed code modifications. Some retailers and manufacturers may need to increase production or availability of materials and equipment needed to accomplish the proposed measures.

Since the proposed measures do not introduce any new technologies, we do not anticipate any gaps in the market that need to be filled before the measures can be implemented. All measures leverage existing materials and processes without the

necessity to develop new products. The proposed code changes do not alter any existing federal, state, or local regulations pertaining to safety and health. We do not anticipate any impact on the employment of building inspectors or the scope of their role conducting energy efficiency inspections.

Cost Effectiveness

The proposed code changes were found to be cost effective for most climate zones where they are proposed to be required. There were some edge cases for specific climate zones and building prototypes with negligible or slightly negative cost effectiveness. These edge cases are described in further detail in the Cost and Cost Effectiveness sections of this report for each measure 2.4.5 and 4.4.5. The benefit-to-cost (B/C) ratios over the 30-year period of analysis for each proposed measure are shown in Table 2 through Table 4; ranges are shown where the cost-effectiveness is dependent on the climate zone.[1]

California consumers and businesses in aggregate would save more money on energy than they would spend to finance the efficiency measure. As a result, over time these proposals would leave more money available to the building owner for discretionary and investment purposes once the initial cost is paid off.

See Sections 2.4.1 and 4.4.1 for the methodology, assumptions, and results of the cost-effectiveness analysis. Cost-effective analysis is not required for Mandatory Opaque Envelope and Mandatory Windows measures as the proposed values are less stringent than the current cost-effective prescriptive values.

Statewide Energy Impacts: Energy, Water, Greenhouse Gas (GHG) Emissions, and Embodied Carbon Impacts

The estimated impacts of the proposed code changes that would be realized statewide during the first 12 months that proposed requirements are in effect are shown in Table 2 through Table 4.

First-year statewide energy impacts are represented by the following metrics: electricity savings in gigawatt-hours per year (GWh/y), peak electrical demand reduction in megawatts (MW), natural gas savings in million therms per year (million therms/y), source energy savings in millions of kilo British thermal units per year (million kBtu/y), and lifecycle energy savings in millions of kilo British thermal units per year (million kBtu/y). See Sections 2.5.1, 3.5.1, and 4.5.1 for more details on the first-year statewide

[1] The benefit-to-cost (B/C) ratio compares the benefits or cost savings to the costs over the 30-year period of analysis. Proposed code changes that have a B/C ratio of 1.0 or greater are cost effective. The larger the B/C ratio, the faster the measure pays for itself from energy cost savings.

impacts. Sections 2.3.2,3.3.2, 4.3.2, and 4.3.3. contain details on the per-unit energy savings.

Avoided GHG emissions are measured in metric tons of carbon dioxide equivalent (metric tons CO2e). Assumptions used in developing the GHG savings are provided in Sections 2.5.2, 3.5.2 & 4.5.2 and Appendix C of this report. The monetary value of avoided GHG emissions is included in the Long-term Systemwide Cost (LSC) hourly factors provided by CEC and is thus included in the cost-effectiveness analysis.

The proposed measures are not expected to have any impact on water use or water quality, excluding impacts that occur at power plants.

In addition to the emissions reductions noted in Table 2 Table 2through Table 4, the Statewide CASE Team calculated impacts on GHG emissions for these measures associated with embodied carbon. These measures increase GHG emissions by 15,453 metric tons CO2e due to embodied carbon impacts. Please note that despite the increase in GHG emissions due to embodied carbon impacts (due to vestibule construction), the overall GHG emissions are reduced due to efficiency and far outweigh embodied carbon impacts. See Sections 2.5.4, 3.5.4 & 4.5.4 for more details on the results and Appendix D for details on the methodology. Refer to Appendix H for information about impacts for other opaque assembly types.

Table 2: Summary of Impacts for Opaque Assemblies – Prescriptive Wood-framed Roof

Category	Metric	New Construction & Additions
Cost Effectiveness	Benefit-Cost Ratio Range (varies by climate zone and building type)	2.41 to 7.21
Statewide Impacts During First Year	Electricity Savings (GWh)	0.37
	Peak Electrical Demand Reduction (MW)	0.03
	Natural Gas Savings (Million Therms)	0.01
	Source Energy Savings (Million kBtu)	0.67
	LSC Electricity Savings (Million 2026 PV$)	$2.21
	LSC Gas Savings (Million 2026 PV$)	$0.43
	Total LSC Savings (Million 2026 PV$)	$2.63
	Avoided GHG Emissions (Metric Tons CO2e)	75.59
	Monetary Value of Avoided GHG Emissions ($2026)	$9,309
	On-site Indoor Water Savings (Gallons)	N/A
	On-site Outdoor Water Savings (Gallons)	N/A
	Embedded Electricity in Water Savings (kWh)	N/A
Per Square Foot Impacts During First Year (weighted average for all prototypes and climate zones)	Electricity Savings (kWh)	0.0073
	Peak Electrical Demand Reduction (W)	0.0007
	Natural Gas Savings (kBtu)	0.0147
	Source Energy Savings (kBtu)	0.0133
	LSC Savings (2026 PV$)	$0.0522
	Avoided GHG Emissions (kg CO2e)	0.0015
	On-site Indoor Water Savings (Gallons)	N/A
	On-site Outdoor Water Savings (Gallons)	N/A
	Embedded Electricity in Water Savings (kWh)	0.00

Table 3: Summary of Impacts for Vestibules

Category	Metric	New Construction & Additions
Cost Effectiveness	Benefit-Cost Ratio Range (varies by climate zone and building type)	0.0 – 41.629
Statewide Impacts During First Year	Electricity Savings (GWh)	14.89
	Peak Electrical Demand Reduction (MW)	0.27
	Natural Gas Savings (Million Therms)	0.06
	Source Energy Savings (Million kBtu)	5.59
	LSC Electricity Savings (Million 2026 PV$)	89.27
	LSC Gas Savings (Million 2026 PV$)	3.69
	Total LSC Savings (Million 2026 PV$)	92.96
	Avoided GHG Emissions (Metric Tons CO2e)	1434.97
	Monetary Value of Avoided GHG Emissions ($2026)	176,713
	On-site Indoor Water Savings (Gallons)	N/A
	On-site Outdoor Water Savings (Gallons)	N/A
	Embedded Electricity in Water Savings (kWh)	0.00
Per square foot/ Impacts During First Year	Electricity Savings (kWh)	0.3691
	Peak Electrical Demand Reduction (W)	0.0066
	Natural Gas Savings (kBtu)	0.1532
	Source Energy Savings (kBtu)	0.1386
	LSC Savings (2026 PV$)	2.3041
	Avoided GHG Emissions (kg CO2e)	0.0356
	On-site Indoor Water Savings (Gallons)	N/A
	On-site Outdoor Water Savings (Gallons)	N/A
	Embedded Electricity in Water Savings (kWh)	0.00

Table 4: Summary of Impacts for Windows

Category	Metric	New Construction & Additions	Alterations
Cost Effectiveness	Benefit-Cost Ratio Range (varies by climate zone and building type)	-0.48 to 2.08	-0.48 to 2.08
Statewide Impacts During First Year	Electricity Savings (GWh)	0.50	3.47
	Peak Electrical Demand Reduction (MW)	0.01	0.08
	Natural Gas Savings (Million Therms)	0.01	0.04
	Source Energy Savings (Million kBtu)	0.57	3.98
	LSC Electricity Savings (Million 2026 PV$)	$2.48	$17.15
	LSC Gas Savings (Million 2026 PV$)	$0.37	$2.59
	Total LSC Savings (Million 2026 PV$)	$2.85	$19.74
	Avoided GHG Emissions (Metric Tons CO2e)	57.56	400.13
	Monetary Value of Avoided GHG Emissions ($2026)	$7,089	$49,275
	On-site Indoor Water Savings (Gallons)	N/A	N/A
	On-site Outdoor Water Savings (Gallons)	N/A	N/A
	Embedded Electricity in Water Savings (kWh)	N/A	N/A
Per square foot/ Impacts During First Year	Electricity Savings (kWh)	0.0828	0.0799
	Peak Electrical Demand Reduction (W)	0.0019	0.0019
	Natural Gas Savings (kBtu)	0.1044	0.1015
	Source Energy Savings (kBtu)	0.0943	0.0916
	LSC Savings (2026 PV$)	$0.4679	$0.4545
	Avoided GHG Emissions (kg CO2e)	0.0094	0.0092
	On-site Indoor Water Savings (Gallons)	N/A	N/A
	On-site Outdoor Water Savings (Gallons)	N/A	N/A
	Embedded Electricity in Water Savings (kWh)	N/A	N/A

Compliance and Enforcement

Overview of Compliance Process

The compliance process is described in Sections 2.1.5, 0 and 4.1.5. Impacts that the proposed measure would have on market actors is described in Sections 2.2.3, 3.2.3, 4.2.3, and Appendix E. The Statewide CASE Team worked with stakeholders to develop a recommended compliance and enforcement process and to identify the impacts this process would have on various market actors.

The key issues related to compliance and enforcement are summarized below:

1. Making modifications to the software and compliance documents to include new code provisions.

Field Verification and Acceptance Testing

The field verification process for each of the NR Envelope measures would be unchanged from existing procedures.

Addressing Energy Equity and Environmental Justice

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in disproportionately impacted populations (DIPs) and the role this history plays in the environmental justice issues that persist today. DIPs refers to the areas throughout California that most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes, as well as high incidence of asthma and heart disease. DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience the world.[2] While the term disadvantaged communities (DACs) is often used in the energy industry and state agencies, the Statewide CASE Team chose to use terminology that is more acceptable to and less stigmatizing for those it seeks to describe (DC Fiscal Policy Institute, 2017).

Including impacted communities in the decision-making process, ensuring that the benefits and burdens of the energy sector are evenly distributed, and grappling with the unjust legacies of the past all serve as critical steps to achieving energy equity. Code change proposals must be developed and adopted with intentional screening for

[2] Environmental disparities have been shown to be associated with unequal harmful environmental exposure correlated with race/ethnicity, gender, and socioeconomic status. For example, chronic diseases, such as respiratory diseases, cardiovascular disease, and cancer, associated with environmental exposure have been shown to occur in higher rates in the LGBTQ+ population than in the cisgender, heterosexual population (Goldsmith & Bell, 2021). Socioeconomic inequities, climate, energy, and other inequities are inextricably linked and often mutually reinforcing.

unintended consequences, otherwise they risk perpetuating systemic injustices and oppression.

The Statewide CASE Team assessed the potential impacts of the proposed measures, and based on a preliminary review, the measures are unlikely to have significant impacts on energy equity or environmental justice, therefore reducing the effects of disparities in DIPs. Full details addressing energy equity and environmental justice can be found in sections 2.6, 3.6, and 4.6.

1. Introduction

This is a draft report intended to allow for public review and comment before the Final Report is issued. The Statewide CASE Team encourages readers to provide comments on the proposed code changes and the analyses presented. When possible, include supporting data and justifications in addition to comments. The Statewide CASE Team will review all suggestions and consider them when revising and refining proposals and analyses. The Final CASE Report will be submitted to the California Energy Commission in summer 2023.

For this report, the Statewide CASE Team is requesting input on the following:

1. *Incremental cost information for improved insulation, improved windows, and added vestibules.*
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*Email comments and suggestions to Maureen Guttman (*mguttman@energy-solution.com*) and* info@title24stakeholders.com *by July 26, 2023. Comments will not be released for public review or will be anonymized if shared with stakeholders.*

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The CEC is the state agency that has authority to adopt revisions to Title 24, Part 6. One of the ways the Statewide CASE Team participates in the CEC's code development process is by submitting code change proposals to the CEC for consideration. The CEC will evaluate proposals the Statewide CASE Team and other stakeholders submit and may revise or reject proposals. See the CECs 2025 Title 24 website for information about the rulemaking schedule and how to participate in the process.

The goal of this Draft CASE Report is to present a code change proposal for high performance envelope. The report contains pertinent information supporting the proposed code change.

When developing the code change proposal and associated technical information presented in this report, the Statewide CASE Team worked with many industry stakeholders including building officials, manufacturers, builders, utility incentive program managers, Title 24 energy analysts, and others involved in the code compliance process. The proposal incorporates feedback received during public stakeholder workshops that the Statewide CASE Team held on February 14, 2023 and May 22, 2023 as well as follow-up discussions with the stakeholders at large.

Sections 2 through 4 of the report describe in detail each of the nonresidential envelope measure categories. Section 2 addresses Opaque Assemblies, Section 3 addresses Vestibules, and Section 4 addresses Windows. The following is a summary of the contents within each Section:

- Section x.1 – Measure Description of this CASE Report provides a description of the measure and its background. This section also presents a detailed description of how this code change is accomplished in the various sections and documents that make up the Title 24, Part 6 Standards.
- Section x.2 – Market Analysis includes a review of the current market structure. Section x.2.2 Technical Feasibility and Market Availability describes the feasibility issues associated with the code change, including whether the proposed measure overlaps or conflicts with other portions of the building standards, such as fire, seismic, and other safety standards, and whether technical, compliance, or enforceability challenges exist.
- Section x.3 – Energy Savings presents the per-unit energy, demand reduction, and Long-term Systemwide Cost (LSC) savings associated with the proposed code change. This section also describes the methodology that the Statewide CASE Team used to estimate per-unit energy, demand reduction, and LSC savings.
- Section x.4 – Cost and Cost Effectiveness presents the lifecycle cost and cost-effectiveness analysis. This includes a discussion of the materials and labor required to implement the measure and a quantification of the incremental cost. It also includes estimates of incremental maintenance costs, i.e., equipment lifetime and various periodic costs associated with replacement and maintenance during the period of analysis.
- Section x.5 – First-Year Statewide Impacts presents the statewide energy savings and environmental impacts of the proposed code change for the first year after the 2025 code takes effect. This includes the amount of energy that would be saved by California building owners and tenants and impacts

(increases or reductions) on material with emphasis placed on any materials that are considered toxic. Statewide water consumption impacts are also reported in this section.

- Section x.6 – Addressing Energy Equity and Environmental Justice presents the potential impacts of proposed code changes on disproportionately impacted populations (DIPs), as well as a summary of research and engagement methods.

- Section 5 – Proposed Revisions to Code Language concludes the report with specific recommendations for all measures with ~~strikeout~~ (deletions) and underlined (additions) language for the Standards, Reference Appendices, and Alternative Calculation Method (ACM) Reference Manual. Generalized proposed revisions to sections are included for the compliance manual and compliance documents.
- Section 6 – Bibliography presents the resources that the Statewide CASE Team used when developing this report.
- Appendix A: Statewide Savings Methodology presents the methodology and assumptions used to calculate statewide energy impacts.
- Appendix B: Embedded Electricity in Water Methodology presents the methodology and assumptions used to calculate the electricity embedded in water use (e.g., electricity used to draw, move, or treat water) and the energy savings resulting from reduced water use.
- Appendix C: California Building Energy Code Compliance (CBECC) Software Specification presents relevant proposed changes to the compliance software (if any).
- Appendix D: Environmental Analysis presents the methodologies and assumptions used to calculate impacts on GHG emissions and water use and quality.
- Appendix E: Discussion of Impacts of Compliance Process on Market Actors presents how the recommended compliance process could impact identified market actors.
- Appendix F: Summary of Stakeholder Engagement documents the efforts made to engage and collaborate with market actors and experts.
- Appendix G: Energy Cost Savings in Nominal Dollars presents LSC savings over the period of analysis in nominal dollars.
- Appendix H: Per-Unit Energy Impact Results for additional analyses not included in the body of the report.
- Appendix I: Energy Cost Savings Results for additional analyses not included in the body of the report.

- Appendix J: Statewide Energy and Energy Cost Savings for additional analyses not included in the body of the report.

The California IOUs offer free energy code training, tools, and resources for those who need to understand and meet the requirements of Title 24, Part 6. The program recognizes that building codes are one of the most effective pathways to achieve energy savings and GHG reductions from buildings – and that well-informed industry professionals and consumers are key to making codes effective. With that in mind, the California IOUs provide tools and resources to help both those who enforce the code, as well as those who must follow it. Visit EnergyCodeAce.com to learn more and to access content, including a glossary of terms.

2. Opaque Assemblies

2.1 Measure Description

2.1.1 Proposed Code Change

This proposal consists of five individual code changes. The first three would reduce the existing mandatory and prescriptive U-factor values for most opaque envelope assemblies. Currently, these proposals apply to all climate zones and building types, but the Statewide CASE Team will update the proposals in the Final CASE Report based on any new findings from continued analyses, including additional building energy modeling and feedback from stakeholders.

The other two code changes would provide updates that would simplify the code while improving energy savings. The first would eliminate the separate prescriptive requirements for hotel/motel guest rooms by incorporating them into the general provisions for nonresidential buildings. The second would consolidate some of the prescriptive U-factors for certain opaque assembly types into fewer values across all sixteen climate zones.

This proposal would not add or modify field verification or acceptance tests or require any technology not previously regulated.

New Construction Mandatory Maximum U-factors

The measure would reduce the mandatory maximum U-factors for new construction opaque assemblies by up to twenty percent. This proposal specifically applies to roof/ceiling and walls.

New Construction Prescriptive U-factors

This measure would reduce the existing maximum prescriptive U-factors for most opaque assemblies. The U-factors for metal-framed walls were revised for the 2022 Title 24, Part 6 code cycle and are not proposed to be revised again. This measure does include prescriptive values for all other wall assemblies and all roof/ceiling assemblies.

Alterations Mandatory U-factors

This measure would introduce U-factors required in opaque assembly alterations, including roof/ceiling insulation and reduce U-factors for wall insulation for all assembly types. Currently, the mandatory requirement for alterations to roof/ceiling insulation references the incorrect requirements. This measure would rectify this by requiring maximum U-factors.

Hotel/Motel Guest Rooms

This measure would incorporate hotel/motel guest room prescriptive requirements into the prescriptive requirements for a nonresidential building.

Consolidate U-factors

This measure would reduce the number of prescriptive U-factors across climate zones for mass walls and wood-framed walls as part of the process of increasing the prescriptive stringency of the measures.

2.1.2 Justification and Background Information

2.1.2.1 Justification

Improved U-factors

The mandatory U-factors for opaque assemblies have not changed since they were introduced in 2013. Some of the prescriptive U-factors for opaque envelope assemblies in new construction were updated in 2016 but have remained unchanged since. Building energy performance can be significantly improved through the reduction of U-factor values for opaque envelope assemblies.

These proposed measures would help downsize HVAC equipment and reduce the operational costs throughout the lifecycle of the buildings.

Hotel/Motel Guest Rooms

The separate U-factor table for hotel/motel guest rooms is a vestige from when high-rise residential was included in the nonresidential provisions. High-rise residential was separated from nonresidential in 2022 to create the new multifamily chapters, but the hotel/motel guest room provisions were not incorporated into the envelope requirements for residential buildings. Hotels and motel guest rooms are R-1 residential occupancy types within the California Building Code, Title 24, Part 2, but the buildings themselves are classified as nonresidential buildings.

Consolidate U-factors

This measure would reduce the number of prescriptive U-factors across climate zones for mass walls and wood-framed walls. The current values represent insignificant differences in comparison with the differences across other assembly types, and it would provide a simplification that would make it easier for designers and builders working across multiple climate zones.

2.1.2.2 Background Information

Improved U-factors

The term “opaque assemblies” of a building refers to all aspects of the envelope that are not transparent, such as roof/ceiling and walls. For the purposes of this Draft CASE Report, they refer to the opaque assemblies that separate conditioned spaces from unconditioned spaces or ambient air. The heat losses or heat gain through a standard building component are defined by the U-factor, also known as the rate of heat transfer through the envelope. The higher the insulation of the element, the lower the U-factor and the lower the rate of heat transfer of the opaque assembly. The proposed measure would reduce the existing mandatory U-factor for opaque assemblies, providing energy savings and non-energy benefits to all climate zones. These modifications to the mandatory values are deemed to be cost effective, as the proposed values are less stringent than the current cost-effective prescriptive values.

During development of the 2013 code, the Statewide CASE Team proposed mandatory U-factor values for opaque assemblies, however, they have not been updated since those changes were adopted. ASHRAE and IECC do not have mandatory insulation or U-factor requirements for envelope assemblies. They do, however, have envelope backstops.

In the 2016 cycle, the prescriptive U-factor requirements for metal-framed walls (all climate zones), and wood-framed (Climate Zone 1) walls, metal building roof and wood-framed roof construction assemblies were made more stringent. In the 2022 cycle, the prescriptive U-factor requirements for new construction metal-framed walls were updated again. The prescriptive U-factor requirements for metal walls, mass walls and wood-framed walls have not changed since 2008.

This proposal would increase the stringency of the opaque assemblies for new construction and alterations. The U-factors and insulation values vary based on climate zones.

Hotel/Motel Guest Rooms

The Statewide CASE Team considered simplifying the requirements for Hotel/Motels during the 2022 code cycle. This revision was not adopted because it was deemed to be lower priority than other code changes for the 2022 code cycle, and because there were limited resources the hotel/motel simplification did not move forward. See Appendix M of the 2022 Nonresidential High Performance Envelope CASE Report for recommendations for hotel/motel simplification. The following document describes why the hotel/motel proposal did not move forward for the 2022 code cycle. It also includes the entire Final CASE Report as an appendix: https://title24stakeholders.com/wp-content/uploads/2023/01/T24-2022-CASE-Study-Results-Reports-NR-HPE_Final-1.pdf.

2.1.3 Summary of Proposed Changes to Code Documents

The changes to Title 24, Part 6 proposed for this measure would replace the current U-factor with values that increase stringency in the sections addressing both new construction and alterations.

The sections below summarize how the Energy Code, Reference Appendices, Alternative Calculation Method (ACM) Reference Manuals, and compliance documents would be modified by the proposed change.[3] See Section 5.2 of this report for detailed proposed revisions to code language.

2.1.3.1 Specific Purpose and Necessity of Proposed Code Changes

Each proposed change to language in Title 24, Part 6 as well as the reference appendices to Part 6 are described below. See Section 5.2 of this report for marked-up code language.

Section: **120.7 MANDATORY INSULATION REQUIREMENTS**

Specific Purpose: The specific purpose is to change the title of the section to accommodate new and possible future subsections regarding the building thermal envelope.

Necessity: This change is necessary to appropriately describe the updated contents of the section.

Section: **120.7(a) Roof/Ceiling Insulation**

Specific Purpose: The specific purpose of the change to this section is to increase stringency of mandatory roof/ceiling insulation U-factors in new construction nonresidential applications.

Necessity: These changes are necessary to reduce energy consumption associated with building cooling and heating loads.

Section: **120.7(b) Wall Insulation**

Specific Purpose: The specific purpose of the changes to this section is to increase stringency of mandatory wall insulation U-factors in new construction nonresidential applications.

Necessity: These changes are necessary to reduce energy consumption from building cooling and heating loads.

[3] Visit EnergyCodeAce.com for trainings, tools and resources to help people understand existing code requirements.

Section: 140.3(a)1ii Guest rooms of hotel and motel buildings

Specific Purpose: The specific purpose of this change is to incorporate prescriptive opaque assembly criteria for hotel and motel guest rooms into the requirements of nonresidential construction.

Necessity: This change is necessary to eliminate confusion and inefficient use of energy in the construction of R-1 buildings.

Section: Table 140.3-B Prescriptive Envelope Criteria for Nonresidential Buildings – Modify U-factors

Specific Purpose: The specific purpose of this change is to increase stringency of prescriptive envelope U-factor criteria for walls and roof of nonresidential buildings.

Necessity: This change is necessary to reduce energy consumption from building cooling and heating loads. The prescriptive compliance approach remains the same, using updated U-factor criteria.

Section: Table 140.3-B Prescriptive Envelope Criteria for Nonresidential Buildings – Consolidate U-factors

Specific Purpose: The specific purpose of this change is to reduce the number of U-factor values required for each assembly type of walls and roof for nonresidential buildings.

Necessity: This change is necessary to align the number of different U-factors per assembly type from five or six different values, which have not been modified since 2008, with the more recently updated assembly values, which have only two or three U-factors per assembly.

Section: Table 140.3C Prescriptive Envelope Criteria for Guest Rooms of Hotel/Motel Buildings

Specific Purpose: The specific purpose of this change is to incorporate prescriptive opaque assembly criteria for hotel and motel guest rooms into the requirements of nonresidential construction.

Necessity: This change is necessary to eliminate confusion and inefficient use of energy in the construction of R-1 buildings.

Section: Section 141.0(b)1A Mandatory Roof Ceiling/Insulation for Alterations

Specific Purpose: The specific purpose of the changes to this section is to introduce a new mandatory roof U-factor requirements in alterations and remove the reference to 141.0(b)2Bii.

Necessity: This change is necessary since the current language refers to a requirement that is more stringent than new construction mandatory requirements for roof.

Section: Section 141.0(b)1B Mandatory Wall Insulation for Alterations

Specific Purpose: The specific purpose of the changes to this section is to increase stringency of mandatory wall insulation U-factor requirements in alterations.

Necessity: These changes are necessary to reduce energy consumption from building cooling and heating loads in nonresidential alteration applications.

2.1.3.2 Specific Purpose and Necessity of Changes to the Nonresidential ACM Reference Manual

The purpose and necessity of proposed changes to the Nonresidential ACM Reference Manual are described below. See Section 5.4 of this report for the detailed proposed revisions to the text of the ACM Reference Manual.

Section: **5.5**

Specific Purpose: The specific purpose of this change is to update the standard design construction assemblies to mandatory and prescriptive requirements outlined in Title 24, Part 6 Sections 120.7(a), 120.7(b), Table 140.3-B, Table 140.3-C, and Section 141(b)1B.

Necessity: These changes are necessary to ensure the ACM Reference Manual reflects the proposed code changes and that compliance with the performance pathway can be achieved.

2.1.3.3 Summary of Changes to the Nonresidential Compliance Manual

Chapter 1, Sections 1.7.1 and 1.7.8 would need to be revised to address the incorporation of hotel/motel guest rooms into nonresidential requirements. Similarly, Table 3-2 would need to be edited to delete sections related to hotel/motel guest rooms.

Sections of Chapter 3 pertaining to mandatory and prescriptive U-factor values for roof/wall and ceiling assemblies in both new construction and alterations would need to be revised.

2.1.3.4 Summary of Changes to Compliance Documents

The proposed code change would modify the compliance documents listed below. Details of the required revisions to the compliance documents are presented in Section 5.5.

- NRCC-ENV-E Certificate of Compliance would require several changes to delete references to hotel/motel buildings, as well as modified references to alterations in roofing.
- 2022-NRCI-ENV-E Certificate of Installation – No changes would be required for this document.

2.1.4 Regulatory Context

2.1.4.1 Determination of Inconsistency or Incompatibility with Existing State Laws and Regulations

This proposed measure's intent is to update existing requirements in Title 24, Part 6. Therefore, there are no expected issues with inconsistencies or incompatibility.

2.1.4.2 Duplication or Conflicts with Federal Laws and Regulations

There are no relevant federal laws or regulations.

2.1.4.3 Difference From Existing Model Codes and Industry Standards

The model energy codes used elsewhere in the country, ASHRAE 90.1 and the International Energy Conservation Code (IECC) currently have more stringent envelope provisions for many assembly types in similar climate zones. ASHRAE and IECC have eight climate zones, compared to the sixteen in California. Most of the California climate zones fall within ASHRAE/IECC Climate Zones 3, 4, and 5. Table 5 maps out the corresponding climate zones for reference.

Table 5: Comparison of California and ASHRAE/IECC Climate Zones (CZs)

California CZs	National Model Codes CZs	Notes
1	4c	4c is Mixed Marine, covered by CZ 4 in 90.1, and CZ 5 in IECC
2-6	3c	3c is Warm Marine, covered by CZ 3 in 90.1 and IECC
7-13	3b	3b is Warm Dry, covered by CZ 3 in 90.1 and IECC
14	4b	4b is Mixed Dry, covered by CZ 4 in 90.1 and IECC
15	2b	2b is Hot Dry, covered by CZ 2 in 90.1 and IECC
16	4b, 5b, 6b	4b is Mixed Dry, covered by CZ 4 in 90.1 and IECC 5b is Cool Dry, covered by CZ 5 in 90.1 and IECC 6b is Cold Dry, covered by CZ 6 in 90.1 and IECC

Table 6 compares U-factor values between Title 24, Part 6, and the national model codes. Values highlighted in green represent the most stringent of the three standards.

Table 6: Comparison of New Construction U-factor Requirements

Envelope Assembly	California Climate Zone	Title 24 – 2022 Mandatory	Title 24 – 2022 Prescriptive	ASHRAE 90.1 2022	IECC 2021
Roof/Ceiling – Metal Building	1, 14, 16	0.098	0.041	0.037	**0.035**
	2-13, 15	0.098	0.041	0.041	**0.035**
Roof/Ceiling – Wood Frame and Others	1, 14, 16	0.075	0.034	**0.021**	**0.021**
	2-5	0.075	0.034	**0.027**	**0.027**
	6-8	0.075	0.049	**0.027**	**0.027**
	9-13	0.075	0.034	**0.027**	**0.027**
	15	0.075	0.034	**0.027**	**0.027**
Walls – Metal Building	1	0.113	0.113	0.060	**0.050**
	2, 4, 5, 8-13	0.113	**0.061**	0.094	**0.079**
	3,6,7	0.113	0.113	0.094	**0.079**
	14, 16	0.113	0.061	**0.050**	**0.050**
	15	0.113	**0.057**	0.094	0.079
Walls – Metal Framed [a]	1	0.151	0.060	0.064	**0.055**
	2, 4, 5, 8-13	0.151	**0.055**	0.077	**0.064**
	3	0.151	0.071	0.077	**0.064**
	6, 7	0.151	**0.060**	0.077	0.064
	14	0.151	**0.055**	0.064	0.064
	15	0.151	**0.055**	0.084	0.077
	16	0.151	**0.055**	**0.055**	**0.055**
Walls – Mass Light	1	0.440	0.196	0.104	**0.090**
	2, 10-13	0.440	0.170	**0.123**	**0.123**
	3	0.440	0.278	**0.123**	**0.123**
	4	0.440	0.227	**0.123**	**0.123**
	5-9	0.440	0.440	**0.123**	**0.123**
	14	0.440	0.170	**0.104**	**0.104**
	15	0.440	0.170	**0.151**	**0.151**
	16	0.440	0.170	**0.090**	**0.090**
Walls – Mass Heavy	1	0.690	0.253	0.104	**0.090**
	2-5, 10	0.690	0.650	**0.123**	**0.123**
	6-9	0.690	0.690	**0.123**	**0.123**
	11	0.690	0.184	**0.123**	**0.123**
	12	0.690	0.253	**0.123**	**0.123**
	13	0.690	0.211	**0.123**	**0.123**
	14	0.690	0.184	**0.104**	**0.104**
	15	0.690	0.184	**0.151**	**0.151**
	16	0.690	0.160	**0.090**	**0.090**
Walls – Wood Framed and Other	1	0.110	0.095	0.064	**0.051**
	2, 4, 9, 10,12-13	0.110	**0.059**	0.089	0.064
	3, 6, 7	0.110	0.110	0.089	**0.064**
	5, 8	0.110	0.102	0.089	**0.064**
	11	0.110	**0.045**	0.089	0.064
	14	0.110	**0.059**	0.064	0.064
	15	0.110	**0.042**	0.089	0.064
	16	0.110	0.059	**0.051**	**0.051**

a. These values were updated in the 2022 code cycle and would not be updated in this proposal.

2.1.5 Compliance and Enforcement

When developing this proposal, the Statewide CASE Team considered methods to streamline the compliance and enforcement process and how negative impacts on market actors who are involved in the process could be mitigated or reduced. This section describes how to comply with the proposed code change. It also describes the compliance verification process. Appendix E presents how the proposed changes could impact various market actors.

The compliance verification activities related to this measure that need to occur during each phase of the project are described below:

- **Design Phase:** Building designers must be aware of the code changes to the envelope U-factors. The qualified design reviewer, per commissioning requirements, as well as energy consultants and compliance documentation authors must verify that plans and specifications match, and therefore meet the requirements of Title 24, Part 6. No change in the process to complete NRCC compliance documents.
- **Permit Application Phase:** Plans examiners would verify that the project meets new envelope U-factor requirements by ensuring that the compliance documentation (NRCC) matches the plan and specifications.
- **Construction Phase:** Envelopes would be built to new U-factor requirements per energy documentations and/or specifications. Installers need to complete the required installation certificates (NRCI).
- **Inspection Phase:** Building inspectors would verify that the U-factor meets what is listed on energy documentation, plans, and/or specifications.

The compliance process would not vary from the current compliance process, with designers, builders, and compliance officials referencing the same tables with updated values.

2.2 Market Analysis

2.2.1 Current Market Structure

The Statewide CASE Team performed a market analysis with the goals of identifying current technology availability, current product availability, and market trends. It then considered how the proposed standard may impact the market in general as well as individual market actors. Information was gathered about the incremental cost of complying with the proposed measure. Estimates of market size and measure applicability were identified through research and outreach with stakeholders including utility program staff, CEC staff, and a wide range of industry actors. In addition to

conducting personalized outreach, the Statewide CASE Team discussed the current market structure and potential market barriers during a public stakeholder meetings that the Statewide CASE Team held on February 14, 2023 and May 22, 2023.

The nonresidential building envelope market involves many market actors in a variety of roles. This includes designers, architects, component manufacturers (shell, insulation, etc.), installers, construction companies, and certification/compliance specialists. The opaque envelope measure would have some impact on all these market actors. Designers and architects would have to be aware of the new code changes and then design to those requirements. Examiners would need to verify that the project meets new envelope U-factor requirements; builders would need to build to the correct specifications; and inspectors would need to verify that the assembly U-factor meets what is listed in the specifications.

The market actors most impacted by this measure would likely be designers and architects. This measure does not introduce new technologies, so component manufacturers would not be greatly impacted. This proposal would necessitate that designers learn the new U-factor requirements and factor those into their designs. This could be accomplished with current techniques and materials. Compliance specialists would need to learn the new standards and verify building compliance for both mandatory and prescriptive requirements.

Component manufacturers, design-build consultants, and industry organizations have been the most vocal actors for this code cycle. The most common feedback for the opaque envelope measure has highlighted the necessity for cost effectiveness. The Statewide CASE Team understands these concerns and while this measure has a broad impact on first cost, there would be significant energy savings allowing this measure to be cost-effective.

2.2.2 Technical Feasibility and Market Availability

No new materials or processes would need to be developed for the measure to be successful. There are different requirements for different construction materials and methods, such as wood-framed, metal-framed, and mass walls, and many products are available to enable designers to meet or exceed the proposed standards. Best practices of installation and maintenance are already well understood. Common types of wall insulation for commercial buildings include fiberglass, cellulose, extruded polystyrene (XPS), expanded polystyrene (EPS), polyisocyanurate, and spray-applied polyurethane. Wider dimensional lumber (2x6, 2x8, etc.) is commonly used to create room for additional cavity insulation. When continuous exterior insulation is utilized, rigid or semi-rigid insulation such as EPS, XPS, or mineral wool is installed outboard of exterior sheathing to increase thermal efficiency. For mass walls, common practice is to fill hollow concrete masonry units (CMU) with insulation, while reduced webbed CMUs are

sometimes employed. Wood-framed, metal-framed, and mass walls constitute the vast majority of wall assemblies used in nonresidential construction.

2.2.3 Market Impacts and Economic Assessments

2.2.3.1 Impact on Builders

Increases in thermal performance of mandatory measures affect projects using the performance compliance pathways. Projects permitted under prescriptive compliance pathways are not affected by mandatory measures.

The performance compliance pathway gives project designers leeway to "trade off" by incorporating lower performing systems (relative to the prescriptive baseline), with the understanding that this will be offset by other systems with greater than prescriptive baseline performance. Energy modeling establishes whether the aggregate performance of the project's proposed systems meet or exceed those of the baseline reference, or Standard Design.

Mandatory minimum requirements establish a floor for how much project designers are able to "trade off" when incorporating systems with lesser performance than the prescriptive baseline.

Market impacts are determined by whether the increased mandatory minimums result in envelope assemblies that are more costly than those meeting current mandatory minimum requirements.

Builders of commercial structures are directly impacted by many of the measures proposed by the Statewide CASE Team for the 2025 code cycle. It is within the normal practices of these businesses to adjust their building practices to changes in building codes. When necessary, builders engage in continuing education and training in order to remain up-to-date with changes to design practices and building codes.

California's construction industry comprises approximately 93,000 business establishments and 943,000 employees (see Table 7). For 2022, total estimated payroll would be about $78 billion. Nearly 72,000 of these business establishments and 473,000 employees are engaged in the residential building sector, while another 17,600 establishments and 369,000 employees focus on the commercial sector. The remainder of establishments and employees work in industrial, utilities, infrastructure, and other heavy construction roles (the industrial sector).

Table 7: California Construction Industry, Establishments, Employment, and Payroll in 2022 (Estimated)

Building Type	Construction Sectors	Establishments	Employment	Annual Payroll (Billions $)
Residential	**All**	**71,889**	**472,974**	**31.2**
Residential	Building Construction Contractors	27,948	130,580	9.8
Residential	Foundation, Structure, & Building Exterior	7,891	83,575	5.0
Residential	Building Equipment Contractors	18,108	125,559	8.5
Residential	Building Finishing Contractors	17,942	133,260	8.0
Commercial	**All**	**17,621**	**368,810**	**35.0**
Commercial	Building Construction Contractors	4,919	83,028	9.0
Commercial	Foundation, Structure, & Building Exterior	2,194	59,110	5.0
Commercial	Building Equipment Contractors	6,039	139,442	13.5
Commercial	Building Finishing Contractors	4,469	87,230	7.4
Industrial, Utilities, Infrastructure, & Other (Industrial+)	**All**	**4,206**	**101,002**	**11.4**
Industrial+	Building Construction	288	3,995	0.4
Industrial+	Utility System Construction	1,761	50,126	5.5
Industrial+	Land Subdivision	907	6,550	1.0
Industrial+	Highway, Street, and Bridge Construction	799	28,726	3.1
Industrial+	Other Heavy Construction	451	11,605	1.4

Source: (State of California, n.d.)

The proposed mandatory and prescriptive changes to opaque assemblies would likely affect commercial builders but would not impact firms that focus on construction and retrofit of industrial buildings, utility systems, public infrastructure, or other heavy construction. The effects on the commercial building industry would not be felt by all firms and workers, but rather would be concentrated in specific industry subsectors. Table 8 shows the commercial building subsectors the Statewide CASE Team expects to be impacted by the changes proposed in this report.

Builders would need to factor in higher up-front costs of envelope assembly pricing. They may have to consider longer lead times when ordering if products have lower market availability. Installation processes and costs would be the same as current requirements.

The Statewide CASE Team's estimates of the magnitude of these impacts are shown in Section 2.2.4 Economic Impacts.

Table 8: Specific Subsectors of the California Commercial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2022 (Estimated)

Construction Subsector	Establishments	Employment	Annual Payroll (Billions $)
Commercial Building Construction	4,919	83,028	9.0
Nonresidential structural steel contractors	363	13,110	1.1
Nonresidential Framing Contractors	133	3,406	0.3
Nonresidential Masonry Contractors	229	4,246	0.3
Nonresidential Roofing Contractors	354	10,382	0.9
Nonresidential Siding Contractors	26	668	0.0
Other Nonresidential Exterior contractors	277	3,006	0.2
Nonresidential Drywall Contractors	585	22,824	2.1

Source: (State of California, n.d.)

2.2.3.2 Impact on Building Design Professionals and Energy Consultants

Increasing mandatory stringency affects the choice of envelope assemblies within the context of the performance compliance pathway. The range of code compliant envelope assemblies would be decreased by the number of assemblies no longer meeting the mandatory minimum requirements.

While building designers and energy consultants may need to adjust what envelope assemblies are chosen for a project, building designers and energy consultants would not have to develop new envelope assemblies or incorporate new materials to meet this requirement. Therefore, this measure would have minimal effect on building designers and energy consultants.

Adjusting design practices to comply with changing building codes is within the normal practices of building designers. Building codes (including Title 24, Part 6) are typically updated on a three-year revision cycle, and building designers and energy consultants engage in continuing education and training in order to remain up-to-date with changes to design practices and building codes.

Businesses that focus on residential, commercial, institutional, and industrial building design are contained within the Architectural Services sector (North American Industry Classification System 541310). Table 9 shows the number of establishments, employment, and total annual payroll for Building Architectural Services. The proposed code changes would potentially impact all firms within the Architectural Services sector. The Statewide CASE Team anticipates the impacts for mandatory and prescriptive opaque assemblies to affect firms that focus on nonresidential construction.

There is not a North American Industry Classification System (NAICS)[4] code specific to energy consultants. Instead, businesses that focus on consulting related to building energy efficiency are contained in the Building Inspection Services sector (NAICS 541350), which is comprised of firms primarily engaged in the physical inspection of residential and nonresidential buildings.[5] It is not possible to determine which business establishments within the Building Inspection Services sector are focused on energy efficiency consulting. The information shown in Table provides an upper bound indication of the size of this sector in California.

Table 9: California Building Designer and Energy Consultant Sectors in 2022 (Estimated)

Sector	Establishments	Employment	Annual Payroll (Millions $)
Architectural Services [a]	4,134	31,478	3,623.3
Building Inspection Services [b]	1,035	3,567	280.7

Source: (State of California, n.d.)

a. Architectural Services (NAICS 541310) comprises private-sector establishments primarily engaged in planning and designing residential, institutional, leisure, commercial, and industrial buildings and structures.

b. Building Inspection Services (NAICS 541350) comprises private-sector establishments primarily engaged in providing building (residential & nonresidential) inspection services encompassing all aspects of the building structure and component systems, including energy efficiency inspection services

2.2.3.3 Impact on Occupational Safety and Health

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

[4] NAICS is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. NAICS was development jointly by the U.S. Economic Classification Policy Committee (ECPC), Statistics Canada, and Mexico's Instituto Nacional de Estadistica y Geografia, to allow for a high level of comparability in business statistics among the North American countries. NAICS replaced the Standard Industrial Classification (SIC) system in 1997.

[5] Establishments in this sector include businesses primarily engaged in evaluating a building's structure and component systems and includes energy efficiency inspection services and home inspection services. This sector does not include establishments primarily engaged in providing inspections for pests, hazardous wastes or other environmental contaminates, nor does it include state and local government entities that focus on building or energy code compliance/enforcement of building codes and regulations.

2.2.3.4 Impact on Building Owners and Occupants

Commercial Buildings

The commercial building sector includes a wide array of building types, including offices, restaurants and lodging, retail, and mixed-use establishments, and warehouses (including refrigerated) (Kenney, 2019). Energy use by occupants of commercial buildings also varies considerably, with electricity used primarily for lighting, space cooling and conditioning, and refrigeration, while natural gas is used primarily for water heating and space heating. According to information published in the 2019 California Energy Efficiency Action Plan, there is more than 7.5 billion square feet of commercial floor space in California consuming 19 percent of California's total annual energy use (Kenney, 2019). The diversity of building and business types within this sector creates a challenge for disseminating information on energy and water efficiency solutions, as does the variability in sophistication of building owners and the relationships between building owners and occupants.

Estimating Impacts

Building owners and occupants would benefit from lower energy bills. As discussed in Section 2.2.4.1, when building occupants save on energy bills, they tend to spend it elsewhere in the economy thereby creating jobs and economic growth for the California economy. The Statewide CASE Team does not expect the proposed code change for the 2025 code cycle to impact building owners or occupants adversely.

2.2.3.5 Impact on Building Component Retailers (Including Manufacturers and Distributors)

Retailers, manufacturers, and distributors who offer higher performing wall and roof materials and assemblies could have increased business from proposed code modifications. Some retailers and manufacturers may need to increase production or availability of these lower U-factor materials.

2.2.3.6 Impact on Building Inspectors

Table shows employment and payroll information for state and local government agencies in which many inspectors of residential and commercial buildings are employed. Building inspectors participate in continuing education and training to stay current on all aspects of building regulations, including energy efficiency. The Statewide CASE Team, therefore, anticipates the proposed change would have no impact on employment of building inspectors or the scope of their role conducting energy efficiency inspections.

Table 10: Employment in California State and Government Agencies with Building Inspectors in 2022 (Estimated)

Sector	Govt.	Establishments	Employment	Annual Payroll (Million $)
Administration of Housing Programs[a]	State	18	265	29.0
	Local	38	3,060	248.6
Urban and Rural Development Admin[b]	State	38	764	71.3
	Local	52	2,481	211.5

Source: (State of California, Employment Development Department, n.d.)

a. Administration of Housing Programs (NAICS 925110) comprises government establishments primarily engaged in the administration and planning of housing programs, including building codes and standards, housing authorities, and housing programs, planning, and development.
b. Urban and Rural Development Administration (NAICS 925120) comprises government establishments primarily engaged in the administration and planning of the development of urban and rural areas. Included in this industry are government zoning boards and commissions.

2.2.3.7 Impact on Statewide Employment

As described in Sections 2.2.3.1 through 2.2.3.6, the Statewide CASE Team does not anticipate significant employment or financial impacts to any particular sector of the California economy. This is not to say that the proposed change would not have modest impacts on employment in California. In Section 2.2.4, the Statewide CASE Team estimated the proposed mandatory and prescriptive changes in opaque assemblies would affect statewide employment and economic output directly and indirectly through its impact on builders, designers, energy consultants, and building inspectors. In addition, the Statewide CASE Team estimated how energy savings associated with the proposed mandatory and prescriptive changes in opaque assemblies would lead to modest ongoing financial savings for California residents, which would then be available for other economic activities.

2.2.4 Economic Impacts

For the 2025 code cycle, the Statewide CASE Team used the IMPLAN model software,[6] along with economic information from published sources, and professional judgement to develop estimates of the economic impacts associated with each of the proposed code changes. Conceptually, IMPLAN estimates jobs created as a function of incoming cash flow in different sectors of the economy, due to implementing a code or a standard. The jobs created are typically categorized into direct, indirect, and induced employment. For example, cash flow into a manufacturing plant captures direct employment (jobs created in the manufacturing plant), indirect employment (jobs created in the sectors that

[6] IMPLAN employs economic data and advanced economic impact modeling to estimate economic impacts for interventions like changes to the California Title 24, Part 6 code. For more information on the IMPLAN modeling process, see www.IMPLAN.com.

provide raw materials to the manufacturing plant) and induced employment (jobs created in the larger economy due to purchasing habits of people newly employed in the manufacturing plant). Eventually, IMPLAN computes the total number of jobs created due to a code. The assumptions of IMPLAN include constant returns to scale, fixed input structure, industry homogeneity, no supply constraints, fixed technology, and constant byproduct coefficients. The model is also static in nature and is a simplification of how jobs are created in the macro-economy.

The economic impacts developed for this report are only estimates and are based on limited and to some extent speculative information. The IMPLAN model provides a relatively simple representation of the California economy and, though the Statewide CASE Team is confident that the direction and approximate magnitude of the estimated economic impacts are reasonable, it is important to understand that the IMPLAN model is a simplification of extremely complex actions and interactions of individual, businesses, and other organizations as they respond to changes in energy efficiency codes. In all aspects of this economic analysis, the CASE Authors rely on conservative assumptions regarding the likely economic benefits associated with the proposed code change. By following this approach, the economic impacts presented below represent lower bound estimates of the actual benefits associated with this proposed code change.

Adoption of this code change proposal would result in relatively modest economic impacts through the additional direct spending by those in the commercial building industry, architects, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2025 code cycle regulations would result in additional spending by those businesses.

Table 11: Estimated Impact that Adoption of the Proposed Measure would have on the California Commercial Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Commercial Builders)	146.6	$11.391	$13.164	$22.421
Indirect Effect (Additional spending by firms supporting Commercial Builders)	35.9	$3.103	$4.869	$8.967
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	61.0	$4.162	$7.451	$11.860
Total Economic Impacts	**243.5**	**$18.655**	**$25.484**	**$43.247**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[7]

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

Table 12: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultants

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Designers & Energy Consultants)	13.1	$1.437	$1.423	$2.249
Indirect Effect (Additional spending by firms supporting Bldg. Designers & Energy Consultants)	5.3	$0.428	$0.595	$0.957
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	7.9	$0.536	$0.960	$1.538
Total Economic Impacts	**26.2**	**$2.401**	**$2.977**	**$4.734**

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

Table 13: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Inspectors)	0.1	$0.009	$0.011	$0.013
Indirect Effect (Additional spending by firms supporting Building Inspectors)	0.0	$0.001	$0.001	$0.002
Induced Effect (Spending by employees of Building Inspection Bureaus and Departments)	0.0	$0.003	$0.005	$0.008
Total Economic Impacts	**0.1**	**$0.013**	**$0.017**	**$0.023**

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

2.2.4.1 Creation or Elimination of Jobs

The Statewide CASE Team does not anticipate that the measures proposed for the 2025 code cycle regulation would lead to the creation of new *types* of jobs or the elimination of *existing* types of jobs. In other words, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. Rather, the estimates of economic impacts discussed in Section 2.2.4 would lead to modest changes in employment of existing jobs.

2.2.4.2 Creation or Elimination of Businesses in California

As stated in Section 2.2.4.1, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. The proposed change represents a modest change to nonresidential building assembly practices, which would not excessively burden or competitively disadvantage California businesses – nor would it necessarily lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not foresee any new

businesses being created, nor does the Statewide CASE Team think any existing businesses would be eliminated due to the proposed code changes.

2.2.4.3 Competitive Advantages or Disadvantages for Businesses in California

The proposed code changes would apply to all businesses incorporated in California, regardless of whether the business is located inside or outside of the state.[8] Therefore, the Statewide CASE Team does not anticipate that these measures proposed for the 2025 code cycle regulation would have an adverse effect on the competitiveness of California businesses. Likewise, the Statewide CASE Team does not anticipate businesses located outside of California would be advantaged or disadvantaged.

2.2.4.4 Increase or Decrease of Investments in the State of California

The Statewide CASE Team analyzed national data on corporate profits and capital investment by businesses that expand a firm's capital stock (referred to as net private domestic investment, or NPDI).[9] As Table 14Table shows, between 2017 and 2021, NPDI as a percentage of corporate profits ranged from a low of 18 in 2020 due to the worldwide economic slowdowns associated with the COVID 19 pandemic to a high of 35 percent in 2019, with an average of 26 percent. While only an approximation of the proportion of business income used for net capital investment, the Statewide CASE Team believes it provides a reasonable estimate of the proportion of proprietor income that would be reinvested by business owners into expanding their capital stock.

Table 14: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2017	518.473	1882.460	28
2018	636.846	1977.478	32
2019	690.865	1952.432	35
2020	343.620	1908.433	18
2021	506.331	2619.977	19
5-Year Average	*Intentionally blank*	*Intentionally blank*	**26**

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

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

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

The Statewide CASE Team estimates that the sum of proposed code changes in this report would increase in investment in California:

*Change in Proprietor Income ($4,341,452) * 0.26 = $1,150,166*

2.2.4.5 Incentives for Innovation in Products, Materials, or Processes

There is a consistent trend within the building design and construction industry of increasing focus on thermal performance of the exterior envelope. This trend is reflected by the development, success, and adoption of building performance standards that incentivize increasing usage of insulation, thermal breaks, and U-value optimization. Examples of such standards include LEED, Passive House, Net Zero, Living Building Challenge, Green Globe, etc.

The industry shift toward higher thermal performance envelopes has resulted in building component manufacturers developing products to meet this demand. Examples of such products include new insulation types (i.e., MAI/polyiso panel,[10] Phase Change materials, etc.), higher R-value insulation, structural thermal breaks. The proposed measure would leverage the ready availability of products and design solutions that already exist as a result of broader industry trends. It would further incentivize the development of low-cost options for meeting higher thermal performance envelope requirements.

CEC offers[11] incentives for creativity and innovations in the building industry which includes improvements in envelopes; like Bright Schools program, Building Energy benchmarking program, and Energy Efficiency in Existing Buildings programs. There are incentives based on a project's anticipated modeled energy usage reduction, peak load reduction and greenhouse gas (GHG) emission reduction as compared to the mixed-fuel 2019 Energy Code prescriptive standards.

With our existing code change proposal, the bar for participating in these programs would increase slightly, hence more opportunities and avenues for innovations in the building sector.

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

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

[10] MAI = modified atmosphere insulation; https://www.ornl.gov/news/buildings-inside-out

[11] https://www.energy.ca.gov/programs-and-topics/programs

Cost of Enforcement

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

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

2.2.4.7 Impacts on Specific Persons

While the objective of any of the Statewide CASE Team's proposal is to promote energy efficiency, the Statewide CASE Team recognizes that there is the potential that a proposed code change may result in unintended consequences. There are no foreseen impacts on specific persons or groups. The materials and technologies to meet the proposed code changes are neither proprietary nor sole-sourced. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

2.2.5 Fiscal Impacts

2.2.5.1 Mandates on Local Agencies or School Districts

This measure would impact local agencies and school districts undertaking new construction or building envelope renovation projects.

2.2.5.2 Costs to Local Agencies or School Districts

This measure would impose minor additional costs for increased insulation to local agencies and school districts undertaking new construction or building envelope renovation projects.

2.2.5.3 Costs or Savings to Any State Agency

This measure would impose minor additional costs for increased insulation to state agencies undertaking new construction or building envelope renovation projects and is expected to provide commensurate savings in energy costs.

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

There are no added non-discretionary costs or savings to local agencies.

2.2.5.5 Costs or Savings in Federal Funding to the State

There are no costs or savings to federal funding to the state.

2.3 Energy Savings

The Statewide CASE Team gathered stakeholder input to inform the energy savings analysis. See Appendix F for a summary of stakeholder engagement.

Energy savings benefits may have potential to disproportionately impact DIPs. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

2.3.1 Energy Savings Methodology

2.3.1.1 Energy Savings Analysis Assumptions

This proposal evaluates changes to both prescriptive and mandatory requirements for new construction, additions, and alterations. The Statewide CASE Team used EnergyPlus v9.4.0 to conduct the energy savings calculations for all code change proposals since California Building Energy Code Compliance (CBECC) software is not adequately flexible to handle the input assumptions for some of the envelope measures. Rulesets are sourced from the CBECC prototypical building models. The Statewide CASE Team simulated the energy impacts in every climate zone and applied the climate-zone Long-term Systemwide Cost (LSC) hourly factors when calculating energy cost impacts. The Statewide CASE Team evaluated various scenarios comparing energy impacts and cost-effectiveness across prototypes and climate zones. This process, in parallel with stakeholder outreach and market and technical research, informed the ultimate proposals that are made in this report.

The CBECC energy models are modified to include the proposed changes to the energy standards. The 2022 Standard Design also serves as the baseline with or without modification for mandatory and prescriptive proposals. As a conservative assumption the 2022 Standard Design is used for alterations.

For this Draft CASE Report, the modeling evaluation was completed for a single measure, Wood-framed and Other Roof – Prescriptive, and for five building prototypes: Office Medium, Office Large, Retail Medium, Retail Large, and School Small. All 16 climate zones were evaluated for this measure and these prototypes.

Detailed input assumptions for the models are included in Appendix C.

2.3.1.2 Energy Savings Methodology per Prototypical Building

To quantify impacts, the Statewide CASE Team developed several scenarios by calculating per-unit energy savings expected from the proposed code changes. First, savings are calculated by fuel type. Electricity savings are measured in terms of both energy usage and peak demand reduction. Natural gas savings are quantified in energy usage. Second, the Statewide CASE Team calculated source energy savings. source energy represents the total amount of raw fuel required to operate a building. In addition to all energy used from on-site production, source energy incorporates all transmission, delivery, and production losses. The hourly source energy values provided by CEC are strongly correlated with GHG emissions.[12] Finally, the Statewide CASE Team calculated Long-term Systemwide Cost (LSC) savings, formerly known as Time Dependent Valuation (TDV) Energy Cost Savings. LSC savings are calculated using LSC hourly factors for both electricity and natural gas provided by the CEC. These LSC hourly factors are projected over the 30-year life of the building and incorporate the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade-based CO_2 emissions.[13]

The CEC directed the Statewide CASE Team to model the energy impacts using prototypical building models that represent typical building geometries for different types of buildings. The prototype buildings that the Statewide CASE Team used for this proposal are presented in Table 15.

[12] See hourly factors for source energy, LSC, and GHG emissions at https://www.energy.ca.gov/files/2025-energy-code-hourly-factors.

[13] More information on source energy and LSC hourly factors is available in the March 2020 CEC Staff Workshop on Energy Code Compliance Metrics and the July 2022 CEC Staff Workshop on Energy Code Accounting for the 2025 Building Energy Efficiency Standards.

Table 15: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Number of Stories	Floor Area (Square Feet)	Description
Assembly – Library	1	12,996	Single story, 13 ft ceiling, WWR – 35%
Assembly – Exhibits & Events	1	8,892	Single story, 13 ft ceiling, WWR – 0%
Assembly – Sports & Recreation	1	3,493	Single Story, 25 ft ceiling, WWR-0%, SSR – 4.1%
Assembly – Religious	1	6,889	Single Story, 50 ft ceiling, WWR-33%,
Assembly – Terminals	1	6,448	Single Story, 25 ft ceiling, WWR-28%, SSR – 1%
Warehouse	1	42,554	Single story high ceiling warehouse. Includes one office space. WWR–0.7%, SRR–5%
Hospital	5	241,501	5-Story Hospital plus basement. Source: U.S. DOE Standard 90.1 Hospital prototype and scorecard. The prototype contains Title 24, Part 6, minimally compliant envelope features and lighting. For HVAC systems, AIA guidelines recommend using VAV systems wherever possible.
HotelSmall	4	52,045	4 story Hotel with 77 guest rooms. WWR–11%
OfficeLarge [a]	**12**	**498,589**	**12-story + 1 basement office building with 5 zones and a ceiling plenum on each floor. WWR–0.40.***
OfficeMedium [a]	**3**	**53,628**	**3-story office building with 5 zones and a ceiling plenum on each floor. WWR–0.33**
OfficeMediumLab	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–0.33
OfficeSmall	1	5,502	1-story, 5-zone office building with pitched roof and unconditioned attic. WWR–0.24
RestaurantFastFood	1	2,501	Fast food restaurant with a small kitchen and dining areas. 14% WWR. Pitched roof with an unconditioned attic.
RetailLarge [a]	**1**	**240,000**	**Big-box retail building with WWR–12% and SRR–0.82%**
RetailMedium [a]	**1**	**24,563**	**Similar to a Target or Walgreens. 7% WWR on the front façade, none on other sides. SRR–2.1%.**
RetailStripMall	1	9,375	Strip mall building with WWR–10%
SchoolSmall [a]	**1**	**24,413**	**Elementary school with WWR–0.36**
SchoolLarge	2	210,866	High school with WWR of 35% and SRR–1.4%

a. This prototype has been modeled for this Draft CASE Report.

The Statewide CASE Team estimated LSC, source energy, electricity, natural gas, peak demand, and GHG impacts by simulating the proposed code change in EnergyPlus using prototypical buildings and rulesets from the 2025 Research Version of the California Building Energy Code Compliance (CBECC) software (California Energy Commission, n.d.).

CBECC generates two models based on user inputs: the Standard Design and the Proposed Design. The Standard Design represents the geometry of the prototypical building and a design that uses a set of features that result in a LSC budget and Source Energy budget that is minimally compliant with 2022 Title 24, Part 6 code requirements. Features used in the Standard Design are described in the 2022 Nonresidential ACM Reference Manual. The Proposed Design represents the same geometry as the Standard Design, with energy features entered by the user. To develop savings estimates for the proposed code changes, the Statewide CASE Team created a Standard Design and Proposed Design for each prototypical building with the Standard Design representing compliance with 2022 code and the Proposed Design representing compliance with the proposed requirements. Comparing the energy impacts of the Standard Design to the Proposed Design reveals the outcomes of the proposed code change relative to a building that is minimally compliant with the 2022 Title 24, Part 6 requirements.

There is an existing Title 24, Part 6 requirement that covers the building system in question and applies to both new construction and alterations, so the Standard Design is minimally compliant with the 2022 Title 24 requirements.

The current mandatory U-factors for opaque assemblies are described below.

Table 16: Current Mandatory U-Factors Values for Opaque Assemblies New Construction and Alterations

Envelope Assembly	New Construction (area weighted average)	Alterations
Roofs/Ceilings – Metal building	0.098	N/A [a]
Roofs/Ceilings – Wood Framed and other	0.075	N/A [a]
Walls – Metal building	0.113	0.113
Walls – Metal framed	0.151	0.217
Walls – Mass Light	0.44	No requirement
Walls – Mass Heavy	0.69	No requirement
Walls – Wood-framed and others	0.11	0.11

a. Roof /ceiling alterations do not currently have a mandatory U-factor requirement, only prescriptive. This proposal would correct that omission.

The current prescriptive U-factors for opaque assemblies are described below.

Table 17: Current Prescriptive U-Factors Values for Opaque Assemblies New Construction and Additions

Envelope Assembly	New Construction (area weighted average)	Climate Zones
Roofs/Ceilings – Metal building	0.041	All Climate Zones
Roofs/Ceilings – Wood Framed and other	0.034	5,16
	0.049	6-8
Walls – Metal building	0.057	15
	0.061	1,3,6,7
	0.113	2,4-5,8-14,16
Walls – Mass Light	0.17	2,10-16
	0.196	1
	0.227	4
	0.278	3
	0.44	5-9
Walls – Mass Heavy	0.16	16
	0.184	11,14,15
	0.211	13
	0.253	1,12
	0.65	2-5,10
	0.69	6-9
Walls – Wood-framed and others	0.042	15
	0.059	2,10,12-14,16
	0.095	1
	0.102	5
	0.110	3,6,7

Prescriptive requirements for new construction metal framed walls and roof alterations were updated in the 2022 code cycle. There are no prescriptive requirements for opaque assembly alterations except for roofs.

For the mandatory proposal, the Standard Design default prescriptive U-factor requirements are modified with current mandatory U-factor requirements. This change is necessary to determine how much reduction can be achieved by making the mandatory requirement more stringent. For the prescriptive proposal, the Proposed Design is identical to the Standard Design in all ways except for the revisions that represent the proposed changes to the code. Table 18 presents the parameters that were modified, and which values were used in the Standard Design and Proposed Design.

Table 18: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change

Requirement	Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
New Construction Mandatory Requirement	All prototypes	All	Metal Building Roof	Construction U-factor	0.098	0.078
	All prototypes	All	Wood Framed and Others Roof	Construction U-factor	0.075	0.060
	Warehouse	All	Metal Building Wall	Construction Assembly U-Factor	0.113	0.090
	All prototypes	All	Metal Framed Wall	Construction Assembly U-Factor	0.151	0.121
	Hospital Retail Large Retail Medium	All	Light Mass Wall	Construction Assembly U-Factor	0.440	0.352
	Hospital Retail Large Retail Medium	All	Heavy Mass Wall	Construction Assembly U-Factor	0.690	0.552
	Hotel Small	All	Wood Frame Wall	Construction Assembly U-Factor	0.110	0.088
Alterations Mandatory Requirement	All prototypes	All	Metal Building Roof	Construction U-factor	0.098	0.078
	All prototypes	All	Wood Framed and Others Roof	Construction U-factor	0.075	0.060
	Warehouse	All	Metal Building Wall	Construction Assembly U-Factor	0.113	0.904
	All prototypes	All	Metal Framed Wall	Construction Assembly U-Factor	0.217	0.174
	Hotel Small	All	Wood Frame Wall	Construction Assembly U-Factor	0.110	0.088
New Construction Prescriptive Requirement	All prototypes	All	Metal Building Roof	Construction U-factor	Varies based on CZ	Varies based on CZ- See Table 140.3-B in Section 5.2
	All prototypes	All	Wood Framed and Others Roof	Construction U-factor	Varies based on CZ	Varies based on CZ- See Table 140.3-B in Section 5.2
	Warehouse	All	Metal Building Wall	Construction Assembly U-Factor	Varies based on CZ	Varies based on CZ- See Table 140.3-B in Section 5.2
	Hospital Retail Large Retail Medium	All	Light Mass Wall	Construction Assembly U-Factor	Varies based on CZ	Varies based on CZ- See Table 140.3-B in Section 5.2
	Hospital Retail Large Retail Medium	All	Heavy Mass Wall	Construction Assembly U-Factor	Varies based on CZ	Varies based on CZ- See Table 140.3-B in Section 5.2
	Hotel Small	All	Wood Frame Wall	Construction Assembly U-Factor	Varies based on CZ	Varies based on CZ- See Table 140.3-B in Section 5.2

CBECC calculates whole-building energy consumption for every hour of the year measured in kilowatt-hours per year (kWh/y) and therms per year (therms/y). It then applies the 2025 LSC hourly factors to calculate LSC in 2026 present value dollars (2026 PV$), source energy hourly factors to calculate source energy use in kilo British thermal units per year (kBtu/y), and hourly GHG emissions factors to calculate annual GHG emissions in metric tons of carbon dioxide emissions equivalent per year (MT or "tonnes" CO2e/y). CBECC also calculates annual peak electricity demand in kilowatts (kW).

The energy impacts of the proposed code change vary by climate zone. The Statewide CASE Team simulated the energy impacts in every climate zone and applied the climate-zone specific LSC hourly factors when calculating energy and energy cost impacts.

Per-unit energy impacts for nonresidential buildings are presented in savings per square foot. Annual energy, GHG, and peak demand impacts for each prototype building were translated into impacts per square foot by dividing by the floor area of the prototype building. This step allows for an easier comparison of savings across different building types and enables a calculation of statewide savings using the construction forecast that is published for floor area by building type.

2.3.1.3 Statewide Energy Savings Methodology

The per-unit energy impacts were extrapolated to statewide impacts using the Statewide Construction Forecasts that the CEC provided. The Statewide Construction Forecasts estimate new construction or additions that would occur in 2026, the first year that the 2025 Title 24, Part 6 requirements are in effect (California Energy Commission, 2022; California Energy Commission, 2022). They also estimate the amount of total existing building stock in 2026, which the Statewide CASE Team used to approximate savings from building alterations. The construction forecast provides construction (new construction or additions and existing building stock) by building type and climate zone, as shown in Appendix A.

Appendix A presents additional information about the methodology and assumptions used to calculate statewide energy impacts.

2.3.2 Per-Unit Energy Impacts Results – Prescriptive

This measure to update opaque assembly U-factors will address six different assembly types, analyzed for 18 prototype buildings, across 16 climate zones. This Draft CASE Report includes the analysis results for the new construction prescriptive requirements for one assembly type, wood-framed and other roof, modeled in five building prototypes: Office Large, Office Medium, Retail Medium, Retail Large, and School Small. The tables containing data for the other assembly types and building types, as well as for the mandatory requirements for each combination and analyses for alterations, will be located in Appendix H for the Final CASE Report.

Energy savings and peak demand reductions per unit are presented in Table 19 through Table 23. The per-unit energy savings figures do not account for naturally occurring market adoption or compliance rates.

Table 19: OfficeLarge – Wood Framed and Other Roof – Savings Summary (per square foot)

OfficeLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.000	0.000	0.021	0.019	0.02
2	0.001	0.001	0.017	0.016	0.02
3	0.001	0.000	0.026	0.024	0.02
4	0.000	-0.001	0.018	0.016	0.01
5	0.001	0.000	0.004	0.003	0.01
6	0.001	0.000	0.007	0.006	0.01
7	0.001	0.000	0.013	0.012	0.01
8	0.000	-0.001	0.017	0.015	0.00
9	0.000	0.000	0.014	0.012	0.01
10	0.001	0.000	0.009	0.009	0.01
11	0.000	0.001	0.022	0.020	0.02
12	0.000	0.000	0.015	0.013	0.01
13	0.002	0.000	0.027	0.024	0.02
14	0.001	-0.002	0.011	0.010	0.01
15	0.001	0.001	0.007	0.006	0.01
16	0.002	0.001	0.050	0.045	0.04

Notes on Table 19:

- The highest first-year energy savings for this measure are in Climate Zones 13 and 16. In contrast, the lowest first-year energy savings are in Climate Zones 1, 4, 8, 9, 11, and 12.
- The highest peak demand savings for this measure are found in Climate Zones 2, 11, 15, and 16. In contrast, the lowest peak demand savings for this measure are in Climate Zones 1, 3, 5, 6, 7, 9, 10, 12, and 13. The Statewide CASE Team found negative peak demand savings (i.e., increased peak demand) in Climate Zones 4, 8, and 14.
- The highest natural gas savings are in Climate Zone 16, while the lowest natural gas savings are in Climate Zone 5.

Table 20: OfficeMedium – Wood-Framed and Other Roof – Savings Summary (per square foot)

OfficeMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	0.000	0.000	0.057	0.052	0.03
2	0.000	0.000	0.024	0.022	0.01
3	0.001	0.000	0.043	0.039	0.03
4	0.001	0.000	0.029	0.026	0.02
5	0.001	0.000	0.043	0.039	0.03
6	0.001	0.000	0.037	0.033	0.02
7	-0.003	0.000	-0.123	-0.110	-0.09
8	0.005	0.001	0.137	0.123	0.11
9	0.001	0.000	0.026	0.023	0.02
10	-0.003	-0.001	-0.074	-0.067	-0.07
11	0.001	0.000	0.018	0.016	0.01
12	0.002	0.000	0.040	0.037	0.03
13	0.003	0.000	0.030	0.027	0.03
14	0.003	0.000	0.042	0.038	0.04
15	0.004	0.000	0.015	0.014	0.03
16	0.001	0.001	0.060	0.054	0.04

Notes on Table 20:

- The highest first-year energy savings for this measure are in Climate Zone 8, while the lowest first-year energy savings are in Climate Zones 1 and 2.
- There are negative peak demand savings in Climate Zones 7 and 10, which are being investigated further.
- The highest peak demand savings for this measure are found in Climate Zones 8 and 16. In contrast, the lowest peak demand savings for this measure are in Climate Zones 1-7, 9, and 11-15. Negative peak demand savings were found in Climate Zone 10.
- The highest natural gas savings are in Climate Zone 16, while the lowest natural gas savings are in Climate Zone 15. Negative natural gas savings in Climate Zones 7 and 10.

Table 21: RetailMedium - Wood-Framed and Other Roof – Savings Summary (per square foot)

RetailMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	0.005	0.000	0.114	0.104	0.10
2	0.019	0.002	0.000	0.000	0.11
3	0.004	0.002	0.000	0.000	-0.03
4	0.031	0.002	0.000	0.000	0.20
5	0.003	0.001	0.000	0.000	0.03
6	0.009	0.001	0.000	0.000	0.07
7	0.020	0.002	0.000	0.000	0.22
8	0.058	0.002	0.000	0.000	0.38
9	0.016	0.000	0.000	0.000	0.09
10	0.057	0.001	0.000	0.000	0.33
11	0.007	0.002	0.000	0.000	0.10
12	0.018	0.003	0.000	0.000	0.13
13	0.026	0.002	0.000	0.000	0.11
14	0.054	0.003	0.000	0.000	0.33
15	0.050	0.002	0.000	0.000	0.24
16	0.014	0.001	0.221	0.019	0.20

Notes on Table 21:

- The highest first-year energy savings for this measure are in Climate Zone 8, while the lowest first-year energy savings are in Climate Zones 3 and 5.
- The highest peak demand savings for this measure are found in Climate Zones 12 and 14. In contrast, the lowest peak demand savings for this measure are in Climate Zones 1 and 9. The zero peak demand savings values are being treated as outliers and are being investigated further.
- The highest natural gas savings are in Climate Zones 1 and 16, while the remaining Climate Zones 2-15 indicated zero natural gas savings . The Statewide CASE Team is investigating the cause of the zero natural gas savings.

Table 22: RetailLarge - Wood-Framed and Other Roof – Savings Summary (per square foot)

RetailLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	0.009	0.000	0.086	0.078	0.10
2	0.020	0.002	0.000	0.000	0.12
3	0.011	0.002	0.000	0.000	0.08
4	0.024	0.002	0.000	0.000	0.17
5	0.009	0.002	0.000	0.000	0.06
6	-0.010	0.002	0.000	0.000	-0.03
7	-0.001	0.002	0.000	0.000	-0.04
8	0.025	0.003	0.000	0.000	0.18
9	0.018	0.001	0.000	0.000	0.07
10	0.007	0.002	0.000	0.000	0.07
11	0.011	0.002	0.000	0.000	0.06
12	0.008	0.002	0.000	0.000	0.05
13	0.024	0.002	0.000	0.000	0.15
14	0.015	0.003	0.000	0.000	0.09
15	0.036	0.001	0.000	0.000	0.17
16	0.001	0.001	0.238	0.215	0.15

Notes on Table 22:

- The highest first-year energy savings for this measure are in Climate Zone 15, while the lowest first-year energy savings are in Climate Zone 16.
- Negative peak demand savings are found in Climate Zones 6 and 7. These are being treated as outliers and are being investigated further.
- The highest peak demand savings for this measure are found in Climate Zones 8 and 14. In contrast, the lowest peak demand savings for this measure are in Climate Zones 1, 15, and 16.
- The highest natural gas savings are in Climate Zones 1 and 16, while the remaining Climate Zones 2 through 15 indicated zero natural gas savings. The Statewide CASE Team is investigating the cause of the zero natural gas savings.

Table 23: SchoolSmall - Wood-Framed and Other Roof – Savings Summary (per square foot)

School Small Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	0.013	0.003	0.079	0.072	0.13
2	0.015	0.004	0.000	0.000	0.11
3	0.010	0.002	0.000	0.000	0.07
4	0.014	0.003	0.000	0.000	0.08
5	0.009	0.002	0.000	0.000	0.06
6	0.020	0.004	0.000	0.000	0.13
7	0.015	0.002	0.000	0.000	0.09
8	0.013	0.003	0.000	0.000	0.08
9	0.020	0.005	0.000	0.000	0.13
10	0.009	0.000	0.000	0.000	0.04
11	0.003	0.003	0.182	0.164	0.15
12	0.013	0.003	0.079	0.072	0.13
13	0.015	0.004	0.000	0.000	0.11
14	0.010	0.002	0.000	0.000	0.07
15	0.014	0.003	0.000	0.000	0.08
16	0.009	0.002	0.000	0.000	0.06

Notes on Table 23**:**

- The highest first-year energy savings for this measure are in Climate Zones 6 and 9, while the lowest first-year energy savings are in Climate Zone 11.
- Zero peak demand savings are found in Climate Zone 16; This result is considered an outlier and the Statewide CASE Team will investigate further.
- The highest peak demand savings for this measure are found in Climate Zone 9. In contrast, the lowest peak demand savings for this measure are in Climate Zone 10 with a value of zero. The Statewide CASE Team will investigate this result further.
- The highest natural gas savings are in Climate Zone 11, while the remaining Climate Zones 2-10 and 13-15 indicated zero natural gas savings. The Statewide CASE Team is investigating the cause of the zero natural gas savings.

2.4 Cost and Cost Effectiveness

2.4.1 Energy Cost Savings Methodology

Energy cost savings were calculated by applying the LSC hourly factors to the energy savings estimates that were derived using the methodology described in Section 2.3.1. LSC hourly factors are a normalized metric to calculate energy cost savings that accounts for the variable cost of electricity and natural gas for each hour of the year, along with how costs are expected to change over the 30-year period of analysis.

The CEC requested LSC savings over the 30-year period of analysis in both 2026 present value dollars (2026 PV$) and nominal dollars. The cost-effectiveness analysis uses LSC values in 2026 PV$. Costs and cost-effectiveness using and 2026 PV$ are presented in Section 2.4 of this report. CEC uses results in nominal dollars to complete the Economic and Fiscal Impacts Statement (Form 399) for the entire package of proposed changes to Title 24, Part 6. In the Final CASE Report, Appendix G will present LSC savings results in nominal dollars.

The proposed code change would apply to alterations.

2.4.2 Energy Cost Savings Results – Prescriptive

This measure to update opaque assembly U-factors will address six different opaque assembly types, analyzed for 18 prototype buildings, across 16 climate zones. In this Draft CASE Report, we are showing analysis results for the prescriptive requirements for one assembly type – wood-framed and other roof, modeled in five building prototypes – Office Large, Office Medium, Retail Medium, Retail Large, and School Small. The tables containing data for the other assembly types and building types, as well as for the mandatory requirements for each combination, will be located in Appendix I for the Final CASE Report.

Per-unit energy cost savings for newly constructed buildings, additions, and alterations in terms of LSC savings realized over the 30-year period of analysis are presented in 2026 present value dollars (2026 PV$) in Table 24 through Table 28. Table 29 is for average PV LSC Savings per square foot over 30-year period of analysis.

The LSC methodology allows peak electricity savings to be valued more than electricity savings during non-peak periods.

Any time code changes impact cost, there is potential for unintended consequences impacting DIPs. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

Table 24: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– OfficeLarge -Wood-Framed and Other Roof

OfficeLarge Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Savings (2026 PV$)
1	0.00	0.00	0.00
2	0.00	0.00	0.00
3	0.01	0.01	0.02
4	0.00	0.01	0.01
5	0.00	0.00	0.00
6	0.00	0.00	0.01
7	0.00	0.01	0.01
8	-0.01	0.01	0.00
9	0.00	0.01	0.01
10	0.01	0.00	0.01
11	0.00	0.01	0.02
12	0.00	0.01	0.01
13	0.00	0.00	0.00
14	0.00	0.01	0.01
15	0.01	0.00	0.01
16	0.01	0.03	0.04

Table 25: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– OfficeMedium – Wood Framed and Other Roof

OfficeMedium Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Savings (2026 PV$)
1	0.002	0.032	0.034
2	-0.001	0.015	0.014
3	0.00	0.02	0.03
4	0.01	0.02	0.02
5	0.00	0.02	0.03
6	0.00	0.02	0.02
7	-0.02	-0.07	-0.09
8	0.03	0.08	0.11
9	0.01	0.02	0.02
10	-0.02	-0.05	-0.07
11	0.00	0.01	0.01
12	0.01	0.02	0.03
13	0.01	0.02	0.03
14	0.01	0.03	0.04
15	0.02	0.01	0.03
16	0.01	0.04	0.04

Table 26: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– RetailMedium – Wood Framed and Other Roof

RetailMedium Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Savings (2026 PV$)
1	0.029	0.068	0.097
2	0.113	0.000	0.113
3	-0.03	0.00	-0.03
4	0.20	0.00	0.20
5	0.03	0.00	0.03
6	0.07	0.00	0.07
7	0.22	0.00	0.22
8	0.38	0.00	0.38
9	0.09	0.00	0.09
10	0.33	0.00	0.33
11	0.10	0.00	0.10
12	0.13	0.00	0.13
13	0.11	0.00	0.11
14	0.33	0.00	0.33
15	0.24	0.00	0.24
16	0.07	0.13	0.20

Table 27: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– RetailLarge – Wood Framed and Other Roof

RetailLarge Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Savings (2026 PV$)
1	0.00*	0.00*	0.00*
2	0.00*	0.00*	0.00*
3	0.08	0.00	0.08
4	0.17	0.00	0.17
5	0.06	0.00	0.06
6	-0.03	0.00	-0.03
7	-0.04	0.00	-0.04
8	0.18	0.00	0.18
9	0.07	0.00	0.07
10	0.07	0.00	0.07
11	0.06	0.00	0.06
12	0.05	0.00	0.05
13	0.15	0.00	0.15
14	0.09	0.00	0.09
15	0.17	0.00	0.17
16	0.01	0.14	0.15

*Construction forecast for this prototype near zero in this climate zone

Table 28: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– SchoolSmall – Wood Framed and Other Roof

SchoolSmall Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Savings (2026 PV$)
1	0.083	0.048	0.131
2	0.106	0.000	0.106
3	0.07	0.00	0.07
4	0.08	0.00	0.08
5	0.06	0.00	0.06
6	0.04	0.00	0.04
7	0.01	0.00	0.01
8	0.05	0.00	0.05
9	0.06	0.00	0.06
10	0.04	0.00	0.04
11	0.13	0.00	0.13
12	0.09	0.00	0.09
13	0.08	0.00	0.08
14	0.13	0.00	0.13
15	0.04	0.00	0.04
16	0.04	0.11	0.15

Table 29: Average 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions – All Modeled Prototypes – Wood-framed and Other Roof

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Savings (2026 PV$)
1	0.03	0.05	0.08
2	0.06	0.01	0.07
3	0.02	0.01	0.03
4	0.06	0.01	0.07
5	0.03	0.01	0.04
6	0.01	0.01	0.02
7	0.01	-0.02	-0.01
8	0.09	0.03	0.12
9	0.03	0.01	0.04
10	0.09	-0.02	0.07
11	0.05	0.00	0.05
12	0.04	0.01	0.05
13	0.08	0.01	0.09
14	0.09	0.01	0.10
15	0.11	0.00	0.11
16	0.03	0.09	0.12

2.4.3 Incremental First Cost

The incremental costs include the incremental material cost of additional insulation. This cost information was gathered through calls to general contractors, RS Means, and internet sales information from manufacturers' websites. The cost associated with each R-value represents the incremental cost for an approximate range that includes additional R-2. The final model reflects the cost of adding an additional R-2 insulative value to both roof ($0.288/square foot roof) and wall ($0.10/square foot wall). Installation costs were assumed to remain the same, with a corresponding incremental first cost of $0 for labor. The cost for R-2 for new construction roof continuous insulation is averaged out through California, including the inflation index per Bureau of Labor Statistics. If designers opt for continuous exterior insulation to meet the proposed requirements, incremental costs may include both labor and materials for structures such as steel girts, furring, screws, and clips used to support the exterior insulation and cladding. The degree of incremental cost will vary depending on the type of exterior insulation and cladding chosen and is project specific.

2.4.4 Incremental Maintenance and Replacement Costs

In general, opaque envelope assemblies do not require complete replacement within the typical lifetime (39 years of life per IRS, Publication 946) of a typical building. There are, however, some specific items and elements that require inspection to ensure that materials and assemblies perform as expected for this period. Maintenance and replacement are typically associated with moisture-related damage, often due to precipitation but in other cases due to accumulation of interior condensation without proper drainage and ventilation.

Items requiring maintenance include regular inspections for elements providing water drainage at the building such as roof drains, scuppers, transition flashing, and gutters. Sealant joints are typically employed to transition between different cladding and fenestration types within the building envelope. These sealant joints are often a critical component in the durability of a building envelope and also merit annual inspection. While regular inspections are best practice for the opaque envelope, it is also true that the vast majority of building owners do not inspect their property to ensure drainage. In cases such as these, wholesale replacement of sections of the building envelope or structure is often required. The timing, frequency, and magnitude of these costs are not quantified for this Draft CASE Report.

If building envelopes are inspected as noted above, the only common replacement cost for building envelopes is for exterior sealant joints exposed to the weather and solar UV radiation. The frequency of replacement will depend on the type of sealants used as some are more resistant to the elements than others, but for the purposes of the Draft CASE Report we assume a period of 10 years between sealant joint replacement.

For roofing, the industry standard for roofing warranty periods is 20 years. While roofing replacements may sometimes be only for the roofing membrane, it is fairly common for a building owner to completely replace the roofing insulation also. For the purposes of this Draft CASE Report, we assume a 30-year replacement period for both the roofing and insulation.

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 30-year period of analysis. The present value of equipment maintenance costs (or savings) was calculated using a three percent discount rate (d), which is consistent with the discount rate used when developing the 2025 LSC Hourly Factors. The present value of maintenance costs that occurs in the n^{th} year is calculated as follows:

$$Present\ Value\ of\ Maintenance\ Cost\ =\ Maintenance\ Cost\ \times \left\lfloor \frac{1}{1+d} \right\rfloor^{n}$$

2.4.5 Cost Effectiveness

A cost analysis is required to demonstrate that the measure is cost effective over the 30-year period of analysis. For the opaque assembly measures, the Statewide CASE Team has conducted cost-effectiveness analyses for the revised prescriptive measures. As the proposed mandatory requirements are less stringent than the existing prescriptive values that have already been shown to be cost-effective, no analysis is required for the modified mandatory values.

The CEC establishes the procedures for calculating cost effectiveness. The Statewide CASE Team collaborated with CEC staff to confirm that the methodology in this report is consistent with their guidelines, including which costs were included in the analysis. The incremental first cost and incremental maintenance costs over the 30-year period of analysis were included. The LSC savings from electricity and natural gas were also included in the evaluation. Design costs were not included nor were the incremental costs of code compliance verification.

According to the CEC's definitions, a measure is cost effective if the benefit-to-cost (B/C) ratio is greater than 1.0. The B/C ratio is calculated by dividing the cost benefits realized over 30 years by the total incremental costs, which includes maintenance costs for 30 years. The B/C ratio was calculated using 2026 PV costs and cost savings.

Results of the per-unit cost-effectiveness analyses are presented in Table 30 for new construction/additions. The Statewide CASE Team did not conduct an analysis of the proposed mandatory values for alterations, as the new values are less stringent than

the existing cost-effective prescriptive requirements, and therefore assumed to be cost-effective as well.

Table 30: 30-Year Cost-Effectiveness Summary Per Square Foot – New Construction/Additions – Wood-framed and Other Roof – All Prototypes Modeled

Climate Zone	Benefits LSC Savings + Other PV Savings [a] (2026 PV$)	Costs Total Incremental PV Costs [b] (2026 PV$)	Benefit-to-Cost Ratio
1	1.20	0.49	2.45
2	1.78	0.50	3.58
3	1.22	0.21	5.74
4	1.44	0.22	6.51
5	1.46	0.37	3.91
6	1.28	0.26	4.96
7	1.28	0.27	4.77
8	1.31	0.25	5.34
9	1.33	0.24	5.51
10	1.87	0.36	5.21
11	2.21	0.31	7.21
12	1.62	0.32	5.06
13	2.27	0.41	5.53
14	1.79	0.32	5.53
15	2.35	0.34	6.96
16	0.88	0.37	2.41

a. **Benefits: LSC Savings + Other PV Savings:** Benefits include LSC savings over the period of analysis (California Energy Commission, 2022). Other savings are discounted at a real (nominal – inflation) three percent rate. Other PV savings include incremental first-cost savings if proposed first cost is less than current first cost, incremental PV maintenance cost savings if PV of proposed maintenance costs is less than PV of current maintenance costs, and incremental residual value if proposed residual value is greater than current residual value at end of CASE analysis period.

b. **Costs: Total Incremental Present Valued Costs:** Costs include incremental equipment, replacement, and maintenance costs over the period of analysis if PV of proposed costs is greater than PV of current costs. Costs are discounted at a real (inflation-adjusted) three percent rate. If incremental maintenance cost is negative, it is treated as a positive benefit. If there are no total incremental PV costs, the B/C ratio is infinite. Total Incremental Cost = (Measure Case First Cost + PV of Measure Case Maintenance and Replacement Costs over 30 years) – (Base Case First Cost + PV of Base Case Maintenance and Replacement Costs over 30 years)

2.5 First-Year Statewide Impacts

2.5.1 Statewide Energy and Energy Cost Savings

The Statewide CASE Team calculated the first-year statewide savings for new construction and additions by multiplying the per-unit savings, which are presented in Section 2.3.2, by assumptions about the percentage of newly constructed buildings that would be impacted by the proposed code. The statewide new construction forecast for 2026 is presented in Appendix A, as are the Statewide CASE Team's assumptions about the percentage of new construction that would be impacted by the proposal (by climate zone and building type).

The first-year energy impacts represent the first-year annual savings from all buildings that were completed in 2026. The 30-year energy cost savings represent the energy cost savings over the entire 30-year analysis period. The statewide savings estimates do not take naturally occurring market adoption or compliance rates into account.

The table below presents the first-year statewide energy and energy cost savings from newly constructed buildings and additions (Table 31) by climate zone. This Draft CASE Report includes the analysis results for the prescriptive requirements for one assembly type, wood-framed and other roof, modeled in five building prototypes: Office Large, Office Medium, Retail Medium, Retail Large, and School Small. The tables containing data for the other assembly types and building types, as well as for the mandatory requirements for each combination, will be located in Appendix J for the Final CASE Report.

While a statewide analysis is crucial to understanding broader effects of code change proposals, there is potential for unintended consequences impacting DIPs that needs to be considered. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

The CEC construction forecast is zero in Climate Zones 1, 2, 5 and 13 for Large Offices. For the Large Retail prototype, there is no construction expected in Climate Zones 1 or 2, therefore these zones will not have any statewide savings.

Table 31: Statewide Energy and Energy Cost Impacts Per Square Foot: New Construction and Additions – Wood-Framed and Other Roof – All Modeled Prototypes

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026 (Million Square Feet)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2026 PV$)
1	280,910	0.001	0.000	0.000	0.020	0.02
2	1,093,900	0.010	0.002	0.000	0.010	0.07
3	6,954,300	0.024	0.004	0.001	0.130	0.20
4	3,547,200	0.031	0.002	0.000	0.045	0.23
5	744,840	0.003	0.001	0.000	0.014	0.03
6	4,239,000	0.003	0.003	0.001	0.049	0.08
7	2,584,200	0.004	0.001	0.001	0.079	-0.02
8	5,981,300	0.082	0.004	0.003	0.237	0.69
9	11,082,100	0.061	0.002	0.001	0.126	0.38
10	3,368,800	0.051	0.002	0.001	0.076	0.25
11	917,810	0.006	0.001	0.000	0.006	0.05
12	6,080,400	0.039	0.007	0.001	0.110	0.32
13	1,623,800	0.024	0.003	0.000	0.016	0.14
14	979,600	0.015	0.001	0.000	0.015	0.10
15	617,710	0.014	0.000	0.000	0.004	0.07
16	333,530	0.002	0.000	0.000	0.043	0.04
Total	50,429,400	0.37	0.03	0.01	0.67	2.63

a. First-year savings from all **new construction and additions completed statewide in 2026.**

2.5.2 Statewide Greenhouse Gas (GHG) Emissions Reductions

The Statewide CASE Team calculated avoided GHG emissions associated with energy consumption using the hourly GHG emissions factors that CEC developed along with the 2025 LSC hourly factors and an assumed cost of $123.15 per metric ton of carbon dioxide equivalent emissions (metric tons CO2e) ..

The 2025 LSC hourly factors used in the lifecycle cost-effectiveness analysis include the monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs).[14] The cost-effectiveness analysis presented in Section 2.4 of this report does not include the cost savings from avoided GHG emissions. To demonstrate the cost savings of avoided GHG emissions, the Statewide CASE Team disaggregated the value of avoided GHG emissions from the other economic impacts.

Table 32 presents the estimated first-year avoided GHG emissions of the proposed code change. During the first year, GHG emissions of 76 metric tons CO2e would be avoided. (Note that for the Draft CASE Report, the Statewide CASE Team has evaluated only the Wood-frame and Other Roof prescriptive measure for only five building prototypes).

[14] The permit cost of carbon is equivalent to the market value of a unit of GHG emissions in the California Cap-and-Trade program, while social cost of carbon is an estimate of the total economic value of damage done per unit of GHG emissions. Social costs tend to be greater than permit costs. See more on the Cap-and-Trade Program on the California Air Resources Board website: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program.

Table 32: First-Year Statewide GHG Emissions Impacts

Envelope Assembly	Measure	Electricity Savings[a] (GWh/y)	Reduced GHG Emissions from Electricity Savings[a] (Metric Tons CO2e)	Natural Gas Savings[a] (Million Therms/y)	Reduced GHG Emissions from Natural Gas Savings[a] (Metric Tons CO2e)	Total Reduced GHG Emissions[b] (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions[c] ($)
Metal Building Roof Mandatory	New Construction & Additions	TBD					
	Alterations						
Wood Framed and Others Roof Mandatory	New Construction & Additions						
	Alterations						
Metal Building Wall	New Construction & Additions						
	Alterations						
Metal Framed Wall	New Construction & Additions						
	Alterations						
Light Mass Wall	New Construction & Additions						
Heavy Mass Wall	New Construction & Additions						
Metal Building Roof Prescriptive	New Construction & Additions						
Mass Light Prescriptive	New Construction & Additions						
Mass Heavy Prescriptive	New Construction & Additions						
Wood Framed and Others Prescriptive	New Construction & Additions	0	35	0.01	40	76	9,309
All	Total						

a. First-year savings from all applicable newly constructed buildings, additions, and alterations completed statewide in 2026.

b. GHG emissions savings were calculated using hourly GHG emission factors published alongside the LSC hourly factors and source energy hourly factors by CEC: https://www.energy.ca.gov/files/2025-energy-code-hourly-factors

c. The monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs) derived from the 2022 TDV Update Model published by CEC here: https://www.energy.ca.gov/files/tdv-2022-update-model

2.5.3 Statewide Water Use Impacts

The proposed code change would not result in water savings.

2.5.4 Statewide Material Impacts

The material impacts of this measure would include an increase in the use of continuous insulation products, such as rigid polyisocyanurate, but likely at a minimal quantity. However, the Statewide CASE Team will revisit this for the Final CASE Report. There are no other significant anticipated statewide impacts on material use. For more information on the Statewide CASE Team's methodology and assumptions used to calculated embodied GHG emissions, see Appendix D.

2.5.5 Other Non-Energy Impacts

Increased insulation would improve occupancy comfort by regulating indoor temperature.

2.6 Addressing Energy Equity and Environmental Justice

The Statewide CASE Team assessed the potential impacts of the proposed measure, and based on a preliminary review, the measure is unlikely to have significant impacts on energy equity or environmental justice, therefore reducing the impacts of disparities in DIPs.

The Statewide CASE Team is still in the process of investigating the potential impacts of the proposed code changes to DIPs. Final results of this research will be incorporated into the Final CASE Report.

3. Vestibules

3.1 Measure Description

3.1.1 Proposed Code Change

The proposed code change would establish a new mandatory requirement for vestibules in mixed-used and nonresidential buildings with high-traffic main entrances. These building types would include colleges, schools, grocery stores, hospitals, multi-storied hotels, industrial facilities, offices, refrigerated warehouses, restaurants, and retail.

The vestibule requirement would be applicable to new construction and additions that include new main entrances. This measure would not apply to alterations or in certain climate zones. Exceptions to the requirement will parallel those identified in ASHRAE 90.1 and in IECC. See Section 3.1.4.3 for more details.

The proposed code change would require small changes to the compliance software.

3.1.2 Justification and Background Information

3.1.2.1 Justification

"If global greenhouse gas emissions continue at current rates, the state of California is likely to experience further warming by more than 2 °F by 2040."[15] Additionally, researchers have found that the number of wildfires could grow significantly over the next 40 years, impacting outdoor and indoor air quality. These predicted trends are likely to lead to an increase in air conditioning in all building types, and a need to ensure tighter building envelopes that keep bad air out of the building (e.g., smoky air from wildfires) and high-quality conditioned air in. the building

Vestibules reduce air infiltration under negative pressurization condition and exfiltration under positive pressurization condition through doors and create a tighter seal of the building envelope, leading to energy savings and improved indoor air quality in many climates.

This proposal would not only save energy for certain buildings by controlling heating and cooling losses, but it would also lead to improved indoor air quality by reducing the infiltration of unfiltered outdoor air.

[15] https://scripps.ucsd.edu/research/climate-change-resources/faq-climate-change-california

3.1.2.2 Background Information

This measure was proposed for the 2022 Title 24, Part 6 code cycle, but was not adopted because the measure was deemed to be lower priority due to a lack of data supporting cost-effectiveness. The Statewide CASE Team also found low estimated energy savings when analysis was conducted only for heating-dominated climate zones. As described in Section 3.1.4.3, both ASHRAE 90.1 and IECC have requirements for vestibules.

3.1.3 Summary of Proposed Changes to Code Documents

The sections below summarize how the Energy Code, Reference Appendices, Alternative Calculation Method (ACM) Reference Manuals, and compliance documents would be modified by the proposed change.[16]

3.1.3.1 Specific Purpose and Necessity of Proposed Code Changes

Each proposed change to language in Title 24, Part 6 as well as the reference appendices to Part 6 are described below. See Section 5.2 of this report for marked-up code language.

Section: Section 120.7(e) New mandatory provisions for vestibules

Specific Purpose: The specific purpose of the change is to add a mandatory requirement for incorporating an enclosed vestibule at building entrances, and to clarify scoping with a list of exceptions.

Necessity: This addition is necessary to increase energy efficiency and improve building air barrier performance via cost-effective building design standards, as directed by California Public Resources Code Sections 25213 and 25402.

3.1.3.2 Specific Purpose and Necessity of Changes to the Nonresidential ACM Reference Manual

The purpose and necessity of proposed changes to the Nonresidential ACM Reference Manual are described below. See Section 5.4 of this report for the detailed proposed revisions to the text of the ACM Reference Manual.

Section: **5.5 Building Envelope Data**

Specific Purpose: The specific purpose of the proposed change would be to add the requirement for mandatory vestibules in new construction and certain additions.

[16] Visit EnergyCodeAce.com for trainings, tools and resources to help people understand existing code requirements.

Necessity: This change is necessary to compare the performance of the proposed design with the performance of the standard design.

3.1.3.3 Summary of Changes to the Nonresidential Compliance Manual

Chapter 3 of the Nonresidential Compliance Manual would need to be revised to incorporate information regarding code compliant vestibule design and construction.

3.1.3.4 Summary of Changes to Compliance Documents

The proposed code change would modify the compliance documents listed below. Details of the required revisions to the compliance documents are presented in Section 5.5.

- 2022-NRCC-ENV-E Certificate of Compliance would require several changes to add a reference to mandatory vestibules.
- 2022-NRCI-ENV-E Certificate of Installation would require a new section indicating installation of vestibule where required.

3.1.4 Regulatory Context

3.1.4.1 Determination of Inconsistency or Incompatibility with Existing State Laws and Regulations

Currently, Title 24, Part 6 includes prescriptive requirements for air barriers and there are egress considerations in Title 24, Part 2 – the California Building Code. While the proposed measure has some overlap, there are no expected conflicts or incompatibilities.

3.1.4.2 Duplication or Conflicts with Federal Laws and Regulations

There are no relevant federal laws or regulations.

3.1.4.3 Difference From Existing Model Codes and Industry Standards

For over two decades, ASHRAE has required vestibules as part of building entrances, with some exceptions. Vestibules have also been required by the IECC since at least 2006. Table 33 compares the requirements between 90.1 and IECC. In both model codes, the vestibule requirement is a component of the section addressing building envelope air barrier performance.

Table 33: Comparison of Vestibule Requirements in National Model Codes with Title 24, Part 6 Proposal

Requirement	Title 24, Part 6 Proposed	ASHRAE 90.1-2022	IECC 2021
Location	Building entrances separating conditioned space from the exterior	Building entrances separating conditioned space from the exterior	Building entrances
Doors	Revolving doors shall not eliminate vestibule requirement for any doors adjacent to the revolving doors	Revolving doors can be used as an option	Revolving doors shall not eliminate vestibule requirement for any doors adjacent to the revolving doors
	Revolving doors cannot be used for more than 50 percent of required egress capacity (IBC and Title 24, Part 2 – Section 1010.3.1.1)	N/A	Revolving doors cannot be used for more than 50 percent of required egress capacity (IBC and Title 24, Part 2 – Section 1010.3.1.1)
	Must have self-closing devices	Must have self-closing devices	Must have self-closing devices
Spacing of Doors	Designed so that it is not necessary for the interior and exterior doors to be open at the same time. Minimum distance between them of 7 feet when in the closed position.	Designed so that it is not necessary for the interior and exterior doors to be open at the same time. Minimum distance between them of 7 feet when in the closed position.	Designed so that it is not necessary for the interior and exterior doors to be open at the same time.
Size	No greater than 50 square feet or 2 percent of gross conditioned floor area for that level of the building	No greater than 50 square feet or 2 percent of gross conditioned floor area for that level of the building	N/A
Envelope	Exterior surfaces shall comply with the continuous air barrier requirements	Exterior surfaces shall comply with the continuous air barrier requirements	Air barrier requirements apply per Section C402.5
Exceptions	1. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use. 2. Doors opening directly from a sleeping or dwelling unit. 3. Doors that open directly from a space less than 3,000 square feet in area. 4. Revolving doors. 5. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors. 6. Doors that have an air curtain.	1. Doors not intended to be used as a building entrance. 2. Doors opening directly from a dwelling unit. 3. Building entrances in buildings in Climate Zone 1 or 2. 4. Doors opening into semi-heated spaces. 5. Enclosed elevator lobbies for building entrances directly from parking garages. 6. Building entrances in buildings in Climate Zone 3, where the building is less than 4 stories above grade and less than 10,000 square feet in gross conditioned floor area. 7. Building entrances in buildings in Climate Zones 0, 4-8 where the building is less than 1000 square feet in gross conditioned floor area.	1. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use. 2. Doors opening directly from a sleeping or dwelling unit. 3. Buildings in Climate Zones 0-2. 4. Doors that open directly from a space less than 3,000 square feet in area. 5. Revolving doors. 6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors. 7. Doors that have an air curtain (remainder of language specifies performance of air curtain).

3.1.5 Compliance and Enforcement

When developing this proposal, the Statewide CASE Team considered methods to streamline the compliance and enforcement process and how negative impacts on market actors who are involved in the process could be mitigated or reduced. This section describes how to comply with the proposed code change. It also describes the compliance verification process. Appendix E presents how the proposed changes could impact various market actors.

The compliance verification activities related to this measure that need to occur during each phase of the project are described below:

- **Design Phase:** Building designers must be aware of the code change requiring vestibules in certain building types and climate zones, and how vestibule design must consider factors such as security, lighting, HVAC and accessibility. The qualified design reviewer, per commissioning requirements, as well as energy consultants and compliance documentation authors must verify that plans and specifications match and therefore meet the requirements of Title 24, Part 6.
- **Permit Application Phase:** Plans examiners would verify that the project meets the new mandatory vestibule requirement by ensuring that the compliance documentation (NRCC) matches the plan and specifications.
- **Construction Phase:** Building plans and specifications must be followed regarding incorporation of an enclosed vestibule. Installers need to complete the required installation certificates (NRCI). Where required by Title 24, Part 6 Section 120.8, the vestibule should be tested for air leakage as part of the commissioning process.
- **Inspection Phase:** Building inspectors would verify that the vestibule meets the criteria listed on the approved documentation and specifications, and that testing requirements have been met.

3.2 Market Analysis

3.2.1 Current Market Structure

The Statewide CASE Team performed a market analysis with the goals of identifying current technology availability, current product availability, and market trends. It then considered how the proposed standard may impact the market in general as well as individual market actors. Information was gathered about the incremental cost of complying with the proposed measure. Estimates of market size and measure applicability were identified through research and outreach with stakeholders including utility program staff, CEC staff, and a wide range of industry actors including

manufacturers, industry advocates, and building design and construction consultants. In addition to conducting personalized outreach, the Statewide CASE Team discussed the current market structure and potential market barriers during a public stakeholder meetings that the Statewide CASE Team held on February 14, 2023 and May 22, 2023.

In typical high-trafficked buildings and healthcare facilities, architects tend to add vestibules and/or air barriers in the entrance lobby as a common practice. Vestibules typically include fenestration materials which are already available in the market. Within the current market, vestibules are well-known and common in high-traffic buildings where cost-effective. There are no existing incentive programs or utility programs to encourage the usage of vestibules. There has been an increase in the use of air barriers in main entrances since the early 2000s, due to codes and regulations requiring their use in larger buildings.

3.2.2 Technical Feasibility and Market Availability

While the inclusion of a vestibule into a building would have design impacts such as on usable floor area and HVAC systems design, no new materials or assemblies would need to be developed for measure success. The walls of a vestibule function as an air barrier similar to the exterior enclosure of a building but do not have the same water and thermal control functions. Therefore, the materials and design complexity of a vestibule are less than that of the adjacent exterior envelope.

Opaque vestibules would be comprised of typical interior partition elements such as gasketed doors, wood/steel framing, drywall, batt insulation, and interior finishes. Glazed vestibules would be comprised of typical storefront glazing systems and glazed doors. Similar to vestibule materials and assemblies, alternative compliance approaches such as revolving doors and air curtains already exist in the market and are commonly deployed in existing high-traffic buildings.

All of the materials and equipment noted in this section are readily available products and are commonly seen within the industry. We therefore do not see any technical or market barriers to carrying out this measure.

3.2.3 Market Impacts and Economic Assessments

3.2.3.1 Impact on Builders

Builders of residential and commercial structures are directly impacted by many of the measures proposed by the Statewide CASE Team for the 2025 code cycle. It is within the normal practices of these businesses to adjust their building practices to changes in building codes. When necessary, builders engage in continuing education and training in order to remain up to date with changes to design practices and building codes.

California's construction industry comprises approximately 93,000 business establishments and 943,000 employees (see Table 34). For 2022, total estimated payroll will be about $78 billion. Nearly 72,000 of these business establishments and 473,000 employees are engaged in the residential building sector, while another 17,600 establishments and 369,000 employees focus on the commercial sector. The remainder of establishments and employees work in industrial, utilities, infrastructure, and other heavy construction roles (the industrial sector).

Table 34: California Construction Industry, Establishments, Employment, and Payroll in 2022 (Estimated)

Building Type	Construction Sectors	Establishments	Employment	Annual Payroll (Billions $)
Residential	**All**	**71,889**	**472,974**	**31.2**
Residential	Building Construction Contractors	27,948	130,580	9.8
Residential	Foundation, Structure, & Building Exterior	7,891	83,575	5.0
Residential	Building Equipment Contractors	18,108	125,559	8.5
Residential	Building Finishing Contractors	17,942	133,260	8.0
Commercial	**All**	**17,621**	**368,810**	**35.0**
Commercial	Building Construction Contractors	4,919	83,028	9.0
Commercial	Foundation, Structure, & Building Exterior	2,194	59,110	5.0
Commercial	Building Equipment Contractors	6,039	139,442	13.5
Commercial	Building Finishing Contractors	4,469	87,230	7.4
Industrial, Utilities, Infrastructure, & Other (Industrial+)	**All**	**4,206**	**101,002**	**11.4**
Industrial+	Building Construction	288	3,995	0.4
Industrial+	Utility System Construction	1,761	50,126	5.5
Industrial+	Land Subdivision	907	6,550	1.0
Industrial+	Highway, Street, and Bridge Construction	799	28,726	3.1
Industrial+	Other Heavy Construction	451	11,605	1.4

Source: (State of California, n.d.)

The effects on the commercial building industry would not be felt by all firms and workers, but rather would be concentrated in specific industry subsectors. The proposed change to the Nonresidential Envelope requirements would likely affect commercial builders but would not impact firms that focus on construction and retrofit of residential or industrial buildings, utility systems, public infrastructure, or other heavy construction. Table 35 shows the commercial building subsectors the Statewide CASE Team expects to be impacted by the changes proposed in this report. Builders would need to factor in higher up-front costs of vestibule assembly pricing. They may have to consider longer

lead times when ordering if products have lower market availability. The Statewide CASE Team's estimates of the magnitude of these impacts are shown in Section 2.2.4 Economic Impacts.

Table 35: Specific Subsectors of the California Commercial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2022 (Estimated)

Construction Subsector	Establishments	Employment	Annual Payroll (Billions $)
Commercial building construction	4,919	83,028	9.0
Nonresidential poured foundation contractors	529	18,159	1.6
Nonresidential structural steel contractors	363	13,110	1.1
Nonresidential framing contractors	133	3,406	0.3
Nonresidential masonry contractors	229	4,246	0.3
Nonresidential glass and glazing contractors	283	6,133	0.6
Nonresidential roofing contractors	354	10,382	0.9
Nonresidential siding contractors	26	668	0.0
Other nonresidential exterior contractors	277	3,006	0.2
Nonresidential electrical Contractors	3,137	74,277	7.0
Nonresidential plumbing & HVAC contractors	2,346	55,572	5.5
Other nonresidential equipment contractors	556	9,594	1.0
Nonresidential drywall contractors	585	22,824	2.1
Nonresidential painting contractors	500	10,263	0.7
Nonresidential flooring contractors	278	3,756	0.3
Nonresidential tile and terrazzo contractors	153	2,822	0.2
Nonresidential finish carpentry contractors	363	4,667	0.4
Other nonresidential finishing contractors	491	6,549	0.4
Nonresidential site preparation contractors	1,159	18,322	1.6
All other nonresidential trade contractors	940	18,027	1.6

Source: (State of California, n.d.)

3.2.3.2 Impact on Building Designers and Energy Consultants

Adjusting design practices to comply with changing building codes is within the normal practices of building designers. Building codes (including Title 24, Part 6) are typically updated on a three-year revision cycle, and building designers and energy consultants engage in continuing education and training in order to remain up to date with changes to design practices and building codes.

Businesses that focus on residential, commercial, institutional, and industrial building design are contained within the Architectural Services sector (North American Industry Classification System 541310). Table 36 shows the number of establishments, employment, and total annual payroll for Building Architectural Services. The proposed code changes would potentially impact all firms within the Architectural Services sector. The Statewide CASE Team anticipates the impacts for mandatory vestibules to affect firms that focus on commercial construction.

There is not a North American Industry Classification System (NAICS)[17] code specific to energy consultants. Instead, businesses that focus on consulting related to building energy efficiency are contained in the Building Inspection Services sector (NAICS 541350), which is comprised of firms primarily engaged in the physical inspection of residential and nonresidential buildings.[18] It is not possible to determine which business establishments within the Building Inspection Services sector are focused on energy efficiency consulting. The information shown in Table 36 provides an upper bound indication of the size of this sector in California.

Table 36:California Building Designer and Energy Consultant Sectors in 2022 (Estimated)

Sector	Establishments	Employment	Annual Payroll (Millions $)
Architectural Services [a]	4,134	31,478	3,623.3
Building Inspection Services [b]	1,035	3,567	280.7

Source: (State of California, n.d.)

a. Architectural Services (NAICS 541310) comprises private-sector establishments primarily engaged in planning and designing residential, institutional, leisure, commercial, and industrial buildings and structures.
b. Building Inspection Services (NAICS 541350) comprises private-sector establishments primarily engaged in providing building (residential & nonresidential) inspection services encompassing all aspects of the building structure and component systems, including energy efficiency inspection services

[17] NAICS is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. NAICS was development jointly by the U.S. Economic Classification Policy Committee (ECPC), Statistics Canada, and Mexico's Instituto Nacional de Estadistica y Geografia, to allow for a high level of comparability in business statistics among the North American countries. NAICS replaced the Standard Industrial Classification (SIC) system in 1997.

[18] Establishments in this sector include businesses primarily engaged in evaluating a building's structure and component systems and includes energy efficiency inspection services and home inspection services. This sector does not include establishments primarily engaged in providing inspections for pests, hazardous wastes or other environmental contaminates, nor does it include state and local government entities that focus on building or energy code compliance/enforcement of building codes and regulations.

3.2.3.3 Impact on Occupational Safety and Health

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

It is anticipated that incorporation of vestibules at high-traffic entrances to certain buildings would result in improved air quality due to reduced infiltration of unconditioned outside air.

3.2.3.4 Impact on Building Owners and Occupants

Commercial Buildings

The commercial building sector includes a wide array of building types, including offices, restaurants and lodging, retail, and mixed-use establishments, and warehouses (including refrigerated) (Kenney, 2019). Energy use by occupants of commercial buildings also varies considerably, with electricity used primarily for lighting, space cooling and conditioning, and refrigeration, while natural gas is used primarily for water heating and space heating. According to information published in the 2019 California Energy Efficiency Action Plan, there is more than 7.5 billion square feet of commercial floor space in California consuming 19 percent of California's total annual energy use (Kenney, 2019). The diversity of building and business types within this sector creates a challenge for disseminating information on energy and water efficiency solutions, as does the variability in sophistication of building owners and the relationships between building owners and occupants.

Air infiltration through door openings can be an important factor to the building envelope when doors are used frequently. Many commercial buildings such as restaurants, strip-mall stores, retail stores, supermarkets, offices and hospitals are likely to have high door-opening frequency, either at certain time periods of day or in some cases throughout the occupied hours.[19] 2011 NIST analysis found that the 79 buildings with air barriers have an average air leakage almost 70 percent less than the average for the 290 buildings not specified as having an air barrier.[20]

[19] Energy Saving Impact of ASHRAE 90.1 Vestibule Requirements: Modeling of Air Infiltration through Door Openings; PNNL 2010 (https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20026.pdf)

[20] Analysis of U.S. Commercial Building Envelope Air Leakage Database to Support Sustainable Building Design (https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=914293)

Estimating Impacts

Building owners and occupants would benefit from lower energy bills and improved indoor comfort and air quality. As discussed in Section 3.2.4.1, when building occupants save on energy bills, they tend to spend it elsewhere in the economy thereby creating jobs and economic growth for the California economy. The Statewide CASE Team does not expect the proposed code change for the 2025 code cycle to impact building owners or occupants adversely.

3.2.3.5 Impact on Building Component Retailers (Including Manufacturers and Distributors)

This measure would generally expand the market for building component retailers selling components that would be incorporated into vestibules. The degree of the impact will depend on whether building owners opt for building a vestibule or whether they opt for using accepted alternatives to vestibules such as revolving doors and air curtains.

For building types with greater flexibility in floor space, we anticipate that building owners will opt for incorporating vestibules due to the relatively straightforward nature of constructing an inward extension of the building enclosure. In this case, there will be an expanded market for building component retailers of products such as storefront glazing, steel/wood framing, drywall, sealant, and fasteners.

For buildings with less flexibility in floor area, we anticipate that building owners will opt for incorporating vestibules with air curtains due to those products having a smaller footprint than typical vestibules. In this case, we anticipate an expanded market for building component retailers of vestibules and air curtains.

3.2.3.6 Impact on Building Inspectors

Table 37 shows employment and payroll information for state and local government agencies in which many inspectors of residential and commercial buildings are employed. Building inspectors participate in continuing education and training to stay current on all aspects of building regulations, including energy efficiency. The Statewide CASE Team, therefore, anticipates the proposed change would have no impact on employment of building inspectors or the scope of their role conducting energy efficiency inspections.

Table 37: Employment in California State and Government Agencies with Building Inspectors in 2022 (Estimated)

Sector	Govt.	Establishments	Employment	Annual Payroll (Million $)
Administration of Housing Programs[a]	State	18	265	29.0
	Local	38	3,060	248.6
Urban and Rural Development Admin[b]	State	38	764	71.3
	Local	52	2,481	211.5

Source: (State of California, Employment Development Department, n.d.)

a. Administration of Housing Programs (NAICS 925110) comprises government establishments primarily engaged in the administration and planning of housing programs, including building codes and standards, housing authorities, and housing programs, planning, and development.
b. Urban and Rural Development Administration (NAICS 925120) comprises government establishments primarily engaged in the administration and planning of the development of urban and rural areas. Included in this industry are government zoning boards and commissions.

3.2.3.7 Impact on Statewide Employment

As described in Sections 2.2.3.1 through 2.2.3.6, the Statewide CASE Team does not anticipate significant employment or financial impacts to any particular sector of the California economy. This is not to say that the proposed change would not have modest impacts on employment in California. In Section 2.2.4, the Statewide CASE Team estimated the proposed change in mandatory vestibules would affect statewide employment and economic output directly and indirectly through its impact on builders, designers and energy consultants, and building inspectors. In addition, the Statewide CASE Team estimated how energy savings associated with the proposed change in mandatory vestibules would lead to modest ongoing financial savings for California residents, which would then be available for other economic activities.

3.2.4 Economic Impacts

For the 2025 code cycle, the Statewide CASE Team used the IMPLAN model software,[21] along with economic information from published sources, and professional judgement to develop estimates of the economic impacts associated with each of the proposed code changes. Conceptually, IMPLAN estimates jobs created as a function of incoming cash flow in different sectors of the economy, due to implementing a code or a standard. The jobs created are typically categorized into direct, indirect, and induced employment. For example, cash flow into a manufacturing plant captures direct employment (jobs created in the manufacturing plant), indirect employment (jobs

[21] IMPLAN employs economic data and advanced economic impact modeling to estimate economic impacts for interventions like changes to the California Title 24, Part 6 code. For more information on the IMPLAN modeling process, see www.IMPLAN.com.

created in the sectors that provide raw materials to the manufacturing plant) and induced employment (jobs created in the larger economy due to purchasing habits of people newly employed in the manufacturing plant). Eventually, IMPLAN computes the total number of jobs created due to a code. The assumptions of IMPLAN include constant returns to scale, fixed input structure, industry homogeneity, no supply constraints, fixed technology, and constant byproduct coefficients. The model is also static in nature and is a simplification of how jobs are created in the macro-economy.

The economic impacts developed for this report are only estimates and are based on limited and to some extent speculative information. The IMPLAN model provides a relatively simple representation of the California economy and, though the Statewide CASE Team is confident that the direction and approximate magnitude of the estimated economic impacts are reasonable, it is important to understand that the IMPLAN model is a simplification of extremely complex actions and interactions of individual, businesses, and other organizations as they respond to changes in energy efficiency codes. In all aspects of this economic analysis, the CASE Authors rely on conservative assumptions regarding the likely economic benefits associated with the proposed code change. By following this approach, the economic impacts presented below represent lower bound estimates of the actual benefits associated with this proposed code change.

Adoption of this code change proposal would result in relatively modest economic impacts through the additional direct spending by those in the commercial building industry, architects, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2025 code cycle regulations would result in additional spending by those businesses.

Table 38: Estimated Impact that Adoption of the Proposed Measure would have on the California Commercial Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Commercial Builders)	102.7	$7.976	$9.217	$15.699
Indirect Effect (Additional spending by firms supporting /Commercial Builders)	25.1	$2.173	$3.409	$6.278
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	42.7	$2.914	$5.217	$8.304
Total Economic Impacts	**170.5**	**$13.-62**	**$17.844**	**$30.281**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[22]

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

Table 39: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultants Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Designers & Energy Consultants)	12.2	$1.336	$1.322	$2.090
Indirect Effect (Additional spending by firms supporting Bldg. Designers & Energy Consultants)	4.9	$0.398	$0.553	$0.890
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	7.3	$0.498	$0.893	$1.421
Total Economic Impacts	**24.4**	**$2.232**	**$2.768**	**$4.401**

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

Table 40: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Inspectors)	0.1	$0.011	$0.013	$0.016
Indirect Effect (Additional spending by firms supporting Building Inspectors)	0.0	$0.001	$0.002	$0.003
Induced Effect (Spending by employees of Building Inspection Bureaus and Departments)	0.1	$0.004	$0.006	$0.010
Total Economic Impacts	**0.2**	**$0.016**	**$0.021**	**$0.029**

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

3.2.4.1 Creation or Elimination of Jobs

The Statewide CASE Team does not anticipate that the measures proposed for the 2025 code cycle regulation would lead to the creation of new *types* of jobs or the elimination of *existing* types of jobs. In other words, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. Rather, the estimates of economic impacts discussed in Section 2.2.4 would lead to modest changes in employment of existing jobs.

3.2.4.2 Creation or Elimination of Businesses in California

As stated in Section 2.2.4.1, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. The proposed change represents a modest change to building envelope design, which would not excessively burden or competitively disadvantage California businesses – nor would it necessarily lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not foresee any new businesses being created, nor does

the Statewide CASE Team think any existing businesses would be eliminated due to the proposed code changes.

3.2.4.3 Competitive Advantages or Disadvantages for Businesses in California

The proposed code changes would apply to all businesses incorporated in California, regardless of whether the business is located inside or outside of the state.[23] Therefore, the Statewide CASE Team does not anticipate that these measures proposed for the 2025 code cycle regulation would have an adverse effect on the competitiveness of California businesses. Likewise, the Statewide CASE Team does not anticipate businesses located outside of California would be advantaged or disadvantaged.

3.2.4.4 Increase or Decrease of Investments in the State of California

The Statewide CASE Team analyzed national data on corporate profits and capital investment by businesses that expand a firm's capital stock (referred to as net private domestic investment, or NPDI).[24] As Table 41 shows, between 2017 and 2021, NPDI as a percentage of corporate profits ranged from a low of 18 in 2020 due to the worldwide economic slowdowns associated with the COVID 19 pandemic to a high of 35 percent in 2019, with an average of 26 percent. While only an approximation of the proportion of business income used for net capital investment, the Statewide CASE Team believes it provides a reasonable estimate of the proportion of proprietor income that would be reinvested by business owners into expanding their capital stock.

Table 41: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2017	518.473	1882.460	28
2018	636.846	1977.478	32
2019	690.865	1952.432	35
2020	343.620	1908.433	18
2021	506.331	2619.977	19
5-Year Average	**-**	**-**	**26**

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

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

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

The Statewide CASE Team estimates that the sum of proposed code changes in this report would increase in net private investment in California:

Change in Proprietor Income $3,125,341) * 0.26 = $827,986

3.2.4.5 Incentives for Innovation in Products, Materials, or Processes

There are no existing incentive programs or utility programs that directly offer encouragement for the addition of vestibules in the buildings.

However, there are indirect incentives for adding a vestibule in the building by increasing the airtightness or reducing heat loss via air transfer. The recently passed Inflation Reduction Act provides tax incentives for deductions for energy usage by envelope improvements.

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

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

Cost of Enforcement

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

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this re-training is an expense to local governments, it is not a new cost associated with the 2025 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training and resources provided by the IOU Codes and Standards program (such as Energy Code Ace). As noted in Section 3a and Appendix E, the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

3.2.4.7 Impacts on Specific Persons

While the objective of any of the Statewide CASE Team's proposal is to promote energy efficiency, the Statewide CASE Team recognizes that there is the potential that a proposed code change may result in unintended consequences. There are no foreseen impacts on specific persons or groups. The materials and technologies to meet the proposed code change are neither proprietary nor sole-sourced. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

3.2.5 Fiscal Impacts

3.2.5.1 Mandates on Local Agencies or School Districts

This measure would impact local agencies or school districts undertaking new construction projects of buildings with projected heavy foot traffic at entrances.

3.2.5.2 Costs to Local Agencies or School Districts

This measure would impose additional costs for inclusion of a vestibule to local agencies and school districts undertaking new construction projects of buildings with projected heavy foot traffic at entrances.

3.2.5.3 Costs or Savings to Any State Agency

This measure would impose additional costs for inclusion of a vestibule to state agencies undertaking new construction projects of buildings with projected heavy foot traffic at entrances. The measure is expected to provide commensurate savings in energy costs.

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

There are no added non-discretionary costs or savings to local agencies.

3.2.5.5 Costs or Savings in Federal Funding to the State

There are no costs or savings to federal funding to the state.

3.3 Energy Savings

The Statewide CASE Team gathered stakeholder input to inform the energy savings analysis. See Appendix F for a summary of stakeholder engagement.

Energy savings benefits may have potential to disproportionately impact DIPs. Refer to Section 3.6 for more details addressing energy equity and environmental justice.

3.3.1 Energy Savings Methodology

The Statewide CASE Team used EnergyPlus v9.4.0 to conduct the energy savings calculations for all code change proposals since CBECC is not adequately flexible to handle the input assumptions for some of the envelope measures. Rulesets are sourced from the CBECC prototypical building models (California Energy Commission, n.d.). The Statewide CASE Team simulated the energy impacts in every climate zone and applied the climate-zone Long-term Systemwide Cost (LSC) hourly factors when calculating energy cost impacts. The Statewide CASE Team evaluated various scenarios comparing energy impacts and cost-effectiveness across prototypes and climate zones. This process, in parallel with stakeholder outreach and market and technical research, informed the ultimate proposals that are made in this report.

The CBECC energy models are modified to include the proposed changes to the energy standards. The 2022 Standard Design also serves as the baseline with modification. As a conservative assumption the 2022 Standard Design is used for alterations.

3.3.1.1 Key Assumptions for Energy Savings Analysis

The Statewide CASE Team used a methodology for the energy savings analysis similar to that used by the Pacific Northwest National Laboratory (PNNL) for their study of ASHRAE 90.1 vestibule requirements (Cho, Gowri, & Liu, 2010). The PNNL report presented a method to estimate air infiltration rate through the door openings with and without vestibules. Estimated peak infiltration rates through door openings for each building type, with and without vestibules, were used in EnergyPlus building energy simulation to estimate the impact of specific vestibule requirements on buildings' air leakage and energy use.

The Statewide CASE Team assumed that exterior doors used in each prototype, both for the Standard Design and Proposed Design, are self-closing doors. Because these doors often stay open longer with each use than manual doors, this assumption may result in over-estimates of infiltration rates through door-openings for buildings that more typically use manual doors.

The PNNL methodology for determining air infiltration rates requires analysis of a number of different variables: building type, usage of buildings, outdoor wind speed and building pressure differentials. PNNL discovered that the outdoor temperature has little impact on the estimated peak air infiltration rate through door openings, but a critical

variable is the assumptions of door-opening frequency.[25] Figure 1 shows the impact these variables have on air infiltration.

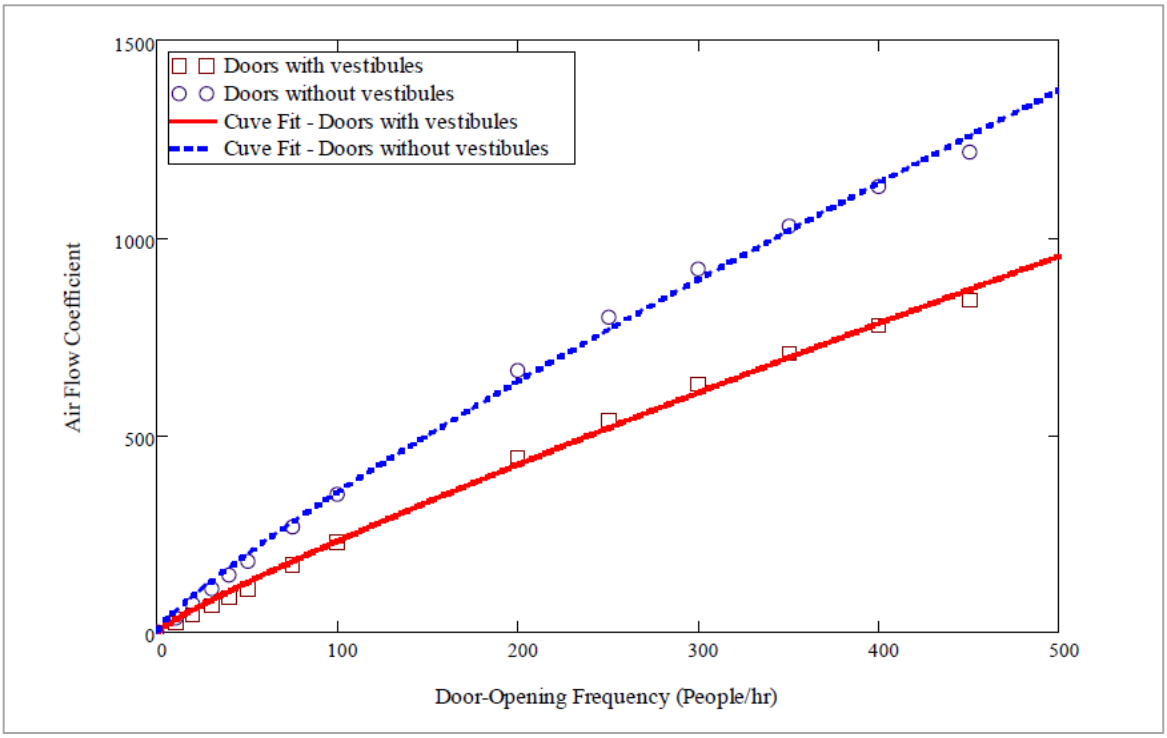

Figure 1: Air flow coefficient vs door opening frequency.

Source: (Cho, Gowri, & Liu, 2010); See footnote 25.

Using the PNNL methodology for calculating air infiltration as a means to understand energy loss and the prototype assumptions in Table 42, the Statewide CASE Team determined the peak and off-peak rates of infiltration for five building prototypes. See the results in **Error! Reference source not found.**.

[25] The door-opening frequency for peak hour can be estimated based on the number of occupants in a building. For retail and strip mall stores, it is assumed that customers would use entrance door two times within 1 hour (i.e., once they enter and once they leave the store). However, for other building types it can be safely assumed that people stay longer than 1 hour in the building and use the entrance door once within 1 hour when they enter or leave. Therefore, the door-opening frequency for peak hour can be estimated to be equal to the number of occupants in all prototypical buildings except retail and strip mall stores.

Table 42: Title 24 2022 Prototype Building Characteristics and Assumptions

Prototype	Number of Floors	Conditioned Floor Area (ft^2)	Floor Area (ft^2)	Entrance Space	Entrance Space (ft^2)	Ceiling Height (ft)	Building Height (ft)	Peak Occupancy	Peak Door-Open Frequency	Off-peak Door-Open Frequency	Vestibule floor area (ft^2)
OfficeLarge	13	498,589	38,357	Ground Floor Core	3,374	9	108	959	959	96	767
OfficeMedium	3	53,628	17,878	Bottom Floor	2,232	9	27	269	269	27	358
RetailLarge	1	240,000	240,000	Main Entry	6,750	25	25	2,137	3,206	321	4,800
RetailMedium	1	24,563	24,563	Core Retail	17,227	20	20	179	358	36	491
SchoolSmall	1	24,413	24,413	Lobby	2,201	14.8	15	442	442	44	488

Table 43: Air Infiltration Rates Through Door Openings With and Without Vestibule

Building Type	Peak Rate with Vestibule (cfm)	Peak Rate without Vestibule (cfm)	Off-Peak Rate with Vestibule (cfm)	Off-Peak Rate without Vestibule (cfm)
OfficeLarge	11,862	16,856	1,465	1,953
OfficeMedium	3,350	5,481	457	548
RetailLarge	37,091	52,708	3,654	5,481
RetailMedium	3,959	6,090	609	609
SchoolSmall	4,568	7,613	761	761

3.3.1.2 Energy Savings Methodology per Prototypical Building

To quantify impacts, the Statewide CASE Team measured per-unit energy savings expected from the proposed code changes in various scenarios. First, savings are calculated by fuel type. Electricity savings are measured in terms of both energy usage and peak demand reduction. Natural gas savings are quantified in terms of energy usage. Second, the Statewide CASE Team calculated source energy savings, representing the total amount of raw fuel required to operate a building. In addition to all energy used from on-site production, source energy incorporates transmission, delivery, and production losses. The hourly source energy values provided by CEC are strongly correlated with GHG emissions.[26] Finally, the Statewide CASE Team calculated Long-term Systemwide Cost (LSC) Savings, formerly known as Time Dependent Valuation (TDV) Energy Cost Savings. LSC savings are calculated using hourly LSC factors for both electricity and natural gas provided by the CEC. These LSC hourly factors are projected over the 30-year life of the building and incorporate the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade CO2 emissions (California Energy Commission, 2022).[27]

The CEC directed the Statewide CASE Team to model the energy impacts using specific prototypical building models that represent typical building geometries for different types of buildings. The prototype buildings that the Statewide CASE Team used in the analysis are presented in Table 44 (California Energy Commission, 2022).

[26] See hourly factors for source energy, LSC, and GHG emissions at https://www.energy.ca.gov/files/2025-energy-code-hourly-factors.

[27] More information on source energy and LSC hourly factors is available in the March 2020 CEC Staff Workshop on Energy Code Compliance Metrics and the July 2022 CEC Staff Workshop on Energy Code Accounting for the 2025 Building Energy Efficiency Standards.

Table 44: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Number of Stories	Floor Area (Square Feet)	Description
OfficeLarge	12	498,589	12-story + 1 basement office building with 5 zones and a ceiling plenum on each floor. WWR–0.40. Because CBECC will model single-zone heat pumps in the Large School prototype's Standard Design, results from measures applied to the prototype should be compared to the Proposed Design prototype model, not the Standard Design. As with the Assembly prototype, if a U-factor measure is applied to the Large School windows, that measure should be applied to a copy of the original Proposed Design. The results from that analysis should then be compared to the results of the original prototype's Proposed Design.
OfficeMedium	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–0.33
RetailLarge	1	240,000	Big-box type retail building with WWR–12% and SRR–0.82%
RetailMedium	1	24,563	Similar to a Target or Walgreens. 7% WWR on the front façade, none on other sides. SRR–2.1%.
RetailStripMall	1	9,375	Strip Mall building with WWR–10%
SchoolSmall	1	24,413	Elementary school with WWR–0.36

The Statewide CASE Team estimated LSC, source energy, electricity, natural gas, peak demand, and GHG impacts by simulating the proposed code change in EnergyPlus using prototypical buildings and rulesets from the 2025 Research Version of the California Building Energy Code Compliance (CBECC) software (California Energy Commission, n.d.).

CBECC generates two models based on user inputs: the Standard Design and the Proposed Design.[28] The Standard Design represents the geometry of the prototypical building and a design that uses a set of features that result in a LSC budget and source energy budget that is minimally compliant with 2022 Title 24, Part 6 code requirements. Features used in the Standard Design are described in the 2022 Nonresidential ACM

[28] CBECC-Res creates a third model, the Reference Design, which represents a building similar to the Proposed Design, but with construction and equipment parameters that are minimally compliant with the 2006 International Energy Conservation Code (IECC). The Statewide CASE Team did not use the Reference Design for energy impacts evaluations.

Reference Manual. The Proposed Design represents the same geometry as the Standard Design, but it assumes the energy features entered by the software user.

To develop savings estimates for the proposed code changes, the Statewide CASE Team created a Standard Design and Proposed Design for each prototypical building with the Standard Design representing compliance with 2022 code and the Proposed Design representing compliance with the proposed requirements. Comparing the energy impacts of the Standard Design to the Proposed Design reveals the impacts of the proposed code change relative to a building that is minimally compliant with the 2022 Title 24, Part 6 requirements, following typical industry practices.

The Proposed Design was identical to the Standard Design in all ways except for the revisions that represent the proposed changes to the code. Table 45 presents which parameters were modified and the values used in the Standard Design and Proposed Design.

Table 45: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change

Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
OfficeLarge	All	Infiltration Rate	Airflow cfm	16856, 1953	11862, 1465
OfficeMedium	All	Infiltration Rate	Airflow cfm	5481, 548	3350, 457
RetailLarge	All	Infiltration Rate	Airflow cfm	52708, 5481	37091, 3654
RetailMedium	All	Infiltration Rate	Airflow cfm	6090, 914	3959, 609
SchoolSmall	All	Infiltration Rate	Airflow cfm	7613, 1218	4568, 761

CBECC calculates whole-building energy consumption for every hour of the year measured in kilowatt-hours per year (kWh/y) and therms per year (therms/y). It then applies the 2025 LSC hourly factors to calculate Long-term Systemwide Cost in 2026 present value dollars (2026PV$), source energy hourly factors to calculate source energy use in thousand British thermal units per year (KBtu/y), and hourly GHG emissions factors to calculate annual GHG emissions in metric tons of carbon dioxide emissions equivalent per year (MT or “tonnes” CO2e/yr). CBECC also calculates annual peak electricity demand measured in kilowatts (kW).

The energy impacts of the proposed code change do vary by climate zone. The Statewide CASE Team simulated the energy impacts in every climate zone and applied the climate-zone specific LSC hourly factors when calculating energy and energy cost impacts.

Per-unit energy impacts for nonresidential buildings are presented in savings per square foot. Annual energy, GHG, and peak demand impacts for each prototype building were translated into impacts per square foot by dividing by the floor area of the prototype building. This step allows for an easier comparison of savings across different building types and enables a calculation of statewide savings using the construction forecast that is published in terms of floor area by building type.

3.3.1.3 Statewide Energy Savings Methodology

The per-unit energy impacts were extrapolated to statewide impacts using the Statewide Construction Forecasts that the CEC provided. The Statewide Construction Forecasts estimate new construction or additions that would occur in 2026, the first year that the 2025 Title 24, Part 6 requirements are in effect (California Energy Commission, 2022; California Energy Commission, 2022). They also estimate the amount of total existing building stock in 2026, which the Statewide CASE Team used to approximate savings from building alterations. The construction forecast provides construction (new construction or additions and existing building stock) by building type and climate zone, as shown in Appendix A.

Appendix A presents additional information about the methodology and assumptions used to calculate statewide energy impacts.

3.3.2 Per-Unit Energy Impacts Results

This measure to add mandatory vestibules in certain buildings will be analyzed for 18 prototype buildings across 16 climate zones. This Draft CASE Report includes the analysis results modeled in five building prototypes: Office Large, Office Medium, Retail Medium, Retail Large, and School Small. The tables containing data for the other building types will be located in Appendix H for the Final CASE Report.

Energy savings and peak demand reductions per unit are presented in Table 46 through Table 50. The per-unit energy savings figures do not account for naturally occurring market adoption or compliance rates.

Table 46: OfficeLarge – Vestibule - Savings Summary (per square foot)

OfficeLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.19	0.00	0.51	0.47	1.21
2	0.21	0.00	0.44	0.40	1.24
3	0.20	0.00	0.37	0.34	1.16
4	0.22	0.00	0.43	0.39	1.28
5	0.20	0.00	0.40	0.36	1.19
6	0.21	0.00	0.14	0.13	1.10
7	0.21	0.00	0.11	0.10	1.11
8	0.22	0.00	0.16	0.15	1.17
9	0.22	0.00	0.18	0.16	1.17
10	0.23	0.00	0.20	0.18	1.21
11	0.22	0.00	0.39	0.36	1.30
12	0.21	0.00	0.37	0.33	1.24
13	0.22	0.00	0.30	0.27	1.25
14	0.22	0.00	0.39	0.35	1.31
15	0.25	0.00	0.10	0.09	1.26
16	0.21	0.00	0.58	0.52	1.34

- The highest first-year electricity savings for this measure are in Climate Zone 15, while the lowest first-year electricity savings are in Climate Zone 1.
- Results indicate zero peak demand savings values. The Statewide CASE Team is investigating the cause for these results.
- The highest natural gas savings are in Climate Zones 1 and 16, while the lowest natural gas savings are in Climate Zones 7 and 15.

Table 47: OfficeMedium – Vestibule - Savings Summary (per square foot)

OfficeMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.21	0.00	0.60	0.54	1.34
2	0.23	0.00	0.44	0.40	1.36
3	0.22	0.00	0.32	0.29	1.25
4	0.25	0.00	0.40	0.37	1.44
5	0.23	0.00	0.35	0.31	1.28
6	0.24	0.00	0.12	0.11	1.24
7	0.25	0.00	0.10	0.09	1.27
8	0.26	0.00	0.14	0.13	1.35
9	0.26	0.00	0.16	0.15	1.35
10	0.27	0.00	0.17	0.15	1.40
11	0.26	0.00	0.40	0.36	1.52
12	0.25	0.00	0.38	0.34	1.42
13	0.27	0.00	0.31	0.28	1.49
14	0.26	0.00	0.40	0.36	1.52
15	0.32	0.00	0.09	0.08	1.60
16	0.23	0.00	0.63	0.56	1.48

- The highest first-year electricity savings for this measure are in Climate Zone 15, while the lowest first-year electricity savings are in Climate Zone 1.
- Results indicate zero peak demand savings values. The Statewide CASE Team is investigating the cause for these results.
- The highest natural gas savings are in Climate Zones 1 and 16, while the lowest natural gas savings are in Climate Zones 7 and 15.

Table 48: RetailLarge – Vestibule - Savings Summary (per square foot)

RetailLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.33	0.00	0.29	0.26	1.89
2	0.61	0.01	0.00	0.00	3.99
3	0.55	0.01	0.00	0.00	3.60
4	0.65	0.01	0.00	0.00	4.24
5	0.56	0.01	0.00	0.00	3.58
6	0.57	0.01	0.00	0.00	3.62
7	0.59	0.01	0.00	0.00	4.00
8	0.64	0.01	0.00	0.00	4.05
9	0.64	0.01	0.00	0.00	4.05
10	0.66	0.01	0.00	0.00	4.21
11	0.70	0.01	0.00	0.00	4.55
12	0.65	0.01	0.00	0.00	4.22
13	0.70	0.01	0.00	0.00	4.52
14	0.71	0.02	0.00	0.00	4.50
15	0.80	0.01	0.00	0.00	5.01
16	0.57	0.01	0.00	0.06	3.68

- The highest first-year electricity savings for this measure are in Climate Zone 15, while the lowest first-year electricity savings are in Climate Zone 1.
- The highest peak demand savings for this measure are in Climate Zone 14. Results indicate zero peak demand savings for Climate Zone 1 which the Statewide CASE Team is investigating.
- The highest natural gas savings are in Climate Zone 1, while the remaining climate zones indicate zero natural gas savings. The Statewide CASE Team is investigating the reason for the zero natural gas savings result, particularly for Climate Zone 16.

Table 49: RetailMedium – Vestibule - Savings Summary (per square foot)

RetailMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.58	0.01	0.00	0.02	3.83
2	0.69	0.02	0.00	0.00	4.55
3	0.62	0.01	0.00	0.00	4.11
4	0.73	0.02	0.00	0.00	4.80
5	0.62	0.01	0.00	0.00	4.06
6	0.63	0.01	0.00	0.00	4.03
7	0.65	0.01	0.00	0.00	4.54
8	0.66	0.01	0.00	0.00	4.25
9	0.70	0.01	0.00	0.00	4.52
10	0.69	0.01	0.00	0.00	4.42
11	0.75	0.02	0.00	0.00	4.94
12	0.73	0.02	0.00	0.00	4.80
13	0.78	0.02	0.00	0.00	5.10
14	0.81	0.02	0.00	0.00	5.19
15	0.83	0.01	0.00	0.00	5.22
16	0.00	0.00	0.00	0.08	0.49

- The highest first-year electricity savings for this measure are in Climate Zones 13-15, while the lowest first-year electricity savings are in Climate Zone 1. Climate Zone 16 indicated zero first-year electricity savings and the Statewide CASE Team is investigating this result.
- The highest peak demand savings are found in Climate Zones 2, 4, and 11-14. Climate Zone 16 returned zero peak demand savings, and the Statewide CASE Team is investigating this result.
- Results indicated zero natural gas savings in all climate zones. The Statewide CASE Team is investigating this result.

Table 50: SchoolSmall – Vestibule - Savings Summary (per square foot)

SchoolSmall Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.03	0.00	-0.07	-0.07	0.99
2	0.29	0.01	0.00	0.00	2.56
3	0.26	0.00	0.00	0.00	2.35
4	0.31	0.01	0.00	0.00	2.70
5	0.27	0.00	0.00	0.00	2.32
6	0.27	0.00	0.00	0.00	2.29
7	0.27	0.00	0.00	0.00	2.34
8	0.29	0.00	0.00	0.00	2.51
9	0.29	0.00	0.00	0.00	2.51
10	0.31	0.00	0.00	0.00	2.62
11	0.32	0.01	0.00	0.00	2.88
12	0.30	0.01	0.00	0.00	2.67
13	0.33	0.01	0.00	0.00	2.89
14	0.33	0.01	0.00	0.00	2.89
15	0.36	0.00	0.00	0.00	3.11
16	0.25	0.00	1.29	1.16	3.01

- The highest first-year electricity savings for this measure are in Climate Zone 15, while the lowest first-year electricity savings are in Climate Zone 1.
- Results indicate some peak demand savings in Climate Zones 2, 4, and 11-14. The remainder of the climate zones indicate zero peak demand savings; The Statewide CASE Team is investigating the cause for the zero peak demand savings results.
- The highest natural gas savings are in Climate Zone 16, while the remaining Climate Zones 2-15 returned zero natural gas savings. Climate Zone 1 returned negative natural gas savings which is considered an outlier – the Statewide CASE Team is investigating the cause for this result.

3.4 Cost and Cost Effectiveness

3.4.1 Energy Cost Savings Methodology

Energy cost savings were calculated by applying the LSC hourly factors to the energy savings estimates that were derived using the methodology described in Section 2.3.1. LSC hourly factors are a normalized metric to calculate energy cost savings that accounts for the variable cost of electricity and natural gas for each hour of the year, along with how costs are expected to change over the 30-year period of analysis.

The CEC requested LSC savings over the 30-year period of analysis in both 2026 present value dollars (2026 PV$) and nominal dollars. The cost-effectiveness analysis uses LSC values in 2026 PV$. Costs and cost-effectiveness using 2026 PV$ are presented in Section 3.4 of this report. CEC uses results in nominal dollars to complete the Economic and Fiscal Impacts Statement (From 399) for the entire package of proposed change to Title 24, Part 6. Appendix G presents LSC savings results in nominal dollars.

The proposed code change would not apply to alterations.

3.4.2 Energy Cost Savings Results

Per-unit energy cost savings for newly constructed buildings and alterations in terms of LSC savings realized over the 30-year period of analysis are presented 2026 present value dollars (2026 PV$) in Table 51 through Table 56.

The LSC methodology allows peak electricity savings to be valued more than electricity savings during non-peak periods.

Any time code changes impact cost, there is potential for unintended consequences impacting DIPs. Refer to Section 3.6 for more details addressing energy equity and environmental justice.

Table 51: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– OfficeLarge

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Savings (2026 PV$)
1	0.00*	0.00*	0.00*
2	0.00*	0.00*	0.00*
3	0.95	0.21	1.16
4	1.03	0.25	1.28
5	0.00*	0.00*	0.00*
6	1.02	0.08	1.10
7	1.04	0.07	1.11
8	1.07	0.10	1.17
9	1.06	0.11	1.17
10	1.09	0.12	1.21
11	1.07	0.23	1.30
12	1.02	0.21	1.24
13	0.00*	0.00*	0.00*
14	1.07	0.24	1.31
15	1.19	0.06	1.26
16	1.00	0.34	1.34

*Construction forecast for this prototype near zero in this climate zone

Table 52: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– OfficeMedium

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Cost Savings (2026 PV$)
1	1.00	0.34	1.34
2	1.11	0.25	1.36
3	1.05	0.19	1.25
4	1.20	0.24	1.44
5	1.08	0.20	1.28
6	1.17	0.07	1.24
7	1.21	0.06	1.27
8	1.27	0.09	1.35
9	1.25	0.10	1.35
10	1.29	0.10	1.40
11	1.28	0.24	1.52
12	1.19	0.23	1.42
13	1.30	0.19	1.49
14	1.28	0.24	1.52
15	1.54	0.06	1.60
16	1.11	0.37	1.48

Table 53: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– RetailLarge

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Cost Savings (2026 PV$)
1	0.00*	0.00*	0.00*
2	0.00*	0.00*	0.00*
3	3.60	0.00	3.60
4	4.24	0.00	4.24
5	3.58	0.00	3.58
6	3.62	0.00	3.62
7	4.00	0.00	4.00
8	4.05	0.00	4.05
9	4.05	0.00	4.05
10	4.21	0.00	4.21
11	4.55	0.00	4.55
12	4.22	0.00	4.22
13	4.52	0.00	4.52
14	4.50	0.00	4.50
15	5.01	0.00	5.01
16	3.61	0.00	3.68

*Construction forecast for this prototype near zero in this climate zone

Table 54: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– RetailMedium

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Cost Savings (2026 PV$)
1	3.80	0.03	3.83
2	4.55	0.00	4.55
3	4.11	0.00	4.11
4	4.80	0.00	4.80
5	4.06	0.00	4.06
6	4.03	0.00	4.03
7	4.54	0.00	4.54
8	4.25	0.00	4.25
9	4.52	0.00	4.52
10	4.42	0.00	4.42
11	4.94	0.00	4.94
12	4.80	0.00	4.80
13	5.10	0.00	5.10
14	5.19	0.00	5.19
15	5.22	0.00	5.22
16	0.39	0.00	0.49

Table 55: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction and Additions– SchoolSmall

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Cost Savings (2026 PV$)
1	0.98	0.02	0.99
2	2.56	0.00	2.56
3	2.35	0.00	2.35
4	2.70	0.00	2.70
5	2.32	0.00	2.32
6	2.29	0.00	2.29
7	2.34	0.00	2.34
8	2.51	0.00	2.51
9	2.51	0.00	2.51
10	2.62	0.00	2.62
11	2.88	0.00	2.88
12	2.67	0.00	2.67
13	2.89	0.00	2.89
14	2.89	0.00	2.89
15	3.11	0.00	3.11
16	2.17	0.84	3.01

Table 56: Average 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction– All Prototypes

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Savings (2026 PV$)
1	1.83	0.17	2.01
2	2.56	0.11	2.67
3	1.84	0.14	1.98
4	2.15	0.16	2.31
5	2.15	0.10	2.25
6	2.01	0.05	2.06
7	2.06	0.04	2.10
8	2.08	0.06	2.15
9	2.09	0.07	2.16
10	2.72	0.05	2.77
11	3.06	0.10	3.16
12	2.38	0.13	2.51
13	3.19	0.07	3.26
14	2.61	0.14	2.74
15	3.38	0.03	3.40
16	1.47	0.32	1.79

3.4.3 Incremental First Cost

The incremental first costs include the material and labor involved with constructing a vestibule. The walls of a vestibule function as an air barrier similar to the exterior enclosure of a building but do not have the same water and thermal control functions. Therefore, the area normalized cost of vestibules can be conservatively assumed to cost the same as that of the adjacent exterior envelope, and most likely costs less. For opaque vestibules, the cost would include typical interior partition elements such as wood/steel framing, drywall, batt insulation, and interior finishes. For glazed vestibules, the cost would be similar to that of a typical storefront glazing system.

The incremental cost of the vestibule is also a function of the floor area dedicated to the vestibule space, which in turn depends on the number/size of entrances needed to meet occupant transit. The greater the maximum occupancy of a space, the more entrances would be needed and the greater the incremental cost.

The vestibule size was calculated using the greater of 50 ft^2 or two percent of the CBECC prototype gross conditioned area of that level of the vestibule. Single-pane glass cost of $75 per square foot was selected for determining the installation cost. The total installation cost includes an additional 50 percent of this cost to account for labor and other material costs including framing. Using the data from Table 57, the Statewide CASE Team used an estimated average cost of $200 per square foot for cost-analysis.

Table 57: Estimated Cost per Square Foot - Vestibule

Prototype	Vestibule Floor Area (ft^2)	Size of the Vestibule Assumed (ft x ft x ft)	Total Surface Area (ft^2)	Material Cost ($)	Unit Cost ($/$ft^2$)
OfficeLarge	768	32x24x7	1,552	174,600	227.34
OfficeMedium	360	24x15x7	906	101,925	283.13
RetailLarge	4,860	81x60x7	6,834	768,825	158.19
RetailMedium	504	24x21x7	1,134	1,134	253.13
SchoolSmall	504	24x21x7	1,134	1,134	253.13

The Statewide CASE Team is in the process of obtaining cost data for accepted vestibule alternatives such as revolving doors and air curtains. These alternatives will be compared against the cost assumptions listed above. We anticipate using the lowest cost option between vestibules, revolving doors, and air curtains for our cost benefit analyses.

3.4.4 Incremental Maintenance and Replacement Costs

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 30-year period of analysis. The present value of equipment maintenance costs (or savings) was calculated using a three percent discount rate (d), which is consistent with the discount rate used when developing the 2025 LSC hourly factors. The present value of maintenance costs that occurs in the n^{th} year is calculated as follows:

$$Present\ Value\ of\ Maintenance\ Cost\ =\ Maintenance\ Cost\ \times \left\lfloor \frac{1}{1+d} \right\rfloor^{n}$$

For this proposal, the Statewide CASE Team assumes the interior construction of a vestibule will be the same as the exterior envelope system. In general, envelope assemblies do not require complete replacement within the typical lifetime (39 years of life per IRS, Publication 946) of a typical building. Ideally, unless the purpose of the building changes, exterior envelope systems are rarely replaced. However, there will be some incidental replacements during the lifetime of a building which would be the same in both proposed and in the baseline cases meaning there are no anticipated incremental maintenance or replacement costs.

3.4.5 Cost Effectiveness

This measure proposes a mandatory requirement. But as there is not a corresponding prescriptive requirement already proven to be cost effective, a cost analysis is required to demonstrate that the measure is cost effective over the 30-year period of analysis.

The CEC establishes the procedures for calculating cost effectiveness (California Energy Commission, 2022). The Statewide CASE Team collaborated with CEC staff to confirm that the methodology in this report is consistent with their guidelines, including which costs were included in the analysis. The incremental first cost and incremental maintenance costs over the 30-year period of analysis were included. The LSC Savings from electricity and natural gas were also included in the evaluation. Design costs were not included nor were the incremental costs of code compliance verification.

According to the CEC's definitions, a measure is cost effective if the benefit-to-cost (B/C) ratio is greater than 1.0. The B/C ratio is calculated by dividing the cost benefits realized over 30 years by the total incremental costs, which includes maintenance costs for 30 years. The B/C ratio was calculated using 2026 PV costs and cost savings.

Results of the per-unit cost-effectiveness analyses are presented in Table 58.

Table 58: 30-Year Cost-Effectiveness Summary Per Square Foot – New Construction/Additions – All Prototypes

Climate Zone	Benefits Lifecycle Energy Cost Savings + Other PV Savings [a] (2026 PV$)	Costs Total Incremental PV Costs [b] (2026 PV$)	Benefit-to-Cost Ratio
1	1.18	0.49	2.41
2	1.78	0.50	3.58
3	1.22	0.21	5.74
4	1.44	0.22	6.51
5	1.46	0.37	3.91
6	1.28	0.26	4.96
7	1.28	0.27	4.77
8	1.31	0.25	5.34
9	1.33	0.24	5.51
10	1.87	0.36	5.21
11	2.21	0.31	7.21
12	1.62	0.32	5.06
13	2.27	0.41	5.53
14	1.79	0.32	5.53
15	2.35	0.34	6.96
16	0.86	0.37	2.36
Total	1.46	0.28	5.30

a. **Benefits: LSC Savings + Other PV Savings:** Benefits include Lifecycle Energy Cost Savings over the period of analysis (California Energy Commission, 2022). Other savings are discounted at a real (nominal – inflation) three percent rate. Other PV savings include incremental first-cost savings if proposed first cost is less than current first cost, incremental PV maintenance cost savings if PV of proposed maintenance costs is less than PV of current maintenance costs, and incremental residual value if proposed residual value is greater than current residual value at end of CASE analysis period.

b. **Costs: Total Incremental Present Valued Costs:** Costs include incremental equipment, replacement, and maintenance costs over the period of analysis. Costs are discounted at a real (inflation-adjusted) three percent rate and if PV of proposed maintenance costs is greater than PV of current maintenance costs. If incremental maintenance cost is negative, it is treated as a positive benefit. If there are no total incremental PV costs, the B/C ratio is infinite. Total Incremental Cost = (Measure Case First Cost + PV of Measure Case Maintenance and Replacement Costs over 30 years) - (Base Case First Cost + PV of Base Case Maintenance and Replacement Costs over 30 years).

3.5 First-Year Statewide Impacts

3.5.1 Statewide Energy and Energy Cost Savings

The Statewide CASE Team calculated the first-year statewide savings for new construction and additions by multiplying the per-unit savings, which are presented in Section 2.3.2, by assumptions about the percentage of newly constructed buildings that would be impacted by the proposed code. The statewide new construction forecast for 2026 is presented in Appendix A, as are the Statewide CASE Team's assumptions about the percentage of new construction that would be impacted by the proposal (by climate zone and building type).

Table 59 below presents the first-year statewide energy and energy cost savings from newly constructed buildings and additions by climate zone.

While a statewide analysis is crucial to understanding broader effects of code change proposals, there is potential for unintended consequences impacting DIPs that needs to be considered. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

Table 59: Statewide Energy and Energy Cost Impacts | Vestibules | New Construction and Additions

Climate Zone	Statewide New Construction Impacted by Proposed Change in 2026 (Million Square Feet)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2026 PV$)
1	280,910	0.08	0.00	0.00	0.07	0.56
2	1,093,900	0.43	0.01	0.00	0.19	2.92
3	6,954,300	2.16	0.04	0.02	1.50	13.76
4	3,547,200	1.28	0.02	0.01	0.89	8.18
5	744,840	0.26	0.01	0.00	0.12	1.68
6	4,239,000	1.46	0.02	0.00	0.31	8.73
7	2,584,200	0.86	0.01	0.00	0.15	5.42
8	5,981,300	2.15	0.04	0.01	0.55	12.83
9	11,082,100	3.99	0.07	0.01	1.15	23.96
10	3,368,800	1.50	0.03	0.00	0.25	9.32
11	917,810	0.44	0.01	0.00	0.14	2.90
12	6,080,400	2.36	0.05	0.01	1.15	15.25
13	1,623,800	0.80	0.02	0.00	0.16	5.29
14	979,600	0.42	0.01	0.00	0.20	2.68
15	617,710	0.35	0.01	0.00	0.02	2.10
16	333,530	0.08	0.00	0.00	0.15	0.60
Total	50,429,400	18.61	0.33	0.08	6.99	116.20

a. First-year savings from all buildings completed statewide in 2026.

3.5.2 Statewide Greenhouse Gas (GHG) Emissions Reductions

The Statewide CASE Team calculated avoided GHG emissions associated with energy consumption using the hourly GHG emissions factors that CEC developed along with the 2025 LSC hourly factors and an assumed cost of $123.15 per metric tons of carbon dioxide equivalent emissions (metric tons CO2e).

The monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs).[29] The cost-effectiveness analysis presented in Section 2.4 of this report does not include the cost savings from avoided GHG emissions. To demonstrate the cost savings of avoided GHG emissions, the Statewide CASE Team disaggregated the value of avoided GHG emissions from the other economic impacts.

Table 60 presents the estimated first-year avoided GHG emissions of the proposed code change. During the first year, GHG emissions of 1,794 metric tons CO2e would be avoided.

Table 60: First-Year Statewide GHG Emissions Impacts

Measure	Electricity Savings[a] (GWh/y)	Reduced GHG Emissions from Electricity Savings[a] (Metric Tons CO2e)	Natural Gas Savings[a] (Million Therms/y)	Reduced GHG Emissions from Natural Gas Savings[a] (Metric Tons CO2e)	Total Reduced GHG Emission[b] (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions[c] ($)
Vestibules	19	1,160	0.08	634	1,794	220,891
TOTAL	19	1,160	0.08	634	1,794	220,891

a. First-year savings from all applicable newly constructed buildings and alterations completed statewide in 2026.

b. GHG emissions savings were calculated using hourly GHG emissions factors published alongside the LSC hourly factors and source energy hourly factors by CEC here: ttps://www.energy.ca.gov/files/2025-energy-code-hourly-factors

c. The monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs) derived from the 2022 TDV Update Model published by CEC here: https://www.energy.ca.gov/files/tdv-2022-update-model

3.5.3 Statewide Water Use Impacts

The proposed code change would not result in water savings.

[29] The permit cost of carbon is equivalent to the market value of a unit of GHG emissions in the California Cap-and-Trade program, while social cost of carbon is an estimate of the total economic value of damage done per unit of GHG emissions. Social costs tend to be greater than permit costs. See more on the Cap-and-Trade Program on the California Air Resources Board website: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program.

3.5.4 Statewide Material Impacts

The proposal would increase the usage of glass and aluminum used for the construction of vestibules. The Statewide CASE Team assumed vestibules of various sizes for different building types, including that most of the materials used for vestibules would be glass with aluminum framing. After translating the size (and amount) of vestibules for each building type to construction estimate, the Statewide CASE Team was able to determine estimated material impacts and embodied GHG emissions. The assumptions and analysis were purposefully kept simplistic for the Draft CASE Report as the Statewide CASE Team knew there was potential for significant embodied emissions associated with vestibule construction. The results of the analysis show an increase in emissions as a result of embodied emissions. However, it is important to note that this was expected and that within nine years, the emissions reductions from increased efficiency surpass the embodied emissions.

For more information on the Statewide CASE Team's methodology and assumptions used to calculated embodied GHG emissions, see Appendix D. The Statewide CASE Team plans to refine the assumptions and calculations for the Final CASE Report.

Table 61: First-Year Statewide Impacts on Material Use

Material	Impact	Per-Unit Impacts (Pounds per Square Foot)	First-Year [b] Statewide Impacts (Pounds)	Embodied GHG emissions saved (Metric Tons CO2e)
Glass	Increase	13	19,937,513	(12,931)
Aluminum Frame	Increase	2.1	579,660	(2,522)
TOTAL	**-**	**-**	**-**	**(15,453)**

a. First-year savings from all buildings completed statewide in 2026.

3.6 Addressing Energy Equity and Environmental Justice

The Statewide CASE Team assessed the potential impacts of the proposed measure, and based on a preliminary review, the measure is unlikely to have significant impacts on energy equity or environmental justice, therefore reducing the impacts of disparities in DIPs.

The Statewide CASE Team is still in the process of investigating the potential impacts of the proposed code changes to DIPs. Final results of this research will be incorporated into the Final CASE Report.

4. Windows

4.1 Measure Description

4.1.1 Proposed Code Change

This proposal would set a new mandatory requirement establishing U-factor and Relative Solar Heat Gain Coefficient (RSHGC) values for window assemblies for most nonresidential buildings. It would affect alterations and new construction, where cost effective, as determined by energy modeling. The proposed mandatory requirements would apply to all vertical fenestration including fixed windows, curtainwall or storefront, and operable windows.

Currently, Title 24, Part 6 includes prescriptive U-factor and RSHGC requirements for exterior vertical fenestration, but these values can be traded away for higher efficiency HVAC equipment or other building systems when a designer uses the performance path to achieve code compliance. This measure, by establishing maximum mandatory U-factor and SHGC values for vertical fenestration, would ensure that there is a backstop to how much window efficiency can be replaced by a non-envelope system that typically has a much shorter lifespan.

Because of the values intended to be used for mandatory requirements, this measure would also require that most vertical fenestration, regardless of materials used, would be thermally broken, adding to the effectiveness of the building's thermal envelope.

This proposal would not add or modify acceptance tests or require any technology not previously regulated. This proposal would not add new field verification but would make modifications to the processes to address the proposed new measures.

4.1.2 Justification and Background Information

4.1.2.1 Justification

Heat transfer through the building envelope and associated air leakage comprise the largest HVAC loads in most climates. Windows, which are known as the weakest link in the thermal envelope, make up approximately eight percent of a typical building envelope but are responsible for 45 percent of the energy transfer through the envelope.[30]

A U.S. DOE and PNNL report from 2020 on non-compliance measures shows windows, wall, and roof insulation measures were found in the top 10 non-compliant

[30] Pathway to Zero Energy Windows: Advancing Technologies and Market Adoption - https://www.nrel.gov/docs/fy22osti/80171.pdf

measures even in cold and hot climate zones (Hart, Rosenberg, Zhang, & Chen, 2020). The same report shows that on average, every thousand square feet of commercial space in a project loses about $1,162 per year on energy cost due to non-compliance of fenestration SHGC requirement.

Currently, there are no mandatory U-factor or SHGC requirements in Title 24, Part 6 for fenestration. As a result, projects pursuing the performance path will frequently trade off the envelope and fenestration requirements, allowing for a much weaker building thermal envelope.

4.1.2.2 Background Information

Vertical fenestration assemblies of a building refer to all aspects of the envelope that are transparent, such as windows and skylights. The heat losses or heat gain through a standard building component are defined by the U-factor, also known as the rate of heat transfer through envelope. The lower the U-factor, the lower the rate of heat transfer, and the better the insulation value of the element. The proposed measure would introduce a maximum mandatory U-factor value and Relative Solar Heat Gain Coefficient (RSHGC) for nonresidential windows, providing energy savings to all climate zones.

4.1.3 Summary of Proposed Changes to Code Documents

The sections below summarize how the Energy Code, Reference Appendices, ACM Reference Manuals, and compliance documents would be modified by the proposed change.[31]

4.1.3.1 Specific Purpose and Necessity of Proposed Code Changes

Each proposed change to language in Title 24, Part 6 as well as the reference appendices to Part 6 are described below. See Section 5.2 of this report for marked-up code language.

Section: Section 120.7(d) New mandatory requirement for exterior windows

Specific Purpose: The specific purpose is to add a mandatory provision for windows.

Necessity: These changes are necessary to ensure a minimum level of performance for the entire building envelope when the performance compliance path is used.

[31] Visit EnergyCodeAce.com for trainings, tools and resources to help people understand existing code requirements.

Section: Section 141.0(b)1E New mandatory requirement for exterior windows in alterations

Specific Purpose: The specific purpose is to add a mandatory provision for window alterations.

Necessity: These changes are necessary to ensure a minimum level of performance for the building envelope when window alterations are undertaken.

4.1.3.2 Specific Purpose and Necessity of Changes to the Nonresidential ACM Reference Manual

The purpose and necessity of proposed changes to the Nonresidential ACM Reference Manual are described below. See Section 5.4 of this report for the detailed proposed revisions to the text of the ACM Reference Manual.

Section: 5.5 Building Envelope Data

Specific Purpose: The specific purpose of the proposed change would be to add the mandatory maximum U-factor requirement for windows in new construction and alterations.

Necessity: These changes are necessary to create a non-tradeable minimum level of performance for windows when the performance compliance path is used.

4.1.3.3 Summary of Changes to the Nonresidential Compliance Manual

Chapter 3 of the Nonresidential Compliance Manual would need to be revised to incorporate mandatory U-factor requirements for windows.

4.1.3.4 Summary of Changes to Compliance Documents

The proposed code change would modify the compliance documents listed below. Details of the required revisions to the compliance documents are presented in Section 5.5.

- NRCC-ENV-E Certificate of Compliance would require deletion of Footnote 1 in Section K.
- 2022-NRCI-ENV-E Certificate of Installation – No changes would be required for this document.
- NRCA-ENV-02-F Certificate of Acceptance – No changes would be required for this document.

4.1.4 Regulatory Context

4.1.4.1 Determination of Inconsistency or Incompatibility with Existing State Laws and Regulations

California has already set prescriptive requirements for window U-factor, SHGC, and VT. The tables in the code specify U-factor limits based on frame, product, and glazing type. This set of requirements was created to simplify the code. A single SHGC and VT is listed for all fenestration ratios up to the maximum fenestration ratio; a single U-factor, SHGC, and VT for all climate zones; and a single SHGC and VT for all orientations. The existing language also specifies a calculated RSHGC to account for contributions from overhangs.

4.1.4.2 Duplication or Conflicts with Federal Laws and Regulations

There are no relevant federal laws or regulations.

4.1.4.3 Difference From Existing Model Codes and Industry Standards

The following model codes are relevant to this measure:

- ASHRAE 90.1 2022
- IECC 2021

ASHRAE 90.1 allows unlimited envelope trade-off in the Prescriptive Building Envelope Compliance path (Section 5.6) using the simulation-based envelope performance factor per the Normative Appendix C and performance path (Normative Appendix G).

The most current edition of IECC allows unlimited trade-offs between building envelope components and other building systems.

4.1.5 Compliance and Enforcement

When developing this proposal, the Statewide CASE Team considered methods to streamline the compliance and enforcement process and how negative impacts on market actors who are involved in the process could be mitigated or reduced. This section describes how to comply with the proposed code change. It also describes the compliance verification process. Appendix E presents how the proposed changes could impact various market actors.

The compliance verification activities related to this measure that need to occur during each phase of the project are described below:

- **Design Phase:** Building designers must be aware of the code changes to the window U-factors. The qualified design reviewer, per commissioning requirements, as well as energy consultants and compliance documentation authors must verify that plans and specifications match, and therefore meet the

requirements of Title 24, Part 6. No change in the process to complete NRCC compliance documents.

- **Permit Application Phase:** Plans examiners would verify that the project meets new mandatory window U-factor requirements by ensuring that the compliance documentation (NRCC) matches the plan and specifications.
- **Construction Phase:** Windows must be provided to meet new U-factor requirements per energy documentations and/or specifications. Installers need to complete the required installation certificates (NRCI).
- **Inspection Phase:** Procedure remains the same; Building inspector verifies NFRC labels and/or related certificate.

4.2 Market Analysis

4.2.1 Current Market Structure

The Statewide CASE Team performed a market analysis with the goals of identifying current technology availability, current product availability, and market trends. It then considered how the proposed standard may impact the market in general as well as individual market actors. Information was gathered about the incremental cost of complying with the proposed measure. Estimates of market size and measure applicability were identified through research and outreach with stakeholders including utility program staff, CEC staff, and a wide range of industry actors. In addition to conducting personalized outreach, the Statewide CASE Team discussed the current market structure and potential market barriers during a public stakeholder meeting that the Statewide CASE Team held on February 14, 2023 and May 22, 2023.

In sum, within the current market, there has been an increase of façade engineering in the design consulting world – which implies an increased appreciation of energy-efficient fenestration systems. The production of double-glazed windows has become the norm for top window manufacturers. Real estate owners are putting new efforts into improving building asset values to gain back occupancy in the post-pandemic era. While visibility and aesthetics are top considerations for fenestration choices, there is increased recognition that window performance is also a selling point.

4.2.2 Technical Feasibility and Market Availability

Products exist on the market for meeting updated U-value requirements for mandatory fenestration performance. New products do not need to be developed or adopted by the market.

The proposed U-factor requirement of 0.47 for vertical fenestration is based on products already widely available in the market. The only exception is for large scale storefront

glazing assemblies incorporating single pane structural glazing. In these cases, thermally broken frames would be needed to meet the requirement. Since it is already common practice for retailers to procure fenestration products designed specifically for these conditions, we do not anticipate technical or market challenges to meeting this requirement within the time frame when this code change would take effect (January 1, 2026).

The baseline U-factor requirement of 0.58 matches current existing building alterations requirement for vertical fenestration in California Climate Zone 3. This is typically met with insulated double-pane units rather than un-coated single-pane glazing. Custom ground floor fenestration may be able to achieve this requirement with non-thermally broken frames.

4.2.3 Market Impacts and Economic Assessments

4.2.3.1 Impact on Builders

Builders of residential and commercial structures are directly impacted by many of the measures proposed by the Statewide CASE Team for the 2025 code cycle. It is within the normal practices of these businesses to adjust their building practices to changes in building codes. When necessary, builders engage in continuing education and training in order to remain up to date with changes to design practices and building codes.

California's construction industry comprises approximately 93,000 business establishments and 943,000 employees (see Table 7). For 2022, total estimated payroll will be about $78 billion. Nearly 72,000 of these business establishments and 473,000 employees are engaged in the residential building sector, while another 17,600 establishments and 369,000 employees focus on the commercial sector. The remainder of establishments and employees work in industrial, utilities, infrastructure, and other heavy construction roles (the industrial sector).

Table 62: California Construction Industry, Establishments, Employment, and Payroll in 2022 (Estimated)

Building Type	Construction Sectors	Establishments	Employment	Annual Payroll (Billions $)
Residential	**All**	**71,889**	**472,974**	**31.2**
Residential	Building Construction Contractors	27,948	130,580	9.8
Residential	Foundation, Structure, & Building Exterior	7,891	83,575	5.0
Residential	Building Equipment Contractors	18,108	125,559	8.5
Residential	Building Finishing Contractors	17,942	133,260	8.0

Building Type	Construction Sectors	Establishments	Employment	Annual Payroll (Billions $)
Commercial	**All**	**17,621**	**368,810**	**35.0**
Commercial	Building Construction Contractors	4,919	83,028	9.0
Commercial	Foundation, Structure, & Building Exterior	2,194	59,110	5.0
Commercial	Building Equipment Contractors	6,039	139,442	13.5
Commercial	Building Finishing Contractors	4,469	87,230	7.4
Industrial, Utilities, Infrastructure, & Other (Industrial+)	**All**	**4,206**	**101,002**	**11.4**
Industrial+	Building Construction	288	3,995	0.4
Industrial+	Utility System Construction	1,761	50,126	5.5
Industrial+	Land Subdivision	907	6,550	1.0
Industrial+	Highway, Street, and Bridge Construction	799	28,726	3.1
Industrial+	Other Heavy Construction	451	11,605	1.4

Source: (State of California, n.d.)

The proposed change to mandatory window U-factors would likely affect commercial builders but would not impact firms that focus on construction and retrofit of industrial buildings, utility systems, public infrastructure, or other heavy construction. The effects on the commercial building industry would not be felt by all firms and workers, but rather would be concentrated in specific industry subsectors. Table 63 shows the commercial building subsectors the Statewide CASE Team expects to be impacted by the changes proposed in this report. The Statewide CASE Team's estimates of the magnitude of these impacts are shown in Section 2.2.4 Economic Impacts.

Table 63: Specific Subsectors of the California Commercial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2022 (Estimated)

Construction Subsector	Establishments	Employment	Annual Payroll (Billions $)
Commercial Building Construction	4,919	83,028	9.0
Nonresidential Framing Contractors	133	3,406	0.3
Nonresidential Masonry Contractors	229	4,246	0.3
Nonresidential glass and glazing contractors	283	6,133	0.6

Source: (State of California, n.d.)

4.2.3.2 Impact on Building Designers and Energy Consultants

Adjusting design practices to comply with changing building codes is within the normal practices of building designers. Building codes (including Title 24, Part 6) are typically

updated on a three-year revision cycle, and building designers and energy consultants engage in continuing education and training in order to remain up-to-date with changes to design practices and building codes.

Businesses that focus on residential, commercial, institutional, and industrial building design are contained within the Architectural Services sector (North American Industry Classification System 541310). Table 64 shows the number of establishments, employment, and total annual payroll for Building Architectural Services. The proposed code changes would potentially impact all firms within the Architectural Services sector. The Statewide CASE Team anticipates the impacts for mandatory window U-factors to affect firms that focus on nonresidential construction.

There is not a North American Industry Classification System (NAICS)[32] code specific to energy consultants. Instead, businesses that focus on consulting related to building energy efficiency are contained in the Building Inspection Services sector (NAICS 541350), which is comprised of firms primarily engaged in the physical inspection of residential and nonresidential buildings.[33] It is not possible to determine which business establishments within the Building Inspection Services sector are focused on energy efficiency consulting. The information shown in Table 64 provides an upper bound indication of the size of this sector in California.

Table 64: California Building Designer and Energy Consultant Sectors in 2022 (Estimated)

Sector	Establishments	Employment	Annual Payroll (Millions $)
Architectural Services [a]	4,134	31,478	3,623.3
Building Inspection Services [b]	1,035	3,567	280.7

Source: (State of California, n.d.)

a. Architectural Services (NAICS 541310) comprises private-sector establishments primarily engaged in planning and designing residential, institutional, leisure, commercial, and industrial buildings and structures.

[32] NAICS is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. NAICS was development jointly by the U.S. Economic Classification Policy Committee (ECPC), Statistics Canada, and Mexico's Instituto Nacional de Estadistica y Geografia, to allow for a high level of comparability in business statistics among the North American countries. NAICS replaced the Standard Industrial Classification (SIC) system in 1997.

[33] Establishments in this sector include businesses primarily engaged in evaluating a building's structure and component systems and includes energy efficiency inspection services and home inspection services. This sector does not include establishments primarily engaged in providing inspections for pests, hazardous wastes or other environmental contaminates, nor does it include state and local government entities that focus on building or energy code compliance/enforcement of building codes and regulations.

b. Building Inspection Services (NAICS 541350) comprises private-sector establishments primarily engaged in providing building (residential & nonresidential) inspection services encompassing all aspects of the building structure and component systems, including energy efficiency inspection services

4.2.3.3 Impact on Occupational Safety and Health

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

4.2.3.4 Impact on Building Owners and Occupants

Commercial Buildings

The commercial building sector includes a wide array of building types, including offices, restaurants and lodging, retail, and mixed-use establishments, and warehouses (including refrigerated) (Kenney, 2019). Energy use by occupants of commercial buildings also varies considerably, with electricity used primarily for lighting, space cooling and conditioning, and refrigeration, while natural gas is used primarily for water heating and space heating. According to information published in the 2019 California Energy Efficiency Action Plan, there is more than 7.5 billion square feet of commercial floor space in California consuming 19 percent of California's total annual energy use (Kenney, 2019). The diversity of building and business types within this sector creates a challenge for disseminating information on energy and water efficiency solutions, as does the variability in sophistication of building owners and the relationships between building owners and occupants.

Estimating Impacts

Building owners and occupants would benefit from lower energy bills. As discussed in Section 2.2.4.1, when building occupants save on energy bills, they tend to spend it elsewhere in the economy thereby creating jobs and economic growth for the California economy. The Statewide CASE Team does not expect the proposed code change for the 2025 code cycle to impact building owners or occupants adversely.

4.2.3.5 Impact on Building Component Retailers (Including Manufacturers and Distributors)

The Statewide CASE Team anticipates the proposed change would have no material impact on California component retailers.

4.2.3.6 Impact on Building Inspectors

Table shows employment and payroll information for state and local government agencies in which many inspectors of residential and commercial buildings are employed. Building inspectors participate in continuing education and training to stay current on all aspects of building regulations, including energy efficiency. The Statewide CASE Team, therefore, anticipates the proposed change would have no impact on employment of building inspectors or the scope of their role conducting energy efficiency inspections.

Table 65: Employment in California State and Government Agencies with Building Inspectors in 2022 (Estimated)

Sector	Govt.	Establishments	Employment	Annual Payroll (Million $)
Administration of Housing Programs[a]	State	18	265	29.0
	Local	38	3,060	248.6
Urban and Rural Development Admin[b]	State	38	764	71.3
	Local	52	2,481	211.5

Source: (State of California, Employment Development Department, n.d.)

a. Administration of Housing Programs (NAICS 925110) comprises government establishments primarily engaged in the administration and planning of housing programs, including building codes and standards, housing authorities, and housing programs, planning, and development.
b. Urban and Rural Development Administration (NAICS 925120) comprises government establishments primarily engaged in the administration and planning of the development of urban and rural areas. Included in this industry are government zoning boards and commissions.

4.2.3.7 Impact on Statewide Employment

As described in Sections 2.2.3.1 through 2.2.3.6, the Statewide CASE Team does not anticipate significant employment or financial impacts to any particular sector of the California economy. This is not to say that the proposed change would not have modest impacts on employment in California. In Section 2.2.4, the Statewide CASE Team estimated the proposed mandatory U-factors for windows would affect statewide employment and economic output directly and indirectly through its impact on builders, designers and energy consultants, and building inspectors. In addition, the Statewide CASE Team estimated how energy savings associated with the proposed mandatory U-factors in windows would lead to modest ongoing financial savings for California residents, which would then be available for other economic activities.

4.2.4 Economic Impacts

For the 2025 code cycle, the Statewide CASE Team used the IMPLAN model software,[34] along with economic information from published sources, and professional judgement to develop estimates of the economic impacts associated with each of the proposed code changes. Conceptually, IMPLAN estimates jobs created as a function of incoming cash flow in different sectors of the economy, due to implementing a code or a standard. The jobs created are typically categorized into direct, indirect, and induced employment. For example, cash flow into a manufacturing plant captures direct employment (jobs created in the manufacturing plant), indirect employment (jobs created in the sectors that provide raw materials to the manufacturing plant) and induced employment (jobs created in the larger economy due to purchasing habits of people newly employed in the manufacturing plant). Eventually, IMPLAN computes the total number of jobs created due to a code. The assumptions of IMPLAN include constant returns to scale, fixed input structure, industry homogeneity, no supply constraints, fixed technology, and constant byproduct coefficients. The model is also static in nature and is a simplification of how jobs are created in the macro-economy.

The economic impacts developed for this report are only estimates and are based on limited and to some extent speculative information. The IMPLAN model provides a relatively simple representation of the California economy and, though the Statewide CASE Team is confident that the direction and approximate magnitude of the estimated economic impacts are reasonable, it is important to understand that the IMPLAN model is a simplification of extremely complex actions and interactions of individual, businesses, and other organizations as they respond to changes in energy efficiency codes. In all aspects of this economic analysis, the CASE Authors rely on conservative assumptions regarding the likely economic benefits associated with the proposed code change. By following this approach, the economic impacts presented below represent lower bound estimates of the actual benefits associated with this proposed code change.

Adoption of this code change proposal would result in relatively modest economic impacts through the additional direct spending by those in the commercial building industry, architects, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2025 code cycle regulations would result in additional spending by those businesses.

[34] IMPLAN employs economic data and advanced economic impact modeling to estimate economic impacts for interventions like changes to the California Title 24, Part 6 code. For more information on the IMPLAN modeling process, see www.IMPLAN.com.

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

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Commercial Builders)	122.2	$9.493	$10.970	$18.684
Indirect Effect (Additional spending by firms supporting Commercial Builders)	29.9	$2.586	$4.057	$7.472
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	50.8	$3.468	$6.209	$9.883
Total Economic Impacts	**202.9**	**$15.546**	**$21.237**	**$36.039**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[35]

Table 67: Estimated Impact that Adoption of the Proposed Measure would have on the California Commercial Construction Sector – Retrofit

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Commercial Builders)	1,004.4	$79.877	$120.262	$260.211
Indirect Effect (Additional spending by firms supporting Commercial Builders)	585.5	$46.172	$79.268	$138.775
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	530.8	$36.222	$64.855	$103.224
Total Economic Impacts	**2,120.7**	**$162.271**	**$264.385**	**$502.211**

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

Table 68: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultants Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Designers & Energy Consultants)	8.3	$0.914	$0.904	$1.430
Indirect Effect (Additional spending by firms supporting Bldg. Designers & Energy Consultants)	3.3	$0.272	$0.378	$0.609
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	5.0	$0.341	$0.610	$0.972
Total Economic Impacts	**16.7**	**$1.526**	**$1.893**	**$3.010**

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

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

Table 69: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Inspectors)	0.1	$0.012	$0.014	$0.017
Indirect Effect (Additional spending by firms supporting Building Inspectors)	0.0	$0.001	$0.002	$0.003
Induced Effect (Spending by employees of Building Inspection Bureaus and Departments)	0.1	$0.004	$0.006	$0.010
Total Economic Impacts	**0.2**	**$0.016**	**$0.022**	**$0.030**

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

4.2.4.1 Creation or Elimination of Jobs

The Statewide CASE Team does not anticipate that the measures proposed for the 2025 code cycle regulation would lead to the creation of new *types* of jobs or the elimination of *existing* types of jobs. In other words, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. Rather, the estimates of economic impacts discussed in Section 2.2.4 would lead to modest changes in employment of existing jobs.

4.2.4.2 Creation or Elimination of Businesses in California

As stated in Section 4.2.4.1, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. The proposed change represents a modest change to windows in commercial buildings which would not excessively burden or competitively disadvantage California businesses – nor would it necessarily lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not foresee any new businesses being created, nor does the Statewide CASE Team think any existing businesses would be eliminated due to the proposed code changes.

4.2.4.3 Competitive Advantages or Disadvantages for Businesses in California

The proposed code changes would apply to all businesses incorporated in California, regardless of whether the business is located inside or outside of the state.[36] Therefore, the Statewide CASE Team does not anticipate that these measures proposed for the 2025 code cycle regulation would have an adverse effect on the competitiveness of

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

California businesses. Likewise, the Statewide CASE Team does not anticipate businesses located outside of California would be advantaged or disadvantaged.

4.2.4.4 Increase or Decrease of Investments in the State of California

The Statewide CASE Team analyzed national data on corporate profits and capital investment by businesses that expand a firm's capital stock (referred to as net private domestic investment, or NPDI).[37] As Table 70 shows, between 2017 and 2021, NPDI as a percentage of corporate profits ranged from a low of 18 in 2020 due to the worldwide economic slowdowns associated with the COVID 19 pandemic to a high of 35 percent in 2019, with an average of 26 percent. While only an approximation of the proportion of business income used for net capital investment, the Statewide CASE Team believes it provides a reasonable estimate of the proportion of proprietor income that would be reinvested by business owners into expanding their capital stock.

Table 70: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2017	518.473	1882.460	28
2018	636.846	1977.478	32
2019	690.865	1952.432	35
2020	343.620	1908.433	18
2021	506.331	2619.977	19
5-Year Average	**-**	**-**	**26**

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

The Statewide CASE Team estimates that the sum of proposed code changes in this report would increase in investment in California:

Change in Proprietor Income ($36,256,679) * 0.26 = $9,605,355

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

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

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

Cost of Enforcement

Cost to the State: State government already has budget for code development, education, and compliance enforcement. While state government will be allocating resources to update the Title 24, Part 6 Standards, including updating education and compliance materials and responding to questions about the revised requirements, these activities are already covered by existing state budgets. The costs to state government are small when compared to the overall costs savings and policy benefits associated with the code change proposals. The inclusion of a mandatory U-factor requirement for windows may impact new construction state buildings; however, the proposed change has been found to be cost effective.

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

4.2.4.6 Impacts on Specific Persons

While the objective of any of the Statewide CASE Team's proposal is to promote energy efficiency, the Statewide CASE Team recognizes that there is the potential that a proposed code change may result in unintended consequences. There are no foreseen impacts on specific persons or groups. The materials and technologies to meet the proposed code changes are neither proprietary nor sole-sourced. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

4.2.5 Fiscal Impacts

4.2.5.1 Mandates on Local Agencies or School Districts

This measure would impact local agencies and school districts undertaking new construction or window renovation projects.

4.2.5.2 Costs to Local Agencies or School Districts

This measure may impose additional costs to local agencies and school districts undertaking new construction or window renovation projects, depending on the energy

code compliance path being used. The measure is expected to provide commensurate savings in energy costs.

4.2.5.3 Costs or Savings to Any State Agency

This measure may impose additional costs to state agencies undertaking new construction or window renovation projects, depending on the energy code compliance path being used. The measure is expected to provide commensurate savings in energy costs.

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

There are no added non-discretionary costs or savings to local agencies.

4.2.5.5 Costs or Savings in Federal Funding to the State

There are no costs or savings to federal funding to the state.

4.3 Energy Savings

The Statewide CASE Team gathered stakeholder input to inform the energy savings analysis. See Appendix F for a summary of stakeholder engagement.

Energy savings benefits may have potential for unintended consequences impacting DIPs. Refer to Section 42.6 for more details addressing energy equity and environmental justice.

4.3.1 Energy Savings Methodology

4.3.1.1 Key Assumptions for Energy Savings Analysis

This proposal evaluates changes to new construction, additions, and alterations. The Statewide CASE Team used EnergyPlus v9.4.0 to conduct the energy savings calculations for all code change proposals since CBECC is not adequately flexible to handle the input assumptions for some of the envelope measures. Energy models are sourced from the CBECC prototypical building models (California Energy Commission, n.d.). The Statewide CASE Team simulated the energy impacts in every climate zone and applied the climate-zone Long-term Systemwide Cost (LSC) hourly factors when calculating energy cost impacts.

The Statewide CASE Team evaluated various scenarios comparing the energy impacts and cost-effectiveness across prototypes and climate zones. This process, in parallel with stakeholder outreach and market and technical research, informed the ultimate proposals that are made in this report. These models are modified to include the proposed changes to the energy standards.

The 2022 Standard Design also serves as the baseline with modification for mandatory and prescriptive proposals. The 2022 Standard Design is used for alterations as a conservative assumption. All 16 climate zones are included in the modeling evaluation and statewide results for fixed windows. A survey was conducted to reach a broad range of stakeholders. The prototype selection for each assembly simulation is based on the prevailing market information and stakeholders' feedback. Detailed input assumptions for the models are included in Appendix C.

4.3.1.2 Energy Savings Methodology per Prototypical Building

To quantify impacts, the Statewide CASE Team calculated per-unit energy savings expected from the proposed code changes in several ways. First, savings are calculated by fuel type. Electricity savings are measured in both energy usage and peak demand reduction; natural gas savings are quantified in terms of energy usage. Second, the Statewide CASE Team calculated source energy Savings. source energy represents the total amount of raw fuel required to operate a building. In addition to all energy used from on-site production, source energy incorporates all transmission, delivery, and production losses. The hourly source energy values provided by CEC are strongly correlated with GHG emissions (California Energy Commission, 2022).[38] Finally, the Statewide CASE Team calculated Long-term Systemwide Cost (LSC) Savings, formerly known as Time Dependent Valuation (TDV) Energy Cost Savings. LSC Savings are calculated using hourly LSC factors for both electricity and natural gas provided by the CEC. These LSC hourly factors are projected over the 30-year life of the building, and incorporate the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade CO_2 emissions.[39]

The CEC directed the Statewide CASE Team to model the energy impacts using prototypical building models that represent typical building geometries. The prototype buildings that the Statewide CASE Team used for this proposal are presented in Table 71.

[38] See hourly factors for source energy, LSC, and GHG emissions at https://www.energy.ca.gov/files/2025-energy-code-hourly-factors

[39] More information on source energy and LSC hourly factors is available in the March 2020 CEC Staff Workshop on Energy Code Compliance Metrics and the July 2022 CEC Staff Workshop on Energy Code Accounting for the 2025 Building Energy Efficiency Standards.

Table 71: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Number of Stories	Floor Area (Square Feet)	Description
Assembly – Library	1	12,996	Single story, 13 ft ceiling, WWR – 35%
Assembly – Exhibits and Events	1	8,892	Single story, 13 ft ceiling, WWR – 0%
Assembly – Sports and Recreation	1	3,493	Single Story, 25 ft ceiling, WWR-0%, SSR – 4.1%
Assembly – Religious	1	6,889	Single Story, 50 ft ceiling, WWR-33%,
Assembly – Terminals	1	6,448	Single Story, 25 ft ceiling, WWR-28%, SSR – 1%
Hospital	5	241,501	5-story Hospital plus basement. Source: U.S. DOE Standard 90.1 Hospital prototype and scorecard. The prototype contains Title 24, Part 6, minimally compliant envelope features and lighting. For HVAC systems, the AIA guidelines recommended using VAV systems wherever possible.
HotelSmall	4	52,045	4-story Hotel with 77 guest rooms. WWR-11%
OfficeLarge	12	498,589	12 story + 1 basement office building with 5 zones and a ceiling plenum on each floor. WWR–0.40. Because CBECC will model single-zone heat pumps in the Large School prototype's Standard Design, results from measures applied to the prototype should be compared to the Proposed Design prototype model, not the Standard Design. For example, as with the Assembly prototype, if a U-factor measure is applied to the Large School windows, that measure should be applied to a copy of the original Proposed Design. The results from that analysis should then be compared to the results of the original prototype's Proposed Design.
OfficeMedium	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–0.33
OfficeMediumLab	3	53,628	3-story office building with 5 zones and a ceiling plenum on each floor. WWR–0.33
OfficeSmall	1	5,502	1-story, 5 zone office building with pitched roof and unconditioned attic. WWR–0.24
RestaurantFastFood	1	2,501	Fast food restaurant with a small kitchen and dining areas. 14% WWR. Pitched roof with an unconditioned attic.
RetailLarge	1	240,000	Big-box type retail building with WWR–12% and SRR–0.82%
RetailStripMall	1	9,375	Strip Mall building with WWR–10%
SchoolSmall	1	24,413	Elementary school with WWR–0.36
SchoolLarge	2	210,866	High school with WWR–35% and SRR–1.4%

The Statewide CASE Team estimated LSC, source energy, electricity, natural gas, peak demand, and GHG impacts by simulating the proposed code change in EnergyPlus using prototypical buildings and rulesets from the 2025 Research Version of the California Building Energy Code Compliance (CBECC) software (California Energy Commission, n.d.).

CBECC generates two models based on user inputs: the Standard Design and the Proposed Design. The Standard Design represents the geometry of the prototypical building and a design that uses a set of features that result in a LSC budget and source energy budget that is minimally compliant with 2022 Title 24, Part 6 code requirements. Features used in the Standard Design are described in the 2022 Nonresidential ACM Reference Manual. The Proposed Design represents the same geometry as the Standard Design, but it assumes the energy features that the software user inputs. To develop savings estimates for the proposed code changes, the Statewide CASE Team created a Standard Design and Proposed Design for each prototypical building with the Standard Design representing compliance with 2022 code and the Proposed Design representing compliance with the proposed requirements. Comparing the energy impacts of the Standard Design to the Proposed Design reveals the impacts of the proposed code change relative to a building that is minimally compliant with the 2022 Title 24, Part 6 requirements.

There is no existing Title 24, Part 6 requirement that covers the building system in question and applies to both new construction and alterations, so the Standard Design is modified to reflect the market conditions.

The default values in the CBECC prototypes represent prescriptive requirements for fixed windows. These values were modified to reflect the baseline and proposed assumptions as indicated in Table 72.

Table 72: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change, Existing Buildings

Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
New Construction OfficeLarge	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.58, 0.49	0.47, 041
New Construction OfficeMedium	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.58, 0.49	0.47, 041
New Construction RetailLarge	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.58, 0.49	0.47, 041
New Construction RetailMedium	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.58, 0.49	0.47, 041

Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
New Construction SchoolSmall	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.58, 0.49	0.47, 041
Alterations OfficeLarge	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.86, 0.58	0.58, 0.49
Alterations OfficeMedium	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.86, 0.58	0.58, 0.49
Alterations RetailLarge	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.86, 0.58	0.58, 0.49
Alterations RetailMedium	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.86, 0.58	0.58, 0.49
Alterations SchoolSmall	All	Base_AllCZ_Fixed WindowU34	U-factor and SGHC	0.86, 0.58	0.58, 0.49

CBECC calculates whole-building energy consumption for every hour of the year measured in kilowatt-hours per year (kWh/y) and therms per year (therms/y). It then applies the 2025 LSC hourly factors to calculate Long-term Systemwide Cost in 2026 present value dollars (2026 PV$), source energy hourly factors to calculate source energy use in thousand British thermal units per year (KBtu/y), and hourly GHG emissions factors to calculate annual GHG emissions in metric tons of carbon dioxide emissions equivalent per year (MT or “tonnes” CO2e/yr).

The energy impacts of the proposed code change vary by climate zone. The Statewide CASE Team simulated the energy impacts in every climate zone and applied the climate-zone specific LSC hourly factors when calculating energy and energy cost impacts.

Per-unit energy impacts for nonresidential buildings are presented in savings per square foot. Annual energy, GHG, and peak demand impacts for each prototype building were translated into impacts per square foot by dividing by the floor area of the prototype building. This step allows for an easier comparison of savings across different building types and enables a calculation of statewide savings using the construction forecast that is published in terms of floor area by building type.

4.3.1.3 Statewide Energy Savings Methodology

The per-unit energy impacts were extrapolated to statewide impacts using the Statewide Construction Forecasts that the CEC provided. The Statewide Construction Forecasts estimate new construction/additions that would occur in 2026, the first year that the 2025 Title 24, Part 6 requirements are in effect (California Energy Commission,

2022; California Energy Commission, 2022). They also estimate the amount of total existing building stock in 2026, which the Statewide CASE Team used to approximate savings from building alterations. The construction forecast provides construction (new construction/additions and existing building stock) by building type and climate zone, as shown in Appendix A.

Appendix A presents additional information about the methodology and assumptions used to calculate statewide energy impacts.

4.3.2 Per-Unit Energy Impacts Results: New Construction and Additions

This measure to add mandatory U-factors for vertical fenestration in new construction and additions will be analyzed for 18 prototype buildings across 16 climate zones. This Draft CASE Report includes the analysis results modeled in five building prototypes: Office Large, Office Medium, Retail Medium, Retail Large, and School Small. The tables containing data for the other building types will be located in Appendix H for the Final CASE Report.

Energy savings and peak demand reductions per unit are presented in Table 73 through Table 77. The per-unit energy savings figures do not account for naturally occurring market adoption or compliance rates.

Table 73: OfficeMedium – Windows New Construction & Additions– Savings Summary (per square foot)

OfficeMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.05	0.00	0.38	0.35	0.42
2	0.10	0.00	0.23	0.21	0.57
3	0.09	0.00	0.16	0.14	0.48
4	0.11	0.00	0.17	0.15	0.67
5	0.10	0.00	0.18	0.16	0.54
6	0.12	0.00	0.07	0.07	0.59
7	0.11	0.00	0.06	0.05	0.60
8	0.13	0.00	0.08	0.07	0.68
9	0.13	0.00	0.10	0.09	0.68
10	0.14	0.00	0.09	0.08	0.72
11	0.13	0.01	0.27	0.24	0.87
12	0.11	0.00	0.13	0.12	0.65
13	0.14	0.00	0.20	0.18	0.85
14	0.14	0.00	0.19	0.17	0.81
15	0.21	0.00	0.05	0.05	1.06
16	0.09	0.00	0.38	0.34	0.64

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings are in Climate Zones 1 and 16.
- The greatest peak demand savings for this measure are found in Climate Zone 11. In contrast, the remaining Climate Zones 1-10 and 12-16 demonstrated little to no peak demand savings. We are investigating the reasons for why the remaining climate zones have a negligible impact in peak demand savings.
- The greatest natural gas savings are in Climate Zone 1 and 16, while the lowest natural gas savings are in Climate Zone 15.

Table 74: OfficeLarge – Windows New Construction & Additions – Savings Summary (per square foot)

OfficeLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.05	0.00	0.40	0.37	0.38
2	0.10	0.00	0.39	0.35	0.51
3	0.09	0.00	0.31	0.28	0.44
4	0.11	0.00	0.33	0.30	0.54
5	0.10	0.00	0.35	0.32	0.50
6	0.12	0.00	0.21	0.19	0.47
7	0.11	0.00	0.17	0.15	0.49
8	0.13	0.00	0.03	0.03	0.38
9	0.13	0.00	0.18	0.16	0.51
10	0.14	0.00	0.19	0.17	0.54
11	0.13	0.00	0.40	0.36	0.62
12	0.11	0.00	0.32	0.29	0.55
13	0.14	0.00	0.24	0.22	0.53
14	0.14	0.00	0.32	0.29	0.58
15	0.21	0.00	0.14	0.13	0.58
16	0.09	0.00	0.49	0.44	0.53

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings are in Climate Zones 1.
- Energy modeling returned negligible peak demand savings for this measure in all climate zones. We are investigating the reasons for this result.
- The greatest natural gas savings are in Climate Zone 1 and 16, while the lowest natural gas savings are in Climate Zone 8.

Table 75: RetailMedium – Windows New Construction & Additions – Savings Summary (per square foot)

RetailMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.00	0.00	-0.03	-0.02	-0.02
2	0.03	0.00	0.00	0.00	0.14
3	0.02	0.00	0.00	0.00	0.09
4	0.03	0.00	0.00	0.00	0.03
5	0.02	0.00	0.00	0.00	0.06
6	0.05	0.00	0.00	0.00	0.30
7	0.02	0.00	0.00	0.00	0.18
8	0.06	0.00	0.00	0.00	0.40
9	0.04	0.00	0.00	0.00	0.14
10	0.04	0.00	0.00	0.00	0.20
11	0.02	0.00	0.00	0.00	0.16
12	0.04	0.00	0.00	0.00	0.25
13	0.01	0.00	0.00	0.00	-0.03
14	-0.01	0.00	0.00	0.00	-0.11
15	0.10	0.00	0.00	0.00	0.46
16	0.02	0.00	-0.03	-0.03	0.08

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings are in Climate Zone 1. Climate Zone 14 indicated negative savings—we consider this result and outlier and are investigating the causes.
- Energy modeling returned negligible peak demand savings for this measure in all climate zones. We are investigating the reasons for this result.
- Energy modeling returned negligible natural gas savings for Climate Zones 2-15, with Climate Zones 1 and 16 giving negative natural gas savings. We consider the negative savings results as outliers and are investigating the cause.

Table 76: RetailLarge – Windows New Construction & Additions – Savings Summary (per square foot)

RetailLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.00	0.00	0.00	0.00	0.01
2	0.02	0.00	0.00	0.00	0.07
3	0.01	0.00	0.00	0.00	0.06
4	0.02	0.00	0.00	0.00	0.14
5	0.03	0.00	0.00	0.00	0.11
6	0.03	0.00	0.00	0.00	0.15
7	0.02	0.00	0.00	0.00	0.11
8	0.03	0.00	0.00	0.00	0.17
9	0.05	0.00	0.00	0.00	0.25
10	0.03	0.00	0.00	0.00	0.15
11	0.04	0.00	0.00	0.00	0.19
12	0.02	0.00	0.00	0.00	0.11
13	0.05	0.00	0.00	0.00	0.24
14	0.03	0.00	0.00	0.00	0.17
15	0.06	0.00	0.00	0.00	0.30
16	0.00	0.00	-0.01	-0.01	0.01

- Energy modeling returned the greatest first-year electricity savings for this measure in Climate Zone 15. In contracts, Climate Zone 3 returned the lowest first-year electricity savings . Climate Zones 1 and 16 gave negligible first-year electricity savings results. We are investigating the reasons for the negligible and lowest results.
- Energy modeling returned negligible peak demand savings for this measure in all climate zones. We are investigating the reasons for this result.
- Energy modeling returned negligible natural gas savings for all Climate Zones except 16 which returned a negative result. We are investigating the cause for these results.

Table 77: SchoolSmall – Windows New Construction & Additions – Savings Summary (per square foot)

SchoolSmall Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.04	0.00	0.07	0.06	0.24
2	0.12	0.01	0.00	0.00	0.56
3	0.09	0.00	0.00	0.00	0.40
4	0.15	0.01	0.00	0.00	0.81
5	0.09	0.00	0.00	0.00	0.42
6	-0.03	0.00	0.00	0.00	-0.12
7	0.12	0.00	0.00	0.00	0.66
8	0.18	0.01	0.00	0.00	0.88
9	0.18	0.01	0.00	0.00	0.93
10	0.19	0.01	0.00	0.00	1.00
11	0.20	0.02	0.00	0.00	1.10
12	0.16	0.01	0.00	0.00	0.89
13	0.21	0.01	0.00	0.00	1.14
14	0.22	0.01	0.00	0.00	1.10
15	0.29	0.01	0.00	0.00	1.46
16	0.14	0.01	0.34	0.30	0.87

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings savings are in Climate Zone 1. Climate Zone 6 indicated negative savings—we consider this result and outlier and are investigating the causes.
- The greatest peak demand savings for this measure are in Climate Zone 11, with the lowest peak demand savings in Climate Zones 1, 3, and 5-7. We are investigating the reasons for the negligible peak demand savings.
  Energy modeling returned the greatest natural gas savings in Climate Zones 1 and 16. Climate Zones 2-15 indicated negligible natural gas savings and we are investigating the cause of this result.

4.3.3 Per-Unit Energy Impacts Results: Alterations

This measure to add mandatory U-factors for vertical fenestration in alterations will be analyzed for 18 prototype buildings across 16 climate zones. This Draft CASE Report includes the analysis results modeled in five building prototypes: Office Large, Office Medium, Retail Medium, Retail Large, and School Small. The tables containing data for the other building types will be located in Appendix H for the Final CASE Report.

Energy savings and peak demand reductions per unit are presented in Table 78 through Table 82. The per-unit energy savings figures do not account for naturally occurring market adoption or compliance rates.

Table 78: OfficeMedium – Windows Alterations – Savings Summary (per square foot)

OfficeMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.11	0.00	0.44	0.40	0.77
2	0.24	0.00	0.45	0.40	1.32
3	0.22	0.00	0.49	0.44	1.25
4	0.30	0.01	0.36	0.32	1.68
5	0.24	0.00	0.31	0.28	1.23
6	0.30	0.00	0.14	0.12	1.47
7	0.28	0.00	0.11	0.10	1.49
8	0.35	0.01	0.27	0.24	1.86
9	0.34	0.01	0.31	0.28	1.84
10	0.36	0.01	0.17	0.15	1.84
11	0.35	0.01	0.57	0.52	2.12
12	0.29	0.01	0.39	0.36	1.69
13	0.37	0.01	0.29	0.26	2.02
14	0.37	0.01	0.38	0.34	2.01
15	0.55	0.01	0.15	0.13	2.76
16	0.22	0.01	0.81	0.73	1.51

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings are in Climate Zone 1.
- The greatest peak demand savings for this measure are found in Climate Zone 4 and 8-16. In contrast, the remaining Climate Zones 1-3 and 5-8 demonstrated negligible peak demand savings. We are investigating the reasons for this result.
- The greatest natural gas savings are in Climate Zone 11 and 16, while the lowest natural gas savings are in Climate Zone 7.

Table 79: OfficeLarge – Windows Alterations – Savings Summary (per square foot)

OfficeLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.11	0.01	0.99	0.89	0.91
2	0.24	0.00	0.69	0.63	1.07
3	0.22	0.00	0.64	0.58	0.87
4	0.30	0.01	0.67	0.61	1.29
5	0.24	0.01	0.60	0.54	1.04
6	0.30	0.00	0.38	0.34	1.09
7	0.28	0.00	0.34	0.31	1.15
8	0.35	0.00	0.37	0.33	1.20
9	0.34	0.00	0.45	0.40	1.19
10	0.36	0.00	0.43	0.39	1.33
11	0.35	0.01	0.75	0.68	1.39
12	0.29	0.01	0.66	0.60	1.25
13	0.37	0.01	0.46	0.42	1.26
14	0.37	0.01	0.72	0.64	1.41
15	0.55	0.01	0.31	0.28	1.59
16	0.22	0.01	1.07	0.96	1.22

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings are in Climate Zones 1.
- The greatest peak demand savings for this measure are found in Climate Zone 1, 4, 5 and 11-16. In contrast, the remaining Climate Zones 2, 3 and 6-10 demonstrated negligible peak demand savings. We are investigating the reasons for this result.
- The greatest natural gas savings are in Climate Zone 1 and 16, while the lowest natural gas savings are in Climate Zone 15.

Table 80: RetailMedium – Windows Alterations – Savings Summary (per square foot)

RetailMedium Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.01	0.00	-0.06	-0.05	0.01
2	0.02	0.00	0.00	0.00	0.07
3	0.03	0.00	0.00	0.00	0.10
4	0.02	0.00	0.00	0.00	0.07
5	0.05	0.00	0.00	0.00	0.19
6	0.05	0.00	0.00	0.00	0.21
7	0.09	0.00	0.00	0.00	0.47
8	0.16	0.00	0.00	0.00	0.69
9	0.05	0.00	0.00	0.00	0.21
10	0.15	0.00	0.00	0.00	0.71
11	0.14	0.00	0.00	0.00	0.68
12	0.07	0.00	0.00	0.00	0.29
13	0.05	0.00	0.00	0.00	0.20
14	0.08	0.00	0.00	0.00	0.36
15	0.25	0.00	0.00	0.00	1.31
16	0.05	0.00	-0.10	-0.09	0.16

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings are in Climate Zone 1.
- Energy modeling returned negligible peak demand savings for this measure in all climate zones. We are investigating the reasons for this result.
- Energy modeling returned negligible natural gas savings for Climate Zones 2-15, with Climate Zones 1 and 16 giving negative natural gas savings. We consider the negative savings results as outliers and are investigating the cause.

Table 81: RetailLarge – Windows Alterations – Savings Summary (per square foot)

RetailLarge Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.02	0.00	0.02	0.02	0.11
2	0.07	0.00	0.00	0.00	0.30
3	0.05	0.00	0.00	0.00	0.23
4	0.06	0.00	0.00	0.00	0.28
5	0.07	0.00	0.00	0.00	0.29
6	0.09	0.00	0.00	0.00	0.45
7	0.09	0.00	0.00	0.00	0.52
8	0.11	0.00	0.00	0.00	0.55
9	0.00	0.00	0.00	0.00	0.00
10	0.12	0.00	0.00	0.00	0.58
11	0.11	0.00	0.00	0.00	0.58
12	0.05	0.00	0.00	0.00	0.28
13	0.11	0.00	0.00	0.00	0.55
14	0.12	0.00	0.00	0.00	0.61
15	0.12	0.00	0.00	0.00	0.61
16	0.07	0.00	-0.03	-0.03	0.30

- Energy modeling returned the greatest first-year electricity savings for this measure in Climate Zones 14 and 15. In contrast, Climate Zone 1 returned the lowest first-year electricity savings. Climate Zones 9 gave negligible first-year electricity savings results. We are investigating the reasons for the negligible result.
- Energy modeling returned negligible peak demand savings for this measure in all climate zones. We are investigating the reasons for this result.
- Energy modeling returned the greatest natural gas savings result for Climate Zone 1, while Climate Zones 2-15 gave negligible natural gas savings and Climate Zone 16 gave a negative result. We are investigating the cause for these results.

Table 82: SchoolSmall – Windows Alterations – Savings Summary (per square foot)

SchoolSmall Climate Zones	First-Year Electricity Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	LSC Savings ($2026)
1	0.12	0.01	0.11	0.10	0.65
2	0.33	0.02	0.00	0.00	1.56
3	0.25	0.01	0.00	0.00	1.20
4	0.52	0.01	0.00	0.00	2.68
5	0.27	0.00	0.00	0.00	1.28
6	-0.10	0.00	0.00	0.00	-0.44
7	0.35	0.01	0.00	0.00	1.91
8	0.47	0.01	0.00	0.00	2.33
9	0.50	0.01	0.00	0.00	2.50
10	0.52	0.01	0.00	0.00	2.61
11	0.51	0.04	0.00	0.00	2.86
12	0.44	0.03	0.00	0.00	2.41
13	0.53	0.03	0.00	0.00	2.81
14	0.56	0.02	0.00	0.00	2.83
15	0.80	0.02	0.00	0.00	3.99
16	0.00	0.00	0.00	0.00	0.00

- The greatest first-year electricity savings for this measure are in Climate Zone 15. In contrast, the lowest first-year electricity savings are in Climate Zone 1. Climate Zone 6 indicated negative savings and Climate Zone 16 gave a negligible savings—we consider these results to be outliers and are investigating the causes.
- The greatest peak demand savings for this measure are in Climate Zone 11, with the lowest peak demand savings in Climate Zones 1, 3, 4 and 7-10. We are investigating the reasons for the negligible peak demand savings in Climate Zone 16.
- Energy modeling returned the greatest natural gas savings in Climate Zones 1. Climate Zones 2-16 indicated negligible natural gas savings and we are investigating the cause of this result.

4.4 Cost and Cost Effectiveness

4.4.1 Energy Cost Savings Methodology

Energy cost savings were calculated by applying the LSC hourly factors to the energy savings estimates that were derived using the methodology described in Section 2.3.1. LSC hourly factors are a normalized metric to calculate energy cost savings that accounts for the variable cost of electricity and natural gas for each hour of the year, along with how costs are expected to change over the 30-year period of analysis.

The CEC requested LSC savings over the 30-year period of analysis in both 2026 present value dollars (2026 PV$) and nominal dollars. The cost-effectiveness analysis uses LSC in 2026 PV$. Costs and cost-effectiveness using and 2026 PV$ are presented in Section 2.4 of this report. CEC uses results in nominal dollars to complete the Economic and Fiscal Impacts Statement (From 399) for the entire package of proposed change to Title 24, Part 6. Appendix G presents LSC savings results in nominal dollars.

4.4.2 Energy Cost Savings Results

This measure adds mandatory U-factors for vertical fenestration in new construction, additions, and alterations will be analyzed for 18 prototype buildings across 16 climate zones. This Draft CASE Report includes the analysis results modeled in five building prototypes: Office Large, Office Medium, Retail Medium, Retail Large, and School Small. The tables containing data for the other building types will be located in Appendix I for the Final CASE Report.

Per-unit energy cost savings for newly constructed buildings, additions, and alterations in terms of LSC savings realized over the 30-year period of analysis are presented 2026 present value dollars (2026 PV$) in Table 83 through Table 88.

The LSC methodology allows peak electricity savings to be valued more than electricity savings during non-peak periods.

Any time code changes impact cost, there is potential for unintended consequences impacting DIPs. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

Table 83: 2026 PV LSC Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction, Additions and Alterations– OfficeLarge Prototype

Climate Zone	New Construction and Additions 30-Year LSC Electricity Savings (2026 PV$)	New Construction and Additions 30-Year LSC Natural Gas Savings (2026 PV$)	New Construction and Additions Total 30-Year LSC Savings (2026 PV$)	Alterations 30-Year LSC Electricity Savings (2026 PV$)	Alterations 30-Year LSC Natural Gas Savings (2026 PV$)	Alterations Total 30-Year LSC Savings (2026 PV$)
1	-	-	-	0.35	0.56	0.91
2	-	-	-	0.67	0.40	1.07
3	0.27	0.17	0.44	0.51	0.36	0.87
4	0.35	0.19	0.54	0.90	0.39	1.29
5	-	-	-	0.70	0.34	1.04
6	0.36	0.12	0.47	0.88	0.22	1.09
7	0.39	0.10	0.49	0.96	0.20	1.15
8	0.35	0.02	0.38	0.98	0.22	1.20
9	0.40	0.11	0.51	0.93	0.26	1.19
10	0.43	0.11	0.54	1.08	0.25	1.33
11	0.38	0.23	0.62	0.94	0.45	1.39
12	0.37	0.18	0.55	0.87	0.38	1.25
13	-	-	-	0.98	0.28	1.26
14	0.39	0.19	0.58	0.99	0.42	1.41
15	0.50	0.09	0.58	1.40	0.19	1.59
16	0.24	0.29	0.53	0.60	0.62	1.22

Table 84: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction, Additions and Alterations– OfficeMedium Prototype

Climate Zone	New Construction and Additions 30-Year LSC Electricity Savings (2026 PV$)	New Construction and Additions 30-Year LSC Natural Gas Savings (2026 PV$)	New Construction and Additions Total 30-Year LSC Savings (2026 PV$)	Alterations 30-Year LSC Electricity Savings (2026 PV$)	Alterations 30-Year LSC Natural Gas Savings (2026 PV$)	Alterations Total 30-Year LSC Savings (2026 PV$)
1	0.22	0.20	0.42	0.49	0.28	0.77
2	0.44	0.14	0.57	1.05	0.26	1.32
3	0.39	0.09	0.48	0.96	0.29	1.25
4	0.57	0.10	0.67	1.48	0.21	1.68
5	0.44	0.10	0.54	1.05	0.18	1.23
6	0.55	0.04	0.59	1.39	0.08	1.47
7	0.56	0.04	0.60	1.42	0.07	1.49
8	0.63	0.05	0.68	1.69	0.17	1.86
9	0.63	0.06	0.68	1.65	0.19	1.84
10	0.67	0.05	0.72	1.74	0.10	1.84
11	0.70	0.16	0.87	1.77	0.35	2.12
12	0.57	0.08	0.65	1.46	0.24	1.69
13	0.72	0.12	0.85	1.84	0.17	2.02
14	0.69	0.12	0.81	1.78	0.23	2.01
15	1.02	0.03	1.06	2.67	0.09	2.76
16	0.42	0.22	0.64	1.03	0.48	1.51

Table 85: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction, Additions and Alterations– RetailLarge Prototype

Climate Zone	New Construction and Additions 30-Year LSC Electricity Savings (2026 PV$)	New Construction and Additions 30-Year LSC Natural Gas Savings (2026 PV$)	New Construction and Additions Total 30-Year LSC Savings (2026 PV$)	Alterations 30-Year LSC Electricity Savings (2026 PV$)	Alterations 30-Year LSC Natural Gas Savings (2026 PV$)	Alterations Total 30-Year LSC Savings (2026 PV$)
1	-	-	-	0.10	0.01	0.11
2	-	-	-	0.30	0.00	0.30
3	0.06	0.00	0.06	0.23	0.00	0.23
4	0.14	0.00	0.14	0.28	0.00	0.28
5	0.11	0.00	0.11	0.29	0.00	0.29
6	0.15	0.00	0.15	0.45	0.00	0.45
7	0.11	0.00	0.11	0.52	0.00	0.52
8	0.17	0.00	0.17	0.55	0.00	0.55
9	0.25	0.00	0.25	-0.64	0.00	-0.64
10	0.15	0.00	0.15	0.58	0.00	0.58
11	0.19	0.00	0.19	0.58	0.00	0.58
12	0.11	0.00	0.11	0.28	0.00	0.28
13	0.24	0.00	0.24	0.55	0.00	0.55
14	0.17	0.00	0.17	0.61	0.00	0.61
15	0.30	0.00	0.30	0.61	0.00	0.61
16	0.02	-0.01	0.01	0.32	-0.02	0.30

Table 86: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction, Additions and Alterations– RetailMedium Prototype

Climate Zone	New Construction and Additions 30-Year LSC Electricity Savings (2026 PV$)	New Construction and Additions 30-Year LSC Natural Gas Savings (2026 PV$)	New Construction and Additions Total 30-Year LSC Savings (2026 PV$)	Alterations 30-Year LSC Electricity Savings (2026 PV$)	Alterations 30-Year LSC Natural Gas Savings (2026 PV$)	Alterations Total 30-Year LSC Savings (2026 PV$)
1	-0.01	-0.02	-0.02	0.05	-0.03	0.01
2	0.14	0.00	0.14	0.07	0.00	0.07
3	0.09	0.00	0.09	0.10	0.00	0.10
4	0.03	0.00	0.03	0.07	0.00	0.07
5	0.06	0.00	0.06	0.19	0.00	0.19
6	0.30	0.00	0.30	0.21	0.00	0.21
7	0.18	0.00	0.18	0.47	0.00	0.47
8	0.40	0.00	0.40	0.69	0.00	0.69
9	0.14	0.00	0.14	0.21	0.00	0.21
10	0.20	0.00	0.20	0.71	0.00	0.71
11	0.16	0.00	0.16	0.68	0.00	0.68
12	0.25	0.00	0.25	0.29	0.00	0.29
13	-0.03	0.00	-0.03	0.20	0.00	0.20
14	-0.11	0.00	-0.11	0.36	0.00	0.36
15	0.46	0.00	0.46	1.31	0.00	1.31
16	0.09	-0.02	0.08	0.22	-0.06	0.16

Table 87: 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction, Additions and Alterations– SchoolSmall Prototype

Climate Zone	New Construction and Additions 30-Year LSC Electricity Savings (2026 PV$)	New Construction and Additions 30-Year LSC Natural Gas Savings (2026 PV$)	New Construction and Additions Total 30-Year LSC Savings (2026 PV$)	Alterations 30-Year LSC Electricity Savings (2026 PV$)	Alterations 30-Year LSC Natural Gas Savings (2026 PV$)	Alterations Total 30-Year LSC Savings (2026 PV$)
1	0.20	0.04	0.24	0.58	0.07	0.65
2	0.56	0.00	0.56	1.56	0.00	1.56
3	0.40	0.00	0.40	1.20	0.00	1.20
4	0.81	0.00	0.81	2.68	0.00	2.68
5	0.42	0.00	0.42	1.28	0.00	1.28
6	-0.12	0.00	-0.12	-0.44	0.00	-0.44
7	0.66	0.00	0.66	1.91	0.00	1.91
8	0.88	0.00	0.88	2.33	0.00	2.33
9	0.93	0.00	0.93	2.50	0.00	2.50
10	1.00	0.00	1.00	2.61	0.00	2.61
11	1.10	0.00	1.10	2.86	0.00	2.86
12	0.89	0.00	0.89	2.41	0.00	2.41
13	1.14	0.00	1.14	2.81	0.00	2.81
14	1.10	0.00	1.10	2.83	0.00	2.83
15	1.46	0.00	1.46	3.99	0.00	3.99
16	0.67	0.20	0.87	2.26	-0.13	2.13

Table 88: Average 2026 PV LSC Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction, Additions and Alterations– All Prototypes

Climate Zone	New Construction and Additions **30-Year LSC Electricity Savings (2026 PV$)**	New Construction and Additions **30-Year LSC Natural Gas Savings (2026 PV$)**	New Construction and Additions **Total 30-Year LSC Savings (2026 PV$)**	Alterations **30-Year LSC Electricity Savings (2026 PV$)**	Alterations **30-Year LSC Natural Gas Savings (2026 PV$)**	Alterations **Total 30-Year LSC Savings (2026 PV$)**
1	0.15	0.10	0.25	0.40	0.14	0.54
2	0.37	0.06	0.43	0.83	0.14	0.97
3	0.25	0.10	0.35	0.56	0.21	0.77
4	0.35	0.11	0.46	0.92	0.21	1.13
5	0.33	0.05	0.38	0.82	0.10	0.92
6	0.33	0.05	0.38	0.67	0.10	0.77
7	0.41	0.04	0.45	0.99	0.09	1.08
8	0.44	0.02	0.46	1.12	0.12	1.24
9	0.47	0.07	0.54	0.87	0.15	1.03
10	0.46	0.03	0.49	1.23	0.08	1.31
11	0.46	0.08	0.53	1.55	0.13	1.67
12	0.46	0.05	0.51	1.03	0.16	1.19
13	0.52	0.04	0.56	1.33	0.07	1.39
14	0.45	0.08	0.53	1.17	0.17	1.34
15	0.71	0.02	0.73	1.83	0.05	1.87
16	0.28	0.13	0.41	0.84	0.19	1.03

4.4.3 Incremental First Cost

We anticipate marginal incremental first costs associated with instituting a mandatory U-factor requirements for vertical fenestration. This is because the proposed requirements are easily met by insulated glazing unit products already existing in the market and in common use. As noted in the Technical Feasibility and Market Availability section, any increased incremental first cost will be limited to the small subset of projects that utilized custom-made large-scale fenestration such as that commonly used in ground floors. The incremental first cost for these types of fenestrations may increase in order to provide thermally broken framing needed to meet the proposed requirements.

4.4.4 Incremental Maintenance and Replacement Costs

In general, vertical fenestration is only replaced on an as-needed basis like in the case of accidental damage. Maintenance and replacement are typically associated with moisture-related damage and for condensation issues in the frame assembly.

Items requiring maintenance include inspections for adjacent building elements providing water drainage at the building such as window head flashing, roof drains, scuppers, transition flashing, and gutters. Sealant joints are typically employed to transition between different cladding and fenestration types within the building envelope. These sealant joints are often a critical component in the durability of a building envelope and also merit annual inspection. While regular inspections are best practice for the opaque envelope, it is also true that the vast majority of building owners do not inspect their property to ensure drainage. In cases such as these, wholesale replacement of sections of the vertical fenestration is often required. The timing, frequency, and magnitude of these costs are not quantified for this Draft CASE Report.

If building drainage elements are inspected as noted above, the only common replacement cost for vertical fenestration is exterior sealant joints exposed to the weather and solar UV radiation. The frequency of replacement will depend on the type of sealants used as some are more resistant to the elements than others, but for the purposes of the Draft CASE Report we assume a period of 10 years between sealant joint replacement.

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 30-year period of analysis. The present value of equipment maintenance costs (or savings) was calculated using a three percent discount rate (d), which is consistent with the discount rate used when developing the 2025 LSC hourly factors. The present value of maintenance costs that occurs in the n^{th} year is calculated as follows:

$$Present\ Value\ of\ Maintenance\ Cost\ =\ Maintenance\ Cost\ \times \left\lfloor \frac{1}{1+d} \right\rfloor^{n}$$

4.4.5 Cost Effectiveness

This measure proposes a mandatory requirement that is less stringent than the existing prescriptive requirements, which have already proven to be cost-effective. As such, a cost analysis is not required to demonstrate that the measure is cost effective over the 30-year period of analysis.

4.5 First-Year Statewide Impacts

4.5.1 Statewide Energy and Energy Cost Savings

The Statewide CASE Team calculated the first-year statewide savings for new construction and additions by multiplying the per-unit savings, which are presented in Section 2.3.2, by assumptions about the percentage of newly constructed buildings that would be impacted by the proposed code. The statewide new construction forecast for 2026 is presented in Appendix A, as are the Statewide CASE Team's assumptions about the percentage of new construction that would be impacted by the proposal (by climate zone and building type).

The first-year energy impacts represent the first-year annual savings from all buildings that were completed in 2026. The 30-year energy cost savings represent the energy cost savings over the entire 30-year analysis period. The statewide savings estimates do not take naturally occurring market adoption or compliance rates into account.

Table 89 and Table 90 present the first-year statewide energy and energy cost savings from new construction / additions and alterations, respectively, by climate zone. Table 91 presents first-year statewide savings from new construction, additions, and alterations.

While a statewide analysis is crucial to understanding broader effects of code change proposals, there is potential for unintended consequences impacting DIPs that needs to be considered. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

Table 89: Statewide Energy and Energy Cost Impacts – New Construction and Additions

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2026 PV$)
1	35,114	0.00	0.00	0.00	0.01	0.01
2	136,738	0.01	0.00	0.00	0.01	0.06
3	869,288	0.05	0.00	0.00	0.14	0.30
4	443,400	0.03	0.00	0.00	0.07	0.20
5	93,105	0.01	0.00	0.00	0.01	0.04
6	529,875	0.04	0.00	0.00	0.04	0.20
7	323,025	0.03	0.00	0.00	0.02	0.15
8	747,663	0.07	0.00	0.00	0.02	0.35
9	1,385,263	0.13	0.00	0.00	0.12	0.69
10	421,100	0.04	0.00	0.00	0.02	0.21
11	114,726	0.01	0.00	0.00	0.01	0.06
12	760,050	0.07	0.00	0.00	0.06	0.39
13	202,975	0.02	0.00	0.00	0.01	0.11
14	122,450	0.01	0.00	0.00	0.01	0.06
15	77,214	0.01	0.00	0.00	0.00	0.06
16	41,691	0.00	0.00	0.00	0.01	0.02
Total	6,303,675	0.52	0.01	0.01	0.57	2.90

a. First-year savings from all buildings completed statewide in 2026.

Table 90: Statewide Energy and Energy Cost Impacts – Alterations

Climate Zone	Statewide New Construction & Additions Impacted by Proposed Change in 2026	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2026 PV$)
1	118,718	0.01	0.00	0.00	0.02	$0.06
2	1,004,955	0.19	0.01	0.00	0.22	$0.98
3	5,210,400	0.67	0.02	0.02	1.73	$4.03
4	2,658,735	0.49	0.01	0.01	0.86	$3.01
5	462,675	0.08	0.00	0.00	0.07	$0.42
6	3,739,050	0.53	0.01	0.01	0.59	$2.87
7	2,873,100	0.56	0.01	0.00	0.40	$3.11
8	5,494,950	1.29	0.02	0.01	1.03	$6.83
9	8,279,250	1.81	0.04	0.02	2.21	$10.18
10	4,176,000	1.06	0.02	0.01	0.50	$5.48
11	822,270	0.24	0.01	0.00	0.16	$1.38
12	5,115,750	1.03	0.04	0.01	1.25	$6.08
13	1,568,160	0.41	0.02	0.00	0.16	$2.18
14	1,031,400	0.25	0.01	0.00	0.26	$1.39
15	556,590	0.20	0.00	0.00	0.04	$1.04
16	256,545	0.03	0.00	0.00	0.10	$0.20
Total	43,368,548	8.85	0.21	0.11	9.60	$49.24

a. First-year savings from all buildings completed statewide in 2026.

Table 91: Statewide Energy and Energy Cost Impacts – New Construction, Additions, and Alterations

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First -Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2026 PV$)
New Construction & Additions	0.1	0.0	0.0	0.0	3
Alterations	8.9	0.2	0.1	9.6	49
Total	9.0	0.2	0.1	9.6	52

4.5.2 Statewide Greenhouse Gas (GHG) Emissions Reductions

The Statewide CASE Team calculated avoided GHG emissions associated with energy consumption using the hourly GHG emissions factors that CEC developed along with the 2025 LSC hourly factors and an assumed cost of $123.15 per metric tons of carbon dioxide equivalent emissions (metric tons CO2e).

The monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs).[40] The cost-effectiveness analysis presented in Section 2.4 of this report does not include the cost savings from avoided GHG emissions. To demonstrate the cost savings of avoided GHG emissions, the Statewide CASE Team disaggregated the value of avoided GHG emissions from the other economic impacts.

Table 92 presents the estimated first-year avoided GHG emissions of the proposed code change. During the first year, GHG emissions of over 1,000 metric tons CO2e would be avoided.

[40] The permit cost of carbon is equivalent to the market value of a unit of GHG emissions in the California Cap-and-Trade program, while social cost of carbon is an estimate of the total economic value of damage done per unit of GHG emissions. Social costs tend to be greater than permit costs. See more on the Cap-and-Trade Program on the California Air Resources Board website: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program.

Table 92: First-Year Statewide GHG Emissions Impacts

Measure	Electricity Savings[a] (GWh/y)	Reduced GHG Emissions from Electricity Savings[a] (Metric Tons CO2e)	Natural Gas Savings[a] (Million Therms/yr)	Reduced GHG Emissions from Natural Gas Savings[a] (Metric Tons CO2e)	Total Reduced GHG Emissions[b] (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions[c] ($)
Windows (New Construction and Additions)	0.5	23.3	0.0	34.8	58.0	7,148.5
Windows (Alterations)	8.9	399.1	0.1	581.0	980.0	120,689.2
TOTAL	**9.4**	**422.3**	**0.1**	**615.7**	**1,038.1**	**127,837.7**

a. First-year savings from all applicable newly constructed buildings, additions, and alterations completed statewide in 2026.

b. GHG emissions savings were calculated using hourly GHG emissions factors published alongside the LSC hourly factors and source energy hourly factors CEC here: https://www.energy.ca.gov/files/2025-energy-code-hourly-factors

c. The monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs) derived from the 2022 TDV Update Model published by CEC here: https://www.energy.ca.gov/files/tdv-2022-update-model

4.5.3 Statewide Water Use Impacts

The proposed code change would not result in water savings.

4.5.4 Statewide Material Impacts

The Statewide CASE Team expects little to no changes to materials impacts because the proposed code change is only changing existing U-factors and SHGC which doesn't necessarily translate to more or different materials being used. However, the Statewide CASE Team will revisit these assumptions for the Final CASE Report. For more information on the Statewide CASE Team's methodology and assumptions used to calculated embodied GHG emissions, see Appendix D.

4.5.5 Other Non-Energy Impacts

This section will be updated for the Final CASE Report.

4.6 Addressing Energy Equity and Environmental Justice

The Statewide CASE Team assessed the potential impacts of the proposed measure, and based on a preliminary review, the measure is unlikely to have significant impacts on energy equity or environmental justice, therefore reducing the impacts of disparities in DIPs. Research Methods and Engagement

This section will be updated for the Final CASE Report.

5. Proposed Revisions to Code Language

5.1 Guide to Markup Language

The proposed changes to the standards, Reference Appendices, and the ACM Reference Manuals are provided below. Changes to the 2022 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions).

5.2 Standards

SECTION 120.7 – MANDATORY ~~INSULATION~~ THERMAL ENVELOPE REQUIREMENTS

Nonresidential and hotel/motel buildings shall comply with the applicable requirements in Sections 120.7(a) through 120.7~~(c)~~(e).

(a) Roof/Ceiling Insulation.

The opaque portions of the roof/ceiling that separates conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 3 below:

1. **Metal Building-** The weighted average U-factor of the roof assembly shall not exceed ~~0.098~~ 0.078.
2. **Wood Framed and Others-** The weighted average U-factor of the roof assembly shall not exceed ~~0.075~~ 0.060.
3. **Insulation Placement-** Insulation installed to limit heat loss and gain from conditioned spaces to unconditioned spaces shall comply with all of the following:

   A. Insulation shall be installed in direct contact with a roof or ceiling that is sealed to limit infiltration and exfiltration as specified in Section 110.7. This may include, but is not limited to, placing insulation either above or below the roof deck or on top of the finished ceiling.

   B. When insulation is installed at the roof in nonresidential buildings, fixed vents or openings to the outdoors or to unconditioned spaces shall not be installed. When the space between the ceiling and the roof is either directly or indirectly conditioned space, it shall not be considered an attic for the purposes of complying with CBC attic ventilation requirements.

   C. Insulation placed on top of a suspended ceiling with removable ceiling panels shall not be used to meet the Roof/Ceiling requirement of Sections 140.3 and 141.0.

EXCEPTION to Section 120.7(a)3: When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable

ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations.

NOTE: Vents that do not penetrate the roof deck and are instead designed for wind resistance for roof membranes are not within the scope of Section 120.7(a)3B.

(b) Wall Insulation.

The opaque portions of walls that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 7 below:

1. **Metal Building.** The weighted average U-factor of the wall assembly shall not exceed ~~0.113~~ 0.904.
2. **Metal Framed.** The weighted average U-factor of the wall assembly shall not exceed ~~0.151~~ 0.121.
3. **Light Mass Walls.** A 6 inch or greater Hollow Core Concrete Masonry Unit shall have a U-factor not to exceed ~~0.440~~ 0.035.
4. **Heavy Mass Walls.** An 8 inch or greater Hollow Core Concrete Masonry Unit shall have a U-factor not to exceed ~~0.690~~ 0.55.
5. **Wood Framed and Others.** The weighted average U-factor of the wall assembly shall not exceed ~~0.110~~ 0.088.
6. **Spandrel Panels and Curtain Wall.** The weighted average U-factor of the spandrel panels and curtain wall assembly shall not exceed 0.280.
7. **Demising Walls.** The opaque portions of framed demising walls shall meet the requirements of Item A or B below:

   A. Wood framed walls shall be insulated to meet a U-factor not greater than 0.099.

   B. Metal Framed walls shall be insulated to meet a U-factor not greater than 0.151.

(c) Floor and Soffit Insulation.

The opaque portions of floors and soffits that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 and 2 below:

1. **Raised Mass Floors.** Shall have a minimum of 3 inches of lightweight concrete over a metal deck or the weighted average U-factor of the floor assembly shall not exceed 0.269.
2. **Other Floors.** The weighted average U-factor of the floor assembly shall not exceed 0.071.
3. **Heated Slab On Grade Floor.** A heated slab on grade floor shall be insulated to meet the requirements of Section 110.8(g)

(d) **Exterior Windows.** Vertical fenestration assemblies shall:

1. Have an area-weighted average U-factor no greater than 0.47.

2. Have an area-weighted average Relative Solar Heat Gain Coefficient no greater than 0.41.

(e) **Vestibules.** Building entrances shall be protected with an enclosed vestibule meeting the applicable requirements of Items 1 and 2 below:

1. All doors opening into and out of the vestibule shall be equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors.

2. Where provided, the heating system for heated vestibules and air curtains with integral heating shall be provided with controls configured to shut off the source of heating when the outdoor air temperature is greater than 45°F. Vestibule heating and cooling systems shall be controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than 60°F and cooling to a temperature not less than 85°F.

EXCEPTIONS to Section 120.7(e): Vestibules are not required for the following:

1. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use.
2. Doors opening directly from a sleeping unit or dwelling unit.
3. Doors that open directly from a space less than 3,000 square feet in area.
4. Revolving doors.
5. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
6. Doors that have an air curtain with a velocity of not less than 6.56 feet per second at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that operate the air curtain with the opening and closing of the door.

SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

A building complies with this section by being designed with and constructed to meet all prescriptive requirements in Subsection (a) and the requirements of Subsection (c) and (d) where they apply.

(a) Envelope Component Requirements.

1. Exterior roofs and ceilings.

Exterior roofs and ceilings shall comply with each of the applicable requirements in this subsection:

A. **Roofing Products.** Shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i through ii:

i. Nonresidential buildings including Hotel and Motel buildings:

a. Low-sloped roofs in Climate Zones 1 through 16 shall have:

1. A minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75; or
2. A minimum Solar Reflectance Index (SRI) of 75.

EXCEPTION 1 to Section 140.3(a)1Aia: Wood-framed roofs in Climate Zones 3 and 5 are exempt from the requirements of Section 140.3(a)1Aia if the roof assembly has a U-factor of 0.034 or lower.

EXCEPTION 2 to Section 140.3(a)1Aia: Roof constructions with a weight of at least 25 lb/ft² over the roof membrane are exempt from the requirements of Section 140.3(a)1Aia.

EXCEPTION 3 to Section 140.3(a)1Aia: An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling U-factor in TABLE 140.3 is not exceeded.

b. Steep-sloped roofs

1. In Climate Zones 1 and 3 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.
2. In Climate Zones 2 and 4 through 16 shall have a minimum aged solar reflectance of 0.25 and a minimum thermal emittance of 0.80, or a minimum SRI of 23.

~~ii. Guest rooms of Hotel and motel buildings:~~

~~a. Low-sloped roofs in Climate Zones 9, 10, 11, 13, 14 and 15 shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.~~

~~**EXCEPTION to Section 140.3(a)1Aiia:** Roof constructions with a weight of at least 25 lb/ft² over the roof membrane.~~

~~b. Steep-sloped roofs in Climate Zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.~~

EXCEPTION to Section 140.3(a)1A: Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

B. **Roof Insulation.** Roofs shall have an overall assembly U-factor no greater than the applicable value in Table 140.3-B, or C ~~or D~~., and where required by Section 110.8 and), insulation shall be placed in direct contact with a roof or drywall ceiling.

2. Exterior Walls.

Exterior walls shall have an overall assembly U-factor no greater than the applicable value in Table 140.3-B, or C ~~or D~~.

3. Demising Walls.

Demising walls shall meet the requirements of Section 120.7(b)7. Vertical windows in demising walls between conditioned and unconditioned spaces shall have an area-weighted average U-factor no greater than the applicable value in Table 140.3-B, or C ~~or D~~.

4. Exterior Floors and Soffits.

Exterior floors and soffits shall have an overall assembly U-factor no greater than the applicable value in Table 140.3-B, or C ~~or D~~.

5. Exterior Windows.

Vertical windows in exterior walls shall:

A. Have a ~~Percent~~ window area percentage ~~shall be~~ limited in accordance with the applicable requirements of i and ii below:

i. a west-facing area no greater than 40 percent of the gross west-facing exterior wall area, or 6 feet times the west-facing display perimeter, whichever is greater; and

ii. a total area no greater than 40 percent of the gross exterior wall area, or 6 feet times the display perimeter, whichever is greater; and

NOTE: Demising walls are not exterior walls, and therefore demising wall area is not part of the gross exterior wall area or display perimeter, and windows in demising walls are not part of the window area.

EXCEPTION to Section 140.3(a)5A: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

B. Have an area-weighted average U-factor no greater than the applicable value in Table 140.3-B or C ~~or D~~.

EXCEPTION1 to Section 140.3(a)5B: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

EXCEPTION 2 to Section 140.3(a)5B: For vertical windows containing chromogenic type glazing:

i. The lower-rated labeled U-factor shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and
ii. Chromogenic glazing shall be considered separately from other glazing; and
iii. Area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

C. Have an area-weighted average Relative Solar Heat Gain Coefficient, RSHGC, excluding the effects of interior shading, no greater than the applicable value in Table 140.3-B, or C ~~or D~~.

For purposes of this paragraph, the Relative Solar Heat Gain Coefficient, RSHGC, of a vertical window is:

i. The Solar Heat Gain Coefficient of the window; or
ii. Relative Solar Heat Gain Coefficient is calculated using EQUATION 140.3-A, if the window has an overhang or series of exterior horizontal slats that extend~~s~~ beyond each side of the window jamb by a distance equal to the overhang's horizontal projection.

EXCEPTION 1 to Section 140.3(a)5C: An area-weighted average Relative Solar Heat Gain Coefficient of 0.56 or less shall be used for windows:

a. That are in the first story of exterior walls that form a display perimeter; and
b. For which codes restrict the use of overhangs to shade the windows.

EXCEPTION 2 to Section 140.3(a)5C: For vertical glazing containing chromogenic type glazing:

i. the lower-rate labeled RSHGC shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and
ii. chromogenic glazing shall be considered separately from other glazing; and
iii. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

EXCEPTION 3 to Section 140.3(a)5C: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

NOTE: Demising walls are not exterior walls, and therefore windows in demising walls are not subject to SHGC requirements.

D. Have an area-weighted average Visible Transmittance (VT) no less than the applicable value in TABLE 140.3-B ~~and C~~, or EQUATION 140.3-B, as applicable.

6. Skylights.

Skylights shall:

A. Have an area no greater than 5 percent of the gross exterior roof area Skylight Roof Ratio (SRR); and

EXCEPTION 1 to Section 140.3(a)6A: Buildings with an atria over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.

EXCEPTION 2 to Section 140.3(a)6A: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

B. Have an Area-Weighted Performance Rating U-factor no greater than the applicable value in
Table 140.3-B, or C ~~or D~~.

EXCEPTION 1 to Section 140.3(a)6B: For skylights containing chromogenic type glazing:

i. the lower-rate labeled U-factor shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and
ii. chromogenic glazing shall be considered separately from other glazing; and
iii. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

EXCEPTION 2 to Section 140.3(a)6B: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

C. Have an area-weighted performance rating Solar Heat Gain Coefficient no greater than the applicable value in Table 140.3-B, or C ~~or D~~.

EXCEPTION 1 to Section 140.3(a)6C: For skylights containing chromogenic type glazing:

i. the lower-rated labeled SHGC shall be used to demonstrate compliance ~~compliance~~ with this section; and
ii. chromogenic glazing shall be considered separately from other glazing; and
iii. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

EXCEPTION 2 to Section 140.3(a)6C: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

D. Have an Area-Weighted Performance Rating VT no less than the applicable value in Table 140.3-B, or C ~~or D~~; and

EXCEPTION 1 to Section 140.3(a)6D: For skylights containing chromogenic type glazing:

i. the higher-rated labeled VT shall be used with automatic controls to modulate the amount of light transmitted into the space in multiple steps in response to daylight levels or solar intensity and;
ii. chromogenic glazing shall be considered separately from other glazing; and
iii. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

EXCEPTION 2 to Section 140.3(a)6D: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

E. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, determined according to ASTM D1003, or other test method approved by the Energy Commission.

EXCEPTION 1 to Section 140.3(a)6E: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of the skylight and light well.

EXCEPTION 2 to Section 140.3(a)6E: Conditioned greenhouses. The requirements of Section
120.6(h)4 apply.

7. Exterior doors.

All exterior doors that separate conditioned space from unconditioned space or from ambient air shall have a U-factor not greater than the applicable value in Table 140.3-B, or C ~~or D~~. Doors that are more than one-quarter glass in area are considered Glazed Doors.

8. **Relocatable Public School Buildings**

In complying with Sections 140.3(a)1A to 7 shall meet the following:

A. Relocatable public school buildings shall comply with TABLE 140.3-B for a specific Climate Zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use only in a specific Climate Zone; or

B. Relocatable public school buildings shall comply with TABLE 140.3-CD for any Climate Zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use in any Climate Zone; and

C. The manufacturer or builder of a relocatable public school building shall certify that components of the building comply with requirements of this section by:

i. The placement of two (2) metal identification labels on the building, one mechanically fastened and visible from the exterior and the other mechanically fastened to the interior frame above the ceiling at the end of the module, both labels stating (in addition to any other information by the Division of the State Architect or other law) "Complies with Title 24, Part 6 for all Climate Zones"; and

ii. Identification of the location of the 2 labels on the plans submitted to the enforcing agency.

9. **Air Barrier.** (not shown)

TABLE 140.3-A MATERIALS DEEMED TO COMPLY WITH SECTION 140.3(a)9B

(not shown)

TABLE 140.3-B – PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS ~~(~~INCLUDING HOTEL/MOTEL BUILDINGS AND RELOCATABLE PUBLIC SCHOOL BUILDINGS ~~(~~WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE~~; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)~~

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036	~~0.041~~ 0.036
			Wood Framed and Other	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.049~~ 0.044	~~0.049~~ 0.044	~~0.049~~ 0.044	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032	~~0.034~~ 0.032
		Walls	Metal Building	~~0.113~~ 0.092	~~0.061~~ 0.054	~~0.113~~ 0.092	~~0.061~~ 0.054	~~0.061~~ 0.054	~~0.113~~ 0.092	~~0.113~~ 0.092	~~0.061~~ 0.054	~~0.061~~ 0.054	~~0.061~~ 0.054	~~0.061~~ 0.054	~~0.061~~ 0.054	~~0.061~~ 0.054	~~0.061~~ 0.054	~~0.057~~ 0.051	~~0.061~~ 0.054
			Metal-framed	0.060	0.055	0.071	0.055	0.055	0.060	0.060	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
			Mass Light[1]	~~0.196~~ 0.141	~~0.170~~ 0.127	~~0.278~~ 0.179	~~0.227~~ 0.156	~~0.440~~ 0.234	~~0.440~~ 0.234	~~0.440~~ 0.234	~~0.440~~ 0.234	~~0.440~~ 0.234	~~0.170~~ 0.127	~~0.170~~ 0.127	~~0.170~~ 0.127	~~0.170~~ 0.127	~~0.170~~ 0.127	~~0.170~~ 0.127	~~0.170~~ 0.127
			Mass Heavy[1]	~~0.253~~ 0.168	~~0.650~~ 0.282	~~0.650~~ 0.282	~~0.650~~ 0.282	~~0.650~~ 0.282	~~0.690~~ 0.290	~~0.690~~ 0.290	~~0.690~~ 0.290	~~0.690~~ 0.290	~~0.650~~ 0.282	~~0.184~~ 0.135	~~0.253~~ 0.168	~~0.211~~ 0.135	~~0.184~~ 0.135	~~0.184~~ 0.135	~~0.160~~ 0.122
			Wood-framed and Other	~~0.095~~ 0.080	~~0.059~~ 0.053	~~0.110~~ 0.090	~~0.059~~ 0.053	~~0.102~~ 0.085	~~0.110~~ 0.090	~~0.110~~ 0.090	~~0.102~~ 0.085	~~0.059~~ 0.053	~~0.059~~ 0.053	~~0.045~~ 0.041	~~0.059~~ 0.053	~~0.059~~ 0.053	~~0.059~~ 0.053	~~0.042~~ 0.039	~~0.059~~ 0.053
		Floors/ Soffits	Raised Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.058
			Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039
	Roofing Products	Low-sloped	Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Steep Sloped	Aged Solar Reflectance	0.20	0.25	0.20	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
			Thermal Emittance	0.75	0.80	0.75	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Air Barrier			REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Exterior Doors, Maximum U-factor		Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
			Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

CONTINUED: TABLE 140.3-B – PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (INCLUDING HOTEL/MOTEL BUILDINGS AND RELOCATABLE PUBLIC SCHOOL BUILDINGS WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Fenestration	Vertical		Fixed Window															
			Area-weighted Performance Rating – Max U-factor	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.34	0.36	0.34	0.34	0.34	0.34	0.34	0.36
			Area-weighted Performance Rating – Max RSHGC	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.22	0.25	0.22	0.22	0.22	0.22	0.22	0.25
			Area-weighted Performance Rating – Min VT	0.42															
				Curtainwall or Storefront															
			Max U-factor	0.38	0.41	0.41	0.41	0.41	0.41	0.38	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
			Max RSHGC	0.25	0.26	0.26	0.26	0.26	0.26	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
			Min VT	0.46															
				Operable Window															
			Max U-factor	0.46															
			Max RSHGC	0.22															
			Min VT	0.32															
				Glazed Doors															
			Max U-factor	0.45															
			Max RSHGC	0.23															
			Min VT	0.17															
			Max WWR%	40%															
		Skylights		**All Climate Zones**															
				Glass, Curb Mounted				**Glass, Deck Mounted**				**Plastic, Curb Mounted**				**Tubular Daylighting Devices (TDDs)**			
			Area-Weighted Performance Rating – Max U-factor	0.58				0.46				0.88				0.88			
			Area-Weighted Performance Rating – Max SHGC	0.25				0.25				NR				NR			
			Area-Weighted Performance Rating – Min VT (Min VT_{annual} for TDDs)	0.49				0.49				0.64				0.38			
			Maximum SRR%	5%															

TABLE 140.3-C – PRESCRIPTIVE ENVELOPE CRITERIA FOR GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs / Ceilings	Metal Building	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Walls	Wood Framed and Other	0.028	0.028	0.034	0.028	0.034	0.034	0.039	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
			Metal Building	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.057	0.057	0.057	0.057	0.057
			Metal framed	0.069	0.069	0.069	0.069	0.069	0.069	0.105	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.048	0.069
			Mass, Light[1]	0.170	0.170	0.170	0.170	0.170	0.227	0.227	0.227	0.196	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass, Heavy[1]	0.160	0.160	0.160	0.184	0.211	0.690	0.690	0.690	0.690	0.690	0.184	0.253	0.211	0.184	0.184	0.160
			Wood framed and Other	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059	0.059	0.042	0.042	0.042
		Floors / Soffits	Raised Mass[1]	0.045	0.045	0.058	0.058	0.058	0.069	0.092	0.092	0.092	0.069	0.058	0.058	0.058	0.045	0.058	0.037
			Other	0.034	0.034	0.039	0.039	0.039	0.039	0.071	0.039	0.039	0.039	0.039	0.039	0.039	0.034	0.039	0.034
	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	0.55	0.55	0.55	NR	0.55	0.55	0.55	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	NR	0.75	0.75	0.75	NR
		Steep-Sloped	Aged Solar Reflectance	NR	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0. 75	0.75	0.75	0.75	0.75	0.75	NR
	Air Barrier			REQ	REQ	REQ	REQ	REQ	REQ	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Exterior Doors, Maximum U-factor		Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
			Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

CONTINUED: TABLE 140.3-C – PRESCRIPTIVE ENVELOPE CRITERIA FOR GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

			All Climate Zones				
				Fixed Window	Operable Window	Curtainwall/ Storefront	Glazed Doors[2]
Envelope	Fenestration	Vertical	Area-Weighted Performance Rating	Max U-factor	0.36	0.46	0.41	0.45
				Max RSHGC	0.25	0.22	0.26	0.23
			Area-Weighted Performance Rating	Min VT	0.42	0.32	0.46	0.17
			Maximum WWR%	40%				
					Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	
		Skylights	Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88	
				Max SHGC	0.25	0.25	NR	
			Area-Weighted Performance Rating	Min VT	0.49	0.49	0.64	
			Maximum SRR%	5%				

Notes:
1. As defined in Section 100.1, light mass walls are walls with a heat capacity of at least 7.0 Btu/ft² oF and less than 15.0 Btu/ft² oF. Heavy mass walls are walls with a heat capacity of at least 15.0 Btu/ft² oF.
2. Glazed Doors applies to both site-built and to factory-assembled glazed doors.

TABLE 140.3-CD PRESCRIPTIVE ENVELOPE CRITERIA FOR RELOCATABLE PUBLIC SCHOOL BUILDINGS FOR USE IN ALL CLIMATE ZONES

(not shown)

SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

(b) Alterations.

Alterations to components of existing nonresidential, hotel/motel, or relocatable public school buildings, including alterations made in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy shall meet item 1, and either Item 2 or 3 below:

1. Mandatory Requirements.

Altered components in a nonresidential, or hotel/motel building shall meet the minimum requirements in this Section.

A. **Roof/Ceiling Insulation.** The opaque portions of the roof/ceiling that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 and 2 below: ~~Section 141.0(b)2Biii.~~

1.**Metal Building.** A minimum of R-19 cavity + R-6 continuous insulation, or equivalent, or the area-weighted average U-factor of the roof assembly shall not exceed U-0.078.

2. **Wood Framed and Others.** A minimum of R-19 cavity + R-4 continuous insulation, or equivalent, or the area-weighted average U-factor of the roof assembly shall not exceed U-0.060.

B. **Wall Insulation.** ~~For the~~ The altered opaque portion of walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 4 below:

1. **Metal Building.** A minimum of R-13 cavity + R-2 continuous insulation, or equivalent, ~~between framing members,~~ or the area-weighted average U-factor of the wall assembly shall not exceed ~~U-0.113~~ U-0.904.

2. **Metal Framed.** A minimum of R-13 cavity + R-2 continuous insulation, or equivalent, ~~between framing members,~~ or the area-weighted average U-factor of the wall assembly shall not exceed ~~U-0.217~~ U-0.174.

3. **Wood Framed and Others.** A minimum of R-11 cavity + R-2 continuous insulation, or equivalent, ~~between framing members,~~ or the area-weighted average U-factor of the wall assembly shall not exceed ~~U-0.110~~ U-0.088.

4. **Spandrel Panels and Glass Curtain Walls.** A minimum of R-4, or the area-weighted average U-factor of the wall assembly shall not exceed U-0.280.

EXCEPTION to Section 141.0(b)1B: Light and heavy mass walls.

C. **Floor Insulation.** (not shown)

D**. Fan Energy Index:** (not shown)

E. **Exterior Windows.** Fenestration alterations other than repair shall meet the requirements below:

1. **Vertical fenestration alterations.** Where over 150 square feet of the entire building's vertical fenestration is replaced, the maximum U-factor of the replaced units shall not

exceed U-0.58 and the maximum Relative Solar Heat Gain Coefficient, RSGC, excluding the effects of interior shading, shall not exceed 0.49.

NOTE: Glass replaced in an existing sash and frame, or sashes replaced in an existing frame, are considered repairs. In these cases, Section 141.0(c) requires that the replacement be at least equivalent to the original in performance.

2. **Added vertical fenestration.** Where over 50 square feet of vertical fenestration is added, it shall meet the requirements of Section 120.7(d). Where 50 square feet or less of vertical fenestration is added, this requirement shall not apply.

5.3 Appendices

Include marked-up language for all relevant sections of the Appendices, including the glossary.

If there are no propose changes, state: “There are no proposed changes to the Reference Appendices.”

5.4 Nonresidential ACM Reference Manual

The Nonresidential ACM Reference Manual would require modifications in Section 5.5 Building Envelope Data. Specifically, changes would be made in Section 5.5.3 to Roof Construction U-factors, to 5.5.4 to Exterior Walls U-factors and to add Vestibule requirements, and to Section 5.5.7 Vertical Fenestration U-factors.

5.5 Compliance Documents

Compliance document NRCI-ENV-01-E (based on 2019 Code) has been retired. Effective from this year January 1st, 2023, there will be no Dynamic PDF but only Energy Code Ace Virtual Compliance Assistant (VCA) and compliance documents reports from the simulation tool EnergyPro will be accepted – necessary changes need to happen on these platforms.

The proposed code changes would modify the compliance documents listed below.

NRCC-ENV-E Certificate of Compliance:

- Delete references to hotel/motel buildings, as well as modified references to alterations in roofing.
- Add references to mandatory vestibules.
- Delete Footnote 1 in Section K.

2022-NRCI-ENV-E Certificate of Installation:

- Add a new section indicating installation of vestibule where required.

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Appendix A: Statewide Savings Methodology

The Statewide CASE Team estimated statewide impacts for the first year by multiplying per-unit savings estimates by statewide construction forecasts that the CEC provided. The CEC provided the construction estimates on March 27, 2023, at the Staff Workshop on Triennial California Energy Code Measure Proposal Template (California Energy Commission, 2022; California Energy Commission, 2022).

The CEC Building Standards Branch provided the nonresidential construction forecast, which is available for public review on the CEC's website: https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency.

The construction forecast presents the total floorspace of newly constructed buildings in 2026 by building type and climate zone. The building types included in the CECs' forecast and included in the analysis for this draft report are summarized in Table 93 (nonresidential new construction forecast) and Table 94 (nonresidential existing statewide building stock). The proposed changes would impact all building types. For this draft report, the first-year statewide savings are understated because savings from prototypical buildings and opaque envelope assemblies that we did not simulate for the draft report are not accounted for yet.

To calculate first-year statewide savings, the Statewide CASE Team multiplied the per-unit savings by statewide construction estimates for the first year the standards would be in effect (2026). The projected nonresidential new construction that would be impacted by the proposed code changes in 2026 are presented in Table 95 through Table 97. The projected nonresidential existing statewide building stock that would be impacted by the proposed code change as a result of alterations in 2026 is presented in Table 98. This section describes how the Statewide CASE Team developed these estimates.

The Statewide CASE Team made assumptions about the percentage of newly constructed floorspace that would be impacted by the proposed code change. The assumed percentage of floorspace that would be impacted by the proposed code change by building type is presented in Table 99 through Table 101. If a proposed code change does not apply to a specific building type, it is assumed that zero percent of the floorspace would be impacted by the proposal. If the assumed percentage is non-zero, but less than 100 percent, it is an indication that some but not all buildings would be impacted by the proposal.

Table 93: Estimated New Nonresidential Construction in 2026 (Million Square Feet) by Climate Zone (CZ)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0.00	0.00	3.23	1.58	0.00	1.42	0.83	2.29	4.15	0.39	0.11	0.57	0.00	0.20	0.01	0.05	14.84
Medium Office	0.13	0.48	1.37	0.74	0.37	1.20	0.80	1.65	3.18	1.17	0.27	2.80	0.59	0.35	0.26	0.10	15.47
Large Retail	0.00	0.00	1.10	0.55	0.15	0.70	0.37	0.83	1.66	0.63	0.30	1.30	0.36	0.14	0.18	0.06	8.34
Medium Retail	0.08	0.35	0.79	0.45	0.09	0.60	0.29	0.86	1.42	0.82	0.14	0.63	0.38	0.18	0.12	0.08	7.29
Small School	0.07	0.27	0.46	0.23	0.14	0.32	0.29	0.35	0.66	0.35	0.10	0.78	0.30	0.11	0.04	0.04	4.50
TOTAL	0.28	1.09	6.95	3.55	0.74	4.24	2.58	5.98	11.08	3.37	0.92	6.08	1.62	0.98	0.62	0.33	50.43

Source: CEC Measure Proposal Template https://www.energy.ca.gov/media/3538

Table 94: Estimated Existing Nonresidential Construction in 2026 (Million Square Feet) by Climate Zone (CZ)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0.13	3.10	139.80	72.35	1.83	99.54	72.71	162.60	303.10	58.48	2.61	78.61	9.26	20.27	4.43	4.66	1033.49
Medium Office	3.38	30.99	78.79	42.28	13.32	47.81	43.87	59.11	86.34	66.69	16.94	101.70	25.18	13.33	10.25	4.06	644.04
Large Retail	1.00	8.67	58.68	26.90	4.20	31.96	25.34	43.46	66.53	53.31	11.40	58.16	22.51	10.91	9.40	3.21	435.64
Medium Retail	1.18	13.11	44.52	25.74	5.43	44.27	34.66	66.72	108.20	66.89	10.37	60.50	24.15	15.53	8.77	5.17	535.21
Small School	2.23	11.13	25.57	9.98	6.06	25.69	14.96	34.44	54.31	33.03	13.50	42.08	23.44	8.72	4.25	3.65	313.04
TOTAL	7.91	67.00	347.36	177.25	30.85	249.27	191.54	366.33	618.48	278.40	54.82	341.05	104.54	68.76	37.11	20.75	2961.41

Table 95: Estimated New Nonresidential Construction Impacted by Wood Roof Opaque Assemblies Proposed Code Change in 2026, by Climate Zone (CZ) and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0.00	0.00	3.23	1.58	0.00	1.42	0.83	2.29	4.15	0.39	0.11	0.57	0.00	0.20	0.01	0.05	14.84
Medium Office	0.13	0.48	1.37	0.74	0.37	1.20	0.80	1.65	3.18	1.17	0.27	2.80	0.59	0.35	0.26	0.10	15.47
Large Retail	0.00	0.00	1.10	0.55	0.15	0.70	0.37	0.83	1.66	0.63	0.30	1.30	0.36	0.14	0.18	0.06	8.34
Medium Retail	0.08	0.35	0.79	0.45	0.09	0.60	0.29	0.86	1.42	0.82	0.14	0.63	0.38	0.18	0.12	0.08	7.29
Small School	0.07	0.27	0.46	0.23	0.14	0.32	0.29	0.35	0.66	0.35	0.10	0.78	0.30	0.11	0.04	0.04	4.50
TOTAL	0.28	1.09	6.95	3.55	0.74	4.24	2.58	5.98	11.08	3.37	0.92	6.08	1.62	0.98	0.62	0.33	50.43

Table 96: Estimated New Nonresidential Construction Impacted by Mandatory Vestibule Proposed Code Change in 2026, by Climate Zone (CZ) and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0.00	0.00	2.59	1.26	0.00	1.14	0.66	1.83	3.32	0.31	0.09	0.46	0.00	0.16	0.01	0.04	11.87
Medium Office	0.10	0.38	1.10	0.60	0.30	0.96	0.64	1.32	2.55	0.94	0.21	2.24	0.47	0.28	0.21	0.08	12.38
Large Retail	0.00	0.00	0.88	0.44	0.12	0.56	0.30	0.67	1.33	0.51	0.24	1.04	0.29	0.12	0.14	0.04	6.67
Medium Retail	0.07	0.28	0.64	0.36	0.07	0.48	0.23	0.69	1.14	0.66	0.11	0.50	0.30	0.14	0.10	0.06	5.83
Small School	0.05	0.22	0.37	0.18	0.11	0.25	0.24	0.28	0.53	0.28	0.08	0.62	0.24	0.09	0.03	0.04	3.60
TOTAL	0.22	0.88	5.56	2.84	0.60	3.39	2.07	4.79	8.87	2.70	0.73	4.86	1.30	0.78	0.49	0.27	40.34

Table 97: Estimated New Nonresidential Construction Impacted by the Mandatory Windows Proposed Code Change in 2026, by Climate Zone and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0.00	0.00	0.40	0.20	0.00	0.18	0.10	0.29	0.52	0.05	0.01	0.07	0.00	0.03	0.00	0.01	1.85
Medium Office	0.02	0.06	0.17	0.09	0.05	0.15	0.10	0.21	0.40	0.15	0.03	0.35	0.07	0.04	0.03	0.01	1.93
Large Retail	0.00	0.00	0.14	0.07	0.02	0.09	0.05	0.10	0.21	0.08	0.04	0.16	0.04	0.02	0.02	0.01	1.04
Medium Retail	0.01	0.04	0.10	0.06	0.01	0.08	0.04	0.11	0.18	0.10	0.02	0.08	0.05	0.02	0.02	0.01	0.91
Small School	0.01	0.03	0.06	0.03	0.02	0.04	0.04	0.04	0.08	0.04	0.01	0.10	0.04	0.01	0.00	0.01	0.56
TOTAL	0.04	0.14	0.87	0.44	0.09	0.53	0.32	0.75	1.39	0.42	0.11	0.76	0.20	0.12	0.08	0.04	6.30

Table 98: Estimated Existing Nonresidential Floorspace Impacted by Mandatory Windows Proposed Code Change in 2026 (Alterations), by Climate Zone (CZ) and Building Type (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0.00	0.05	2.10	1.09	0.03	1.49	1.09	2.44	4.55	0.88	0.04	1.18	0.14	0.30	0.07	0.07	15.50
Medium Office	0.05	0.46	1.18	0.63	0.20	0.72	0.66	0.89	1.30	1.00	0.25	1.53	0.38	0.20	0.15	0.06	9.66
Large Retail	0.02	0.13	0.88	0.40	0.06	0.48	0.38	0.65	1.00	0.80	0.17	0.87	0.34	0.16	0.14	0.05	6.53
Medium Retail	0.02	0.20	0.67	0.39	0.08	0.66	0.52	1.00	1.62	1.00	0.16	0.91	0.36	0.23	0.13	0.08	8.03
Small School	0.03	0.17	0.38	0.15	0.09	0.39	0.22	0.52	0.81	0.50	0.20	0.63	0.35	0.13	0.06	0.05	4.70
TOTAL	0.12	1.00	5.21	2.66	0.46	3.74	2.87	5.49	9.28	4.18	0.82	5.12	1.57	1.03	0.56	0.31	44.42

Table 99: Percentage of Nonresidential Floorspace Impacted by Proposed Wood Roof Assemblies Code Change in 2026, by Building Type – New Construction

Building Type	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
Large Office	100%	0%
Medium Office	100%	0%
Large Retail	100%	0%
Medium Retail	100%	0%
Small School	100%	0%

Table 100: Percentage of Nonresidential Floorspace Impacted by Proposed Vestibules Code Change in 2026, by Building Type – New Construction

Building Type	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
Large Office	80%	0%
Medium Office	80%	0%
Large Retail	80%	0%
Medium Retail	80%	0%
Small School	80%	0%

Table 101: Percentage of Nonresidential Floorspace Impacted by Proposed Mandatory Windows Code Change in 2026, by Building Type – New Construction

Building Type	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
Large Office	13%	1.5%
Medium Office	13%	1.5%
Large Retail	13%	1.5%
Medium Retail	13%	1.5%
Small School	13%	1.5%

Appendix B: Embedded Electricity in Water Methodology

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

Appendix C: California Building Energy Code Compliance (CBECC) Software Specification

Introduction

The purpose of this appendix is to present proposed revisions to CBECC for commercial buildings (CBECC) along with the supporting documentation that the CEC staff and the technical support contractors would need to approve and implement the software revisions. The Statewide CASE Team will include software specifications in the Final CASE Report.

Appendix D: Environmental Analysis

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 standards. 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).)

The Statewide CASE Team has considered the environmental benefits and adverse impacts of its proposal including, but not limited to, an evaluation of factors contained in the California Code of Regulations, Title 14, section 15064 and determined that the proposal would not result in a significant effect on the environment.

Direct Environmental Impacts

Opaque Assemblies

There are significant energy savings and GHG emission reductions from this proposal due to tighter envelope requirements so less air leakage and thermal exchange occurs. There are no water savings associated with this proposal. For more information on the energy savings, see Section 2.5.1. For more information on the GHG emission reductions, see Section 2.5.2. There are no identified direct adverse environmental impacts from this code change proposal.

Vestibules

There are significant energy savings and GHG emission reductions from this proposal due to less air leakage and thermal exchange occurs as a result of the required vestibules. There are no water savings associated with this proposal. For more information on the energy savings, see Section 3.5.1. For more information on the GHG emission reductions, see Section 3.5.2. There are no identified direct adverse environmental impacts from this code change proposal.

Windows/ Fenestration

There are significant energy savings and GHG emission reductions from this proposal as a result of mandatory U-factor and RSHGC requirements for vertical fenestration. These requirements ensure less thermal energy is exchanged through windows which increases the heating and cooling efficiency within spaces. There are no water savings associated with this proposal. For more information on the energy savings, see Section 4.5.1. For more information on the GHG emission reductions, see Section 4.5.2. There are no identified direct adverse environmental impacts from this code change proposal.

Indirect Environmental Impacts

Opaque Assemblies

The proposed code change is likely to lead to increased embodied carbon emissions from the likely increase in the usage of insulation to meet updated R-values and U-factors. For more information on the material impacts see Section 2.5.4.

The Statewide CASE Team has determined that the operational emissions reductions from this proposal would likely far outweigh the potential increase in embodied carbon emissions. There are no identified indirect environmental benefits from this code change proposal.

Vestibules

The proposed code change is likely to lead to increased embodied carbon emissions from the increase in the usage of construction materials to build vestibules. These materials typically include aluminum and glass. For more information on the material impacts see Section 3.5.4.

The Statewide CASE Team has determined that the operational emissions reductions from this proposal would outweigh the increase in embodied carbon emissions. The Statewide CASE Team plans to revisit this calculation for the Final CASE Report. There are no identified indirect environmental benefits from this code change proposal.

Windows/ Fenestration

There are no identified indirect adverse environmental impacts nor indirect environmental benefits from this code change proposal.

Mitigation Measures

The Statewide CASE Team has considered opportunities to minimize the environmental impact of the proposal, including an evaluation of “specific economic, environmental, legal, social, and technological factors.” (Cal. Code Regs., tit. 14, § 15021.) The Statewide CASE Team did not determine whether this measure would result in significant direct or indirect adverse environmental impacts and therefore, did not develop any mitigation measures.

Reasonable Alternatives to Proposal

If an Environmental Impact Report (EIR) is developed, CEQA requires a lead agency to evaluate reasonable alternatives to proposals that would have a significant adverse effect on the environment, including a “no project” alternative. (Cal. Code Regs. Tit. 14, §§ 15002(h)(4) and 15126.6.)

The Statewide CASE Team has considered alternatives to the proposal and believes that no alternative achieves the purpose of the proposal with less environmental effect.

Water Use and Water Quality Impacts Methodology

There are no impacts to water quality or water use from the proposed code change.

Embodied Carbon in Materials

Accounting for embodied carbon emissions is important for understanding the full picture of a proposed code change's environmental impacts. The embodied carbon in materials analysis accounts specifically for emissions produced during the "cradle-to-gate" phase: emissions produced from material extraction, manufacturing, and transportation. Understanding these emissions ensures the proposed measure considers these early stages of materials production and manufacturing instead of emissions reductions from energy efficiency alone.

The Statewide CASE Team calculated emissions impacts associated with embodied carbon from the change in materials as a result of the proposed measures. The calculation builds off the materials impacts outlined in 2.5.4, 3.5.4, and 4.5.4. See these sections for more details on the materials impact analysis.

After calculating the materials impacts, the Statewide CASE Team applied average embodied carbon emissions for each material. The embodied carbon emissions are based on industry-wide environmental product declarations (EPDs).[41, 42] These industry-wide EPDs provide global warming potential (GWP) values per weight of specific materials.[43] The Statewide CASE Team chose the industry-wide average for GWP values in the EPDs because the materials accounted for in the statewide calculation will have a range of embodied carbon; i.e. some materials like concrete have a wide range

[41] EPDs are documents which disclose a variety of environmental impacts, including embodied carbon emissions. These documents are based on lifecycle assessments on specific products and materials. Industry-wide EPDs disclose environmental impacts for one product for all (or most) manufacturers in a specified area and are often developed through the coordination of multiple manufacturers and/or associations. A manufacturer specific EPD only examines one product from one manufacturer. Therefore, an industry-wide EPD discloses all the environmental impacts from the entire industry (for a specific product/material) but a manufacturer specific EPD only factors one manufacturer.

[42] An industry wide EPD was not used for mercury, lead, copper, plastics, and refrigerants. Global warming potential values of mercury, lead and copper are based on data provided in a Lifecycle Assessment (LCA) conducted by Yale University in 2014. The GWP value for plastic is based on a LCA conducted by Franklin Associates, which capture roughly 59% of the U.S.' total production of PVC and HDPE production. The GWP values for refrigerants are based on data provided by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report.

[43] GWP values for concrete and wood were in units of kg CO2 equivalent by volume of the material rather than by weight. An average density of each material was used to convert volume to weight.

of embodied carbon depending on the manufacturer's processes, source of the materials, etc. The Statewide CASE Team assumes that most building projects will not specify low embodied carbon products. Therefore, an average is appropriate for a statewide estimate.

First-year statewide impacts per material (in pounds) were multiplied by the GWP impacts for each material. This provides the total statewide embodied carbon impact for each material. If a material's use is increased, then there is an increase in embodied carbon impacts (additional emissions). If a material's use is decreased, then there is a decrease in embodied carbon impacts (emissions reduced). The total emissions reductions from this measure are the total GHG emissions reductions from 2.5.2, 3.5.2, and 4.5.2 combined with emissions reductions (or additional emissions) from embodied carbon in 2.5.4, 3.5.4, and 4.5.4.

Appendix E: Discussion of Impacts of Compliance Process on Market Actors

This appendix discusses how the recommended compliance process, which is described in Sections 2.1.5, 3.1.5, and 4.1.5, could impact various market actors. Table identifies the market actors who will play a role in complying with the proposed change, the tasks for which they are responsible, how the proposed code change could impact their existing workflow, and ways negative impacts could be mitigated. The information contained in Table is a summary of key feedback the Statewide CASE Team received when speaking to market actors about the compliance implications of the proposed code changes. Appendix F summarizes the stakeholder engagement that the Statewide CASE Team conducted when developing and refining the code change proposal, including gathering information on the compliance process.

Table identifies the market actors who will play a role in complying with the proposed change, the tasks for which they will be responsible, their objectives in completing the tasks, how the proposed code change could impact their existing workflow, and ways negative impacts could be mitigated.

Table 102: Roles of Market Actors in the Proposed Compliance Process

Market Actor	Task(s) in current compliance process relating to the CASE measure	How will the proposed measure impact the current task(s) or workflow?	How will the proposed code change impact compliance and enforcement?	Opportunities to minimize negative impacts of compliance requirement
Owners / Tenants	Understand options and negotiate design, materials and orientation.	Provide direction to Architects & design team	Owners would have to account for cost differences of the new material based on changed code for time and materials.	Include in-depth cost effectiveness of each measure in CASE Report.
Architects/ Architectural Designers	• Select the design of the exterior objects including opaque and transparent assemblies • Coordinate with design engineers and select the envelope materials based on the required thermal values per codes • Discuss with the market actors (i.e., suppliers, contractors, manufacturers and specifiers) and the owners from the cost/budget perspective and establish the final selection of materials. • Complete compliance documentation or use energy consultant to complete the compliance report • Review submittals during construction • Coordinate with Building Inspectors, Commissioning agent, ATT or authorities for necessary steps in completion of the project	• There will be a change of the selection of the materials process based on the cost of the products • With the current supply chain issues, narrowing the available selection of materials might encourage the alternative compliance pathways (such as tailored or performance) bypassing using the required materials. • Provide plans to building owners. • Show compliance on the building plans.	• Building Energy Modeling software would need to be updated to include proposed U-factors • NRCC-ENV-E form would need to be updated with new vestibule requirement and updated U-factors.	• Information about the updated values would create enough awareness; not much extra training is required. • Software update notice with the newer required values would be enough for the designers' awareness. • Proposed documentation methodology uses materials already produced as part of the design/construction process. No additional documentation necessary just updates to existing.

Market Actor	Task(s) in current compliance process relating to the CASE measure	How will the proposed measure impact the current task(s) or workflow?	How will the proposed code change impact compliance and enforcement?	Opportunities to minimize negative impacts of compliance requirement
HVAC Designer & Energy Consultants	• Following Architectural designers' recommendations on the product/material selection, find the most optimum product/material based on the energy & cost performance • Possibly find the alternate routes for compliance based on the feedback from the previous step. • Coordinate with Building Inspectors, Commissioning agent, ATT or authorities for necessary steps in completion of the project	N/A	Same as above like Architectural Designers	N/A
Plans Examiner	Read drawings and confirm compliance with forms and standards.	Review compliance documents and be able to quickly verify that the plans meet requirements.	Verify in plans and NRCC that the new requirements were properly designed.	Clear code language and compliance documents
CEC	N/A	N/A	N/A	N/A
Plumbing Designer	N/A	N/A	N/A	N/A
Electrical Designer	N/A	N/A	N/A	N/A
Commissioning Agent	N/A	N/A	N/A	N/A
Building Inspector	Conduct site visits to verify code compliance and proper installation of approved plans.	• Coordinate with general contractor to conduct visits. • For Opaque U Values: Confirm the u values meet the proposed Title 24, Part 6 Standards.	No changes to workflow.	Clear and easy to understand code language and compliance documents.
ATT	N/A	N/A	N/A	N/A

Market Actor	Task(s) in current compliance process relating to the CASE measure	How will the proposed measure impact the current task(s) or workflow?	How will the proposed code change impact compliance and enforcement?	Opportunities to minimize negative impacts of compliance requirement
Manufacturers	Design and build envelope parts.	Manufacture envelope components that are up to code.	Provide cut sheets of products that meet the new code requirements.	Easy to understand code language and compliance documents.
General Contractors	• Adhere to current Title 24, Part 6 requirements. • Constructing building in accordance with building plans. • High Performance Windows: Coordinate installation of windows that meet requirements, which in some cases includes heavier windows. • Verify NFRC certification and window performance factor adherence to code	• Follow requirements in Title 24, Part 6 to meet compliance. • Ensure the quick and efficient completion of compliance documents. • Coordinate a quick and efficient building	Coordinate with the architect and subcontractors to ensure the new requirements are being built to code.	Make simple and easy to understand code language and compliance documents.

Appendix F: Summary of Stakeholder Engagement

Collaborating with stakeholders that might be impacted by proposed changes is a critical aspect of the Statewide CASE Team's efforts. The Statewide CASE Team aims to work with interested parties to identify and address issues associated with the proposed code changes so that the proposals presented to the CEC in this Draft CASE Report are generally supported. Public stakeholders provide valuable feedback on draft analyses and help identify and address challenges to adoption including: cost effectiveness, market barriers, technical barriers, compliance and enforcement challenges, or potential impacts on human health or the environment. Some stakeholders also provide data that the Statewide CASE Team uses to support analyses.

This appendix summarizes the stakeholder engagement that the Statewide CASE Team conducted when developing and refining the recommendations presented in this report.

Utility-Sponsored Stakeholder Meetings

Utility-sponsored stakeholder meetings provide an opportunity to learn about the Statewide CASE Team's role in the advocacy effort and to hear about specific code change proposals that the Statewide CASE Team is pursuing for the 2025 code cycle. The goal of stakeholder meetings is to solicit input on proposals from stakeholders early enough to ensure the proposals and the supporting analyses are vetted and have as few outstanding issues as possible. To provide transparency in what the Statewide CASE Team is considering for code change proposals, during these meetings the Statewide CASE Team asks for feedback on:

- Proposed code changes
- Draft code language
- Draft assumptions and results for analyses
- Data to support assumptions
- Compliance and enforcement, and
- Technical and market feasibility

The Statewide CASE Team hosted two stakeholder meetings for Nonresidential Envelope measures via webinar described in Table 103. Please see below for dates and links to event pages on Title24Stakeholders.com. Materials from each meeting, such as slide presentations, proposal summaries with code language, and meeting notes, are included in the bibliography section of this report.

Table 103: Utility-Sponsored Stakeholder Meetings

Meeting Name	Meeting Date	Event Page from Title24stakeholders.com
First Round of Nonresidential Envelope Utility-Sponsored Stakeholder Meeting	Tuesday, February 14, 2023	https://title24stakeholders.com/event/nonresidential-multifamily-and-single-family-envelope-utility-sponsored-stakeholder-meeting/
Second Round of Nonresidential Envelope Utility-Sponsored Stakeholder Meeting	Monday, May 22, 2023	https://title24stakeholders.com/event/nonresidential-envelope-existing-buildings-and-multifamily-restructuring-utility-sponsored-stakeholder-meeting/

The first round of utility-sponsored stakeholder meetings occurred throughout January and February 2023 and were important for providing transparency and an early forum for stakeholders to offer feedback on measures being pursued by the Statewide CASE Team. The objectives of the first round of stakeholder meetings were to solicit input on the scope of the 2025 code cycle proposals; request data and feedback on the specific approaches, assumptions, and methodologies for the energy impacts and cost-effectiveness analyses; and understand potential technical and market barriers. The Statewide CASE Team also presented initial draft code language for stakeholders to review.

The second round of utility-sponsored stakeholder meetings occurred in May 2023 and provided updated details on proposed code changes. The second round of meetings introduced early results of energy, cost-effectiveness, and incremental cost analyses, and solicited feedback on refined draft code language.

Utility-sponsored stakeholder meetings were open to the public. For each stakeholder meeting, two promotional emails were distributed from info@title24stakeholders.com One email was sent to the entire Title 24 Stakeholders listserv, totaling over 3,000 individuals, and a second email was sent to a targeted list of individuals on the listserv depending on their subscription preferences. The Title 24 Stakeholders' website listserv is an opt-in service and includes individuals from a wide variety of industries and trades, including manufacturers, advocacy groups, local government, and building and energy professionals. Each meeting was posted on the Title 24 Stakeholders' LinkedIn page (and cross-promoted on the CEC LinkedIn page) two weeks before each meeting to reach out to individuals and larger organizations and channels outside of the listserv. The Statewide CASE Team conducted extensive personal outreach to stakeholders identified in initial work plans who had not yet opted into the listserv. Exported webinar meeting data captured attendance numbers and individual comments, and recorded outcomes of live attendee polls to evaluate stakeholder participation and support.

Statewide CASE Team Communications

The Statewide CASE Team held personal communications over email and phone with numerous stakeholders when developing this report, listed in Table 104.

Table 104: Engaged Stakeholders

Organization/Individual Name	Market Role
Birch Point Consulting	Manufacturer's representative
AIA California	Architects
Jeff Mang	Manufacturer's representative
Gabel Energy	Consultant
NRDC	Consultant
Responsible Energy Code Alliance	Advocate
WDMA	Manufacturer's representative
McHugh Energy	Consultant
Owens Corning	Manufacturer
American Chemistry Council	Manufacturer's representative
Covestro	Manufacturer
NAIMA	Manufacturer's representative
Oldcastle Building Envelope/ Ben West	Manufacturer
Bear Insulation/Seth Duty	Manufacturer/Contractor
Starline/Amber Mengede	Manufacturer
Gensler/Kirsten Ritchie, Robert Garlipp	Architects, Engineers
Sika/Steve Dubin	Manufacturer
Alcal Specialty Contracting/George Thym	Manufacturer's representative/Wholesaler
Alpen/Brad Begin	Manufacturer

Appendix G: Energy Cost Savings in Nominal Dollars

The additional data for this appendix will be added for the Final CASE Report.

Appendix H: Per-Unit Energy Impact Results

Additional data for this appendix will be added for the Final CASE Report.

Appendix I: Energy Cost Savings Results

Additional data for this appendix will be added for the Final CASE Report.

Appendix J: Statewide Energy and Energy Cost Savings

Additional data for this appendix will be added for the Final CASE Report.