Codes and Standards Enhancement (CASE) Initiative

2025 California Energy Code

Existing Buildings

Nonresidential Multiple
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Draft CASE Report

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A STATEWIDE UTILITY PROGRAM

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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. Although this measure will not be presented as a Final CASE Report, stakeholders are encouraged to submit comments that will inform the next code cycle.

Email comments and suggestions to info@title24stakeholders.com*. 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. 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 mandatory commissioning in additions and alterations. This CASE Report contains pertinent information supporting the code change.

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. 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). Similar to the California Public Utilities Commission (CPUC) definition, DIPs refer to the populations 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" (CPUC). DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience the world.[1]

Including impacted communities in the decision-making process, ensuring that the benefits and burdens of the energy sector are evenly distributed, and facing the unjust legacies of the past serve as critical steps to achieving energy equity. To minimize the risk of perpetuating inequity, code change proposals are being developed with intentional consideration of the unintended consequences of proposals on DIPs.

Proposal Description

Proposed Code Change

This measure would add requirements for commissioning (Cx) of additions and alterations and identify triggers for when Cx must be performed in additions and alterations. Mandating commissioning for nonresidential building additions and alterations would not require any software updates or changes to the ACM.

Justification

Increasing efficiency for new construction is necessary, but the impact of energy consumption and greenhouse gas emissions from existing buildings dwarfs the impacts

[1] 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.

from new construction. To meet statewide climate goals, the efficiency of existing buildings must be improved. Currently, there is no requirement in the code to complete Cx for any upgrade project. Designing and installing high-efficiency equipment and systems alone will not help energy or emissions reduction without a proper Cx process.

The absence of Cx requirements for additions and alterations represents a gap in requirements that is no longer in the best interests of California climate goals.

Background Information

Cx for new construction design review was first introduced as a mandatory requirement in 2013 to realize the benefits of energy efficiency, however, additions and alterations were excluded from the requirement. More than 90 percent of the buildings that exist today were built before 2013. Retro-commissioning, recommissioning, and ongoing commissioning have been widely accepted practices for more than two decades and are widely supported by energy efficiency programs throughout the US. The documents from these programs report verified savings from Cx in existing buildings. This proposal would mandate a Cx requirement for either system replacement or new system installations in additions and alterations.

Scope of Code Change Proposal

Table 1 summarizes the scope of the proposed changes and the sections of standards, Reference Appendices, Alternative Calculation Manual (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	
Type of Requirement	Mandatory for Additions and Alterations
Applicable Climate Zones	All
Modified Section(s) of Title 24, Part 6	Section 120.8, Section 141.0
Modified Title 24, Part 6 Appendices	None. Current Appendices do not have any reference to new construction commissioning requirements.
Would Compliance Software Be Modified	No
Modified Compliance Document(s)	CEC-NRCC-CXR-E NONRESIDENTIAL BUILDING COMMISSIONING

Market Analysis and Regulatory Assessment

The Statewide CASE Team performed a market analysis with the goals of identifying current status of qualified Cx professionals' availability, non-compliance measures, Cx practice in New Construction and existing building sectors, and market trends. The Statewide CASE Team then considered how the proposed standard may impact the market in general as well as individual market actors. The Cx process market actors include building owners, Cx agents, controls designers, architects, MEP professionals, acceptance test technicians, plans examiners and building inspectors, enforcing agents, various contractors involved in various systems including lighting, roofing, insulation, windows, HVAC, domestic hot water systems, and building operators. The Statewide CASE Team collected information on technical and market barriers through stakeholder interviews, a survey of Cx agents, and ongoing discussions with other stakeholders.

Cost Effectiveness

The Cx measure includes any and all non-compliance issues existing in the current market. However, only a few from the following list were selected for the Draft CASE Report's analysis:

- Non-compliance windows (analyzed)
- Improper chiller operation mode (analyzed)
- Installation and set point issue with variable pump systems (analyzed)
- Overridden demand-controlled ventilation in single zone packaged hvac (analyzed)
- Selection and installation of lower efficiency buildings systems without proper design review. The building systems under consideration for the final report are service water system for selected prototypes, hydronic heating systems, lighting systems.
- Controls that are not working as designed due to uncalibrated sensors, improper location of sensors, incompatibility of new/old controls integrated with old/new control systems
- Controls that are identified but not incorporated in the system, etc.

Non-compliance in alterations could be due to one or a combination of multiple design/installation/inspection/operation issues. It is not possible to quantify the savings of all non-compliant issues, therefore only a few non-compliant measures from each system as indicated in the above list were selected for the Draft CASE Report. Additional measures will be included in the Final CASE Report after collecting specific information on existing non-compliant measures. For the measures analyzed, the proposed code change was found to be cost effective for all climate zones where it is

proposed to be required. For the non-compliant envelope measure (windows) the benefit-to-cost (B/C) ratio over the 30-year period of analysis varies between 4.33 and 6.61. Refer to Table 34 for more details.[2]

California commercial facility owners and operators would save more money on energy by incorporating commissioning in their addition and alteration projects than they would spend to finance the efficiency measure. As a result, over time this proposal would leave more money available for discretionary and investment purposes once the initial cost is paid off. This will also reduce the initial cost of retrofitted systems by right sizing the systems, and operating cost with an increased benefit of IAQ/IEQ and thermal comfort of the occupants.

See Section 6 for the methodology, assumptions, and results of the cost-effectiveness analysis.

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

Table 2, Table 3, and Table 4 present the estimated impacts of the proposed code change on the three modeled systems that would be realized statewide during the first 12 months that proposed requirement is in effect.

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 Section 7 for more details on the first-year statewide impacts. Table 20 through Table 25 contains 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 Section 5.1 and Appendix C of this report. The monetary value of avoided GHG emissions is included in the Long-term Systemwide Cost hourly factors provided by CEC and is thus included in the cost-effectiveness analysis.

No water savings were estimated for commissioning measures.

Even though there might be some indirect material impact savings due to reduced maintenance and material cost, they are not quantified here.

[2] 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.

Table 2: Summary of Impacts for Commissioning - Windows

Category	Metric	Alterations
Cost Effectiveness	Benefit-Cost Ratio Range (varies by climate zone and building type)	4.33 - 6.61
Statewide Impacts During First Year	Electricity Savings (GWh)	1.74
	Peak Electrical Demand Reduction (MW)	0.05
	Natural Gas Savings (Million Therms)	0.06
	Source Energy Savings (Million kBtu)	5.53
	Long-term Systemwide Electricity Savings (Million kBtu)	8.42
	Long-term Systemwide Gas Savings (Million kBtu)	3.53
	Total Long-term Systemwide Energy Savings (Million kBtu)	11.96
	Avoided GHG Emissions (Metric Tons CO2e)	420.84
	Monetary Value of Avoided GHG Emissions ($2026)	51,825
	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)	0.0750
	Peak Electrical Demand Reduction (W)	0.0021
	Natural Gas Savings (kBtu)	0.2639
	Source Energy Savings (kBtu)	0.2380
	Long-term Systemwide Energy Savings (kBtu)	0.5142
	Avoided GHG Emissions (kg CO2e)	0.0181
	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 Commissioning – Central Plant Pump Controls

Category	Metric	Alterations
Cost Effectiveness	Benefit-Cost Ratio Range (varies by climate zone and building type)	-0.04 - 7.36
Statewide Impacts During First Year	Electricity Savings (GWh)	2.18
	Peak Electrical Demand Reduction (MW)	0.18
	Natural Gas Savings (Million Therms)	-0.01
	Source Energy Savings (Million kBtu)	-0.79
	Long-term Systemwide Electricity Savings (Million kBtu)	12.01
	Long-term Systemwide Gas Savings (Million kBtu)	-0.52
	Total Long-term Systemwide Energy Savings (Million kBtu)	11.49
	Avoided GHG Emissions (Metric Tons CO2e)	105.12
	Monetary Value of Avoided GHG Emissions ($2026)	12,945
	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)	0.1178
	Peak Electrical Demand Reduction (W)	0.0109
	Natural Gas Savings (kBtu)	-0.0475
	Source Energy Savings (kBtu)	-0.0430
	Long-term Systemwide Energy Savings (kBtu)	0.6216
	Avoided GHG Emissions (kg CO2e)	0.0057
	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 Commissioning - Single Zone HVAC DCV

Category	Metric	Alterations
Cost Effectiveness	Benefit-Cost Ratio Range (varies by climate zone and building type)	8.16 - 55.22
Statewide Impacts During First Year	Electricity Savings (GWh)	0.30
	Peak Electrical Demand Reduction (MW)	0.01
	Natural Gas Savings (Million Therms)	0.23
	Source Energy Savings (Million kBtu)	20.71
	Long-term Systemwide Electricity Savings (Million kBtu)	1.45
	Long-term Systemwide Gas Savings (Million kBtu)	13.88
	Total Long-term Systemwide Energy Savings (Million kBtu)	15.33
	Avoided GHG Emissions (Metric Tons CO2e)	1263.85
	Monetary Value of Avoided GHG Emissions ($2026)	155,640
	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)	0.1028
	Peak Electrical Demand Reduction (W)	0.0019
	Natural Gas Savings (kBtu)	7.9791
	Source Energy Savings (kBtu)	7.2004
	Long-term Systemwide Energy Savings (kBtu)	5.3284
	Avoided GHG Emissions (kg CO2e)	0.4393
	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 5: Summary of Impacts for Commissioning – Central Load Distribution

Category	Metric	Alterations
Cost Effectiveness	Benefit-Cost Ratio Range (varies by climate zone and building type)	-1.25 - 100
Statewide Impacts During First Year	Electricity Savings (GWh)	1.06
	Peak Electrical Demand Reduction (MW)	0.13
	Natural Gas Savings (million therms)	0.00
	Source Energy Savings (million kBtu)	-0.03
	LSC Electricity Savings (million 2026 PV$)	7.10
	LSC Gas Savings (million 2026 PV$)	-0.03
	Total LSC Savings (million 2026 PV$)	7.07
	Avoided GHG Emissions (Metric Tons CO2e)	89.34
	Monetary Value of Avoided GHG Emissions ($)	11,002
	On-site Indoor Water Savings (gallons)	N/A
	On-site Outdoor Water Savings (gallons)	N/A
	Embedded Electricity Savings (kWh)	0.00
Per Square Foot Impacts During First Year	Electricity Savings (kWh)	0.0318
	Peak Electrical Demand Reduction (W)	0.0039
	Natural Gas Savings (kBtu)	-0.0008
	Source Energy Savings (kBtu)	-0.0008
	LSC Savings (2026 PV$)	0.2115
	Avoided GHG Emissions (kg CO2e)	0.0027
	On-site Indoor Water Savings (gallons)	N/A
	On-site Outdoor Water Savings (gallons)	N/A
	Embedded Electricity Savings (kWh)	0.00

Compliance and Enforcement

Overview of Compliance Process

The compliance process is described in Section 3.5. Impacts that the proposed measure would have on market actors is described in 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:

- Enforcement improvement is needed for the current commissioning requirement in new construction

- The enforcement agency does not verify whether the commissioning started at the early phase of the project
- For new construction projects, the commissioning personnel are brought in at a later phase, therefore the basis of design (BOD) and owner's project requirements (OPR) are not readily available for Cx agents to review
- Sequence of operation for HVAC controls are generic in the submittals. There seems to be a disconnect between the installation contractors and control contractors.
- Many of the acceptance test technicians (ATTs) are part of the installation contractor company, introducing a conflict of interest that may produce biased results.
- The sampling of testing and verification is based on certain percent for the total project. This practice of sampling leaves the components and systems installed at a later phase untested and unverified in many buildings like core and shall and other phased-out projects. These untested samples are prone to non-compliant issues.

Field Verification and Diagnostic Testing/Acceptance Testing

No new field verification and diagnostic testing/acceptance testing is required.

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 does not recommend further research or action at this time but is open to receiving feedback and data that may prove otherwise. Please reach out to Maureen Guttman (mguttman@energy-solution.com) and Marissa Lerner (mlerner@energy-solution.com) for further engagement.

Full details addressing energy equity and environmental justice can be found in Section 2 of this report.

1. Introduction

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. Although this measure will not be presented as a Final CASE Report, stakeholders are encouraged to submit comments that will inform the next code cycle.

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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. 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 mandatory commissioning in additions and alterations of existing buildings. 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 building officials, manufacturers, builders, utility incentive program managers, Title 24 energy analysts, and others involved in the code compliance

process. The proposal will incorporate feedback received during a public stakeholder workshop scheduled by the Statewide CASE Team for February 24, 2023.

The following is a summary of the contents of this report:

- Section 2 – 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 3 – Measure Description of this Draft 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 4 – Market Analysis includes a review of the current market structure. It 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 5 – Energy Savings presents the per-unit energy, demand reduction, and Long-term Systemwide Cost 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 Long-term Systemwide Cost savings.
- Section 6 – 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 7 – 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 8 – Proposed Revisions to Code Language concludes the report with specific recommendations with ~~strikeout~~ (deletions) and underlined (additions) language for the Standards. Generalized proposed revisions to sections are included for the Compliance Manual and compliance forms.

- Section 9 – 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
- Appendix C: : California Building Energy Code Compliance (CBECC) Software Specification
- 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.

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. Addressing Energy Equity and Environmental Justice

2.1 General Equity Impacts

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. 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). Similar to the California Public Utilities Commission (CPUC) definition, DIPs refer to the populations 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" (CPUC). DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience the world.[3]

Including impacted communities in the decision-making process, ensuring that the benefits and burdens of the energy sector are evenly distributed, and facing the unjust legacies of the past all serve as critical steps to achieving energy equity. Recognizing the importance of engaging DIPs and gathering their input to inform the code change process and proposed measures, the Statewide CASE Team is working to build relationships with community-based organizations (CBOs) to facilitate meaningful engagement. A participatory approach allows individuals to address problems, develop innovative ideas, and bring forth a different perspective. Please reach out to Maureen Guttman (mguttman@energy-solution.com) and Marissa Lerner (mlerner@energy-solution.com) for further engagement.

Energy equity and environmental justice (EEEJ) is a newly emphasized component of the Statewide CASE Team's work and is an evolving dialogue within California and

[3] 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.

beyond.[4] To minimize the risk of perpetuating inequity, code change proposals were developed with intentional consideration of the unintended consequences of proposals on DIPs. The Statewide CASE Team identified potential impacts via research and stakeholder input. While the listed potential impacts should be comprehensive, they may not yet be exhaustive. As the Statewide CASE Team continues to build relationships with CBOs, these partnerships will inform and further improve the identification of potential impacts. The Statewide CASE Team is open to additional peer-reviewed studies that contribute to or challenge the information on this topic presented in this report. The Statewide CASE Team is currently continuing outreach with CBOs and EEEJ partners. Results of that outreach as well as a summary of the 2025 code cycle EEEJ activities will be documented in the 2025 EEEJ Summary Report that is expected to be published on title24stakeholders.com by the end of 2023.

2.1.1 Procedural Equity and Stakeholder Engagement

As mentioned, representation from DIPs is crucial to considering factors and potential impacts that may otherwise be missed or misinterpreted. The Statewide CASE Team is committed to engaging with representatives from as many affected communities as possible. This code cycle, the Statewide CASE Team is focused on building relationships with CBOs and representatives of DIPs across California. To achieve this end, the Statewide CASE Team is prioritizing the following activities:

- Identification and outreach to relevant and interested CBOs
- Holding a series of working group meetings to solicit feedback from CBOs on code change proposals
- Developing a 2025 EEEJ Summary Report

In support of these efforts, the Statewide CASE Team is also working to secure funds to provide fair compensation to those who engage with the Statewide CASE Team. While the 2025 code cycle will come to an end, the Statewide CASE Team's EEEJ efforts will continue, as this is not an effort that can be "completed" in a single or even multiple code cycles. In future code cycles, the Statewide CASE Team is committed to furthering relationships with CBOs and inviting feedback on proposed code changes with a goal of

[4] The CEC defines energy equity as "the quality of being fair or just in the availability and distribution of energy programs" (CEC, 2018). American Council for an Energy-Efficient Economy (ACEEE) defines energy equity as that which "aims to ensure that disadvantaged communities have equal access to clean energy and are not disproportionately affected by pollution. It requires the fair and just distribution of benefits in the energy system through intentional design of systems, technology, procedures and policies" (ACEEE). Title 7, Planning and Land Use, of the California Government Code defines environmental justice as "the fair treatment and meaningful involvement of people of all races, cultures, incomes, and national origins, with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (State of California).

engagement with these organizations representing DIPs throughout the code cycle. Several strategies for future code cycles are being considered, including:

- Creating an advisory board of trusted CBOs that may provide consistent feedback on code change proposals throughout the development process
- Establishing a robust compensation structure that enables participation from CBOs and DIPs in the Statewide CASE Team's code development process
- Holding equity-focused stakeholder meetings to solicit feedback on code change proposals that seem more likely to have strong potential impacts

2.1.2 Potential Impacts on DIPs in Nonresidential Buildings

To assess potential inequity of proposals for nonresidential buildings the Statewide CASE Team considered which building types are used by DIPs most frequently and evaluated the allocation of impacts related to the following areas among all populations.

- **Cost:** People historically impacted by poverty and other historic systems of wealth distribution can be affected more severely by the incremental first cost of proposed code changes. Costs can also create an economic burden for DIPs that does not similarly affect other populations. See section(s) 6 for an estimate of energy cost savings from the current proposals.
- **Health:** Any potential health burdens from proposals could more severely affect DIPs that can have limited access to healthcare and live in areas affected by environmental and other health burdens. Several of the potential negative health impacts from buildings on DIPs are addressed by energy efficiency (Norton, 2014.; Cluett, 2015; Rose, 2020). For example, indoor air quality (IAQ) improvements through ventilation or removal of combustion appliances can lessen the incidents of asthma, chronic obstructive pulmonary disease (COPD), and some heart problems. Black and Latinx people are 56 percent and 63 percent more likely to be exposed to dangerous air pollution than white people, respectively (Tessum, et al., 2019). Water heating and building shell improvements can reduce stress levels associated with energy bills by lowering utility bill costs. Electrification can reduce the health consequences resulting from NOx, SO_2, and $PM_{2.5}$.
- **Resiliency:** DIPs are more vulnerable to the negative consequences of natural disasters, extreme temperatures, and weather events due to climate change. Black Americans are 40 percent more likely to currently live in areas with the highest projected increases in extreme heat related mortality rates, compared to other groups (EPA, 2021). Similarly, natural disasters affect DIPs differently. Race and wealth affect the ability to evacuate for a natural disaster, as evidenced during Hurricane Harvey wherein White and wealthy residents were overrepresented by 19.8 percent among evacuees (Deng, et al., 2021).

Proposals that improve buildings' resiliency to natural disasters and extreme weather could positively impact DIPs. For example, buildings with more insulation and tighter envelopes can reduce the health impacts of infiltration of poor-quality air, reduce risk of moisture damage and related health impacts (mildew and mold), and help maintain thermal comfort during extreme weather events.

- **Comfort:** Thermal comfort and proper lighting are important considerations for any building where people work, though impacts are not proportional across all populations. Thermal comfort can also have serious health effects as heat related illness is on the rise in California. DIPs are at a greater risk for heat illness due in part to socioeconomic factors. From 2005 to 2015 the number of emergency room visits for heat related illness in California rose 67 percent for Black people, 53 percent for Asian-Americans, and 63 percent for Latinx people (Abualsaud, Ostrovskiy, & Mahfoud, 2019). Studies have shown that not only do the effects of urban heat islands lead to higher mortality during heat waves, but those in large buildings are disproportionately affected (Smargiassi, 2008; Laaidi, 2012). These residents tend to be the elderly, people of color, and low-income households (Drehobl, 2020; Blankenship, 2020; IEA, 2014). Comfort is not only a nice quality to have in workplaces, schools, etc., but it also has real world health impacts on people's health.

2.1.2.1 Potential Impacts by Building Type

Proposals for the following building types would not have disproportionate impacts because all populations use the buildings with the same relative frequency. While there may be impacts on costs, health, resiliency, or comfort, DIPs would not be affected more or less than any other population. It is unlikely that DIPs would pay a disparate share of the incremental first costs.

- Office buildings of all sizes
- Retail buildings of all sizes
- Non-refrigerated buildings
- Laboratories
- Open air parking garage
- Vehicle service

Below is a description of how the proposed code changes might impact DIPs by building type.

Strip Mall

Proposals for the strip mall building type have the potential to create disproportionate impacts. The benefits of strip malls are complex and vary based on factors such as location, economic conditions, and community needs. Rents in strip malls are often

more affordable than they would be in heavily trafficked or more upscale areas. Strip malls often serve as affordable business centers for DIPs. Some shop owners indicate strip mall stores feel like “the center of social life” (Ramanathan, 2017). Historically, small and minority owned businesses face challenges such as discrimination, difficulty in securing funding, and a lack of social capital that impact start-up costs and ability costs to secure business locations. Black entrepreneurs are almost three times more likely to lose profitability due to start-up costs compared to white entrepreneurs (Morelix, 2016). Increases in cost could disrupt these DIP-owned businesses even more.

Mixed-Use Retail

DIPs use mixed-use retail buildings more frequently than other populations so there is a possibility of uneven impacts. Rents are often higher in mixed-use retail. Historically, small and minority owned businesses face challenges such as discrimination, difficulty in securing funding, and a lack of social capital that impact start-up costs and ability to secure business locations (Morelix, 2016). Impacts on health, resiliency, or comfort are not anticipated to be disproportionate.

Schools (Small and Large)

Incremental costs could have a larger impact on DIPs than the general population because school funding is linked with race and income in the United States (U.S.). Jurisdictions with lower income populations where the tax base, funding, and capital improvement budgets may be more constrained may find it more challenging to accommodate the incremental first costs. Costs can affect educational quality, as incremental costs present a significant burden for schools with lower budgets. Analysis from the U.S. Government Accountability Office shows that students in poorer and smaller schools tend to have less access to college-prep courses and 80 percent of the students in these poorest schools were Black and Latinx (United States Government Accountability Office , 2018). Incremental costs can deepen these educational inequalities by burdening schools with low budgets. Proposals will impact individuals attending and working at schools including those from DIPs. Proposals that impact health, resiliency, and comfort all have the potential to disproportionately impact those who attend or work in majority DIP schools, as those schools can less often afford considerations for those criteria.

Hotel

Proposals that impact health and resiliency have the potential to disproportionately impact those working or residing in hotels. California has used hotels for temporary housing, and many unhoused people rely on these buildings for shelter on a regular basis and during extreme weather events. California’s Project Roomkey offered temporary hotel housing for more than 42,000 unhoused Californians in the COVID-19 crisis (California Governer's Office of Emergency Services, 2021). More than 1.6 million people are employed year-round in accommodation and food services with more than

49 percent of that industry identifying as Black, Asian American, or Latinx (U.S. BUREAU OF LABOR STATISTICS, 2023). While the costs may increase for this nonresidential building type, the burden of that cost is unlikely to be disproportionate.

Assembly

While proposals to most assembly buildings will not have a disproportionate impact, some of the buildings such as places of worship, community or recreation centers, homeless shelters used for temporary housing, and libraries, for example could more significantly affect DIPs. Places of worship can be valuable community fixtures for DIPs. Forty-seven percent of Black people and 39 percent of Latinx people report attending religious services weekly, compared to only 32 percent for White people (Pew Research Center, 2023). Churches and other community assembly buildings serve as significant spaces for spiritual, cultural, and economic resources for DIPs. Specifically, building types that provide shelter in times of extreme weather events; aid in disaster preparedness; or provide shelter, food, or other resources to those in need would be more likely to result in disproportional impacts. Shelters and churches serve DIP populations. While the costs may increase for this nonresidential building type, the burden of that cost is unlikely to be disproportionate.

Hospital

Increased incremental costs for hospitals can present challenges to jurisdictions with lower income populations where the tax base, funding, and budgets may be more constrained. Proposed measures that impact health and resiliency, have the potential to disproportionately impact those who attend or work in hospitals.

Restaurant

Proposals for restaurants could affect DIPs more significantly than the general population, particularly those who work in the foodservice industry, own a small business that is a restaurant, or rely on restaurants for food (especially those living in food deserts). An estimated 23.5 million Americans live in food deserts. Defined as an area with “limited access to a variety of healthy and affordable food” (Chapple). In these food deserts, restaurants can play a role feeding in providing access to more food for DIPs. Access to restaurants with healthy food is also limited for many DIPs in food deserts. In South Los Angeles, neighborhoods with a higher percentage of Black residents only 27 percent of restaurants provided 5 or more healthy options, while in the more affluent West Los Angeles, 40 percent of restaurants offered 5 or more healthy options (Lewis, et al., 2005). Many of California’s restaurants are owned by DIPs, and even more are staffed by DIPs. Of the 150,000 fast food employees in Los Angeles, 9 of 10 are people of color (UCLA Labor Center, 2022). Proposals that have high incremental costs and health effects could have notable impacts on DIPs.

Enclosed Parking Garage

Breathing the air in an enclosed parking garage can expose people to carbon monoxide, gasoline, or diesel engine exhaust. Over time in an enclosed parking garage accumulated pollutants become more concentrated and daily exposure to this concentration is a serious indoor air quality issue (Oh, 2020) Anyone spending extensive time in an enclosed parking garage, including unhoused people, would be impacted by this air quality danger.

Grocery

Proposals for groceries could affect DIPs more significantly than the general population, particularly those who work in grocery buildings, own a small grocery business, or depend upon a specific grocery as a food source in a food desert. An estimated 23.5 million Americans live in food deserts (Chapple). Defined as an area with “limited access to a variety of healthy and affordable food,” food deserts put a significant health burden on DIPs. In California almost one million people live in food deserts (The Sarah Samuels Center for Public Health Research and Evaluation, 2016). Living in a food desert can raise the price of living and cause people to travel further for food. Nearly two-thirds of Californians have reported feeling “very concerned” about paying for their rent with the rising cost of living (Public Policy Institute of California 2022). Even higher prices due to proposed measures and longer distances for food have the potential to harm DIPs. Proposals that impact incremental cost, health, resiliency, and comfort all have the potential to disproportionately impact those working in grocery buildings or relying on them as one of their only food sources in a food desert.

Refrigerated Warehouse

Proposals that impact health, especially thermal comfort or air quality impacts, have the potential to disproportionately impact those working in refrigerated warehouses, many of whom are from DIPs. While the costs may increase for this nonresidential building type, the burden of that cost is unlikely to be disproportionate.

2.2 Specific Impacts of the Proposal

This proposal is unlikely to have significant negative impacts on DIPs. This proposal will result in energy savings as well as building systems that are commissioned to work together which can help increase resiliency and reduce the health impacts. Therefore, this proposal has the potential to impact DIPs in relation to cost and health positively.

3. Measure Description

3.1 Proposed Code Change

This measure would add mandatory requirements for commissioning (Cx) of additions and alterations and identify triggers for when Cx must be performed in additions and alterations. The mandatory Cx will address only those units of equipment or system components being added or altered, as well as the existing equipment that are integrated with added or altered systems. Cx is not required for any unaltered system or accessories that would not impact the performance of the altered system even though it is recommended. The provision will apply to additions or alterations with over 10,000 square feet of altered or added conditioned space.

This Draft CASE Report shows energy savings that are possible through mandatory Cx of systems and equipment in additions and alterations. While the attributed savings in this draft report were determined through energy modeling for selected building prototypes in all climate zones, the proposed measure would apply to all building types except health care facilities and other facilities that are exempted in new construction Cx requirements.

Mandating Cx for nonresidential building additions and alterations would require no software updates.

3.2 Justification and Background Information

3.2.1 Justification

Increasing energy efficiency for new construction is necessary, but the impact of energy consumption and greenhouse gas emissions from existing buildings dwarfs the impacts from new construction. To meet statewide climate goals, the efficiency of existing buildings must be improved.

The absence of a Cx requirement for additions and alterations is no longer in the best interests of California climate goals. Altered systems in existing buildings may not function as they are intended due to various reasons, including but not limited to:

- Improper communication protocols between existing control platform and new systems,
- Presence of unknown issues,
- Mix of non-compatible old and new sensors and control actuators,
- Lack of appropriate facility personnel training on new systems, or
- Ambiguous energy efficiency goals for alteration projects.

Title 24, Part 6 has Cx requirements in addition to Cx requirements in Title 24, Part 11 (Section 5.410), but additions and alterations are explicitly excluded. There are acceptance testing for certain equipment and systems and as many as 52 nonresidential compliance acceptance (NRCA) forms for alterations and additions. Alterations and additions are not exempt from these other requirements and should not be exempt from Cx requirements either.

Additionally, while the bounds of acceptance testing are limited, the scope of Cx encompasses many systems, both isolated and integrated. Acceptance testing does not start until construction is complete and the relevant system is installed. However, the Cx process begins during the project development and design phase, and continues through verification and into operations during occupancy. Unlike Cx, acceptance testing does not cover training for facility personnel, a critical service component to ensuring optimal performance through operations and maintenance. The comprehensive Cx process is a necessary addition to acceptance testing, especially in existing buildings.

Table 6: Scope of Commissioning vs Acceptance Testing Responsibilities

Commissioning Authority (CxA)	Acceptance Testing Technician
• Documents current facility conditions and operations • Collaborates with building owner and design team to develop Owner's Project Requirements (OPR), Basis for Design (BOD), and Commissioning Plan • Conducts design review to verify adherence to OPR • Prepares and submits certificates of acceptance • Facilitates training for facility personnel	• Not involved in establishing energy performance goals • Not responsible for other equipment or system performance that may impact the equipment or system being tested • Performs acceptance testing of single systems or units of equipment • Prepares and submits certificates of acceptance

3.2.2 Background Information

Cx for new construction was first introduced as a mandatory requirement in 2013 to realize the benefits of energy efficiency, but additions and alterations were excluded from the requirement. This exemption should be removed, especially considering more than 90 percent of the buildings that exist today were built before 2013. Retro-commissioning, recommissioning, and ongoing Cx have been widely accepted practices for more than two decades and are widely supported by energy efficiency programs throughout the US. The documents from these programs report verified savings from Cx in existing buildings. This proposal would mandate a Cx requirement for either system replacement or new system installations in additions and alterations.

3.3 Summary of Proposed Changes to Code Documents

The sections below summarize how the standards, Reference Appendices, Alternative Calculation Method (ACM) Reference Manuals, and compliance forms would be modified by the proposed change.[5] See Section 8 of this report for detailed proposed revisions to code language.

3.3.1 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 8 of this report for marked up code language.

Section: Section 120.8 Nonresidential Building Commissioning

Specific Purpose: The specific purpose of the change to this section is to incorporate language identifying the scope of commissioning required for additions and alterations.

Necessity: These changes are necessary to eliminate the exception to commissioning requirements in additions and alterations.

Section: Section 141.0 Additions, Alterations, and Repairs to Existing Nonresidential and Hotel/Motel Buildings.

Specific Purpose: The specific purpose of the change to this section is to add references to Section 120.8 to the requirements for additions and alterations.

Necessity: These changes are necessary to eliminate the exception to commissioning requirements in additions and alterations.

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

The proposed code change would not modify the ACM Reference Manual.

3.3.3 Summary of Changes to the Nonresidential Compliance Manual

Chapter 13 of the Nonresidential Compliance Manual would need to be revised to incorporate requirements for alterations.

3.3.4 Summary of Changes to Compliance Forms

The proposed code change would modify the compliance forms listed below.

- NRCC-CXR-E Nonresidential Building Commissioning would require minor modifications to delete the exclusion of applicability to additions and alterations.

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

3.4 Regulatory Context

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

For additions and alterations, there is no requirement for commissioning in Title 24, Part 6, Part 11, or other codes.

Healthcare facilities would be exempt from this new requirement. Performance verification for healthcare facilities is covered under the authority of the California Department of Health Care Access and Information (HCAI).

3.4.2 Duplication or Conflicts with Federal Laws and Regulations

There are no relevant federal laws or regulations.

3.4.3 Difference From Existing Model Codes and Industry Standards

The Statewide CASE Team has reviewed existing model codes and industry standards relating to Cx.

The existing buildings chapter in IECC-2021 requires Cx of new mechanical systems and equipment, and new lighting equipment that are part of an addition. For alterations, Cx is required for new heating, cooling and duct systems, new service hot water systems, and new lighting systems that are part of the alteration. Neither the additions section nor the alterations section of the IECC-2021 code identifies a building or system size threshold for when Cx should apply.

Cx is also required in ASHRAE 90.1-2022 for all building projects, except “buildings, additions and alterations less than 10,000 square feet of conditioned space and combined heating, cooling, and service water heating equipment totaling less than 960,000 Btu/h in capacity.” Note, there are additional exceptions to this requirement, but they are unrelated to additions and alterations.

Similar to ASHRAE 90.1, this proposed measure is triggered when greater than 10,000 square feet of floor area of an addition or alteration is performed. The Statewide CASE Team is also considering an alteration compliance trigger with a permit valuation of $200,000 or higher (as defined in Section 301.3 of Title 24, Part 11). The Statewide CASE Team has received preliminary feedback from stakeholders on a potential compliance triggered tied with permit valuation which is why it is being only considered at this time. Note, the proposed measure does not incorporate triggers/exceptions based on capacity of combined heating, cooling, and service water heating equipment. ASHRAE 90.1-2022 Section 4.2.5.1 (Building Systems Verification and Testing Requirements) notes that “verification and testing (V&T) shall be performed for new systems, and their interface and integration with existing building systems shall be

verified or tested." This is similar to the Statewide CASE Team's proposed measure, with the exception that the proposed measure further includes a Cx requirement in cases where existing systems are modified, whether or not they interface with new systems.

3.5 Compliance and Enforcement

This section describes compliance with the proposed code change as well as the verification process. When developing this proposal, the Statewide CASE Team considered methods for streamlining compliance and enforcement while mitigating or reducing negative impacts on market actors. Appendix E presents how the proposed changes could impact various market actors.

Compliance verification activities are phased as described below:

- **Design Phase:**
  - Review Current Facility Requirement (CFR) and energy performance relevant to the scope of the additions and alterations if exists
  - Develop CFR or modify Owner's Project Requirements (OPR), Basis of Design (BOD)
  - Develop Commissioning Plan and incorporate measures into construction documents.
  - Design Kickoff in Schematic Design Phase.
  - Design Review in Construction Documents.
- **Permit Application Phase:**
  - Submit Cx Plan.
  - Submit Certificates of Compliance of Design Kickoff and Construction Document Design Review.
- **Construction Phase:**
  - Document envelope Cx construction checklists.
- **Inspection Phase:**
  - Perform and document Functional Performance Testing.
  - Provide Cx Report to owner.

4. Market Analysis

4.1 Current Market Structure

The Statewide CASE Team performed a market analysis with the goal of identifying current market trends in building Cx. The Statewide CASE Team 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 24, 2023.

Cx has grown to be standard practice since its introduction for new construction in the 2013 version of Title 24, Part 6. Cx agents are well positioned to provide Cx services for additions/alterations.

4.2 Technical Feasibility and Market Availability

Cx for additions and alterations is technically feasible in that the processes will mirror existing code requirements already in place for new construction. As such, the proposed measure will utilize the same services and knowledge as new construction Cx services already available in the industry.

One aspect of Cx for additions and alterations that differs from the process for new construction is in cases where the scope of work utilizes, modifies, or interfaces with existing systems. In these situations, the technical feasibility of Cx will vary according to the availability of the following information regarding existing systems:

- What systems currently exist and what is the design intent?
- What is the condition, function, and capacity of existing equipment?
- Which existing equipment remains in service and what has been abandoned in place?
- Where is existing equipment located and what is the layout of the existing distribution such as ducts, piping, and electrical service?

In cases where documentation of existing equipment and systems is available, conditions may deviate if the building has been modified during the course of the building's history. For these reasons, Cx existing buildings requires a physical

walkthrough and survey of the building. Within the proposed measure, this scope would be assigned to the project Commissioning Agent (CxA).

There may be technical challenges interfacing with legacy systems in existing buildings. When existing equipment is no longer documented or supported by the manufacturer, the Cx process will identify these systems for potential upgrade or replacement. The Design Review stage of the Cx process in the proposed measure would establish the condition and functionality of the existing systems and any design intent that involves continued use or replacement of existing systems.

Identifying the design intent for reusing, repurposing, or replacing existing systems is the main area in which the proposed measure for Cx in additions and alterations would differ from existing requirements for new construction. Stakeholder feedback to the Statewide CASE Team has indicated that this scope is necessary for the success of additions and alterations projects currently.

4.3 Market Impacts and Economic Assessments

4.3.1 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 compliant 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 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 change to add Cx requirements for additions and alterations 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. The Statewide CASE Team's estimates of the magnitude of these impacts are shown in Section 4.4 Economic Impacts.

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

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 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
All other Nonresidential trade contractors	940	18,027	1.6

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

4.3.2 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 compliant with changes to design practices and building codes. As with new construction projects, the requirement for commissioning in additions and alterations requires the design team to work closely with the project owner to develop the Owner's Project Requirements, and to develop the Basis of Design. The design team would be expected to collaborate with the Cx agent from the project inception through closeout and occupancy.

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 this measure to affect firms that focus on nonresidential additions and alterations.

There is not a North American Industry Classification System (NAICS)[6] 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.[7] 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 9 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

4.3.3 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.

[6] 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.

[7] 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.

4.3.4 Impact on Building Owners and Occupants

4.3.4.1 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.

4.3.4.2 Estimating Impacts

Building owners and occupants would benefit from lower energy bills. As discussed in Section 4.4.1, 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.

4.3.5 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.

4.3.6 Impact on Building Inspectors

Table 10 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 Cx requirement improves compliance and can reduce the burden on enforcement officials.

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.

4.3.7 Impact on Statewide Employment

As described in Sections 4.3.1 through 4.3.6, 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 4.4, the Statewide CASE Team estimated the proposed change requiring Cx in additions and alterations would affect statewide employment and economic output directly and indirectly through its impact on builders, designers and energy consultants, CxA, and building inspectors. In addition, the Statewide CASE Team estimated how energy savings associated with this proposed change would lead to modest ongoing financial savings for California residents, which would then be available for other economic activities.

4.4 Economic Impacts

For the 2025 code cycle, the Statewide CASE Team used the IMPLAN model software,[8] 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

[8] 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 Retro Commissioning (RCx) process on the building by a professional experienced engineering team is estimated to be $0.27[9] per square foot for consultation fees. Any recommendation from the finding of the RCx process would not be mandatory to implement. It is up to the owner to pursue the recommended changes (one or all recommendations) based on return on investment (ROI) of the recommendations/measure provided in the post RCx report. Economic Impact is analyzed based on just the consulting fees of $0.27 per square foot; no post RCx measures is included in this Economic Forecast. 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, commissioning agents, 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.

[9] Building Upgrade Manual Retro-commissioning Chapter 5, Page 16, 5.5 Summary - https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH5_RetroComm.pdf

Table 11: Estimated Impact that Adoption of the Proposed Measure would have on the California Commercial Construction Sector (only Large Office Type is considered in this analysis)

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by Commercial Builders)	158.9	$12,634,452	$19,022,434	$41,158,759
Indirect Effect (Additional spending by firms supporting Commercial Builders)	92.6	$7,303,274	$12,538,109	$21,950,727
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	84.0	$5,729,339	$10,258,322	$16,327,424
Total Economic Impacts	**335.4**	**$25,667,065**	**$41,818,866**	**$79,436,910**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[10]

Table 12: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultants Sectors (only Large Office Type is considered in this analysis)

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by Building Designers & Energy Consultants)	0.9	$99,611	$98,613	$155,868
Indirect Effect (Additional spending by firms supporting Bldg. Designers & Energy Consultants)	0.4	$29,659	$41,220	$66,356
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	0.5	$37,171	$66,565	$105,949
Total Economic Impacts	**1.8**	**$166,441**	**$206,399**	**$328,172**

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

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

Table 13: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors (only Large Office Type is considered in this analysis)

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by Building Inspectors)	0.0	$628	$745	$905
Indirect Effect (Additional spending by firms supporting Building Inspectors)	0.0	$58	$91	$158
Induced Effect (Spending by employees of Building Inspection Bureaus and Departments)	0.0	$198	$354	$563
Total Economic Impacts	**0.0**	**$884**	**$1,189**	**$1,626**

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

4.4.1 Creation or Elimination of Jobs

The Statewide CASE Team anticipates that the measures proposed for the 2025 code cycle regulation would lead to the creation of new *types* of jobs. Currently, Cx is included for additions and alterations projects due to owner's interest or projects that are pursuing financial incentives. Including this mandatory requirement in the Standard will require more Cx jobs; in the future, it will also help ease the transition to outcome-based code or Building Performance Standards. There are more than 200 certified professionals in California who can meet the demand of the current proposal. The estimates of economic impacts discussed in Section 4.4 would lead to modest changes in employment of existing jobs.

4.4.2 Creation or Elimination of Businesses in California

As stated in Section 4.4.1, 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 the requirements for major additions and alterations, 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. As noted in above

Section 4.4.1, however, there are likely to be significantly more opportunities for growth in businesses that provide Cx services.

4.4.3 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.[11] 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.

4.4.4 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).[12] As Table 14 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	***Fill / "Intentionally blank"***	***Fill / "Intentionally blank"***	**26**

Source: (Federal Reserve Bank of St. Louis, n.d.)

[11] 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.

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

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

Total Estimated Proprietor Income, $5,199,904 * 0.26 = $1,377,592

The Statewide CASE Team does not anticipate that the economic impacts associated with the proposed measure would lead to significant change (increase or decrease) in investment, directly or indirectly, in any affected sectors of California's economy. Nevertheless, the Statewide CASE Team is able to derive a reasonable estimate of the change in investment by California businesses based on the estimated change in economic activity associated with the proposed measure and its expected effect on proprietor income, which was use a conservative estimate of corporate profits, a portion of which was assume will be allocated to net business investment.[13]

4.4.5 Incentives for Innovation in Products, Materials, or Processes

The Statewide CASE Team is in contact with Cx professionals to collect case studies from regions in California. The content will be added to this section for the final report.

4.4.6 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.

4.4.6.1 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 would be reduced when compared to the overall costs savings and policy benefits associated with the code change proposals. The new Cx measure may impact state buildings undergoing additions and/or alterations; however, the proposed code changes have been found to be cost effective.

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this re-training is an expense to local governments, it is not a new cost associated with

[13] 26 percent of proprietor income was assumed to be allocated to net business investment; see Table 14.

the 2025 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training and resources provided by the IOU Codes and Standards program (such as Energy Code Ace). As noted in Section 3.5 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.

4.4.7 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 of this measure on specific persons or groups. Refer to Section 2 for more details addressing energy equity and environmental justice.

4.5 Fiscal Impacts

4.5.1 Mandates on Local Agencies or School Districts

This measure would impact local agencies and school districts undertaking building addition or alteration projects.

4.5.2 Costs to Local Agencies or School Districts

This measure will impose additional costs for Cx services to local agencies and school districts undertaking building addition or alteration projects and is expected to provide commensurate savings in energy costs.

4.5.3 Costs or Savings to Any State Agency

This measure will impose additional costs for Cx services to state agencies undertaking building addition or alteration projects and is expected to provide commensurate savings in energy costs.

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

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

4.5.5 Costs or Savings in Federal Funding to the State

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

5. 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 for more details addressing energy equity and environmental justice.

5.1 Energy Savings Methodology

5.1.1 Key Assumptions for Energy Savings Analysis

This proposal evaluates changes to mandatory requirements for additions and alterations. The savings methodology was based on the 2013 Title 24, Part 6 Design-Phase Commissioning CASE Report.[14] For each non-compliant measure and measure-specific prototype, a code-compliant model and a model that included non-code compliant measures were developed. The savings were calculated to be the difference between two model output metrics. The metrics included electric savings, gas savings, demand savings, emission savings and LSC savings. It is cumbersome to select and model all measures that represent all possible non-compliant items. Therefore, the Statewide CASE Team selected only a few measures based on the 2013 Title 24, Part 6 Design-Phase Commissioning CASE Report and stakeholder feedback. Specifically, the Statewide CASE Team reached out to CxA to ask which measures they typically find to be out of compliance (i.e. don't meet code requirements). See more details about stakeholder outreach in Appendix F. The Statewide CASE Team is still conducting research and outreach to understand if there are other measures that should be modeled instead of the ones chosen for this Draft CASE Report.

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 for Commercial/Nonresidential Buildings Software (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. 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.

[14] https://title24stakeholders.com/wp-content/uploads/2020/01/2013_CASE-Report_Draft-Measure-Information-Template-Design-Phase-Commissioning-1.pdf

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 represent the non-compliant measures energy standards. The 2022 Standard Design also serves as a proposed run. As a conservative assumption the 2022 Standard Design is used for alterations instead of using vintage Title 24, Part 6 CBECC prototypes.

5.1.2 Energy Savings Methodology per Prototypical Building

The Statewide CASE Team measured per unit energy savings expected from the proposed code changes in several ways to quantify impacts. 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. 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. Finally, the Statewide CASE Team calculated Long-term Systemwide Cost (LSC) Savings, formerly known as Time Dependent Value (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-based CO_2 emissions.[15]

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.[16] Because it would be impossible to model every potential occurrence of non-compliance, the Statewide CASE Team selected a few measures to illustrate the savings potential of mandatory Cx requirements for additions and alterations. As noted in Section 5.1.1 above, the non-compliant measures chosen was based on the 2013 Title 24, Part 6 Design-Phase Commissioning CASE Report and stakeholder feedback.

The attributed savings were determined through energy modeling for selected prototypes in all climate zones. For each prototype, two energy models were created: 1) the baseline model which meets current code compliance or prototype default values,

[15] More information on Source Energy and Long-term Systemwide Cost 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.

[16] See Appendix A of the CEC's New Measure Proposal Template: https://www.energy.ca.gov/media/3538

and 2) the design model with a non-compliant measure. The estimated savings were calculated to be the difference in energy use of the two models.

Modeling for this proposal include the following non-compliant measures:

- Envelope – Window Assembly U-factor and RSGHC
  - Prototypes selected - OfficeLarge
- Pump System Controls – Chiller Water Pump System
  - Prototypes selected – OfficeLarge and SchoolLarge
- Single-Zone HVAC - Demand Control Ventilation System
  - Prototype selected - Fast Food Restaurant

The prototype buildings that the Statewide CASE Team used for this proposal are presented in Table 15.

Table 15: 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–40%
RestaurantFastFood	1	2,501	Fast food restaurant with a small kitchen and dining areas. 14% WWR. Pitched roof with an unconditioned attic.
SchoolLarge	2	210,866	High school with WWR of 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 rule sets from the 2025 Research Version of the CBECC software.[17]

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

[17] See 2025 Energy Code Compliance Software, Research Versions: https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency-1.

Standard Design, but it assumes the energy features that the software user describes with user inputs. The Standard Design is minimally compliant with 2022 Title 24, Part 6 and the Proposed Design represents the out of compliance measures.

To develop savings estimates for the proposed code changes, the Statewide CASE Team compared the energy impacts of the Standard Design and Proposed Design for each prototypical building.

There are no existing requirements in Title 24, Part 6 for Cx for additions and alterations. The Statewide CASE Team developed the Proposed Design so that it calculated energy impacts of out of compliance systems based on stakeholder feedback.

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 16, Table 17, Table 18, and Table 19 present precisely which parameters were modified and what values were used in the Standard Design and Proposed Design.

Table 16: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change - Windows

Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
OfficeLarge	1 and 16	Base_AllCZ_FixedWindowU34	U-factor and SGHC	0.47, 0.41	0.74, 0.49
OfficeLarge	3 and 5	Base_AllCZ_FixedWindowU34	U-factor and SGHC	0.58, 0.41	0.41, 0.49
OfficeLarge	All other zones	Base_AllCZ_FixedWindowU34	U-factor and SGHC	0.47,0.31	0.59, 0.39

Table 17: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change - Central Plant Pump Controls

Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
OfficeLarge	All	Pump:VariableSpeed Pump:ConstantSpeed	Pump Control Type	Intermittent	Continuous
SchoolLarge	All	Pump:VariableSpeed Pump:ConstantSpeed	Pump Control Type	Intermittent	Continuous

Note: Variable speed pump is for chilled water and hot water and continuous speed pumps are for condenser water pumps.

Table 18: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change - Single Zone HVAC DCV

Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
LowRiseGarden	All	WaterUse:Connections	Drain Water Heat Exchanger Type	blank	CounterFlow
LoadedCorridor	All	WaterUse:Connections	Drain Water Heat Exchanger Destination	blank	PlantAndEquipment
MidRiseMixedUse	All	WaterUse:Connections	Drain Water Heat Exchanger U-Factor Times Area	blank	1,500

Table 19: Modifications Made to Standard Design in Each Prototype to Simulate Proposed Code Change - Central Load Distribution

Prototype ID	Climate Zone	Objects Modified	Parameter Name	Standard Design Parameter Value	Proposed Design Parameter Value
LowRiseGarden	All	WaterUse:Connections	Drain Water Heat Exchanger Type	blank	CounterFlow
LoadedCorridor	All	WaterUse:Connections	Drain Water Heat Exchanger Destination	blank	PlantAndEquipment
MidRiseMixedUse	All	WaterUse:Connections	Drain Water Heat Exchanger U-Factor Times Area	blank	1,500
HighRiseMixedUse	All	0	0	0	0
ApartmentHighRise	All	0	0	0.00	0.00

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 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/yr). CBECC also calculates annual peak electricity demand measured 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 in terms of floor area by building type.

5.1.3 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 and additions that would occur in 2026, the first year that the 2025 Title 24, Part 6 requirements are in effect.[18] 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 and 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.

5.2 Per-Unit Energy Impacts Results

Energy savings and peak demand reductions per-unit are presented in Table 20, Table 21, Table 22, Table 23, Table 24, and Table 25. The presented savings are from alterations. The per-unit energy savings figures do not account for naturally occurring market adoption or compliance rates.

[18] See CEC New Measure Proposal Template: https://www.energy.ca.gov/media/3538.

For this Draft CASE Report, modeling was completed for the OfficeLarge prototype for all climate zones for the windows scenario. For the central plant pump system operation scenario, modeling was completed for the OfficeLarge and SchoolLarge prototype. Finally, for the single zone HVAC DCV scenario, modeling was completed for the RestaurantFastFood prototype.

For windows, per-unit electricity savings for the first year are expected to range from 0.031 to 0.106 kWh/y depending on climate zone. Per-unit natural gas savings for the first year are expected to range from 0.147 to 0.565 kBtu/y depending on climate zone.

For the OfficeLarge prototype for central plant pump system operation, per-unit electricity savings for the first year are expected to range from 0.04 to 0.28 kWh/y depending on climate zone. Per-unit natural gas savings for the first year are expected to range from -0.25 to 0.12 kBtu/y depending on climate zone. For the SchoolLarge prototype, per-unit electricity savings for the first year are expected to range from 0.00 to 0.36 kWh/y depending on climate zone. Per-unit natural gas savings for the first year are expected to range from -0.04 to 0.02 kBtu/y depending on climate zone.

Finally, for single zone HVAC DCV, per-unit electricity savings for the first year are expected to range from -0.03 to 0.60 kWh/y depending on climate zone. Per-unit natural gas savings for the first year are expected to range from 3.00 to 24.53 kBtu/y depending on climate zone.

Table 20: OfficeLarge – Commissioning Windows – Savings Summary (per square foot)

OfficeLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	0.03	0.00	0.47	0.43	0.42
2	0.07	0.00	0.37	0.33	0.51
3	0.08	0.00	0.44	0.40	0.59
4	0.07	0.00	0.33	0.30	0.54
5	0.09	0.00	0.43	0.39	0.64
6	0.09	0.00	0.21	0.19	0.53
7	0.08	0.00	0.18	0.16	0.50
8	0.07	0.00	0.16	0.14	0.43
9	0.07	0.00	0.24	0.21	0.49
10	0.08	0.00	0.21	0.19	0.53
11	0.07	0.00	0.42	0.38	0.62
12	0.07	0.00	0.36	0.32	0.58

OfficeLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
13	0.07	0.00	0.27	0.25	0.54
14	0.07	0.01	0.35	0.31	0.59
15	0.11	0.00	0.15	0.13	0.62
16	0.05	0.00	0.57	0.51	0.57

- 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 1.
- The highest Peak Demand Savings for this measure are in Climate Zone 14, while the lowest Peak Demand Savings are in Climate Zones 6 and 7.
- The highest Natural Gas Savings are in Climate Zone 16, while the lowest Natural Gas Savings are in Climate Zone 15.

Table 21: RestaurantFastFood – Commissioning Single Zone HVAC DCV – Savings Summary (per square foot)

Restaurant FastFood Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	-0.00	N/A	24.53	22.21	13.81
2	0.03	N/A	17.36	15.72	10.17
3	-0.00	N/A	12.10	10.95	7.12
4	0.11	N/A	14.57	13.19	9.13
5	0.00	N/A	13.02	11.79	7.48
6	0.00	N/A	3.87	3.48	2.37
7	-0.03	N/A	3.42	3.06	2.04
8	0.09	N/A	4.79	4.31	3.41
9	0.10	0.00	5.74	5.16	4.02
10	0.16	0.00	5.93	5.33	4.41
11	0.22	0.00	13.39	12.12	9.17
12	0.10	-0.00	14.13	12.80	8.99
13	0.22	0.01	11.53	10.44	8.23
14	0.22	N/A	12.57	11.31	8.70
15	0.60	0.02	3.00	2.70	4.83
16	-0.00	-0.00	19.37	17.43	11.27

- 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 7.
- The highest Peak Demand Savings for this measure are in Climate Zone 15, while the lowest Peak Demand Savings are in Climate Zones 9, 10, 11, 12 and 16.
- The highest Natural Gas Savings are in Climate Zone 1, while the lowest Natural Gas Savings are in Climate Zone 15.

Table 22: OfficeLarge – Commissioning Central Plant Pump Controls – Savings Summary (per square foot)

OfficeLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	N/A	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	N/A	N/A
3	0.25	0.03	-0.25	-0.22	1.32
4	0.28	0.05	-0.11	-0.10	1.55
5	0.04	0.00	-0.11	-0.10	0.13
6	0.07	0.00	0.02	0.02	0.36
7	0.08	0.01	-0.05	-0.05	0.42
8	0.07	0.00	-0.08	-0.07	0.34
9	0.07	0.00	0.02	0.02	0.39
10	N/A	N/A	N/A	N/A	N/A
11	0.06	0.01	0.12	-0.11	0.28
12	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A
14	0.06	0.01	-0.13	-0.11	0.28
15	N/A	N/A	N/A	N/A	N/A
16	0.04	0.01	-0.12	-0.11	0.14

- The highest First-Year Energy Savings for this measure are in Climate Zone 4, while the lowest First-Year Energy Savings are in Climate Zone 16.
- The highest Peak Demand Savings for this measure are in Climate Zone 4, while the lowest Peak Demand Savings are in Climate Zones 5, 6, 8, and 9.
- The highest Natural Gas Savings are in Climate Zone 11, while the lowest Natural Gas Savings are in Climate Zone 3.

Table 23: SchoolLarge – Commissioning Central Plant Pump Controls – Savings Summary (per square foot)

SchoolLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	0.00	0.00	-0.02	-0.02	-0.01
2	0.07	0.00	-0.01	-0.01	0.30
3	0.03	N/A	-0.04	-0.04	0.12
4	0.10	0.00	-0.02	-0.01	0.54
5	0.05	0.00	-0.10	-0.09	0.14
6	0.09	0.00	-0.02	-0.01	0.46
7	0.13	0.00	0.00	0.00	0.68
8	N/A	N/A	N/A	N/A	N/A
9	0.13	0.00	0.02	0.02	0.67
10	0.16	0.00	0.01	0.01	0.78
11	0.15	0.00	0.03	0.03	0.88
12	0.11	0.00	-0.03	-0.03	0.60
13	0.17	0.01	0.00	0.00	0.89
14	0.14	0.00	-0.03	-0.03	0.66
15	0.36	0.01	-0.01	-0.01	1.84
16	0.04	0.00	-0.03	-0.03	0.14

- The highest First-Year Energy Savings for this measure are in Climate Zone 15, while the lowest are in Climate Zone 1.
- The highest Peak Demand Savings for this measure are in Climate Zones 13 and 15, while the rest of the climate zones have Peak Demand Savings of 0.00 kW.
- The highest Natural Gas Savings for this measure are in Climate Zone 11, while the lowest are in Climate Zone 3.

Table 24: OfficeLarge – Commissioning Central Load Distribution – Savings Summary (per square foot)

OfficeLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	0.00	0.00	-0.03	-0.02	0.01
2	0.01	0.00	-0.04	-0.03	0.03
3	0.04	0.00	-0.03	-0.03	0.16

OfficeLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
4	-0.00	0.00	-0.03	-0.02	0.03
5	0.03	0.00	-0.02	-0.02	0.12
6	0.05	0.01	0.00	0.00	0.35
7	0.06	0.01	-0.00	-0.00	0.37
8	0.03	0.01	-0.01	-0.01	0.24
9	0.02	0.00	0.03	0.02	0.19
10	0.00	0.00	-0.01	-0.01	0.08
11	0.01	0.01	-0.05	-0.04	0.05
12	N/A	N/A	N/A	N/A	N/A
13	0.01	0.01	-0.03	-0.03	0.09
14	0.02	0.01	-0.06	-0.06	0.13
15	-0.03	0.00	-0.00	-0.00	-0.13
16	0.04	0.01	-0.04	-0.04	0.18

- The highest First-Year Energy Savings for this measure are in Climate Zone 7, while the lowest are in Climate Zone 15.
- The highest Peak Demand Savings for this measure are in Climate Zones 6 to 8, 11, 13, 14, and 16, while the rest of the climate zones have Peak Demand Savings of 0.00 kW.
- The highest Natural Gas Savings for this measure are in Climate Zone 9, while the lowest are in Climate Zone 14.

Table 25: SchoolLarge – Commissioning Central Load Distribution – Savings Summary (per square foot)

OfficeLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
1	-0.01	-0.00	-0.02	-0.02	-0.05
2	0.03	0.00	-0.03	-0.03	0.10
3	-0.00	-0.00	-0.01	-0.01	-0.01
4	0.04	-0.00	0.01	0.00	0.27
5	0.01	-0.00	-0.00	-0.00	0.01
6	0.00	0.00	-0.01	-0.01	0.03
7	0.04	0.00	-0.00	-0.00	0.22

OfficeLarge Climate Zones	First Year Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (kBtu)	Source Energy Savings (kBtu)	Long-term Systemwide Cost Savings ($2026)
8	0.04	0.00	0.03	0.03	0.27
9	0.04	0.00	0.01	0.01	0.25
10	0.04	0.00	0.01	0.01	0.27
11	0.07	0.00	0.04	0.03	0.42
12	0.05	0.00	-0.01	-0.01	0.29
13	0.08	0.00	-0.00	-0.00	0.45
14	0.05	0.00	-0.02	-0.02	0.28
15	0.12	0.00	-0.02	-0.02	0.64
16	-0.00	-0.00	-0.02	-0.02	-0.04

- The highest First-Year Energy Savings for this measure are in Climate Zone 15, while the lowest are in Climate Zone 1.
- The changes are no significant for Peak Demand Savings for this measure but for Climate Zones 1, 3, 4, 5, and 16 have slightly negative Peak Demand Savings because they are heating dominated climate zones.
- The highest Natural Gas Savings for this measure are in Climate Zone 11, while the lowest are in Climate Zone 2.

6. Cost and Cost-Effectiveness

6.1 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 5.1. LSC hourly factors are a normalized metric to calculate energy cost savings and 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 6 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 change to Title 24, Part 6.[19] Appendix G presents LSC savings results in nominal dollars.

6.2 Energy Cost Savings Results

Per-unit energy cost savings for Cx 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 26, Table 27, Table 28, and Table 29.

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 to disproportionately impact DIPs. Refer to Section 2 for more details addressing energy equity and environmental justice.

Table 26: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Prototype Square Foot – Alterations – Commissioning – Windows – 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	0.15	0.27	0.42
2	0.30	0.21	0.51
3	0.34	0.25	0.59
4	0.34	0.19	0.54

19 https://efiling.energy.ca.gov/GetDocument.aspx?tn=237722&DocumentContentId=70943

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Savings (2026 PV$)
5	0.40	0.24	0.64
6	0.41	0.12	0.53
7	0.40	0.10	0.50
8	0.33	0.09	0.43
9	0.35	0.14	0.49
10	0.41	0.12	0.53
11	0.38	0.24	0.62
12	0.37	0.21	0.58
13	0.38	0.16	0.54
14	0.38	0.21	0.59
15	0.53	0.09	0.62
16	0.24	0.33	0.57

Table 27: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Prototype Square Foot – Alterations – Commissioning – Single Zone HVAC DCV – RestaurantFastFood

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ01	-0.01	13.82	13.81
CZ02	0.13	10.04	10.17
CZ03	-0.01	7.13	7.12
CZ04	0.50	8.62	9.13
CZ05	0.00	7.47	7.48
CZ06	0.02	2.35	2.37
CZ07	-0.08	2.12	2.04
CZ08	0.44	2.97	3.41
CZ09	0.49	3.53	4.02
CZ10	0.77	3.64	4.41
CZ11	1.08	8.09	9.17
CZ12	0.50	8.49	8.99
CZ13	1.18	7.05	8.23
CZ14	0.97	7.73	8.70
CZ15	2.95	1.88	4.83
CZ16	-0.01	11.39	11.37

Table 28: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Prototype Square Foot – Alterations – Commissioning – Central Plant Pump Controls – OfficeLarge

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ01	N/A	N/A	N/A
CZ02	N/A	N/A	N/A
CZ03	1.46	-0.14	1.32
CZ04	1.62	-0.07	1.55
CZ05	0.20	-0.06	0.13
CZ06	0.35	0.01	0.36
CZ07	0.45	-0.03	0.42
CZ08	0.39	-0.05	0.34
CZ09	0.38	0.01	0.39
CZ10	N/A	N/A	N/A
CZ11	0.35	-0.07	0.28
CZ12	N/A	N/A	N/A
CZ13	N/A	N/A	N/A
CZ14	0.36	-0.08	0.28
CZ15	N/A	N/A	N/A
CZ16	0.22	-0.07	0.14

Table 29: 2026 PV Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Prototype Square Foot – Alterations – Commissioning – Central Plant Pump Controls – SchoolLarge

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ01	0.00	-0.01	-0.01
CZ02	0.30	-0.01	0.30
CZ03	0.15	-0.02	0.12
CZ04	0.55	-0.01	0.54
CZ05	0.19	-0.06	0.14
CZ06	0.47	-0.01	0.46
CZ07	0.68	0.00	0.68
CZ08	N/A	N/A	N/A
CZ09	0.67	0.01	0.67
CZ10	0.77	0.01	0.78
CZ11	0.86	0.02	0.88
CZ12	0.62	-0.02	0.60
CZ13	0.90	0.00	0.89

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ14	0.68	-0.02	0.66
CZ15	1.84	0.00	1.84
CZ16	0.16	-0.02	0.14

Table 30: Average 2026 Present Value Long-term Systemwide Cost Savings Per Square Foot Over 30-Year Period of Analysis – Alterations – Commissioning – Central Plant Pump Controls – All Prototypes

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ01	0.00	-0.01	-0.01
CZ02	0.30	-0.01	0.30
CZ03	1.20	-0.11	1.08
CZ04	1.44	-0.06	1.38
CZ05	0.20	-0.06	0.14
CZ06	0.38	0.01	0.39
CZ07	0.51	-0.02	0.48
CZ08	0.39	-0.05	0.34
CZ09	0.43	0.01	0.44
CZ10	0.77	0.01	0.78
CZ11	0.76	0.00	0.75
CZ12	0.62	-0.02	0.60
CZ13	0.90	0.00	0.89
CZ14	0.48	-0.06	0.42
CZ15	1.84	0.00	1.84
CZ16	0.19	-0.05	0.14

Table 31: 2026 Present Value Long-term Systemwide Cost Savings Per Square Foot Over 30-Year Period of Analysis – Alterations – Central Load Distribution – OfficeLarge Prototype

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ01	0.02	-0.01	0.01
CZ02	0.05	-0.02	0.03
CZ03	0.17	-0.02	0.16
CZ04	0.04	-0.02	0.03
CZ05	0.14	-0.01	0.12
CZ06	0.35	0.00	0.35
CZ07	0.37	0.00	0.37

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ08	0.24	0.00	0.24
CZ09	0.18	0.01	0.19
CZ10	0.09	-0.01	0.08
CZ11	0.08	-0.03	0.05
CZ12	N/A	N/A	N/A
CZ13	0.11	-0.02	0.09
CZ14	0.17	-0.04	0.13
CZ15	-0.12	0.00	-0.13
CZ16	0.21	-0.03	0.18

Table 32: 2026 Present Value Long-term Systemwide Cost Savings Per Square Foot Over 30-Year Period of Analysis – Alterations – Central Load Distribution – SchoolLarge Prototype

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ01	-0.04	-0.01	-0.05
CZ02	0.11	-0.01	0.10
CZ03	-0.01	-0.01	-0.01
CZ04	0.26	0.00	0.27
CZ05	0.01	0.00	0.01
CZ06	0.04	-0.01	0.03
CZ07	0.22	0.00	0.22
CZ08	0.25	0.02	0.27
CZ09	0.25	0.00	0.25
CZ10	0.26	0.01	0.27
CZ11	0.40	0.02	0.42
CZ12	0.30	-0.01	0.29
CZ13	0.45	0.00	0.45
CZ14	0.29	-0.02	0.28
CZ15	0.65	-0.01	0.64
CZ16	-0.02	-0.01	-0.04

Table 33: Average 2026 Present Value Long-term Systemwide Cost Savings Per Square Foot Over 30-Year Period of Analysis – Alterations – Load Distribution – All Prototypes

Climate Zone	30-Year LSC Electricity Savings (2026 PV $)	30-Year LSC Gas Savings (2026 PV $)	Total 30-Year LSC Savings (2026 PV $)
CZ01	-0.03	-0.01	-0.05
CZ02	0.09	-0.02	0.08
CZ03	0.14	-0.02	0.12
CZ04	0.08	-0.01	0.06
CZ05	0.07	-0.01	0.07
CZ06	0.28	0.00	0.28
CZ07	0.33	0.00	0.33
CZ08	0.25	0.00	0.25
CZ09	0.19	0.01	0.20
CZ10	0.17	0.00	0.17
CZ11	0.33	0.01	0.35
CZ12	0.30	-0.01	0.29
CZ13	0.36	-0.01	0.35
CZ14	0.22	-0.03	0.19
CZ15	0.37	-0.01	0.36
CZ16	0.11	-0.02	0.09

6.3 Incremental First Cost

Incremental first costs include time and labor by the CxA to develop, maintain, and document the Cx process throughout the project lifetime. The traditional existing building Cx per square foot cost varies from $0.25 to $1.50. However, this cost is for all systems and all retro-commissioning measures, not for a single measure. Also, in current non-code mandated practice, existing building Cx will also cover tasks that are outside of the code compliance. Therefore, the Statewide CASE Team used $0.10 per square foot for each measure because the pre-phase commissioning task will reduce the cost of data collection and survey work performed by individual contractors. This cost reduction to the design team and contractor team are not deducted here. The cost assumption includes the following:

Project Phase	CxA Scope Items
Pre-Design Phase	▪ Current Facility requirements relevant to systems that are part of the scope of additions and alterations project.
Design	▪ Commissioning design review kickoff. ▪ Developing the commissioning plan and owner's project requirements (OPR)
Construction	▪ Field review and documentation ▪ Coordination with contractors and owners after documenting variances from the commissioning plan.
Post-Construction	▪ Writing final commissioning report.

The Statewide CASE Team estimates that incremental costs of Cx activities will be equivalent in additions or alterations compared to the costs of Cx for new construction. Costs may increase for projects where the design calls for tying in new systems to existing systems. This cost increase would be driven by additional information gathering and coordination relating to understanding the location, type, nature, and condition of existing systems.

6.4 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 proposal involves only process, not materials or equipment, so there are no incremental maintenance or replacement costs associated with a Cx requirement. However, the Statewide CASE Team received feedback from some stakeholders that reductions in maintenance and replacement costs can be expected due to Cx of the system.

6.5 Cost Effectiveness

This measure proposes a mandatory requirement and 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. 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 34, Table 35,Table 36, and Table 37.

Table 34: 30-Year Cost-Effectiveness Summary Per Square Foot – Alterations – Commissioning – Windows

Climate Zone	Benefits LSC Savings + Other PV Savings[a] (2026 PV$)	Costs Total Incremental PV Costs[b] (2026 PV$)	Benefit-to-Cost Ratio
1	0.42	0.10	4.33
2	0.51	0.10	5.23
3	0.59	0.10	6.05
4	0.54	0.10	5.52
5	0.64	0.10	6.61
6	0.53	0.10	5.49
7	0.50	0.10	5.16
8	0.43	0.10	4.38
9	0.49	0.10	5.05
10	0.53	0.10	5.42
11	0.62	0.10	6.42
12	0.58	0.10	5.97
13	0.54	0.10	5.58
14	0.59	0.10	6.05
15	0.62	0.10	6.40
16	0.57	0.10	5.88
Total	0.51	0.10	5.30

a. **Benefits: Long-term Systemwide Cost 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 the 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 benefit-to-cost ratio is infinite.

Table 35: 30-Year Cost-Effectiveness Summary Per Square Foot – Alterations – Commissioning – Single Zone HVAC DCV

Climate Zone	Benefits: LSC Savings + Other PV Savings	Costs: Total Incremental PV Costs	Benefit-to-Cost Ratio
	(2026 PV$/square foot)	(2026 PV$/square foot)	
1	13.81	0.25	55.24
2	10.17	0.25	40.70
3	7.12	0.25	28.49
4	9.13	0.25	36.52
5	7.48	0.25	29.92
6	2.37	0.25	9.48
7	2.04	0.25	8.16
8	3.41	0.25	13.64
9	4.02	0.25	16.09
10	4.41	0.25	17.65
11	9.17	0.25	36.69
12	8.99	0.25	35.96
13	8.23	0.25	32.93
14	8.70	0.25	34.82
15	4.83	0.25	19.34
16	11.37	0.25	45.50
Total	**5.33**	**0.25**	**21.32**

Table 36: 30-Year Cost-Effectiveness Summary Per Square Foot – Alterations – Commissioning – Central Plant Pump Controls

Climate Zone	Benefits: LSC Savings + Other PV Savings	Costs: Total Incremental PV Costs	Benefit-to-Cost Ratio
	(2026 PV$/square foot)	(2026 PV$/square foot)	
1	-0.01	0.25	-0.04
2	0.30	0.25	1.19
3	1.08	0.25	4.33
4	1.38	0.25	5.54
5	0.14	0.25	0.54
6	0.39	0.25	1.54
7	0.48	0.25	1.93
8	0.34	0.25	1.36
9	0.44	0.25	1.77
10	0.78	0.25	3.11
11	0.75	0.25	3.02
12	0.60	0.25	2.39
13	0.89	0.25	3.58
14	0.42	0.25	1.70
15	1.84	0.25	7.36
16	0.14	0.25	0.57
Total	**0.62**	**0.25**	**2.49**

Table 37: 30-Year Cost Effectiveness Summary Per Square Foot – Alterations – Commissioning Central Load Distribution

Climate Zone	Benefits: LSC Savings + Other PV Savings	Costs: Total Incremental PV Costs	Benefit-to-Cost Ratio
	(2026 PV$/square foot)	(2026 PV$/square foot)	
1	-0.05	0.01	-3.18
2	0.08	0.03	2.76
3	0.12	0.08	1.53
4	0.06	0.08	0.77
5	0.07	0.05	1.41
6	0.28	0.08	3.58
7	0.33	0.08	4.35
8	0.25	0.08	3.12
9	0.20	0.08	2.52
10	0.17	0.05	3.40
11	0.35	0.02	16.92
12	0.29	0.00	N/A
13	0.35	0.03	13.64
14	0.19	0.06	2.96
15	0.36	0.04	9.78
16	0.09	0.06	1.52
Total	**0.21**	**0.07**	**2.99**

7. First-Year Statewide Impacts

7.1 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 5.2, 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 additions and alterations 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 additions and alterations 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 tables below present the first-year statewide energy and energy cost savings from Cx windows in Large Offices, Cx single zone HVAC DCV in Fast Food Restaurants, and Cx pump controls in Large Offices and School Offices by climate zone.

While a statewide analysis is crucial to understanding broader effects of code change proposals, there is potential to disproportionately impact DIPs that needs to be considered. Refer to Section 2 for more details addressing energy equity and environmental justice.

Table 38: Statewide Energy and Energy Cost Impacts – Alterations – Commissioning – Windows – OfficeLarge

Climate Zone	Statewide Alterations 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	2,869	0.00	0.00	0.00	0.00	0.00
2	69,795	0.00	0.00	0.00	0.02	0.04
3	3,145,500	0.24	0.01	0.01	1.26	1.85
4	1,627,875	0.11	0.01	0.01	0.49	0.87
5	41,220	0.00	0.00	0.00	0.02	0.03
6	2,239,650	0.20	0.00	0.00	0.42	1.19
7	1,635,975	0.13	0.00	0.00	0.26	0.82
8	3,658,500	0.26	0.01	0.01	0.51	1.56
9	6,819,750	0.49	0.01	0.02	1.44	3.35
10	1,315,800	0.11	0.00	0.00	0.24	0.69
11	58,680	0.00	0.00	0.00	0.02	0.04
12	1,768,725	0.13	0.01	0.01	0.57	1.03
13	208,440	0.01	0.00	0.00	0.05	0.11
14	456,075	0.03	0.00	0.00	0.14	0.27
15	99,765	0.01	0.00	0.00	0.01	0.06
16	104,918	0.00	0.00	0.00	0.05	0.06
Total	23,253,536	1.74	0.05	0.06	5.53	11.96

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

Table 39: Statewide Energy and Energy Cost Impacts – Alterations – Commissioning – Single Zone HVAC DCV – RestaurantFastFood

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2026	First-Year[a] Electricity Savings	First-Year Peak Electrical Demand Reduction	First-Year Natural Gas Savings	First-Year Source Energy Savings	30-Year Present Valued Energy Cost Savings
	(square feet)	(GWh)	(MW)	(million therms)	(million kBtu)	(million 2026 PV$)
CZ01	9,131	-0.00	N/A	0.00	0.20	$0.13
CZ02	54,240	0.00	N/A	0.01	0.85	$0.55
CZ03	220,800	-0.00	N/A	0.03	2.42	$1.57
CZ04	112,410	0.01	N/A	0.02	1.48	$1.03
CZ05	23,190	0.00	N/A	0.00	0.27	$0.17
CZ06	246,900	0.00	N/A	0.01	0.86	$0.59
CZ07	160,950	-0.01	N/A	0.01	0.49	$0.33
CZ08	356,700	0.03	N/A	0.02	1.54	$1.22
CZ09	600,000	0.06	0.00	0.03	3.10	$2.41
CZ10	486,150	0.08	0.00	0.03	2.59	$2.14
CZ11	52,725	0.01	0.00	0.01	0.64	$0.48
CZ12	254,250	0.03	-0.00	0.04	3.25	$2.29
CZ13	116,130	0.03	0.00	0.01	1.21	$0.96
CZ14	102,885	0.02	N/A	0.01	1.16	$0.90
CZ15	51,795	0.03	0.00	0.00	0.14	$0.25
CZ16	28,455	-0.00	-0.00	0.01	0.50	$0.32
Total	**2,876,711**	**0.30**	**0.01**	**0.23**	**20.71**	**$15.33**

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

Table 40: Statewide Energy and Energy Cost Impacts – Alterations – Commissioning – Central Plant Pump Controls – OfficeLarge and SchoolLarge Prototypes

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2026	First-Year[a] Electricity Savings	First-Year Peak Electrical Demand Reduction	First-Year Natural Gas Savings	First-Year Source Energy Savings	30-Year Present Valued Energy Cost Savings
	(square feet)	(GWh)	(MW)	(million therms)	(million kBtu)	(million 2026 PV$)
CZ01	11,384	0.00	0.00	0.00	0.00	$0.00
CZ02	120,300	0.01	0.00	0.00	0.00	$0.04
CZ03	2,619,450	0.54	0.06	-0.01	-0.49	$2.84
CZ04	1,294,500	0.32	0.06	0.00	-0.11	$1.79
CZ05	58,545	0.00	0.00	0.00	-0.01	$0.01
CZ06	1,918,650	0.14	0.01	0.00	0.02	$0.74
CZ07	1,428,750	0.13	0.01	0.00	-0.05	$0.69
CZ08	2,439,000	0.17	0.01	0.00	-0.17	$0.83
CZ09	5,650,200	0.46	0.02	0.00	0.09	$2.50
CZ10	840,150	0.13	0.00	0.00	0.01	$0.65
CZ11	191,070	0.02	0.00	0.00	0.00	$0.14
CZ12	800,700	0.09	0.00	0.00	-0.02	$0.48
CZ13	396,150	0.07	0.00	0.00	0.00	$0.35
CZ14	484,950	0.04	0.00	0.00	-0.04	$0.21
CZ15	114,315	0.04	0.00	0.00	0.00	$0.21
CZ16	123,780	0.00	0.00	0.00	-0.01	$0.02
Total	**18,491,894**	**2.18**	**0.18**	**-0.01**	**-0.79**	**$11.49**

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

Table 41: Statewide Energy and Energy Cost Impacts – Alterations – Central Load Distribution

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2026	First-Year[a] Electricity Savings	First-Year Peak Electrical Demand Reduction	First-Year Natural Gas Savings	First-Year Source Energy Savings	30-Year Present Valued LSC Savings
	(square feet)	(GWh)	(MW)	(million therms)	(million kBtu)	(million 2026 PV$)
CZ01	22,160	-0.00	-0.00	-0.00	-0.00	$0.00
CZ02	278,050	0.01	0.00	-0.00	-0.01	$0.02
CZ03	4,365,750	0.12	0.01	-0.00	-0.10	$0.53
CZ04	2,157,500	0.01	0.00	-0.00	-0.04	$0.14
CZ05	97,575	0.00	0.00	-0.00	-0.00	$0.01
CZ06	3,197,750	0.14	0.02	-0.00	-0.00	$0.88
CZ07	2,381,250	0.12	0.01	-0.00	-0.01	$0.78
CZ08	5,137,750	0.17	0.03	0.00	0.01	$1.25
CZ09	9,417,000	0.24	0.04	0.00	0.19	$1.89
CZ10	2,862,250	0.07	0.01	0.00	0.01	$0.49
CZ11	318,450	0.02	0.00	0.00	0.01	$0.11
CZ12	1,334,500	0.06	0.00	-0.00	-0.02	$0.38
CZ13	891,850	0.05	0.00	-0.00	-0.01	$0.31
CZ14	808,250	0.02	0.00	-0.00	-0.04	$0.15
CZ15	301,375	0.02	0.00	-0.00	-0.00	$0.11
CZ16	206,300	0.00	0.00	-0.00	-0.01	$0.02
Total	**33,777,760**	**1.06**	**0.13**	**-0.00**	**-0.03**	**$7.07**

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

Table 42: Statewide Energy and Energy Cost Impacts – Additions and Alterations – Commissioning – Summary of All Measures

Measure and Construction Type	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$)
Windows					
Alterations	1.7	0.05	0.1	5.5	12
Single Zone HVAC DCV					
Alterations	0.3	0.0	0.2	20.7	15
Central Plant Pump Controls					
Alterations	2.2	0.2	0.0	-0.8	11
Central Load Distribution					
Alterations	1.1	0.1	-0.0	-0.0	7
Total	5.3	0.35	0.3	25.4	45

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

7.2 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) (California Energy Commission 2020).

The monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs).[20] The cost-effectiveness analysis presented in Section 6 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 4343presents the estimated first-year avoided GHG emissions of the proposed code change. During the first year, GHG emissions of 1,790 (metric tons CO2e) would be avoided.

[20] 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 4343: 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 Emissions[b] (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions[c] ($)
Windows	2	86	0.06	335	421	51,825
Single Zone HVAC DCV	0	11	0.23	1,252	1,264	155,640
Central Plant Pump Controls	2	153	-0.01	-48	105	12,945
Central Load Distribution	1	91	0.00	-1	89	11,002
TOTAL	5	341	0.28	1,538	1,879	231,412

a. First-year savings from all applicable building additions and alterations completed statewide in 2026.

a. GHG emissions savings were calculated using hourly GHG emissions factors published alongside the LSC hourly factors and Source Energy hourly factors by CEC.[21]

b. 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.[22]

7.3 Statewide Water Use Impacts

The proposed code change will not result in water savings.

7.4 Statewide Material Impacts

The proposed code change will not result in statewide material impacts.

7.5 Other Non-Energy Impacts

The Statewide CASE Team did not quantify other non-energy impacts for this proposed measure.

[21] https://www.energy.ca.gov/files/2025-energy-code-hourly-factors

[22] https://www.energy.ca.gov/files/tdv-2022-update-model

8. Proposed Revisions to Code Language

8.1 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).

8.2 Standards

SECTION 120.8 – NONRESIDENTIAL BUILDING COMMISSIONING

Nonresidential buildings other than healthcare facilities, with conditioned space of 10,000 square feet or more, shall comply with the applicable requirements of Sections 120.8(a) through 120.8(i) in the building design and construction processes. All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding those related solely to covered processes.

Nonresidential buildings other than healthcare facilities, with conditioned space of less than 10,000 square feet, shall comply with the design review requirements specified in Sections 120.8(d) and shall include any measures or requirements necessary for completing this review in the construction documents in a manner consistent with Section 120.8(e).

Healthcare facilities shall instead comply with the applicable requirements of Chapter 7 of the California Administrative Code (Title 24, Part 1).

NOTE: Nonresidential buildings include nonresidential spaces such as nonresidential function areas within hotel/motel and high-rise residential buildings. The requirements of Section 120.8 apply based on the square footage of the nonresidential spaces.

The commissioning described in this Section is in addition to any commissioning required by Title 24, Part 11, Section 5.410.2, 5.410.4, and subsections.

For additions and alterations, the reference sections are applicable only to systems being added or altered. Commissioning of unaltered systems is not required.

(a) Summary of Commissioning Requirements.

Commissioning shall include completion of the following items:

1. Owner's or owner representative's project requirements;
2. Basis of design;
3. Design phase design review;
4. Commissioning measures shown in the construction documents;

5. Commissioning plan;
6. Functional performance testing;
7. Documentation and training; and
8. Commissioning report.

(b) Owner's or Owner Representative's Project Requirements (OPR).

The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following:

1. New construction and additions:

i~~1~~. Energy efficiency goals;

ii~~2~~. Ventilation requirements;

iii~~3~~. Project documentation requirements, including facility functions, hours of operation~~,~~ and need for after-hours operation;

iv~~4~~. Equipment and systems expectations; and

v~~5~~. Building envelope performance expectations.

2. Alterations:

i. Current energy performance of the system being altered;

ii. Energy efficiency goals;

iii. Ventilation requirements if HVAC systems are altered;

iv. Current system requirements including altered system functions, SOO, set points, hours of operation, and need for after-hours operation;

v. Equipment and systems expectations;

vi. Building envelope performance expectations and efficiency improvement over current envelope performance;

vii. Incompatible controls or control systems that do not support the newly installed system;

viii. Status of sensors' locations and calibration and any required change without which the altered system will not perform as intended.

(c) Basis of Design (BOD).

A written explanation of how the design of the building systems and components meet the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. For alteration projects, the documentation shall include any changes to the building's original BOD. The BOD document shall cover the following systems and components:

1. Heating, ventilation, air conditioning (HVAC) systems and controls;
2. Indoor lighting system and controls;

3. Water heating systems and controls;
4. Any other building equipment or system listed in the OPR; and
5. Any building envelope component considered in the OPR.

(d) Design Phase Design Review.

1. **Design Reviewer Requirements.** The design reviewer shall be the signer of the Design Review Kickoff Certificate(s) of Compliance and Construction Document Design Review Checklist Certificate(s) of Compliance as specified in Part 1 Section 10-103(a)1.
2. **Design Review Kickoff.** During the schematic design phase of the building project, the owner or owner's representative, design team and design reviewer must meet to discuss the project scope, schedule and how the design reviewer will coordinate with the project team. The building owner or owner's representative shall include the Design Review Kickoff Certificate of Compliance form in the Certificate of Compliance documentation as specified in Part 1 Section 10-103.
3. **Construction Documents Design Review.** The Construction Document Design Review Checklist Certificate of Compliance shall list the items checked by the design reviewer during the construction document review. The completed form shall be returned to the owner and design team for review and sign-off. The building owner or owner's representative shall include this form in the Certificate of Compliance documentation as specified in Part 1 Section 10-103.

(e) Commissioning measures shown in the construction documents.

Complete descriptions of all measures or requirements necessary for commissioning shall be included in the construction documents (plans and specifications). Commissioning measures or requirements shall be clear, detailed and complete to clarify the commissioning process.

(f) Commissioning Plan.

Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following:

1. General project information;
2. Commissioning goals;
3 Systems to be commissioned; and
4. Plans to test systems and components, which shall include:

A. An explanation of the original design intent;

B. Equipment and systems to be tested, including the extent of tests;

C. Functions to be tested;

D. Conditions under which the test shall be performed;

E. Measurable criteria for acceptable performance;

F. Commissioning team information; and

G. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included.

(g) Functional performance testing.

Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the acceptance test requirements in Sections 120.5, 130.4 and 140.9, 160.3(d) and 160.5(e) Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.

EXCEPTION to Section 120.8(g): Healthcare facilities.

(h) Documentation and training.

A Systems Manual and Systems Operations Training shall be completed.

1. **Systems manual.** Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual shall include the following:

A. Site information, including facility description, history and current requirements;

B. Site contact information;

C. Instructions for basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, and a site events log;

D. Description of major systems;

E. Site equipment inventory and maintenance notes; and

F. A copy of all special inspection verifications required by the enforcing agency or the Standards.

2. **Systems operations training**. The training of the appropriate maintenance staff for each equipment type or system shall be documented in the commissioning report. Training materials shall include the following:

A. System and equipment overview (i.e., what the equipment is, what it does and with what other systems or equipment it interfaces);

B. Review and demonstration of operation, servicing and preventive maintenance procedures;

C. Review of the information in the Systems Manual; and

D. Review of the record drawings on the systems and equipment

(i) Commissioning report.

A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or owner's representative.

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

(a) Additions. Additions shall meet either Item 1 or 2 below.

1. Prescriptive approach.

The envelope and lighting of the addition; any newly installed space-conditioning system, electrical power distribution system, or water-heating system; any addition to an outdoor lighting system; and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110.0 through ~~120.7, 120.9 through~~ 130.5, and 140.2 through 140.10.

2. Performance approach.

A. The envelope and indoor lighting in the conditioned space of the addition, and any newly installed space-conditioning system, electrical power distribution system, or water-heating system, shall meet the applicable requirements of Sections 110.0 through ~~120.7, 120.9 through~~ 130.5 and

(Item B not shown for clarity)

(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.

(Items A through D not shown for clarity)

E. **Commissioning.** For nonresidential building alterations other than healthcare facilities, with conditioned space of 10,000 square feet or more, the altered components of the envelope, or space conditioning, lighting, electrical power distribution and water heating systems, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Section 120.8.

EXCEPTIONS. Systems and components related to:
1. Covered processes
2, Building envelope alterations of less than 50% of the building envelope assembly area
3. Solar readiness

8.3 Reference Appendices

There are no proposed changes to the Reference Appendices.

8.4 ACM Reference Manual

There are no proposed changes to the ACM Reference Manual.

8.5 Compliance Forms

The Certificate of Compliance would need to be revised. Specifically, language would need to be added (and struck) to note alterations are now required to complete commissioning requirements. The vast majority of this form would be remain unchanged.

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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 (California Energy Commission, 2022). The CEC provided the construction estimates on March, 27, 2023 at the Staff Workshop on Triennial California Energy Code Measure Proposal Template.

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 nonresidential new construction forecast is presented in Table 44 and nonresidential existing statewide building stock is presented in Table 45. 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 46 through Table 49. This section describes how the Statewide CASE Team developed these estimates.

The CEC Building Standards Office 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 total floorspace of newly constructed buildings in 2026 by building type and climate zone. The building types included in the CECs' forecast are summarized in Table 44.

The Statewide CASE Team made assumptions about the percentage of newly constructed floorspace that would be impacted by the proposed code change. Table 46 through Table 49 presents the assumed percentage of floorspace that would be impacted by the proposed code change by climate zone. 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 46 through Table 49 presents percentage of floorspace assumed to be impacted by the proposed change by climate zone.

Table 44: Estimated New Nonresidential Construction in 2026 (Million Square Feet)

Building Prototype	Floorspace (million square feet)																
Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
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
Small Office	0.01	0.44	0.19	0.02	0.06	0.15	0.23	0.16	0.36	0.42	0.09	0.54	0.39	0.04	0.11	0.03	3.24
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
Strip Mall	0.00	0.15	0.50	0.23	0.01	0.56	0.49	0.99	1.07	1.35	0.07	0.59	0.33	0.32	0.10	0.06	6.81
Mixed-use Retail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large School	0.01	0.13	0.88	0.44	0.04	0.59	0.61	0.91	1.42	0.85	0.35	1.15	0.61	0.17	0.09	0.07	8.31
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
Non-refrigerated Warehouse	0.06	0.37	2.16	1.12	0.18	1.36	0.71	1.95	3.01	1.36	0.63	2.84	0.82	0.36	0.37	0.14	17.44
Hotel	0.04	0.22	1.03	0.53	0.11	0.55	0.48	0.78	1.18	0.57	0.15	0.80	0.26	0.14	0.12	0.04	7.02
Assembly	0.01	0.39	1.58	0.56	0.06	0.79	0.80	1.43	1.82	1.14	0.17	1.41	0.30	0.25	0.12	0.08	10.92
Hospital	0.03	0.17	0.84	0.44	0.08	0.33	0.55	0.44	0.79	0.81	0.15	0.83	0.27	0.14	0.12	0.05	6.03
Laboratory	0.00	0.05	0.63	0.36	0.02	0.07	0.05	0.10	0.12	0.06	0.01	0.05	0.01	0.01	0.01	0.00	1.57
Restaurant	0.01	0.08	0.33	0.17	0.03	0.34	0.20	0.49	0.82	0.41	0.07	0.31	0.14	0.10	0.05	0.03	3.59
Enclosed Parking Garage	0.00	0.01	1.83	1.25	0.00	2.59	0.71	2.27	1.53	0.05	0.00	0.04	0.00	0.02	0.00	0.01	10.29
Open Parking Garage	0.00	0.12	2.47	1.68	0.06	3.65	1.20	3.20	2.16	0.65	0.02	0.53	0.04	0.20	0.05	0.09	16.12
Grocery	0.01	0.05	0.10	0.06	0.01	0.05	0.02	0.05	0.09	0.05	0.01	0.04	0.02	0.01	0.01	0.01	0.58
Refrigerated Warehouse	0.00	0.00	0.06	0.05	0.01	0.02	0.00	0.01	0.01	0.04	0.00	0.07	0.12	0.01	0.01	0.01	0.41

Building Prototype	Floorspace (million square feet)																
Controlled-environment Horticulture	0.09	0.08	0.32	0.04	0.20	0.26	0.00	0.02	0.03	0.28	0.30	0.31	0.09	0.01	0.05	0.00	2.08
Vehicle Service	0.00	0.08	0.55	0.36	0.03	0.55	0.34	0.80	1.81	0.57	0.02	0.39	0.25	0.20	0.06	0.05	6.05
Manufacturing	0.01	0.13	0.40	0.19	0.06	0.13	0.09	0.11	0.10	0.11	0.06	0.16	0.02	0.02	0.02	0.01	1.62
Unassigned	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
TOTAL	0.6	3.6	20.8	11.5	1.7	16.2	9.1	19.7	27.4	12.1	3.0	16.2	5.3	3.0	1.9	1.0	152.9

Source: CEC Measure Proposal Template https://www.energy.ca.gov/media/3538

Table 45: Estimated Existing Nonresidential Building Stock in 2026, by Climate Zone and Building Type

Building Prototype	Floorspace (million square feet)																
Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
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
Small Office	4.18	12.75	22.19	11.33	7.50	13.22	8.52	13.28	20.88	24.43	10.60	43.94	21.47	4.99	6.18	2.68	228.13
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
Strip Mall	3.34	9.84	37.42	18.43	5.10	40.23	28.29	55.76	83.70	66.92	12.25	48.37	24.18	15.27	8.70	4.59	462.38
Mixed-use Retail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large School	0.76	8.02	34.83	13.95	2.07	28.37	22.54	42.91	73.58	56.01	10.13	53.38	26.41	12.06	7.62	3.59	396.23
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
Non-refrigerated Warehouse	3.33	20.22	108.30	53.43	9.80	89.98	51.48	128.40	207.30	182.70	33.73	148.30	51.08	38.87	29.05	11.63	1167.60
Hotel	1.77	10.52	48.10	24.73	5.01	30.49	32.66	41.97	66.01	37.09	7.22	40.53	13.08	8.01	5.88	2.44	375.50
Assembly	4.33	18.18	91.34	45.06	6.59	57.25	40.90	89.14	120.20	91.75	16.35	69.72	30.13	18.95	11.83	6.44	718.16
Hospital	1.87	11.09	48.33	24.67	5.06	28.25	27.15	40.77	69.88	39.60	11.11	53.18	22.49	8.80	5.03	3.23	400.51

Building Prototype	Floorspace (million square feet)																
Laboratory	0.18	4.01	36.93	28.06	1.53	12.21	17.19	15.61	19.31	10.81	0.68	12.14	4.40	1.72	0.39	0.57	165.74
Restaurant	0.61	3.62	14.72	7.49	1.55	16.46	10.73	23.78	40.00	32.41	3.52	16.95	7.74	6.86	3.45	1.90	191.78
Enclosed Parking Garage	0.02	0.54	40.71	30.94	0.30	29.15	20.67	58.41	72.53	2.67	0.35	3.09	0.49	0.85	0.17	0.43	261.32
Open Parking Garage	0.22	7.02	55.03	41.82	3.86	41.14	35.17	82.44	102.40	34.57	4.46	39.96	6.31	11.05	2.16	5.62	473.23
Grocery	0.10	1.70	5.87	3.56	0.75	3.42	2.08	4.01	6.95	4.02	0.65	3.74	1.45	0.93	0.54	0.38	40.15
Refrigerated Warehouse	0.00	0.46	0.91	0.21	0.39	0.46	0.02	0.42	0.79	0.65	0.26	2.15	3.91	0.18	0.19	0.14	11.15
Controlled-environment Horticulture	0.70	0.46	2.62	1.07	6.33	8.26	1.07	0.74	1.60	3.61	2.51	4.53	5.36	0.47	0.64	0.23	40.21
Vehicle Service	0.91	6.18	33.65	15.98	2.97	33.73	23.08	49.52	81.78	56.54	6.30	38.32	18.24	15.09	6.18	3.54	392.01
Manufacturing	4.11	16.89	61.93	79.55	5.59	73.33	33.27	122.70	168.10	49.58	12.86	57.01	25.97	16.98	5.15	9.27	742.28
Unassigned	0.36	6.58	9.03	6.32	0.22	2.58	0.77	3.78	7.87	2.55	3.37	14.35	2.94	0.77	0.40	1.03	62.89
TOTAL	**34.7**	**205.1**	**999.3**	**583.9**	**95.5**	**757.8**	**547.1**	**1140.0**	**1761.4**	**974.3**	**191.2**	**990.7**	**370.2**	**230.6**	**130.7**	**78.5**	**9090.7**

Source: CEC Measure Proposal Template https://www.energy.ca.gov/media/3538

For this Draft CASE Report, modeling has only been completed for the Large Office prototype.

Table 46: Estimated Existing Nonresidential Floorspace Impacted by Proposed Code Change in 2026 (Alterations), by Climate Zone and Building Type (Million Square Feet), Windows

Building Prototype	Floorspace (million square feet)																
Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
Large Office	0.00	0.07	3.15	1.63	0.04	2.24	1.64	3.66	6.82	1.32	0.06	1.77	0.21	0.46	0.10	0.10	23.25
TOTAL	**0.0**	**0.1**	**3.1**	**1.6**	**0.0**	**2.2**	**1.6**	**3.7**	**6.8**	**1.3**	**0.1**	**1.8**	**0.2**	**0.5**	**0.1**	**0.1**	**23.3**

Table 47: Estimated Nonresidential Alterations Impacted by Proposed Code Change in 2026, by Climate Zone and Building Type, Single Zone HVAC – DCV

Building Prototype	Floorspace (million square feet)																
Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
Restaurant	0.01	0.05	0.22	0.11	0.02	0.25	0.16	0.36	0.60	0.49	0.05	0.25	0.12	0.10	0.05	0.03	2.88
TOTAL	**0.0**	**0.1**	**0.2**	**0.1**	**0.0**	**0.2**	**0.2**	**0.4**	**0.6**	**0.5**	**0.1**	**0.3**	**0.1**	**0.1**	**0.1**	**0.0**	**2.9**

Table 48: Estimated Nonresidential Alterations Impacted by Proposed Code Change in 2026, by Climate Zone and Building Type, Central Plant Pump Controls

Building Prototype	Floorspace (million square feet)																
Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
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
Large School	0.01	0.12	0.52	0.21	0.03	0.43	0.34	0.64	1.10	0.84	0.15	0.80	0.40	0.18	0.11	0.05	5.94
TOTAL	**0.0**	**0.2**	**2.6**	**1.3**	**0.1**	**1.9**	**1.4**	**3.1**	**5.7**	**1.7**	**0.2**	**2.0**	**0.5**	**0.5**	**0.2**	**0.1**	**21.4**

Table 49: Estimated Nonresidential Alterations Impacted by Proposed Code Change in 2026, by Climate Zone and Building Type, Central Load Distribution

Building Prototype	Floorspace (million square feet)																
Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
Large Office	0.00	0.08	3.50	1.81	0.05	2.49	1.82	4.07	7.58	1.46	0.07	1.97	0.23	0.51	0.11	0.12	25.84
Large School	0.02	0.20	0.87	0.35	0.05	0.71	0.56	1.07	1.84	1.40	0.25	1.33	0.66	0.30	0.19	0.09	9.91
TOTAL	**0.0**	**0.3**	**4.4**	**2.2**	**0.1**	**3.2**	**2.4**	**5.1**	**9.4**	**2.9**	**0.3**	**3.3**	**0.9**	**0.8**	**0.3**	**0.2**	**35.7**

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

There are no recommended revisions to the compliance software as a result of this code change proposal.

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 will not result in a significant effect on the environment.

Appendix E: Discussion of Impacts of Compliance Process on Market Actors

Table 50 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 50 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 50 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.

The Statewide CASE Team also collected data from the Virtual Compliance Assistant platform (VCA). The key findings from the VCA data were used to:

- Determine the baseline for the Windows measure,
- Determine the compliance rate of Cx and the reasoning behind non-compliance,
- Understand the compliance of various HVAC controls and efficiency levels,
- Determine the prevalent type of systems based on the climate zones.

Table 50: 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
HVAC Designer	• No tasks because commissioning is not currently required for alterations • Provide documentation to commissioning agents in scenarios where building owner voluntarily uses commissioning process	Providing documents to commissioning agent's and reviewing and resolving comments to equipment or documents as necessary	• Currently, working with commissioning agents is voluntary on a case by case basis based on building owner's request. Proposed code change will make this mandatory	• Identifying issues with existing systems • Identifying non-compatibility issues between equipment • Optimizing and selecting systems based on comments • Reduce installation, operation, and maintenance costs
Plans Examiner	• Review all documents provided for project	• Will make review of documentation easier because commissioning agent collects all documents and puts them in one place	• Commissioning agent collects all documents and puts into one place (easier for plans examiner to review documents) • Commissioning agent finds issues and resolves them related to the existing building	• See issues identified in previous column
CEC	•	•	•	• Improve benchmarking for existing buildings
Plumbing Designer	• No tasks because commissioning is not currently required for alterations • Provide documentation to commissioning agents in scenarios where building owner voluntarily uses commissioning process	• Providing documents to commissioning agent's and reviewing and resolving comments to equipment or documents as necessary	• Currently, working with commissioning agents is voluntary on a case by case basis based on building owner's request. Proposed code change will make this mandatory	• Identifying issues with existing systems • Identifying non-compatibility issues between equipment • Optimizing and selecting systems based on comments • Reduce installation, operation, and maintenance costs

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
Electrical Designer	• No tasks because commissioning is not currently required for alterations • Provide documentation to commissioning agents in scenarios where building owner voluntarily uses commissioning process	• Providing documents to commissioning agent's and reviewing and resolving comments to equipment or documents as necessary	• Currently, working with commissioning agents is voluntary on a case by case basis based on building owner's request. Proposed code change will make this mandatory	• Identifying issues with existing systems • Identifying non-compatibility issues between equipment • Optimizing and selecting systems based on comments • Reduce installation, operation, and maintenance costs
Commissioning Agent	• Participating in project planning, design, and implementation on a case by case basis as required by building owner (not currently required by code)	• Review or create CFR • Draft commissioning plan • Review design and construction documents • Conduct functional testing • Submit commissioning report with a list of issues identified and resolved	• Will improve compliance because commissioning identifies issues and resolves them (related to equipment usage, sizing, etc.)	• Identifying issues and collecting documents pertaining to the existing building (such as energy audits, building plans, etc.)
Architect	• No tasks because commissioning is not currently required for alterations • Provide documentation to commissioning agents in scenarios where building owner voluntarily uses commissioning process	• Providing documents to commissioning agent's and reviewing and resolving comments to equipment or documents as necessary	• Currently, working with commissioning agents is voluntary on a case by case basis based on building owner's request. Proposed code change will make this mandatory	• Identifying issues with existing systems • Identifying non-compatibility issues between equipment • Optimizing and selecting systems based on comments • Reduce installation, operation, and maintenance costs

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 Cx via webinar described in Table 51. 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 51: Utility-Sponsored Stakeholder Meetings

Meeting Name	Meeting Date	Event Page from Title24stakeholders.com
First Round of Nonresidential Existing Buildings Utility-Sponsored Stakeholder Meeting	Friday, February 24, 2023	https://title24stakeholders.com/event/nonresidential-daylighting-lighting-language-clean-up-and-existing-buildings-utility-sponsored-stakeholder-meeting/
Second Round of Nonresidential Existing Buildings 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 in 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 52.

The key questions discussed with the stakeholders are listed below. Although the Existing Buildings Commissioning Draft CASE Report will not be presented as a Final Report this code cycle, the Statewide CASE Team welcomes feedback from stakeholders to inform the next code cycle.

Table 52: Engaged Stakeholders

Company Name	Market Role
3QC	Commissioning Agent
A & S Engineers, Inc.	Commissioning Agent
Abraxas Energy Consulting	Commissioning Agent
AECOM (San Diego)	Commissioning Agent
Akela Engineering and Consulting, LP	Commissioning Agent
alliancePROJECT, LLC	Commissioning Agent
Alpers Engineering Group, LLC	Commissioning Agent
American Commissioning Group, LLC.	Commissioning Agent
Applied Cx, LLC	Commissioning Agent
Axiom Engineers	Commissioning Agent
Balanced Dynamics Inc.	Commissioning Agent
C&J Technical Solutions and Services, Inc.	Commissioning Agent
Capital Engineering Consultants, Inc.	Commissioning Agent
Coffman Engineers, Inc. (Los Angeles)	Commissioning Agent
Coffman Engineers, Inc. (San Diego)	Commissioning Agent
Cook Engineering Inc.	Commissioning Agent
DAV Energy Solutions, Inc.	Commissioning Agent
Digital Energy, Inc.	Commissioning Agent
Farnsworth Group, Inc. (California)	Commissioning Agent
GHD Inc.	Commissioning Agent
Glumac (Los Angeles)	Commissioning Agent
GMC Commissioning Inc.	Commissioning Agent
GreenCAL Air Barrier & Commissioning LLC	Commissioning Agent
HDR Inc. (CA)	Commissioning Agent
Hill International	Commissioning Agent
IMEG Corp. (Ontario)	Commissioning Agent

Company Name	Market Role
IMEG Corp. (Pasadena)	Commissioning Agent
Integral Group, Inc.	Commissioning Agent
Interface Engineering (San Francisco)	Commissioning Agent
Jacobs Engineering (Los Angeles)	Commissioning Agent
LP Consulting Engineers, Inc.	Commissioning Agent
MBO Inc.	Commissioning Agent
Meyers + Engineers	Commissioning Agent
National Air Balance Company	Commissioning Agent
Optimum Energy Design	Commissioning Agent
Partner Energy Inc.	Commissioning Agent
Penn Air Control, Inc.	Commissioning Agent
Pyxis Partners	Commissioning Agent
R & A Engineering Solutions, Inc.	Commissioning Agent
Randall Lamb	Commissioning Agent
Roshanian & Associates	Commissioning Agent
RRC-Engineers	Commissioning Agent
Salas O'Brien (CA)	Commissioning Agent
SC Engineers Inc.	Commissioning Agent
Sindoni Consulting & Management Services, Inc.	Commissioning Agent
Southern California Commissioning	Commissioning Agent
Stok	Commissioning Agent
tk1sc	Commissioning Agent
TMCx Solutions, LLC (SoCal)	Commissioning Agent
UL (Western Region)	Commissioning Agent
WSP (San Francisco)	Commissioning Agent
AEI/Affiliated Engineers	Commissioning Agent
AEI/Affiliated Engineers	Commissioning Agent
Argo Performance Ltd.	Commissioning Agent
Adam G. Williams (Director Cx)	Cx & Healthcare
Sindoni Consulting & Management Services	Cx & Healthcare
Lawrence Engineering Group	Cx (Mechanical Engineering Firm)
Lawrence Engineering Group	Cx (Mechanical Engineering Firm)
AHP Testing (Title 24 Cx agents and ATTS)	Cx & ATT
AHP Testing (Title 24 Cx agents and ATTS)	Cx & ATT
AHP Testing (Title 24 Cx agents and ATTS)	Cx & ATT

Company Name	Market Role
P2S Commissioning	Cx & Healthcare
P2S Commissioning	Cx & Healthcare
P2S Commissioning	Cx
National Laboratory (Idaho)	Cx
Virtual Commissioning Inc.(Cumming Group)	Cx
Virtual Commissioning Inc.(Cumming Group)	Cx

Stakeholders Survey Summary

The following key questions were distributed to more than 75 Cx professionals from xx firms.

1. Do the Cx Agents in California undergo different commissioning training or certification processes?
2. Do you think, there should be a separate commissioning guideline if T24 Part 6 introduces a mandatory commissioning requirement for existing buildings?
3. Are the Cx familiar with compliance requirements for the additions and alterations?
4. Did you or anybody in your firm complete the Acceptance Testing Training programs? If the answer is no, are you interested in becoming an ATT (Acceptance Testing Technician) as part of the existing building Cx requirements?
5. Are the Cx agents currently identifying the Accepting Testing requirements for New Construction projects and verifying the AT submittals?
6. Do the Cx agents coordinate with the field technicians and ATTs in New Construction projects? If they do, at what phase they are involved in the projects?
7. What % of projects are related to alterations and additions?
8. What are the top 5 commissioning issues identified in the issue logs?
9. How often the issues identified in the logs are resolved before the Cx process is complete?
10. Do the facility personnel get trained on when the new systems or controls are installed?
11. What % of project time normally do the MEP/AEC firms spend on collecting site-specific information for renovation projects? Is the site data collection for additions and alterations completed by a single agent or does each design/contractor team do their own data collection survey?
12. In alteration cases, how often do they right size the hvac system (air handlers, packaged HVAC units, chillers, etc., or DHW system?)
13. How much does it cost to implement Cx for simple and complex system alteration projects? A range of costs based on the conditioned sq.ft is fine.
14. What other benefits in addition to energy savings do you see because of the Cx process?

15. What kind of incentive is available for Cx firms in NC and EB?
16. What % of customers want to pursue Cx in EB?
17. Do you support commissioning requirements in the energy code for alterations and additions project?

Appendix G: Energy Cost Savings in Nominal Dollars

The CEC requested energy cost savings over the 30-year period of analysis in both 2026 present value dollars (2026 PV$) and nominal dollars. The cost-effectiveness analysis uses energy cost values in 2026 PV$. Costs and cost effectiveness using and 2026 PV$ are presented in Section 6 of this report. This appendix presents energy cost savings in nominal dollars.

Table 53: Nominal Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – OfficeLarge Prototype

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ01	0.32	1.15	1.47
CZ02	0.43	0.94	1.37
CZ03	0.33	4.79	5.13
CZ04	0.30	5.09	5.39
CZ05	0.38	1.30	1.68
CZ06	0.56	2.29	2.85
CZ07	0.54	4.72	5.26
CZ08	0.62	0.54	1.16
CZ09	0.51	6.00	6.51
CZ10	0.48	2.72	3.19
CZ11	0.40	1.19	1.59
CZ12	0.02	0.68	0.71
CZ13	0.42	4.32	4.74
CZ14	0.45	6.64	7.08
CZ15	0.62	8.69	9.31
CZ16	0.27	3.19	3.46

Table 54: Nominal Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – Single Zone HVAC DCV - RestaurantFastFood Prototype

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ01	-0.02	34.79	34.77
CZ02	0.29	25.29	25.58

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ03	-0.02	17.95	17.93
CZ04	1.13	21.72	22.85
CZ05	0.01	18.82	18.83
CZ06	0.04	5.92	5.96
CZ07	-0.19	5.33	5.15
CZ08	0.99	7.48	8.46
CZ09	1.11	8.88	9.99
CZ10	1.74	9.16	10.90
CZ11	2.43	20.38	22.81
CZ12	1.13	21.37	22.50
CZ13	2.66	17.75	20.42
CZ14	2.19	19.45	21.64
CZ15	6.66	4.73	11.39
CZ16	-0.03	28.65	28.61

Table 55: Nominal Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – Central Plant Pump Controls OfficeLarge Prototype

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ01	N/A	N/A	N/A
CZ02	N/A	N/A	N/A
CZ03	3.30	-0.35	2.95
CZ04	3.65	-0.18	3.47
CZ05	0.44	-0.16	0.28
CZ06	0.80	0.03	0.83
CZ07	1.02	-0.08	0.94
CZ08	0.88	-0.12	0.76
CZ09	0.85	0.03	0.87
CZ10	N/A	N/A	N/A
CZ11	0.79	-0.18	0.61
CZ12	N/A	N/A	N/A
CZ13	N/A	N/A	N/A
CZ14	0.81	-0.19	0.62
CZ15	N/A	N/A	N/A
CZ16	0.49	-0.19	0.31

Table 56: Nominal Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – Central Plant Pump Controls SchoolLarge Prototype

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ01	0.00	-0.02	-0.03
CZ02	0.69	-0.02	0.67
CZ03	0.33	-0.06	0.27
CZ04	1.24	-0.02	1.21
CZ05	0.44	-0.14	0.30
CZ06	1.05	-0.02	1.03
CZ07	1.54	0.00	1.54
CZ08	N/A	N/A	N/A
CZ09	1.51	0.01	1.52
CZ10	1.74	0.02	1.75
CZ11	1.94	0.04	1.99
CZ12	1.39	-0.05	1.34
CZ13	2.03	-0.01	2.02
CZ14	1.54	-0.05	1.49
CZ15	4.16	-0.01	4.15
CZ16	0.35	-0.04	0.31

Table 57: Nominal Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – Central Load Distribution- OfficeLarge Prototype

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ01	0.05	-0.04	0.01
CZ02	0.11	-0.05	0.06
CZ03	0.39	-0.04	0.35
CZ04	0.09	-0.04	0.05
CZ05	0.31	-0.04	0.28
CZ06	0.79	0.00	0.79
CZ07	0.83	-0.01	0.83
CZ08	0.55	-0.01	0.54
CZ09	0.40	0.04	0.44
CZ10	0.20	-0.01	0.18
CZ11	0.19	-0.07	0.12

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ12	N/A	N/A	N/A
CZ13	0.24	-0.04	0.20
CZ14	0.38	-0.10	0.28
CZ15	-0.28	-0.01	-0.28
CZ16	0.46	-0.07	0.40

Table 58: Nominal Long-term Systemwide Cost Savings Over 30-Year Period of Analysis – Per Square Foot – Alterations – SchoolLarge Prototype

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
CZ01	-0.09	-0.03	-0.13
CZ02	0.25	-0.04	0.21
CZ03	-0.02	-0.01	-0.03
CZ04	0.60	0.01	0.60
CZ05	0.03	0.00	0.03
CZ06	0.08	-0.01	0.07
CZ07	0.50	0.00	0.50
CZ08	0.56	0.05	0.61
CZ09	0.56	0.01	0.56
CZ10	0.59	0.02	0.61
CZ11	0.90	0.06	0.96
CZ12	0.67	-0.02	0.65
CZ13	1.02	-0.01	1.01
CZ14	0.66	-0.04	0.62
CZ15	1.47	-0.03	1.45
CZ16	-0.05	-0.03	-0.08