Codes and Standards Enhancement (CASE) Initiative

2025 California Energy Code

Commercial Kitchens

Nonresidential Covered Process
Kiri Coakley, Jasmine Shepard - Energy Solutions
Russell Hedrick, Edward Ruan - Frontier Energy

June 2023
Draft CASE Report

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

This report was prepared by the California Statewide Codes and Standards Enhancement (CASE) Program that is funded, in part, by California utility customers under the auspices of the California Public Utilities Commission.

Pacific Gas and Electric Company | Southern California Edison – Energy for What's Ahead | SDGE | LA DWP Los Angeles Department of Water & Power | SMUD

Document Information

Category:	**Codes and Standards**
Keywords:	Statewide Codes and Standards Enhancement (CASE) Initiative; California Statewide Utility Codes and Standards Team; Codes and Standards Enhancements; 2025 California Energy Code; 2025 Title 24, Part 6; California Energy Commission; energy efficiency; Demand Controlled Kitchen Ventilation (DCKV); electrification.
Authors:	Kiri Coakley, Jasmine Shepard (Energy Solutions); Russell Hedrick, Edward Ruan (Frontier Energy)
Prime Contractor	Energy Solutions, Frontier Energy
Project Management:	California Statewide Utility Codes and Standards Team: Pacific Gas and Electric Company, Southern California Edison, San Diego Gas & Electric Company, Sacramento Municipal Utility District, and Los Angeles Department of Water and Power.

Table of Contents

List of Tables

List of Figures

Executive Summary

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

Email comments and suggestions to *Kiri Coakley (kcoakley@energy-solution.com) and info@title24stakeholders.com by July 12, 2023.* Comments will not be released for public review or will be anonymized if shared.

Introduction

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

The Statewide CASE Team submits code change proposals to the CEC, the state agency that has authority to adopt revisions to Title 24, Part 6. The CEC will evaluate proposals submitted by the Statewide CASE Team and other stakeholders. The CEC may revise or reject proposals. See the CEC's 2025 Title 24 website for Building Energy Efficiency Standards Pre-Rulemaking 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. Stakeholders included manufacturers, designers, distributors, and end users. Key feedback included information on costs, market, technical feasibility, and energy consumption.

See Appendix F for a summary of stakeholder engagement.

The goal of this CASE Report is to present a cost-effective code change proposal for commercial kitchens. The report contains pertinent information supporting the code change proposal.

Proposal Description

Proposed Code Change

This proposal includes two separate but related proposals for commercial kitchens, electrification readiness and ventilation for the kitchen hood systems including demand control kitchen ventilation (DCKV).

Electrification Readiness

This proposal would require that new quick service (fast-food) commercial kitchens have the proper electrical infrastructure to convert to an electrified cookline in the future. The proposal would apply to pizza delivery shops, quick-serve restaurants, takeout eating places, and delicatessens.

This proposal would add a mandatory requirement that newly constructed quick-service (fast food) commercial kitchens have the proper electrical infrastructure to convert to a future electrified cookline. The requirement would appear in the mandatory covered process section of code, Section 120.6(k). Quick-service kitchen facilities could still install gas cooking equipment, but electrical infrastructure would need to be in place when the building is first constructed to enable relatively simply all-electric retrofits in the future.

Demand Control Kitchen Ventilation

The current code includes kitchen ventilation requirements that apply to kitchens and dining facilities that have a total hood exhaust airflow greater than 5,000 cubic feet per minute (cfm). Facilities that meet the exhaust airflow threshold must comply with one of four prescriptive ventilation compliance pathways. This proposal would move the kitchen ventilation requirements to the mandatory section of code. All systems would need to have DCKV (one of the four existing compliance pathways) in addition to complying with one of the remaining three compliance pathways.

Justification

Electrification Readiness

Demand for electric-ready products is increasing due to regulatory landscape, customer interest, and decarbonization goals. Electric-readiness requirements for single family and multifamily buildings in the 2022 code create a pathway for all-electric retrofits in

the future. There is documentation of successful all-electric kitchens in California across a variety of foodservice kitchen types, including large quick-service chains Wendy's and McDonald's (Building Decarbonization Coalition 2019).

Foodservice buildings are one of the most intensive users of commercial energy, with no statistically significant decrease in energy intensity in recent years (U.S. Energy Information Administration 2022). This indicates high energy savings potential in the foodservice sector. Utility incentive programs have been promoting electric equipment and offsetting electrification costs (California EnergyWise 2023). With increasing demand and industry interest around electric equipment, there needs to be a mechanism to remove barriers for electrification in commercial kitchens.

Demand Control Kitchen Ventilation

With advancements in DCKV technology, an effort to capture energy savings, and improved comfort in commercial kitchen spaces, adopting a mandatory requirement for DCKV systems is the next progression in the existing efforts for optimizing kitchen efficiency. Commercial hood manufacturers and retrofit manufacturers are expanding their capabilities and optimizing their DCKV systems for more seamless integration with a variety of sensing technologies that are suitable for specific end users. Research from 13 sites and various case studies ((Livchak, Demonstration of High Efficiency Commercial Cooking Equipment and Kitchens 2020) has demonstrated consistent savings and current projections estimate an average of 55 percent reduction in electricity use when compared to the baseline alternative.

Background Information

Electrification Readiness

The California foodservice market is currently dominated by gas-fired cooking equipment, but demand for electric-ready products is increasing due to regulatory pressures, customer interest, and decarbonization goals. The state of California has a general roadmap to reducing greenhouse gas emissions and gas consumption that this measure would support to help remove the initial barrier for future electrification (CA.gov 2022). Providing a pathway to build all-electric kitchens will greatly reduce gas consumption in commercial kitchens.

Utilities are investigating opportunities to provide incentives for all-electric kitchens. The California statewide electric emerging technologies program, CalNEXT, developed a robust report on electrification in commercial kitchens that investigates cost, energy savings, and feasibility (Monsur, Kuck and Honegger 2022). Discussions with authors of the report determined that full-service facilities are far behind other foodservice business types in electrification readiness, and that snack/beverage (a sub-category of

quick-service) are mostly already all-electric (Kuck, Foodservice Business Trends Towards Electrification 2022).

This proposal would not prohibit or restrict gas hook-ups or require all-electric cooking equipment, but rather ensure that the infrastructure for future electrification is in place when new buildings are constructed.

Demand Control Kitchen Ventilation

A DCKV system is a demand-based energy management system for a commercial kitchen exhaust hood that minimizes fan energy use by reducing the exhaust and makeup air fan speed or air volume and associated energy consumption when little or no cooking is occurring. As a function of the exhaust fan speed and associated airflow reduction, outdoor makeup air heating and cooling energy is also reduced. In addition, the kitchen ambient noise level is significantly decreased.

A DCKV system is equipped with sensors and a controller used in conjunction with variable speed drives for the fan motors that automatically modulating fan speed based on cooking load and/or time of day. The minimum ventilation rate is based on the energy and effluent output from the cooking appliances (i.e., the more heat and smoke/vapor generated, the more ventilation needed). To determining minimum ventilation rates, it is necessary to install temperature sensor(s) in the hood exhaust collar or within the hood, and/or an optic sensor(s) within the hood that senses cooking conditions. Doing so enables the control system to automatically vary the rate of exhaust to what is needed by adjusting the fan speed accordingly. Makeup airflow rate can be controlled by either varying supply fan speed or adjusting dampers that vary the percent of outdoor air. DCKV systems can be integrated with Energy Management Systems (EMS) which are often responsible for controlling makeup air both in the kitchen and the dining room.

The 2022 code includes prescriptive requirements for kitchen hood exhaust systems that apply to kitchens that have greater than 5,000 cfm total Type I (grease) and Type II (condensate) kitchen hood exhaust (Title 24, Part 6 Section 140.9(b)2B). If the exhaust airflow threshold is met, systems must comply with one of four compliance pathways, one of which is installing demand-controlled kitchen ventilation (henceforth DCKV) on 75 percent of exhaust air. The other three pathways are: use transfer air that would have been exhausted for 50 percent of the replacement air, use listed efficient energy recovery devices on 50 percent of exhaust airflow, or use minimally cooled or heated air for 75 percent of the makeup air volume. When the existing requirements were established, offering four options to comply provides multiple pathways for achieving energy savings in a manner most suitable for the facility. Over time the applicability of DCKV technology has broadened into a viable option for any new construction that would meet the 5,000 cfm threshold.

Scope of Code Change Proposal

Table 1 summarizes the scope of the proposed changes and which sections of standards, Reference Appendices, Alternative Calculation Method (ACM) Reference Manuals, and compliance documents that would be modified as a result of the proposed change(s).

Table 1: Scope of Code Change Proposal

Proposal Name	Electrification Readiness	DCKV
Type of Requirement	Mandatory	Prescriptive
Applicable Climate Zones	All	All
Modified Section(s) of Title 24, Part 6	120.6	140.9(b)2B
Modified Title 24, Part 6 Appendices	N/A	N/A
Would Compliance Software Be Modified	No	No
Modified Compliance Document(s)	NRCI-ELC-E	• CEC-NRCC-PRC-E • CEC-NRCA-PRC-02-F and CEC-NRCI-PRC-E can be used without modification

Market Analysis and Regulatory Assessment

Electrification Readiness

As mentioned above, the California foodservice market is dominated by gas-fired cooking equipment, but there is a shift to electrical equipment driven by state policy, incentive programs, and public interests (Monsur, Kuck and Honegger 2022). With the movement to decarbonize buildings and a trend to move away from natural gas use it is prudent to build new buildings so it is easy to retrofit to all-electric designs in the future. Thisproposal would do just that—establish infrastructure needed to simplify electrification in a future retrofit. This proposal starts with quick-service, or fast food, the foodservice sector that is most ready for the switch to all-electric.

Market actors involved in implementing this measure include commercial kitchen designers and consultants, manufacturers of commercial kitchen equipment, contractors and builders, compliance officials and building inspectors, and end users. End users are a key stakeholder group, including a variety from fast food restaurant chain owners to line cooks. These stakeholders have shown increasing support and interest in electrifying the kitchen cookline with further education and socialization of electric equipment (Galarza 2022).

Demand Control Kitchen Ventilation

DCKV is readily available for mainstream adoption and remaining market and technical barriers are limited. A wide range of manufacturers offer DCKV systems, either as a dedicated hood system or as a separate add-on to an existing hood system. Manufacturers the Statewide CASE Team interviewed process have been confident in the reliability of DCKV units within the market. Some DCKV manufacturers have begun adopting practices to minimize maintenance needs, such as implementing remote monitoring systems to continuously check the operational status of the equipment. HVAC technicians will need to expand their knowledge base to service DCKV units, but manufacturers are smoothing the transition with their maintenance features.

All DCKV hoods are equipped with a manual override to bypass the DCKV and run the hood at full exhaust rates if needed. One challenge to achieving persistent savings from DCKV systems is the misuse of the manual override, which can erase the potential savings generated by a DCKV system. This stems from a basic misunderstanding about how much ventilation is needed to properly capture kitchen effluent. Providing clear guidelines on normal hood operations and increasing visibility into hood performance will help address this challenge. With proper education and awareness, this barrier will likely shrink significantly as DCKV becomes more common.

Kitchen consultants have increasingly adopted DCKV into their new designs, with some consultants making it standard practice. Implementation of DCKV varies significantly based on facility type with larger facilities having DCKV systems more often.

The final market barrier is the same as experienced by nearly any technology, cost. End users are typically looking for a payback within three years to determine a worthy investment. The code change would only affect new construction facilities with greater than 5000 cfm of ventilation, so this payback period may be obtainable since DCKV savings scale with the size of the ventilation hood.

The primary actors in the DCKV market are kitchen consultants/designers, manufacturers, and end users. When an end user decides to purchase and install a DCKV system, they will contact the manufacturer of the system to design, install and commission the DCKV to meet the ventilation requirements. This process is sometimes done through the proxy of the end user's chosen consultant or designer, who specifies a DCKV unit for the ventilation components of the end user's facility. Regardless of the requestor, the core impetus for ensuring the DCKV system is properly implemented to meet the needs of the facility falls on the manufacturer, who has the expertise and staffing to ensure proper execution.

Cost Effectiveness

Electrification Readiness

As there are no energy savings associated with this measure, there are no associated energy cost savings. Section 2.4.3 details the difference in costs for establishing properly sized electrical infrastructure for electrification in new construction versus alterations. Electric readiness is expected to result in lower costs when switching over to electric equipment than retrofitting an existing kitchen. By sizing the electric panels and box and running conduits and cables during construction, the kitchen can avoid excessive downtime when replacing a gas fired appliance with an electric appliance. The incremental cost for the increased capacity panel during new construction is minimal, whereas the owner or operator would incur a new panel cost to upgrade as a retrofit.

Demand Control Kitchen Ventilation

The proposed code changes were found to be cost effective for all climate zones where it is proposed to be required. The benefit-to-cost (B/C) ratio over the 30-year period of analysis is 15.9.

California consumers and businesses would save more money on energy 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.

See Incremental First Cost and Cost Effectiveness sections.[1] 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

First-year statewide energy impacts are represented by the following metrics: electricity savings in gigawatt-hours per year (GWh/yr), peak electrical demand reduction in megawatts (MW), natural gas savings in million therms per year (million therms/yr), source energy savings in millions of kilo British thermal units per year (million kBtu/yr), and lifecycle energy savings in millions of kilo British thermal units per year (million kBtu/yr).

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

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

Sections 2.5.2: Statewide Greenhouse Gas (GHG) Emissions Reductions and 3.5.2: Statewide Greenhouse Gas (GHG) Emissions Reductions and Appendix C of this report. The monetary value of avoided GHG emissions is included in the Long-term Systemwide Cost (LSC) hourly factors provided by CEC and is thus included in the cost-effectiveness analysis.

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

Electrification Readiness

As this is an infrastructure measure, there is no expected direct impact for energy, water, GHG emissions, or embodied carbon.

Demand Control Kitchen Ventilation

Table 2 presents the estimated impacts of the proposed code change that would be realized statewide during the first 12 months that proposed requirements are in effect.

In addition to the emissions reductions noted in Table 2, the Statewide CASE Team reviewed potential impacts on GHG emissions for this measure associated with embodied carbon. The Statewide CASE Team concluded that the measure does not have additional reductions from embodied carbon.

Table 2: Summary of Impacts for Demand Control Kitchen Ventilation

Category	Metric	New Construction & Additions
Cost Effectiveness	Benefit-Cost ratio	15.9
Statewide Impacts During First Year	Electricity Savings (GWh)	6.41
	Peak Electrical Demand Reduction (MW)	0.01
	Natural Gas Savings (Million Therms)	N/A
	Source Energy Savings (Million kBtu)	25.2
	Lifecycle Electricity Savings (Million kBtu)	656.4
	Lifecycle Gas Savings (Million kBtu)	N/A
	Total Lifecycle Energy Savings (Million kBtu)	656.4
	Avoided GHG Emissions (Metric Tons CO2e)	1,457
	Monetary Value of Avoided GHG Emissions ($2026)	$179,549
	On-site Indoor Water Savings (Gallons)	N/A
	On-site Outdoor Water Savings (Gallons)	N/A
	Embedded Electricity in Water Savings (kWh)	N/A

Category	Metric	New Construction & Additions
Per Square Foot Impacts During First Year	Electricity Savings (kWh)	0.29
	Peak Electrical Demand Reduction (W)	0.00
	Natural Gas Savings (kBtu)	N/A
	Source Energy Savings (kBtu)	1.12
	Life Cycle Energy Savings (kBtu)	29.3
	Avoided GHG Emissions (kg CO2e)	0.06
	On-site Indoor Water Savings (Gallons)	N/A
	On-site Outdoor Water Savings (Gallons)	N/A
	Embedded Electricity in Water Savings (kWh)	N/A

Compliance and Enforcement

Electrification Readiness

The compliance process is described in Section 2.1.5. The measure primarily impacts electrical contractors installing electric wiring and panels. A certificate of installation would be needed to verify code compliance. An existing certificate of installation (NRCI-ELC-E) could be modified to accommodate this measure. There would not be a new acceptance test.

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

- Adequately sizing the panel to accommodate the extra capacity required by this measure.
- Identifying optimal locations of the outlet relative to the appliance.
- Ensuring that the selected materials can adequately handle the voltage and amps required by an electric cookline appliance.

Demand Control Kitchen Ventilation

The compliance process is described in Section 3.1.5. Impacts that the proposed measure would have on market actors is described in Regulatory Context and Appendix E. The Statewide CASE Team worked with stakeholders to develop a recommended compliance and enforcement process and to identify the impacts this process would have on various market actors.

Enforcement and compliance requirements should not change in comparison to the previous code. Designers who have not selected the DCKV option previously in their design for ventilation systems over 5000 cfm will need to work more closely with DCKV manufacturers to properly incorporate DCKV and maximize the savings.

There is an existing acceptance test for kitchen ventilation that will remain in place and unmodified.

Addressing Energy Equity and Environmental Justice

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in disproportionately impacted populations (DIPs) and the role this history plays in the environmental justice issues that persist today. DIPs refers to the 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. DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience the world.[2] While the term disadvantaged communities (DACs) is often used in the energy industry and state agencies, the Statewide CASE Team chose to use terminology that is more acceptable to and less stigmatizing for those it seeks to describe (DC Fiscal Policy Institute 2017).

Including impacted communities in the decision-making process, ensuring that the benefits and burdens of the energy sector are evenly distributed, and facing with 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 Marissa Lerner (mlerner@energy-solution.com) for further engagement.

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

1. Introduction

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

Email comments and suggestions to Kiri Coakley (kcoakley@energy-solution.com) and info@title24stakeholders.com by July 12, 2023. Comments will not be released for public review or will be anonymized if shared with stakeholders.

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support the California Energy Commission's (CEC's) efforts to update California's Energy Code (Title 24, Part 6) to include new requirements or to upgrade existing requirements for various technologies. The 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 proposal 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 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 CASE Report is to present a code change proposal for electrification and demand controlled kitchen ventilation. The report contains pertinent information supporting the proposed code change.

When developing the code change proposal and associated technical information presented in this report, the Statewide CASE Team worked with many industry

stakeholders including building officials, manufacturers, builders, utility incentive program managers, Title 24 energy analysts, and others involved in the code compliance process. The proposal incorporates feedback received during a public stakeholder workshop that the Statewide CASE Team held on February 9, 2023.

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

Section 2 – Electrification Readiness

- Section 2.1 – Measure Description of this CASE Report provides a description of the measure and its background. This section also presents a detailed description of how this code change is accomplished in the various sections and documents that make up the Title 24, Part 6 Standards.
- Section 2.2 – Market Analysis includes a review of the current market structure. Section 2.2.2 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 2.3 – Energy Savings presents the per-unit energy, demand reduction, and energy 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 energy cost savings.
- Section 2.4 – Cost and Cost Effectiveness presents the lifecycle cost and cost-effectiveness analysis. This includes a discussion of the materials and labor required to implement the measure and a quantification of the incremental cost. It also includes estimates of incremental maintenance costs, i.e., equipment lifetime and various periodic costs associated with replacement and maintenance during the period of analysis.
- Section 2.5 – First-Year Statewide Impacts presents the statewide energy savings and environmental impacts of the proposed code change for the first year after the 2025 code takes effect. This includes the amount of energy that would be saved by California building owners and tenants and impacts (increases or reductions) on material with emphasis placed on any materials that are considered toxic. Statewide water consumption impacts are also reported in this section.
- Section 2.6 – Addressing Energy Equity and Environmental Justice presents the potential impacts of proposed code changes on disproportionately impacted populations (DIPs), as well as a summary of research and engagement methods.

Section 3 – Demand Control Kitchen Ventilation (DCKV)

- Section 3.1 – Measure Description of this CASE Report provides a description of the measure and its background. This section also presents a detailed description of how this code change is accomplished in the various sections and documents that make up the Title 24, Part 6 Standards.
- Section 3.2 – Market Analysis includes a review of the current market structure. Section 3.2.2 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 3.3 – Energy Savings presents the per-unit energy, demand reduction, and energy 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 energy cost savings.
- Section 0 – 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 3.5 – First-Year Statewide Impacts presents the statewide energy savings and environmental impacts of the proposed code change for the first year after the 2025 code takes effect. This includes the amount of energy that would be saved by California building owners and tenants and impacts (increases or reductions) on material with emphasis placed on any materials that are considered toxic. Statewide water consumption impacts are also reported in this section.
- Section 3.6 – Addressing Energy Equity and Environmental Justice presents the potential impacts of proposed code changes on disproportionately impacted populations (DIPs), as well as a summary of research and engagement methods.
- Section 4 – Proposed Revisions to Code Language concludes the report with specific recommendations with ~~strikeout~~ (deletions) and underlined (additions) language for the Standards, Reference Appendices, and Alternative Calculation Method (ACM) Reference Manual. Generalized proposed revisions to sections are included for the Compliance Manual and compliance forms.
- Section 5 – Bibliography presents the resources that the Statewide CASE Team used when developing this report.

- Appendix A: Statewide Savings Methodology presents the methodology and assumptions used to calculate statewide energy impacts.
- Appendix B: Embedded Electricity in Water Methodology presents the methodology and assumptions used to calculate the electricity embedded in water use (e.g., electricity used to draw, move, or treat water) and the energy savings resulting from reduced water use.
- Appendix C: California Building Energy Code Compliance (CBECC) Software Specification presents relevant proposed changes to the compliance software (if any).
- Appendix D: Environmental Analysis presents the methodologies and assumptions used to calculate impacts on GHG emissions and water use and quality.
- Appendix E: Discussion of Impacts of Compliance Process on Market Actors presents how the recommended compliance process could impact identified market actors.
- Appendix F: Summary of Stakeholder Engagement documents the efforts made to engage and collaborate with market actors and experts.
- Appendix G: Energy Cost Savings in Nominal Dollars presents energy cost 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. Electrification Readiness

2.1 Measure Description

2.1.1 Proposed Code Change

This proposal would add a mandatory requirement that newly constructed quick-service (fast food) commercial kitchens have the proper electrical infrastructure to convert to a future electrified cookline. Quick-service kitchens are those that fall under North American Industry Classification System (NAICS) code 722513. This includes pizza delivery shops, quick-serve restaurants, takeout eating places, and delicatessens (NAICS Association 2022). Section 4.2 recommends a definition of quick-service foods that would be added to Title 24, Part 6.

The requirement would appear in the mandatory covered process section of code, Section 120.6(k). Quick-service kitchen facilities could still install gas cooking equipment, but electrical infrastructure would need to be in place when the building is first constructed to enable relatively simply all-electric retrofits in the future.

2.1.2 Justification and Background Information

2.1.2.1 Justification

The 2022 code cycle included mandatory electric readiness requirements for single family and multifamily buildings (Sections 150.0 (t, u, and v), and 160.9). This measure leverages similar rationale to the commercial kitchen environment. Due to the considerable barriers to electrify commercial kitchen appliances (fryers, ranges, ovens, etc.) from the cost to upsize the electrical infrastructure (electrical service panels, transformers, switch gear, etc.) and the costly disruptions to add electrical wiring in commercial kitchens, this proposal looks to ensure that new fast food systems have the requisite infrastructure to convert their appliances to electric in the future. Stakeholder feedback has indicated that this type of commercial kitchen is most ready to convert to all-electric.

Demand for electric-ready products is increasing due to regulatory landscape, customer interest, and decarbonization goals. There is documentation of successful all-electric kitchens in California across a variety of foodservice kitchen types, including large quick-service chains Wendy's and McDonald's (Building Decarbonization Coalition 2019).

Foodservice buildings are one of the most intensive users of commercial energy, with no statistically significant decrease in energy intensity in recent years (U.S. Energy

Information Administration 2022). This indicates high energy savings potential in the foodservice sector.

Utility incentive programs have been promoting electric equipment and offsetting electrification costs (California EnergyWise 2023). With increasing demand and industry buzz around electric equipment, there needs to be a path forward for electrification in commercial kitchens.

2.1.2.2 Background Information

The California foodservice market is currently dominated by gas-fired cooking equipment. The demand for electric-ready products is increasing due to regulatory pressures, customer interest, and decarbonization goals. The state of California has a general roadmap to reducing greenhouse gas emissions and gas consumption that this measure would support (CA.gov 2022).

Some universities, larger companies, and even smaller businesses have begun or completed internal studies on kitchen electrification. The Southern California Edison test kitchen has supported customers and projects throughout the state, including a university kitchen conversion to all-electric (Saldivar 2022). A variety of restaurants at Los Angeles International Airport have been successfully adapted to all-electric, including Shake Shack, Panda Express, and Umami Burger.

Providing a pathway to build all-electric kitchens will greatly reduce gas consumption in commercial kitchens. The electric readiness requirements for single family and multifamily buildings in the 2022 code established precedent for electric readiness requirements in the energy code.

The California statewide electric emerging technologies program, CalNEXT, developed a report on electrification in commercial kitchens that investigates both cost and energy savings. The focus of the report was on quick-service, full-service, and institutional kitchens and showed feasibility analyses on each type (Monsur, Kuck and Honegger 2022). Discussions with authors of the report determined that full-service facilities are far behind other foodservice business types in electrification readiness, and that snack/beverage (a sub-category of quick-service) are mostly already all-electric (Kuck, Foodservice Business Trends Towards Electrification 2022).

The proposed definition for quick-service commercial kitchens is consistent with the definition used by

2.1.3 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.[3] See Section 4 of this report for detailed proposed revisions to code language.

2.1.3.1 Specific Purpose and Necessity of Proposed Code Changes

Each proposed change to language in Title 24, Part 1 and Part 6 as well as the reference appendices to Part 6 are described below. See Section 4.2 of this report for marked-up code language.

Section: 100.1 – Definitions and Rules of Construction

Specific Purpose: To establish definitions for the relevant construction type as necessary to make this code change enforceable.

Necessity: These changes are necessary to ensure that the code language clearly and concisely identifies the types of commercial kitchens that are subject to electric readiness requirements.

Section: **120.6 (k) – Electric Readiness for Quick Service Commercial Kitchens**

Specific Purpose: The specific purpose is to establish the basis for infrastructure that will support future all-electric quick-service commercial kitchens.

Necessity: These changes are necessary to ensure that any new construction of commercial kitchens has the appropriately sized infrastructure for an all-electric cookline.

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

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

2.1.3.3 Summary of Changes to Compliance Forms

The proposed code change would modify the compliance form listed below. Examples of the revised forms are presented in Section 4.5.

- NRCI-ELC-E – Under Part B, Installer Scope, add in a check box for 240v or 208v outlet.

2.1.4 Regulatory Context

Please see Section 2.4.1.

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

2.1.5 Compliance and Enforcement

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

The compliance verification activities related to this measure that need to occur during each phase of the project are described below: See a permitting process factsheet on Energy Code Ace (https://energycodeace.com/download/35782/file_path/fieldList/FactSheet.NR.Res-PermitProcess.2019.pdf) for more information about these construction phases.

- **Design Phase:** Designers will develop a plan for a kitchen that can support an all-electric cookline and contribute to the Certificate of Compliance Documents (NRCI).
- **Permit Application Phase:** Plan reviewers will conduct design and permit review by assessing the design plans.
- **Construction Phase:** Contractors will build the facility in accordance with all requirements mandated by Title 24, Part 6.

1. **Inspection Phase:** The facility will be inspected to determine that correct infrastructure is in place to support an all-electric cookline. Inspectors will verify Certificate of Installation (NRCI) documents. Inspection would need to occur during the construction phase.

Compliance processes would generally fit within the current workflow of market actors involved with construction efforts. No new skills would be required for compliance and building officials.

2.2 Market Analysis

2.2.1 Current Market Structure

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

market structure and potential market barriers during a public stakeholder meeting that the Statewide CASE Team held on February 9, 2023 (Statewide CASE Team 2023).

The California foodservice market is currently dominated by gas-fired cooking equipment. The demand for electric-ready products is increasing due to regulatory pressures, consumer interest, and decarbonization goals as discussed further in Section 2.2.3. There are existing utility incentive programs for electric equipment, and additional incentive measure and program development would help to offset electrification costs (California EnergyWise 2023).

Key market actors involved in implementing this measure include commercial kitchen designers and consultants, manufacturers of commercial kitchen equipment, contractors and builders, compliance officials and building inspectors, and end users.

2.2.2 Technical Feasibility and Market Availability

2.2.2.1 Market Availability

Stakeholders identified one of the largest barriers: the foodservice industry is accustomed to gas-fired equipment (Galarza 2022) (Statewide CASE Team 2023). Awareness campaigns could help stakeholders better understand the benefits of electric equipment. This familiarization of manufacturers, suppliers, and end users would also support an increase in supply. California EnergyWise supports rebates for 25 equipment types, covering an assortment of oven types, cooktops, fryers, griddles, and dishwashers (California EnergyWise 2023).

Existing site-level electrical infrastructure does not support all-electric cooklines. This ptopodsl would apply to new construction and would therefore not impact existing electrical infrastructure. Seventy-seven cities or counties within California have already adopted building codes to reduce their reliance on gas, with requirements ranging from all new construction built as all-electric to all-electric preferred with mixed-fuel options (Gable 2023). The 2022 CalNEXT study on all-electric commercial kitchen electrical requirements highlighted the growing demand for electric cookline equipment (Monsur, Kuck and Honegger 2022).

During the February public stakeholder meeting, the Statewide CASE Team requested input on foodservice business types most ready for becoming all-electric. The top stakeholder-identified business types were quick-service or fast food restaurants, and snack and non-alcoholic beverage bars. These were distantly followed by institutional foodservice (Statewide CASE Team 2023).

2.2.2.2 Technical Feasibility

During the February 9, 2023 Public Stakeholder Meeting, stakeholders agreed with the technical barrier of variations in equipment performance. Some end users have

supported that there are variances in gas versus electric equipment, but there is both availability of high-performing electric equipment and even stakeholders that prefer the consistent performance of electric equipment. Cookline equipment considered includes: ovens (combination, convection, conveyor), fryers, griddles, steamers, broilers, burner ranges, skillets, and kettles (Statewide CASE Team 2023).

Electrical infrastructure including support for additional load is needed for all-electric cooklines. Facility designers would need to evaluate planned spaces and accommodate for equipment configurations based on both infrastructure and expected kitchen use. The measure would require that newly constructed quick-service commercial kitchens have sufficient power supply available for a future all-electric cookline. Overall grid demand for these foodservice facilities would increase. Rather than a sudden increase in demand, the effects would be mitigated by the phased path that this measure lays out: infrastructure development to support all-electric cooklines, but not requiring that all kitchens switch out their equipment at one time. This will allow utilities and customers to adjust to increasing electric demand.

2.2.3 Market Impacts and Economic Assessments

2.2.3.1 Impact on Builders

Builders of residential and commercial structures are directly impacted by many of the measures proposed by the Statewide CASE Team for the 2025 code cycle. It is within the normal practices of these businesses to adjust their building practices to changes in building codes. When necessary, builders engage in continuing education and training in order to remain 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 3). 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 3: 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 commercial kitchens 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 4 shows the commercial building subsectors the Statewide CASE Team expects to be impacted by the changes proposed in this report. The Statewide CASE Team's estimates of the magnitude of these impacts are shown in Section 2.2.4 Economic Impacts.

Table 4: 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 $)
Nonresidential Electrical Contractors	3,137	74,277	7.0

Source: (State of California n.d.)

2.2.3.2 Impact on Building Designers and Energy Consultants

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

Businesses that focus on residential, commercial, institutional, and industrial building design are contained within the Architectural Services sector (North American Industry Classification System 541310). Table 5 shows the number of establishments, employment, and total annual payroll for Building Architectural Services. The Statewide CASE Team anticipates the impacts for commercial kitchen electrification readiness to affect firms that focus on nonresidential construction.

There is not a North American Industry Classification System (NAICS)[3] 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.[4] 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 5 provides an upper bound indication of the size of this sector in California.

Table 5: California Building Designer and Energy Consultant Sectors in 2022 (Estimated)

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

Source: (State of California n.d.)

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

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

2.2.3.3 Impact on Occupational Safety and Health

The proposed code change does not alter any existing federal, state, or local regulations pertaining to safety and health, including rules enforced by the California Division of Occupational Safety and Health (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.

Some recent research on indoor air quality (IAQ) has shown a relationship between the presence of natural gas equipment and decreases in air quality. There are associated safety risks and compounds that can contribute to asthma and allergies (Rashkin 2016). This effect has not been extensively studied in commercial foodservice kitchens but could positively impact working conditions (Monsur, Kuck and Honegger 2022). This electric readiness measure would not require installation of electric equipment at this time, so the improvement in IAQ would be a secondary benefit if foodservice facilities voluntarily elect to install all-electric equipment at the time of construction.

2.2.3.4 Impact on Building Owners and Occupants

Commercial Buildings

The commercial building sector includes a wide array of building types, including offices, restaurants and lodging, retail, and mixed-use establishments, and warehouses (including refrigerated) (Kenney 2019). Energy use by occupants of commercial buildings also varies considerably, with electricity used primarily for lighting, space cooling and conditioning, and refrigeration, while natural gas is used primarily for water heating and space heating. According to information published in the 2019 California Energy Efficiency Action Plan, there are 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 efficiency solutions, as does the variability in sophistication of building owners and the relationships between building owners and occupants.

Estimating Impacts

This measure would benefit building owners and occupants by lowering the barrier to convert to all-electric equipment in the future. The Statewide CASE Team does expect the proposed code change for the 2025 code cycle to impact building owners with a higher up-front cost, with large potential for future savings with a shift to electric equipment. Sections 2.3 and 2.4 further detail this savings potential.

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

The Statewide CASE Team anticipates the proposed change would have a positive material impact on California component retailers. With an increase in demand for breakers, electrical wire, and other associated electrical supply components, there

would be an increase in demand for these products. There would be a decreased demand on manufacturers and distributors of gas lines.

2.2.3.6 Impact on Building Inspectors

Table 6 shows employment and payroll information for state and local government agencies in which many inspectors of residential and commercial buildings are employed. Building inspectors participate in continuing education and training to stay current on all aspects of building regulations, including energy efficiency. The Statewide CASE Team, therefore, anticipates the proposed change would have no impact on employment of building inspectors or the scope of their role conducting energy efficiency inspections.

Table 6: Employment in California State and Government Agencies with Building Inspectors in 2022 (Estimated)

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

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

a. Administration of Housing Programs (NAICS 925110) comprises government establishments primarily engaged in the administration and planning of housing programs, including building codes and standards, housing authorities, and housing programs, planning, and development.

b. Urban and Rural Development Administration (NAICS 925120) comprises government establishments primarily engaged in the administration and planning of the development of urban and rural areas. Included in this industry are government zoning boards and commissions.

2.2.3.7 Impact on Statewide Employment

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

2.2.4 Economic Impacts

For the 2025 code cycle, the Statewide CASE Team used the IMPLAN model software[4], along with economic information from published sources, and professional judgement to develop estimates of the economic impacts associated with each of the proposed code changes. Conceptually, IMPLAN estimates jobs created as a function of incoming cash flow in different sectors of the economy, due to implementing a code or a standard. The jobs created are typically categorized into direct, indirect, and induced employment. For example, cash flow into a manufacturing plant captures direct employment (jobs created in the manufacturing plant), indirect employment (jobs created in the sectors that provide raw materials to the manufacturing plant) and induced employment (jobs created in the larger economy due to purchasing habits of people newly employed in the manufacturing plant). Eventually, IMPLAN computes the total number of jobs created due to a code. The assumptions of IMPLAN include constant returns to scale, fixed input structure, industry homogeneity, no supply constraints, fixed technology, and constant byproduct coefficients. The model is also static in nature and is a simplification of how jobs are created in the macro-economy.

The economic impacts developed for this report are only estimates and are based on limited and to some extent speculative information. The IMPLAN model provides a relatively simple representation of the California economy and, though the Statewide CASE Team is confident that the direction and approximate magnitude of the estimated economic impacts are reasonable, it is important to understand that the IMPLAN model is a simplification of extremely complex actions and interactions of individual, businesses, and other organizations as they respond to changes in energy efficiency codes. In all aspect 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 industrial contractors, architects, energy consultants, and building inspectors. Tables 11, 12, and 13 below illustrate the “best case” impacts that this measure would have. The Statewide CASE Team does not anticipate that money saved by businesses or other organizations affected by the proposed 2025 code cycle regulations would result in additional spending by those businesses.

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

Table 7: Estimated Impact that Adoption of the Proposed Measure would have on the California Commercial Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by Commercial Builders)	0.2	$18,961	$21,913	$37,323
Indirect Effect (Additional spending by firms supporting Commercial Builders)	0.1	$5,165	$8,105	$14,926
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	0.1	$6,928	$12,404	$19,742
Total Economic Impacts	**0.4**	**$31,054**	**$42,422**	**$71,991**

Source: CASE Team analysis of data from the IMPLAN modeling software.[5]

Table 8: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultants Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by Building Designers & Energy Consultants)	876.8	$96,110,812	$95,148,556	$150,391,251
Indirect Effect (Additional spending by firms supporting Bldg. Designers & Energy Consultants)	351.9	$28,617,026	$39,771,956	$64,024,697
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	526.4	$35,865,006	$64,226,602	$102,225,949
Total Economic Impacts	**1,755.1**	**$160,592,844**	**$199,147,114**	**$316,641,897**

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

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

Table 9: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by Building Inspectors)	426.1	$48,487,934	$57,500,759	$69,874,885
Indirect Effect (Additional spending by firms supporting Building Inspectors)	54.5	$4,490,581	$6,994,064	$12,181,303
Induced Effect (Spending by employees of Building Inspection Bureaus and Departments)	223.4	$15,250,947	$27,319,310	$43,483,505
Total Economic Impacts	**704.0**	**$68,229,462**	**$91,814,133**	**$125,539,693**

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

2.2.4.1 Creation or Elimination of Jobs

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

2.2.4.2 Creation or Elimination of Businesses in California

As stated in Section 2.2.4.1, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. The proposed change represents a modest change to new construction of commercial kitchens, which would not excessively burden or competitively disadvantage California businesses. The elimination of a barrier to electrification would be an advantage for California businesses, as it would be easier to shift to electric equipment in the future. Therefore, the Statewide CASE Team does not foresee any new businesses being created, nor does the Statewide CASE Team think any existing businesses would be eliminated due to the proposed code changes.

2.2.4.3 Competitive Advantages or Disadvantages for Businesses in California

The proposed code changes would apply to all businesses incorporated in California, regardless of whether the business is located inside or outside of the state.[6] Therefore, the Statewide CASE Team does not anticipate that these measures proposed for the

[6] 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.

2025 code cycle regulation would have an adverse effect on the competitiveness of California businesses. Likewise, the Statewide CASE Team does not anticipate businesses located outside of California would be advantaged or disadvantaged.

2.2.4.4 Increase or Decrease of Investments in the State of California

The Statewide CASE Team analyzed national data on corporate profits and capital investment by businesses that expand a firm's capital stock (referred to as net private domestic investment, or NPDI).[7] As Table 10 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 10: Net Domestic Private Investment and Corporate Profits, U.S.

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

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

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

$$Change\ in\ Proprietor\ Income * 0.26 = \$7{,}833{,}604$$

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

[7] 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.

proprietor income, which we use a conservative estimate of corporate profits, a portion of which we assume will be allocated to net business investment.[8]

2.2.4.5 Incentives for Innovation in Products, Materials, or Processes

This proposal would motivate stakeholders to shift commercial kitchen design to accommodate for more electrical equipment options. More stakeholders have indicated interest in electrification as these conversations continue (Galarza 2022). While initially skeptical of technology such as induction ovens, the Food Service Technology Center has noted that chefs who participated in their kitchen electrification program are now excited about electric cooking products (Building Decarbonization Coalition 2019).

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

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

Cost of Enforcement

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

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this re-training is an expense to local governments, it is not a new cost associated with the 2025 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training and resources provided by the IOU Codes and Standards program (such as Energy Code Ace). As noted in Section 2.1.4 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.

[8] 26 percent of proprietor income was assumed to be allocated to net business investment; see Table 10.

2.2.4.7 Impacts on Specific Persons

While the objective of any of the Statewide CASE Team's proposal is to promote energy efficiency, the Statewide CASE Team recognizes that there is the potential that a proposed code change may result in unintended consequences. Impacts are not expected to vary for any specific group or groups of persons. Refer to Section 2.6 for more details addressing energy equity and environmental justice.

2.2.5 Fiscal Impacts

2.2.5.1 Mandates on Local Agencies or School Districts

There are no relevant mandates to local agencies or school districts. The affected commercial kitchens are not relevant to local agencies or school districts.

2.2.5.2 Costs to Local Agencies or School Districts

There are no costs to local agencies or school districts as the affected buildings are not relevant to these areas.

2.2.5.3 Costs or Savings to Any State Agency

This measure could affect new construction of state agency buildings with kitchens that fall under NAICS code 722513. The additional cost from added electrical infrastructure described in Section 2.4.3 would apply in those cases.

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

There are no added non-discretionary costs or savings to local agencies as the affected building types are not relevant.

2.2.5.5 Costs or Savings in Federal Funding to the State

There are no costs or savings to federal funding to the state as the affected building types are not relevant.

2.3 Energy Savings

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

2.3.1 Energy Savings Methodology

This measure is an infrastructure improvement measure and therefore has no direct energy savings. By establishing appropriately sized electrical infrastructure there is potential for future energy savings, but there are no requirements for electrical equipment and no bans on gas hook ups at this point in time.

2.4 Cost and Cost Effectiveness

2.4.1 Regulatory Context

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

This measure builds on the electric readiness requirements for single family and multifamily buildings that were added to the code for the 2022 cycle.

There are no relevant state or local laws or regulations specific to commercial kitchens with conflicting regulations.

Local jurisdictions throughout California have adopted local ordinances that encourage or require electric infrastructure for both residential and commercial buildings. More than 75 cities or counties have passed new building electrification codes or ordinances throughout the past few years, including the widely publicized ordinance from Berkeley that banned gas hook-ups in new multifamily construction (Gable 2023). While the Berkeley ordinance bans gas hook-ups this measure would not be banning them, instead requiring electrical infrastructure appropriately sized to future electrification with gas hook-ups still allowed if desired. Half Moon Bay has adopted a reach code policy that covers all new construction, requiring all-electric with no gas or propane (The City Council of the City of Half Moon Bay 2022). The City of Santa Clara has gone further with their introduction of an all-electric reach code ordinance for nonresidential and new construction (City of Santa Clara 2021). The proposed Title 24, Part 6 code change updates would not conflict with any of these regulations.

2.4.1.2 Duplication or Conflicts with Federal Laws and Regulations

There are no relevant federal laws or regulations with conflicting regulations. This measure would not ban gas equipment, but rather require that the appropriate electrical infrastructure for potential future electrification of the cookline is in place.

2.4.1.3 Difference From Existing Model Codes and Industry Standards

There are no relevant industry standards or model codes with conflicting regulations. Industry standards currently include a gas-powered cookline, so this measure would diverge from those practices. However, stakeholders have indicated that there is increase acceptance of electric cooking equipment (Galarza 2022).

2.4.2 Energy Cost Savings Methodology

As there is no energy savings associated with this measure, there are no associated energy cost savings.

2.4.3 Upfront Cost for New Construction and Retrofit Kitchens

The incremental first cost includes the labor and materials for new breakers for each electrical appliance, running branch circuits to each appliance, new panels when applicable, and upgrading the main service panel to accommodate for larger expected future electrical capacity needed for the site. (Monsur, Kuck and Honegger 2022). Cost will likely not change over time, although if the cost of materials to make electrical panels increases then the equipment itself will increase in price.

Table 11: Associated Electrical Work Costs for New Construction and Retrofit All-Electric Quick-Service Kitchens shows the associated costs that the 2022 CalNEXT study determined for the electrical work for new construction versus retrofit (remodel) all-electric quick-service kitchens. Costs included materials per the 2022 market, shipping, basic testing and commissioning, regular working hours, added sub-panel and wiring, and overall quotes conformed to current California and national building electric codes. This measure requires that the infrastructure, or electrical work, for newly constructed quick-service kitchens is sized appropriately for future electrification. It would not require all-electric cooking equipment at the time of construction. The large cost differential is mostly due to needed service upgrades to carry the additional load (Monsur, Kuck and Honegger 2022).

Table 11: Associated Electrical Work Costs for New Construction and Retrofit All-Electric Quick-Service Kitchens

Prototype	Cost for New Construction	Cost for Remodel	Savings
Quick-service 1	$17,285.00	$19,877.75	$2,592.75
Quick-service 2	$61,170.00	$147,675.50	$86,505.50
Quick-service 3	$80,205.00	$170,690.75	$90,485.75
Quick-service 4	$81,625.00	$172,323.75	$90,698.75
Quick-service 5	$101,090.00	$173,443.00	$72,353.00
Quick-service 6	$74,945.00	$164,641.75	$89,696.75
Average	$69,386.67	$141,442.08	$72,055.42

Source: CASE Team analysis of data from the 2022 CalNEXT All-Electric Commercial Kitchen Electrical Requirements Study (Monsur, Kuck and Honegger 2022).

2.4.4 Incremental Maintenance and Replacement Costs

Incremental maintenance cost is the incremental cost of replacing the equipment or parts of the equipment, as well as periodic maintenance required to keep the equipment operating relative to current practices over the 30-year period of analysis. The present value of equipment maintenance costs (or savings) was calculated using a three percent discount rate (d). The present value of maintenance costs that occurs in the n^{th} year is calculated as follows:

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

There is no anticipated increase in maintenance procedures for the addition of increased electrical infrastructure.

2.4.5 Cost Effectiveness

This measure proposes a mandatory requirement. There are no direct energy or GHG savings, and as such, there are only direct costs associated with this measure. However as summarized in Section 2.4.3, the Statewide CASE Team has determined that a mandatory electric readiness requirement in the code is still more inexpensive than a retrofit effort. This measure would provide a concrete pathway towards electrification of California foodservice facilities.

2.5 First-Year Statewide Impacts

2.5.1 Statewide Energy and Energy Cost Savings

This measure has no statewide energy cost or cost savings.

2.5.2 Statewide Greenhouse Gas (GHG) Emissions Reductions

This measure has no statewide GHG impacts.

2.5.3 Statewide Water Use Impacts

The proposed code change will not result in water savings. For more details involving water use and water impacts quality, refer to Appendix B.

2.5.4 Statewide Material Impacts

This measure would require more extensive electrical infrastructure than that of a kitchen with a gas cookline. The impacts were based on the assumption of added materials for an additional electric panel and accompanying copper wiring. Assumptions included 88 additional pounds of steel and 3.173 additional pounds of copper for the necessary components.

For more information on the Statewide CASE Team's methodology and assumptions used to calculated embodied GHG emissions, see 0.

Table 12: First-Year Statewide Impacts on Material Use

Material	Impact	Per-Unit Impacts (Pounds per Square Foot)	First-Year [a] Statewide Impacts (Pounds)	Embodied GHG emissions saved (Metric Tons CO2e)

Mercury	No change	N/A	N/A	N/A
Lead	No change	N/A	N/A	N/A
Copper	Increase	0.001268	4,559	6
Steel	Increase	0.035186	126,447	70
Plastic	No change	N/A	N/A	N/A

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

2.5.5 Other Non-Energy Impacts

There are no non-energy impacts associated with this measure.

2.6 Addressing Energy Equity and Environmental Justice

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in disproportionately impacted populations (DIPs) and the role this history plays in the environmental justice issues that persist today. DIPs 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. DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience the world.[9] While the term disadvantaged communities (DACs) is often used in the energy industry and state agencies, the Statewide CASE Team chose to use terminology that is more acceptable to and less stigmatizing for those it seeks to describe (DC Fiscal Policy Institute 2017).

Including impacted communities in the decision-making process, ensuring that the benefits and burdens of the energy sector are evenly distributed, and facing with 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 Marissa Lerner (mlerner@energy-solution.com) for further engagement.

[9] 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 and Bell 2021). Socioeconomic inequities, climate, energy, and other inequities are inextricably linked and often mutually reinforcing.

The Statewide CASE Team is still in the process of investigating the potential impacts of the proposed code changes on DIPs via both research and outreach with community-based organizations (CBOs). Final results of this research and outreach will be incorporated into the Final CASE Report.

2.6.1 Research Methods and Engagement

During the February public stakeholder meeting, the Statewide CASE Team requested input for impact on end users, and received the feedback that Asian food restaurants might feel more impact from this measure due to equipment types including the wok (Statewide CASE Team 2023). The CASE Team is continuing to research this particular impact and has plans to further engage with stakeholders before the publication of the Final CASE Report. This is important because a participatory approach allows individuals to address problems, develop innovative ideas, and bring forth a different perspective.

The City of Berkeley, California looked into the impacts of electrification on historically marginalized communities, and their electrification strategy report concludes that these communities are most impacted by climate change and should be prioritized. These households should have equitable access to the energy savings, health, safety, and comfort benefits from electrification (City of Berkeley 2021). This should include both a focus on education within these communities, as well as funding and financing options to reduce initial financial burden of purchasing additional electrical infrastructure. Unlike the Berkeley ordinance, this measure would not ban gas hook-ups or affect residential construction, but rather require the establishment of appropriate electrical infrastructure for future commercial electrification that could exist alongside gas infrastructure as of 2025.

2.6.2 Potentially Disproportionately Impacted Populations (DIPs)

The DIPs most directly affected by this measure could include small businesses and foodservice workers. There are hundreds of thousands of restaurant workers in California, with projections that expect this number of employees to grow (National Restaurant Association 2019). According to the National Restaurant Association, seven out of every ten US restaurants are single-unit operators which means that they only have one location and would therefore fall into the category of small business (California Restaurant Association 2023). There is likely a need to provide funding/support for these small businesses to support implementation of this measure.

2.6.3 Potential Impacts

Studies show that DIPs are disproportionately negatively impacted by unhealthy indoor air quality (Katz 2012). Although the proposed code change may not save a lot of energy, it has potential to benefit DIPs, especially those in areas with poor ambient

(outdoor) air quality. In this case, the potentially impacted populations would be all DIPs in California, but especially those with higher rates of asthma, poor indoor air quality, and poor ambient (outdoor) air quality. Appendix F contains more details on this stakeholder outreach. It is likely that there would be positive changes to the workplace environment, including more comfortable temperatures and improved indoor air quality (Rashkin 2016).

Additional impacts include increased cost and potential future energy savings. Added up-front cost would mean more burden of entry without incentive programs, but as shown in Section 2.4 the upfront cost of this electrical infrastructure is significantly less than the cost of a future retrofit. The measure incremental cost would be more demanding upfront for DIPs, which could be mitigated by financial support programs. Energy savings would not be realized directly from this measure because this is an infrastructure measure with no energy savings. This measure does set the stage for future full electrification of the kitchen with these accompanying benefits. Section 2.4.3 details the incremental cost of this measure.

2.6.4 Evolution of the Code Change Proposal and Future Opportunities

Higher up-front cost is the one of the largest barriers for energy efficiency measures among DIPs (Berkouwer and Dean 2021). Upsizing electrical infrastructure increases cost at time of construction, and potential future purchase of electric equipment might have an increase in cost over gas cooking equipment. The Statewide CASE Team recommends that additional incentives, assistance programs, and rebates are explored as options to support DIPs. Further information about the efficacy of these programs will be included in the Final Report. This measure also provides the opportunity for future full electrification of the kitchen, reducing natural gas consumption.

3. Demand Control Kitchen Ventilation (DCKV)

3.1 Measure Description

3.1.1 Proposed Code Change

The current code includes kitchen ventilation requirements that apply to kitchens and dining facilities that have a total hood exhaust airflow greater than 5,000 cubic feet per minute (cfm). Facilities that meet the exhaust airflow threshold must comply with one of four prescriptive ventilation compliance pathways. This proposal would move the kitchen ventilation requirements to the mandatory section of code. All systems would need to have DCKV (one of the four existing compliance pathways) in addition to complying with one of the remaining three compliance pathways.

The total hood(s) design airflow for all kitchen/dining facilities operating under the same roof is taken into account to evaluate the 5,000-cfm threshold. This includes food courts, and cloud kitchens. Standalone restaurants with total design hood exhaust airflow below 5,000-cfm are excluded.

3.1.2 Justification and Background Information

3.1.2.1 Justification

With advancements in DCKV technology, an effort to capture energy savings and improved comfort in commercial kitchen spaces, adopting a mandatory requirement for DCKV systems is the next progression in the existing efforts for optimizing kitchen efficiency. Of the four options currently available in the code, DCKV is the most universally applicable method of capturing savings. Commercial hood manufacturers and retrofit manufacturers are expanding their capabilities and optimizing their DCKV systems for lower costs and more seamless integration with a variety of sensing technologies that are suitable for specific end users. Research from 13 sites and various case studies such as SCE13CC008 have demonstrated consistent savings reductions and current projections estimate an average of 56 percent reduction in electricity use when compared to the baseline alternative. Stakeholder outreach indicates that DCKV adoption is growing for new construction projects, but the proposed code change aims to accelerate the process to make the technology more mainstream and capture those energy savings. The proposed code change will also increase the demand for cost effective DCKV technologies and drive further innovation in the industry. Additionally requiring one of the remaining three measures will maximize energy savings while still providing the flexibility to meet code requirements through the option that is most suitable for the facility.

3.1.2.2 Background Information

Relationship to Existing Title 24, Part 6 Requirements

The 2022 code includes prescriptive requirements for kitchen hood exhaust systems that apply to kitchens that have greater than 5,000 cfm total Type I (grease) and Type II (condensate) kitchen hood exhaust (Title 24, Part 6 Section 140.9(b)2B). If the exhaust airflow threshold is met, systems must comply with one of four compliance pathways, one of which is installing DCKV on 75 percent of exhaust air. The other three pathways are: use transfer air that would have been exhausted for 50 percent of the replacement air, use listed efficient energy recovery devices on 50 percent of exhaust airflow, or use minimally cooled or heated air for 75 percent of the makeup air volume.

When the existing requirements were established, offering four options to comply provides multiple pathways for achieving energy savings in a manner most suitable for the facility. Over time the applicability of DCKV technology has broadened into a viable option for any new construction that would meet the 5,000 cfm threshold.

This measure would move the existing prescriptive requirements in Section 140.9(b)2B to the mandatory section of code (Section 120.6). The requirements would also be modified so that all exhaust systems must have DCKV and one of the remaining three options:

1. At least 50 percent of all replacement air is transfer air that would otherwise be exhausted; or
2. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on at least 50 percent of the total exhaust airflow; or
3. A minimum of 75 percent of makeup air volume that is:
    a. Unheated or heated to no more than 60°F; and
    b. Uncooled or cooled without the use of mechanical cooling.

Any commercial kitchen site being evaluated for compliance will need to provide evidence of the designed flowrate of the exhaust hood being evaluated.

Title 24 requirements apply to new kitchen exhaust hood installations; existing hoods are exempt. ANSI/ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings (section 6.5.7.2.3) provides an identical compliance option for systems with an exhaust airflow rate that exceeds 5,000 cfm.

Background on DCKV Systems

A commercial demand-controlled kitchen ventilation (DCKV) system is a demand-based energy management system for a commercial kitchen exhaust hood that minimizes fan energy use by reducing the exhaust and makeup air fan speed or air volume and associated energy consumption when little or no cooking is occurring. Furthermore, as a function of the exhaust fan speed and associated airflow reduction, outdoor makeup air

heating and cooling energy is also reduced. In addition, the kitchen ambient noise level is significantly decreased.

The DCKV system is equipped with sensors and a controller used in conjunction with either variable speed drives for the fan motors or electronically commutated motors (ECMs), automatically modulating fan speed based on cooking load and/or time of day. The minimum ventilation rate is based on the energy and effluent output from the cooking appliances (i.e., the more heat and smoke/vapor generated, the more ventilation needed). To determining minimum ventilation rates, it is necessary to install temperature sensor(s) in the hood exhaust collar or within the hood, and/or an optic sensor(s) within the hood that senses cooking conditions. Doing so enables the control system to automatically vary the rate of exhaust to what is needed by adjusting the fan speed accordingly. Makeup airflow rate can be controlled by either varying supply fan speed or adjusting dampers that vary the percent of outdoor air. DCKV systems can be integrated with EMS systems which are often responsible for controlling makeup air both in the kitchen and the dining room.

3.1.3 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.[10] See Section 4 of this report for detailed proposed revisions to code language.

3.1.3.1 Specific Purpose and Necessity of Proposed Code Changes

Each proposed change to language in Title 24, Part 1 and Part 6 as well as the reference appendices to Part 6 are described below. See Section 4.2 of this report for marked-up code language.

Section: 140.9(b)2B and 120.6(k)

Specific Purpose: The specific purpose is to move the existing prescriptive requirements to the mandatory section, specifically Section 120.6(k), to make the kitchen exhaust hood requirements mandatory, to require DCKV for all systems, and clarify that systems must also comply with one of the remaining three options.

Necessity: These changes are necessary to increase energy efficiency via implementing DCKV systems for kitchen exhaust hoods which will result in reduced supply and exhaust fan energy along with gas savings as a result of outdoor makeup air

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

heating. Additionally, clarification of the kitchen space is necessary for determining how the code will apply to facilities with multiple kitchens and hoods.

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

The proposed code change for Demand Control Kitchen Ventilation would not modify the ACM Reference Manual.

There will be adjustments to the baseline prototype of Kitchen areas based on final savings results.

3.1.3.3 Summary of Changes to Compliance Forms

The proposed code change would require wording changes to notate that DCKV is a mandatory requirement along with one of the three options, but the functional tests described on the forms would not change since no options were added or subtracted.

3.1.4 Regulatory Context

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

This proposal is not relevant to other parts of the California Building Standards Code (https://www.dgs.ca.gov/BSC/Codes). Changes outside of Title 24, Part 6 are not needed. No other code change proposals under consideration for the 2025 code cycle overlap with the recommendations in this report.

3.1.4.2 Duplication or Conflicts with Federal Laws and Regulations

There are no relevant federal laws or regulations.

3.1.4.3 Difference From Existing Model Codes and Industry Standards

The proposed code generally align with ASHRAE 90.1 and ASHRAE Standard 154, which address general kitchen exhaust and airflow issues.

3.1.5 Compliance and Enforcement

When developing this proposal, the Statewide CASE Team considered methods to streamline the compliance and enforcement process and how negative impacts on market actors who are involved in the process could be mitigated or reduced. This section describes how to comply with the proposed code change. It also describes the compliance verification process. Appendix E presents how the proposed changes could impact various market actors, though impacts should be minimal since the compliance process for the proposed change in already integrated within the previous process as a possible pathway.

The compliance verification activities related to this measure that need to occur during each phase of the project are described below: See a permitting process factsheet on Energy Code Ace for more information about these construction phases.

- **Design Phase:** Designers will specify a DCKV option and work with the provider to design a ventilation system that can properly incorporate DCKV. Designers will also select which of the three options would work best for the facility and plan accordingly. Designers will contribute to the Certificate of Compliance Documents (NRCC).
- **Permit Application Phase:** Plan reviewers will conduct design and permit review by assessing the design plans.
- **Construction Phase:** Contractors will build the facility in accordance with the design and all requirements mandated by Title 24, Part 6.
- **Inspection Phase:** The facility will be inspected after construction to verify construction parameter and perform acceptance tests on DCKV functionality as per the existing 2022-CEC-NRCA-PRC-02-F form. Inspectors will verify Certificate of Installation (NRCI) documents and verify that the selected option among the three additional technologies has been implemented properly. Acceptance tests and acceptance forms already exist for the 2022 code and would not be modified for this proposal.

Compliance processes would generally fit within the current workflow of market actors involved with construction efforts. No new skills would be required for compliance and building officials and compliance forms would be modified in wording but contain the same functional tests.

Enforcement and compliance requirements should not change in comparison to the previous code. Designers who have not selected the DCKV option previously in their design for ventilation systems over 5000 cfm will need to work more closely with DCKV manufacturers to properly incorporate DCKV and maximize the savings.

3.2 Market Analysis

3.2.1 Current Market Structure

The Statewide CASE Team performed a market analysis with the goals of identifying current technology availability, current product availability, and market trends. It then considered how the proposed standard may impact the market in general as well as individual market actors. Information was gathered about the incremental cost of complying with the proposed measure. Estimates of market size and measure applicability were identified through research and outreach with stakeholders including utility program staff, CEC staff, and a wide range of industry actors. 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 9, 2023 (Hedrick 2023).

The primary actors in the DCKV market are kitchen consultants/designers, manufacturers, and end users. When an end user decides to purchase and install a DCKV system, they will contact the manufacturer of the system to design, install and commission the DCKV to meet the ventilation requirements. This process is sometimes done through the proxy of the end user's chosen consultant or designer, who specifies a DCKV unit for the ventilation components of the end user's facility. Regardless of the requestor, the core impetus for ensuring the DCKV system is properly implemented to meet the needs of the facility falls on the manufacturer, who has the expertise and staffing to ensure proper execution.

Among the other three options currently available, manufacturers and consultants noted that the most frequently selected option was using untreated makeup air, since transfer air is not always an option and heat recovery may not always be cost effective depending on the climate and facility. The proposed measure would capture savings by requiring DCKV as the most universal option, while leaving the rest of the market relatively the same as previous.

3.2.2 Technical Feasibility and Market Availability

There are a wide range of manufacturers offering DCKV systems, either as a dedicated hood system or as a separate add-on to an existing hood system. Most major ventilation hood manufacturers offer a DCKV option, with noted DCKV systems available from CaptiveAire, Halton, Accurex, Melink, Streivor, Vent-Tech, Avtec, Intellinox, Spring Air and Noveo. DCKV is readily available for mainstream adoption. The few remaining technical and market barriers are being addressed.

The technical feasibility of DCKV as a mandatory measure for all ventilation systems over 5000 cfm was evaluated by reviewing the largest current market barriers for potential solutions and scrutinizing whether there were any cases in which application of DCKV would not be amenable. Speaking with end users and designers, common concerns hindering adoption of DCKV included uncertainty regarding the reliability of capture and containment, potential difficulty with maintenance of DCKV systems, and the total cost to the customer.

Manufacturers the Statewide CASE Team interviewed process have been confident in the reliability of DCKV units within the market. North American Kitchen Solutions (NAKS) cites minimal failure rates of their deployed units, with the main cause for failure being installation or shipping issues. The most common cause for error are electrical issues such as supplying the wrong voltage or not properly connecting the cables. When properly installed, NAKS maintains that all their systems have maintained robust

performance. End users such as Chipotle that have had negative experiences with DCKV noted that their experiences had come during the early stages on DCKV's implementation around a decade ago, though hesitation persists in the market from those first impressions.

Kitchen consultants have increasingly adopted DCKV into their new designs, with some consultants making it standard practice. However, overall market share is still relatively low and is driven strongly by the availability of utility incentive programs such as the California Instant Rebates Program. Implementation of DCKV also varies significantly based on facility type. NAKS mentioned that only about 2 percent of their recent installations implemented DCKV systems , whereas Halton quoted about 50 percent of their installs including DCKV due to their involvement with larger facilities such as stadiums, universities, and large office cafeterias that have larger kitchen spaces.

DCKV manufacturers have also begun adopting practices to minimize maintenance needs, such as implementing remote monitoring systems to continuously check the operational status of the equipment. Halton offers a full year of remote monitoring with their installations, including a cellular modem and a monthly energy savings report. Meanwhile Melink's third iteration of their DCKV offers automatic calibration which continuously monitors the composition of the kitchen effluent to adjust the ventilation parameters accordingly, minimizing any need for a technician to readjust the hood if the kitchen operations change due to new appliances or menu items. HVAC technicians will need to expand their knowledge base to service DCKV units, but manufacturers are smoothing the transition with their maintenance features.

All DCKV hoods are equipped with a manual override to bypass the DCKV and run the hood at full exhaust rates if needed. However, another barrier discovered when discussing with both manufacturers and end users is the misuse of the manual override, which can erase the potential savings generated by a DCKV system. This stems from a basic misunderstanding about how much ventilation is needed to properly capture kitchen effluent. This misunderstanding can also be propagated by misinformed inspectors, who end users have quoted as sometimes using pieces of paper to visualize airflow, which requires excess airflow that wastes energy. Stakeholders have shared anecdotes of inspectors taking a piece of paper and expecting the airflow to be strong enough to maintain suction and hold the piece of paper in place, which is an inaccurate way of measuring airflow. The solution here would be to release clear guidelines on normal hood operations and increase visibility into hood performance, to ensure that the hood in operating accordingly and not excessively. Manufacturers are beginning to include greater visualization tools to accommodate these shifts, and the barrier will likely shrink significantly as DCKV becomes more commonplace.

The final market barrier is the same as experienced by nearly any technology, cost. End users are typically looking for a payback within three years to determine a worthy

investment, a sentiment confirmed by both NAKS and Chipotle. The code change will only affect new construction facilities with greater than 5000 cfm of ventilation, so this payback period may be obtainable since DCKV savings scale with the size of the ventilation hood.

3.2.3 Market Impacts and Economic Assessments

3.2.3.1 Impact on Builders

Builders of residential and commercial structures are directly impacted by many of the measures proposed by the Statewide CASE Team for the 2025 code cycle. It is within the normal practices of these businesses to adjust their building practices to changes in building codes. When necessary, builders engage in continuing education and training in order to remain 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 13). 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 13: 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

Building Type	Construction Sectors	Establishments	Employment	Annual Payroll (Billions $)
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 DCKV 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 residential and commercial building industry would not be felt by all firms and workers, but rather would be concentrated in specific industry subsectors. Table 14 shows the commercial building subsectors the Statewide CASE Team expects to be impacted by the changes proposed in this report. HVAC and general contractors will be affected by the greater prevalence of DCKV systems, making in-depth understanding of DCKV systems a more valuable skillset and encouraging partnerships with DCKV system manufacturers to formally service their systems. The Statewide CASE Team's estimates of the magnitude of these impacts are shown in Section 32.2.4 Economic Impacts.

Table 14: 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 $)
Nonresidential plumbing & HVAC contractors	2,346	55,572	5.5
Other Nonresidential equipment contractors	556	9,594	1.0

Source: (State of California n.d.)

3.2.3.2 Impact on Building Designers and Energy Consultants

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

The proposed code change likely should not significantly impact the workflow of market actors such as builders, building designers, architects, engineers, and energy consultants. There are not any new forms or processes being proposed, with the proposal being centered upon making a previous ventilation option into a requirement. Thus much of the training/continuing education resources are already readily available

for these market actors, but will likely experience more widespread utilization following the proposed code change.

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 15 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 DCKV to affect firms that focus on nonresidential construction.

There is not a North American Industry Classification System (NAICS)[11] 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.[12] 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 5 provides an upper bound indication of the size of this sector in California.

Table 15: 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

[11] 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.

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

3.2.3.3 Impact on Occupational Safety and Health

The proposed code change may have ancillary effects on occupational safety and health, through noise reduction in the working environment and continuous monitoring of ventilation performance. When activated, DCKV lowers the airflow rate to just what is needed to provide ventilation to the idling appliances, which also significantly lowers the sound levels of the kitchen. With less sound pollution, the workplace becomes more amenable to staff communication and reduces the likelihood of safety incidents that result from miscommunication, such as collisions or trip hazards.

DCKV systems also provide continuous monitoring that is sent to the manufacturer and sometimes shared with the end user, detailing hood performance and providing alerts for any issues or recommended changes to the settings. This reduces the likelihood that the ventilation system ever fails to meet the requirements of the facility operations, unlike issues for a standard hood which would likely not be escalated and addressed until either the effects are causing a significant negative impact or the hood is inspected by an external party. Thus DCKV may promote reliably healthy air quality in workplace environments where it is implemented.

3.2.3.4 Impact on Building Owners and Occupants

Commercial Buildings

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

Estimating Impacts

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

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

The proposed code change may shift the market to ventilation manufacturers and distributors who offer DCKV as part of their product lineup and who have established a reputation for systems that work reliably. Customers are less likely to purchase from those without any DCKV offerings, due to the complexity of a transaction requiring multiple different parties to coordinate. Thus, retailers that have already been supporting DCKV technologies will be better positioned to provide that support for new construction endeavors looking to meet the code change requirements.

3.2.3.6 Impact on Building Inspectors

Table 16 shows employment and payroll information for state and local government agencies in which many inspectors of residential and commercial buildings are employed. Building inspectors participate in continuing education and training to stay current on all aspects of building regulations, including energy efficiency. The Statewide CASE Team, therefore, anticipates the proposed change would have no impact on employment of building inspectors or the scope of their role conducting energy efficiency inspections.

Table 16: Employment in California State and Government Agencies with Building Inspectors in 2022 (Estimated)

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

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

a. Administration of Housing Programs (NAICS 925110) comprises government establishments primarily engaged in the administration and planning of housing programs, including building codes and standards, housing authorities, and housing programs, planning, and development.

b. Urban and Rural Development Administration (NAICS 925120) comprises government establishments primarily engaged in the administration and planning of the development of urban and rural areas. Included in this industry are government zoning boards and commissions.

3.2.3.7 Impact on Statewide Employment

As described in Sections 2.2.3.1 through 2.2.3.6, the Statewide CASE Team does not anticipate significant employment or financial impacts to any particular sector of the California economy. This is not to say that the proposed change would not have modest impacts on employment in California. In Section 2.2.4, the Statewide CASE Team estimated the proposed change in DCKV would affect statewide employment and

economic output directly and indirectly through its impact on builders, designers and energy consultants, and building inspectors. In addition, the Statewide CASE Team estimated how energy savings associated with the proposed change in DCKV would lead to modest ongoing financial savings for California residents, which would then be available for other economic activities.

3.2.4 Economic Impacts

For the 2025 code cycle, the Statewide CASE Team used the IMPLAN model software[13], along with economic information from published sources, and professional judgement to develop estimates of the economic impacts associated with each of the proposed code changes. Conceptually, IMPLAN estimates jobs created as a function of incoming cash flow in different sectors of the economy, due to implementing a code or a standard. The jobs created are typically categorized into direct, indirect, and induced employment. For example, cash flow into a manufacturing plant captures direct employment (jobs created in the manufacturing plant), indirect employment (jobs created in the sectors that provide raw materials to the manufacturing plant) and induced employment (jobs created in the larger economy due to purchasing habits of people newly employed in the manufacturing plant). Eventually, IMPLAN computes the total number of jobs created due to a code. The assumptions of IMPLAN include constant returns to scale, fixed input structure, industry homogeneity, no supply constraints, fixed technology, and constant byproduct coefficients. The model is also static in nature and is a simplification of how jobs are created in the macro-economy.

The economic impacts developed for this report are only estimates and are based on limited and to some extent speculative information. The IMPLAN model provides a relatively simple representation of the California economy and, though the Statewide CASE Team is confident that the direction and approximate magnitude of the estimated economic impacts are reasonable, it is important to understand that the IMPLAN model is a simplification of extremely complex actions and interactions of individual, businesses, and other organizations as they respond to changes in energy efficiency codes. In all aspect 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 energy consultants and building inspectors. The Statewide CASE Team does not anticipate that money saved by

[13] 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.

commercial building owners or other organizations affected by the proposed 2025 code cycle regulations would result in additional spending by those businesses.

Table 17: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultants Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Designers & Energy Consultants)	6.6	0.72	0.71	1.12
Indirect Effect (Additional spending by firms supporting Bldg. Designers & Energy Consultants)	2.6	0.21	0.30	0.48
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	3.9	0.27	0.48	0.77
Total Economic Impacts	**13.1**	**1.20**	**1.49**	**2.37**

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

Table 18: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Inspectors)	0.4	0.045	0.054	0.065
Indirect Effect (Additional spending by firms supporting Building Inspectors)	0.1	0.004	0.007	0.011
Induced Effect (Spending by employees of Building Inspection Bureaus and Departments)	0.2	0.014	0.026	0.041
Total Economic Impacts	**0.7**	**0.064**	**0.086**	**0.118**

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

3.2.4.1 Creation or Elimination of Jobs

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

3.2.4.2 Creation or Elimination of Businesses in California

As stated in Section 2.2.4.1, the Statewide CASE Team's proposed change would not result in significant economic disruption to any sector of the California economy. The proposed change would add DCKV for facilities with large kitchens that would find the technology cost effective, which would not excessively burden or competitively

disadvantage California businesses. The addition of one of the remaining three options provides a flexible pathway for generating further savings. The Statewide CASE Team does not foresee any existing businesses being eliminated due to the proposed code changes, though businesses involving DCKV may be created due to the higher demand.

3.2.4.3 Competitive Advantages or Disadvantages for Businesses in California

The proposed code changes would apply to all businesses incorporated in California, regardless of whether the business is located inside or outside of the state.[14] 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 since the measure is cost effective.

3.2.4.4 Increase or Decrease of Investments in the State of California

The Statewide CASE Team analyzed national data on corporate profits and capital investment by businesses that expand a firm's capital stock (referred to as net private domestic investment, or NPDI).[15] As Table 19 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 19: 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	***539.227***	***2068.156***	**26**

[14] 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.

[15] 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 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 we use a conservative estimate of corporate profits, a portion of which we assume will be allocated to net business investment.[16]

3.2.4.5 Incentives for Innovation in Products, Materials, or Processes

The trend within the foodservice industry is already a growing adoption of DCKV, so this proposal would further accelerate the trend by ensuring that all new construction that meets the 5,000 cfm would have DCKV. This incentivizes innovation in reducing the cost of DCKV systems, while also promoting a natural trend towards reduced costs through economies of scale. As DCKV becomes more prevalent, there will likely also be innovation towards accessibility and ease of specification, to reduce the amount of time needed to design and implement a DCKV system into common kitchen templates.

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

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

Cost of Enforcement

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

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

[16] 26 percent of proprietor income was assumed to be allocated to net business investment; see Table 10.

the 2025 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training and resources provided by the IOU Codes and Standards program (such as Energy Code Ace). As noted in Section 2.1.4 and Appendix E, the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

3.2.4.7 Impacts on Specific Persons

While the objective of any of the Statewide CASE Team's proposal is to promote energy efficiency, the Statewide CASE Team recognizes that there is the potential that a proposed code change may result in unintended consequences. The proposed changes are not known or expected to result in impacts on specific persons outside of the foodservice workers as specified in Section 3.6, who are expected to benefit from safer and more comfortable work environments. Refer to Section 32.6 for more details addressing energy equity and environmental justice.

3.2.5 Fiscal Impacts

3.2.5.1 Mandates on Local Agencies or School Districts

This proposed measure will impose a DCKV mandate on local agencies or school districts, which has been shown to be cost-effective but will add to upfront costs for new construction.

3.2.5.2 Costs to Local Agencies or School Districts

The proposed measure will impose added upfront cost to local agencies or school districts requiring reimbursement pursuant to California Constitution, Government Code sections 17,500 et seq., which requires "the state to reimburse local agencies and school districts for any costs that they are required to incur after July 1, 1980, as a result of a statute enacted or any executive order implementing any statute enacted on or after January 1, 1975, which mandates a new program or higher level of service of an existing program."[17]

3.2.5.3 Costs or Savings to Any State Agency

There are no costs or savings to any state agencies, since state agencies do not generally contain foodservice facilities that would trigger the proposed measure.

[17] For more information, see this link https://www.dgs.ca.gov/Resources/SAM/TOC/6000/6605

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

There are no non-discretionary costs or savings to any local agencies, since local agencies do not generally contain foodservice facilities that would trigger the proposed measure.

3.2.5.5 Costs or Savings in Federal Funding to the State

The proposed measure will likely result in minor added upfront cost in federal funding to the state but will result in savings in federal funding through the implementation of DCKV and school cafeterias.

3.3 Energy Savings

3.3.1 Energy Savings Methodology

Demand Control Kitchen Ventilation (DCKV) is a critical component of commercial kitchen systems that can effectively improve indoor air quality and energy efficiency. With energy savings becoming an increasingly important goal for businesses, DCKV offers a promising solution for reducing energy consumption and costs associated with kitchen exhaust systems. By integrating sophisticated sensors and controls, DCKV systems can dynamically adjust exhaust fan speed and ventilation rates based on cooking activity and indoor air quality, effectively reducing energy usage while maintaining safe and comfortable working conditions. In this methodology, the measure looks at total unit annual energy savings as the difference between the annual unit baseline energy consumption and the annual unit measure energy consumption as seen below:

$$Total\_UES\_Yr = Total\_UEC\_Yr\ kWh\ Base\ -\ Total\_UEC\_Yr\ kWh\ Meas$$

Where,

Total_UES_Yr = Annual electric and gas unit energy savings – (kWh/yr/hp)

Total_UEC_YrkWhBase = Annual electric and gas unit energy consumption – baseline (kWh/yr/hp)

Total_UEC_YrkWhMeas = Annual electric and gas unit energy consumption – measure case (kWh/yr/hp)

Since stakeholder outreach indicated that unconditioned makeup air was the most common choice of the four options included in current code, the baseline unit is modeled as a standard ventilation system with unconditioned makeup air and the measure unit is modeled as a DCKV system with the same maximum cfm and unconditioned makeup air.

3.3.1.1 Key Assumptions for Energy Savings Analysis

The Statewide CASE Team calculated per-unit impacts and statewide impacts associated with new construction only and did not consider alterations. The energy and cost analysis presented in this report used a modeling approach to estimate the yearly unit baseline energy consumption where total supply and exhaust fan energy, and gas heating energy were considered. All energy and savings estimates are normalized by per unit HP (horsepower). The rated exhaust fan horsepower was selected as the single, standard unit of measure because of the larger degree of variance in makeup air system size, type, and complexity (e.g., some facilities do not have dedicated makeup air units, some have a high percentage of transfer air from rooftop equipment serving areas outside the kitchen, some DCKV systems are installed as exhaust- only controls, etc.). Although the energy savings were normalized to the rated exhaust fan horsepower, the estimated energy savings include both the exhaust fan and the makeup air fan energy use of the average system.

Data to develop the unit energy consumption (UEC) were collected from 13 field-monitored case studies conducted by the Pacific Gas and Electric Food Service Technology Center (FSTC, PG&E), the Southern California Edison Foodservice Technology Center (FTC, SCE), and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE across multiple years). The equipment at the 13 sites were power-meter monitored with and without demand-controlled kitchen ventilation (DCKV) to obtain both baseline and measure case UEC data. The average electric energy savings across the 13 sites was 56 percent for the exhaust and supply fan energy after DCKV retrofit. The demonstrated real world savings was used to model the fan energy savings between the baseline case of a standard ventilation system with unconditioned makeup air and the measure case of a DCKV system with unconditioned makeup air. Since both the baseline and measure case models use unconditioned makeup air, air heating and cooling energy were both excluded from the analysis.

Listed below is a breakout of the energy savings analysis as well as any assumptions:

Electric Savings (kWh)

Annual Unit Energy Savings – Electric

$$\mathbf{UES\_Yr = UEC\_Yr\ kWh\ Base - UEC\_Yr\ kWh\ Meas}$$

Where,

UES_Yr = Annual electric unit energy savings – (kWh/yr/hp)
UEC_YrkWhBase = Annual electric energy consumption – baseline (kWh/yr/hp)
UEC_YrkWhMeas = Annual electric unit energy consumption – measure case (kWh/yr/hp)

The calculation for baseline annual electric energy consumption is comprised of the supply and exhaust fan energy. The calculation of the exhaust fan unit energy consumptionUEC baseline is done using fan energy laws making static pressure loss and exhaust and supply fan motor efficiency assumptions.

$$\textbf{Fan kW} = \frac{\mathbf{q} \times \mathbf{dp}}{\mathbf{8.51} \times \boldsymbol{\mu}}$$

Where,

Fan kW = exhaust fan energy consumption
q = airflow rate (CFM)
dp = differential static pressure (inWC)
μ = fan and motor efficiency

(Engineering ToolBox Fans - Efficiency and Power Consumption. 2003)

Fan kWh = Fan kW × hours per day × days per year

Where,

Fan kWh = annual fan energy consumption
Hours per day = 14
Days per year = 339

Total Baseline Fan kWh = Exhaust Fan kWh + Supply Fan kWh

Where,

Exhaust Fan kWh = Fan kWh assuming dp = 1.4”
Supply Fan kWh = Fan kWh assuming dp = 0.6”

Annual Unit Energy Consumption - Electric, DCKV

Total DCKV Fan kWh = Total Baseline Fan kWh × Field DCKV savings percentage

Where,

Total DCKV Fan kWh = exhaust and supply fan energy with a DCKV system installed
Field DCKV Savings Percentage = Average DCKV savings from 13 field monitored sites, 56 percent

Fan power calculations are performed using the actual horsepower (HP) that an exhaust or supply fan will operate at for a given flow rate and static pressure. Fan motors are rated for a higher HP than the actual HP they operate at and come in standard sizes, such as 1, 2, 3, 5, and 10 HP, to enable installation on various systems. For instance, an exhaust fan that operates at 3.6 HP will require a 5 HP-rated fan motor

since it is the next available standard size up. A 3 HP motor would be inadequate for the fan's operation. As the measure savings are calculated per motor HP rating rather than actual HP at the design CFM, the motor rating must be calculated from the calculated fan energy.

Exhaust Fan HP Rating – Normalization

Exhaust fan HP at Design CFM = Fan kW × 1.341

Exhaust fan HP at Design CFM = actual HP of an exhaust fan motor under given static pressure and flowrate

Exhaust fan HP rating = round-up (1.2 × Exhaust fan HP at Design CFM)

Exhaust fan HP rating = the nameplate rating of the exhaust fan motor, usually in 1,2,3,5 and 10HP increments

Equation Assumptions:

Parameter	Value	Source
q, Exhaust airflow rate (cfm)	5,000	Title 24 DCKV CFM eligibility criteria
Daily hours of operation (input time: 9:00 a.m. to 11:00 p.m.)	14	Average facility open hours of 12.5 hours plus 1.5 hours open and closing prep
Days of operation	339	N/A
dpex, Exhaust fan static pressure	1.4” WC	California Rebate application data from 55 sites with 146 hoods:
dpsup, Supply fan static pressure	0.6” WC	California Rebate application data from 55 sites, see attachment above
Exhaust fan HP at design CFM	2.21	Calculated Fan kW × 1.341
Exhaust fan HP rating	3.00	HP at design CFM × 120% rounded up to the next whole HP
Average fan energy reduction due to DCKV	56%	Field data from 13 sites
µfan, Fan efficiency (%)	56%	exhaust fan curves.xlsx exhaust fan curves.xlsx
µmotor, Motor efficiency (%)	84%	motor efficiencies.xlsx motor efficiencies.xlsx

Normalized annual energy savings were calculated per HP for an exhaust system with a flowrate of 5000 cfm. Although the exhaust fan requires 1.97 HP to provide 5000 cfm at 1.4-inch of static pressure, a 3 HP exhaust fan motor will be sized for that system.

Hours and days of operation were normalized across eight facility types to determine annual energy savings.

Baseline Exhaust and Supply Fan Energy

Design CFM	Exhaust HP Rating	Exhaust kWh/yr	Supply kWh/yr	Total kWh/yr
5,000	3	8,352	3,579	11,931

DCKV Exhaust and Supply Fan Energy

Design CFM	Exhaust HP Rating	Exhaust kWh/yr	Supply kWh/yr	Total kWh/yr
5,000	3	3,698	1,585	5,283

DCKV Normalized Savings per HP

Design CFM	Exhaust HP Rating	Total Savings kWh/yr	Total Savings kWh/yr/hp
5,000	3	6,648	2,216

Gas Savings (Therms)

Since the baseline and measure case energy models both assume unconditioned makeup air, there is no assumed heating energy and thus no gas savings associated with this proposed measure.

3.3.1.2 Energy Savings Methodology per Prototypical Building

The Statewide CASE Team measured per unit energy savings expected from the proposed code changes in several ways in order to quantify key 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 proportional to 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 energy cost metrics for both electricity and natural gas provided by the CEC. These LSC hourly factors are projected over the 30-year life of the building. The LCCHF incorporate the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade-based CO2 emissions. More information on Source Energy and LSC hourly factors is available in the March 2020 CEC Staff Workshop on

Energy Code Compliance Metrics and the July 2022 CEC Staff Workshop on Energy Code Accounting for the 2025 Building Energy Efficiency Standards.

The CEC directed the Statewide CASE Team to model the energy impacts using specific prototypical building models that represent typical building geometries for different types of buildings (California Energy Commission 2022). The Statewide CASE Team used hospital, restaurant, large school and small school prototypes in the analysis for this a in all 16 climate zones for new construction. Information on these prototypes can be found in Table 20.

Based on stakeholder engagement with manufacturers and designers, savings were calculated assuming that all new construction of prototypes other than restaurants would be subject to the measure. For restaurants, it was assumed that 50 percent of new construction would be impacted by the proposal since sectors like quick-service were unlikely to meet the 5000 cfm threshold.

Table 20: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Description
Hospital	Average hospital with assumed 4.1 percent of total floor space being occupied by kitchen space, based on prototypes. Kitchen features one 3HP ventilation hood designed to operate at 5000 cfm.
Restaurant	Average restaurant with assumed 50 percent of total floor space being occupied by kitchen space, based on prototypes. Kitchen features one 3HP ventilation hood designed to operate at 5000 cfm.
Large School	Average large school with assumed 1.1 percent of total floor space being occupied by kitchen space, based on prototypes. Kitchen features one 3HP ventilation hood designed to operate at 5000 cfm.
Small School	Average small school with assumed 11.7 percent of total floor space being occupied by kitchen space, based on prototypes. Kitchen features one 3HP ventilation hood designed to operate at 5000 cfm.

The Statewide CASE Team estimated LSC savings, source energy, electricity, natural gas, peak demand, and GHG impacts by simulating the proposed code change in EnergyPlus using prototypical buildings and rulesets from the 2025 Research Version of the California Building Energy Code Compliance (CBECC) software (California Energy Commission n.d.). Specifically, the Statewide CASE Team simulated savings using the prototypical building design in CBECC 2025.0.4 RV (Research Version).

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 energy budget and source energy budget that is minimally compliant with 2022 Title 24, Part 6 code requirements. Features used in the Standard Design are described in the 2022

Nonresidential ACM Reference Manual. The Proposed Design represents the same geometry as the Standard Design, but it assumes the energy features that the software user describes with user inputs. To develop savings estimates for the proposed code changes, the Statewide CASE Team created a Standard Design and Proposed Design for each prototypical building with the Standard Design representing compliance with 2022 code and the Proposed Design representing compliance with the proposed requirements. Comparing the energy impacts of the Standard Design to the Proposed Design reveals the impacts of the proposed code change relative to a building that follows industry typical practices.

There is an existing Title 24, Part 6 requirement that covers the building system in question and applies to both new construction/additions and alterations, so the Standard Design is minimally compliant with the 2022 Title 24 requirements. The current typical industry standard is not to meet the 2022 Title 24 requirement via DCKV but by having a minimum of 75 percent of makeup air volume through air that is minimally conditioned. Thus, the Standard Design is a kitchen ventilation system without DCKV and minimally conditioned makeup air.

The Proposed Design was identical to the Standard Design in all ways except for the revisions that represent the proposed changes to the code. Section 3.3.1.1 presents precisely which parameters were modified and what values were used in the Standard Design and Proposed Design. Specifically, the proposed conditions assume that all new construction affected by this measure will implement DCKV, and with the conservative estimate that the affected ventilation system will be operating at 5,000 cfm as per the criteria for measure applicability.

The proposed measure will impact only the fan energy associated with the affected ventilation hoods.

CBECC calculates whole-building energy consumption for every hour of the year measured in kilowatt-hours per year (kWh/yr) and therms per year (therms/yr). It then applies the 2025 LSC hourly factors to calculate LSC 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/yr), and hourly GHG emissions factors to calculate annual GHG emissions in metric tons of carbon dioxide emissions equivalent. CBECC also calculates annual peak electricity demand measured in kilowatts (kW).

The energy impacts of the proposed code change do vary by climate zone, but the climate zones were normalized to determine average LSC hourly factors when calculating energy and energy cost impacts.

Per-unit energy impacts for nonresidential buildings are presented in savings per square foot. Annual energy, GHG, and peak demand impacts for each prototype building were translated into impacts per square foot by dividing by the floor area of the prototype

building. This step allows for an easier comparison of savings across different building types and enables a calculation of statewide savings using the construction forecast that is published in terms of floor area by building type.

3.3.1.3 Statewide Energy Savings Methodology

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

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

3.3.2 Per-Unit Energy Impacts Results

Energy savings and peak demand reductions per unit are presented in Table 21 and Table 22. Presented savings are only from new construction, as additions and alterations do not apply. The per-unit energy savings figures do not account for naturally occurring market adoption or compliance rates. Per-hood electric savings and demand reductions are not climate zone dependent and are 6,630 kWh/yr and 6W respectively. The proposed design will reduce average electric consumption of affected ventilation systems by more than half.

Estimated savings are conservative since only one 5000 cfm ventilation hood is used for the energy model, regardless of the building type or kitchen size. The proposed code change will result in some minor demand reduction, due to the decrease in airflow rates. It would not have any impacts on demand management however, since the demand reduction is customer driven and therefore is not flexible.

Table 21: First Year Electricity Savings Per Square Foot – DCKV – All Climate Zones

Prototype	First Year Electricity Savings (kWh/ft2)	First Year Peak Demand Reductions (kW/ft2)	First Year Source Energy Savings (kBTU/ft2)
Restaurant	2.65	0	10.42
Small School	0.27	0	1.07
Large School	0.03	0	0.12
Hospital	0.03	0	0.11

Table 22: First Year LSC Energy Savings (kBtu) Per Square Foot by Climate Zone (CZ) - DCKV

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Restaurant	20.02	21.21	25.87	21.79	20.07	22.21	20.90	22.59	26.36	23.42	20.76	24.92	21.67	21.21	19.66	20.81
Small School	2.21	2.46	2.72	2.25	2.19	2.20	2.16	2.17	2.44	2.26	2.14	3.10	2.38	2.14	2.00	2.16
Large School	0.22	0.23	0.31	0.25	0.22	0.24	0.24	0.25	0.28	0.26	0.25	0.32	0.27	0.23	0.22	0.24
Hospital	0.22	0.23	0.31	0.25	0.22	0.23	0.23	0.23	0.25	0.26	0.23	0.30	0.24	0.23	0.21	0.22

3.4 Cost and Cost Effectiveness

3.4.1 Energy Cost Savings Methodology

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

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 0 of this report. CEC uses results in nominal dollars to complete the Economic and Fiscal Impacts Statement (From 399) for the entire package of proposed change to Title 24, Part 6. Appendix G presents energy cost savings results in nominal dollars. The proposed code change only applies to new construction and does not apply to additions and alterations.

Stakeholders were engaged to provide information on purchase and maintenance cost, along with estimates for the percent of restaurants that would meet the 5000 cfm threshold for required code compliance.

3.4.2 Energy Cost Savings Results

Per-unit energy cost savings for newly constructed buildings that are realized over the 30-year period of analysis are presented 2026 present value dollars (2026 PV$) in Table 23. The LSC hourly factors 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 3.6 for more details addressing energy equity and environmental justice.

Table 23: 2026 PV LSC Energy Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction

Climate Zone	30-Year LSC Electricity Savings (2026 PV$)	30-Year LSC Natural Gas Savings (2026 PV$)	Total 30-Year LSC Energy Savings (2026 PV$)
1	5.5	0	5.5
2	29.7	0	29.7
3	114.2	0	114.2
4	58.0	0	58.0
5	13.2	0	13.2
6	71.7	0	71.7
7	75.8	0	75.8
8	100.0	0	100.0
9	168.5	0	168.5
10	111.0	0	111.0
11	28.8	0	28.8
12	140.2	0	140.2
13	60.7	0	60.7
14	23.7	0	23.7
15	13.2	0	13.2
16	8.7	0	8.7

3.4.3 Incremental First Cost

Incremental first cost is equivalent to the average cost of the DCKV control system portion of the ventilation system, as determined by reviewing the claims data for 36 DCKV systems submitted for California incentive programs. Labor and acceptance testing costs are not expected to change between the baseline 5000 cfm ventilation hood without DCKV and the proposed code. The baseline case and measure case both assume unconditioned makeup air, so there is no associated incremental cost included. The incremental cost is expected to decrease over time as greater adoption leads to price competition and economies of scale.

3.4.4 Incremental Maintenance and Replacement Costs

Incremental maintenance cost is the incremental cost of replacing the equipment or parts of the equipment, as well as periodic maintenance required to keep the equipment operating relative to current practices over the 30-year period of analysis. The present value of equipment maintenance costs (or savings) was calculated using a three percent discount rate (d), which is consistent with the discount rate used when

developing the 2025 LSC hourly factors. The present value of maintenance costs that occurs in the n^{th} year is calculated as follows:

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

Based on stakeholder discussions, it is unclear whether average maintenance costs will differ between the current code and proposed code.

3.4.5 Cost Effectiveness

This measure proposes a primary prescriptive requirement. As such, 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 savings 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 24 for new construction/additions. The proposed measure saves money over the 30-year period of analysis relative to the existing conditions. Savings do not vary by climate zone.

Table 24: 30-Year Cost-Effectiveness Summary Per Square Foot – New Construction

Climate Zone	Benefits LSC Savings + Other PV Savings [a] (2026 PV$)	Costs Total Incremental PV Costs [b] (2026 PV$)	Benefit-to-Cost Ratio
All	$45.66	$2.87	15.93

a. **Benefits: LSC Cost Savings + Other PV Savings:** Benefits include LSC savings over the period of analysis (Energy + Environmental Economics 2016, 51-53). Other savings are discounted at a real (nominal – inflation) three percent rate. Other PV savings include incremental first-cost savings if proposed first cost is less than current first cost, incremental PV maintenance cost savings if PV of proposed maintenance costs is less than PV of current maintenance costs, and incremental residual value if proposed residual value is greater than current residual value at end of CASE analysis period.

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

3.5 First-Year Statewide Impacts

3.5.1 Statewide Energy and Energy Cost Savings

The Statewide CASE Team calculated the first-year statewide savings for new construction and additions by multiplying the per-unit savings, which are presented in Section 3.3.2, by assumptions about the percentage of newly constructed buildings that would be impacted by the proposed code. The statewide new construction forecast for 2026 is presented in Appendix A, as are the Statewide CASE Team's assumptions about the percentage of new construction that would be impacted by the proposal (by climate zone and building type).

The first-year energy impacts represent the first-year annual savings from all buildings that were completed in 2026. The 30-year energy cost savings represent the energy cost savings over the entire 30-year analysis period. The statewide savings estimates do not take naturally occurring market adoption or compliance rates into account. Table 25 presents the first-year statewide energy and energy cost savings from newly constructed buildings by climate zone.

Statewide savings are likely to be conservative, since the representative ventilation system used to model energy savings was the minimum 5000 cfm required for the code to take effect. The average ventilation system affected by the code is likely to be significantly higher, which would benefit more from the turndown capabilities of DCKV. This is particularly true with the building types modeled based off the prototypes with kitchens: hospitals, large schools, small schools, and restaurants.

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 3.6 for more details addressing energy equity and environmental justice.

Table 25: Statewide Energy and Energy Cost Impacts – New Construction

Climate Zone	Statewide New Construction Impacted by Proposed Change in 2026 (Million Square Feet)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued Energy Cost Savings (Million 2026 PV$)
1	0.12	0.03	0.00	0	0.135	5.5
2	0.65	0.19	0.00	0	0.731	29.7
3	2.50	0.72	0.00	0	2.812	114.2
4	1.27	0.36	0.00	0	1.429	58.0
5	0.29	0.08	0.00	0	0.326	13.2
6	1.57	0.45	0.00	0	1.766	71.7
7	1.66	0.48	0.00	0	1.867	75.8
8	2.19	0.63	0.00	0	2.464	100.0
9	3.69	1.06	0.00	0	4.151	168.5
10	2.43	0.70	0.00	0	2.734	111.0
11	0.63	0.18	0.00	0	0.709	28.8
12	3.07	0.88	0.00	0	3.454	140.2
13	1.33	0.38	0.00	0	1.496	60.7
14	0.52	0.15	0.00	0	0.585	23.7
15	0.29	0.08	0.00	0	0.326	13.2
16	0.19	0.05	0.00	0	0.214	8.7
Total	22.43	6.41	0.00	0	25.20	1,022.8

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

3.5.2 Statewide Greenhouse Gas (GHG) Emissions Reductions

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

The 2025 LSC hourly factors used in the lifecycle cost-effectiveness analysis include the monetary value of avoided GHG emissions based on a proxy for permit costs (not social costs).[18] The Cost-Effectiveness Analysis presented in Section 0 of this report does not include the cost savings from avoided GHG emissions. To demonstrate the

[18] 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.

cost savings of avoided GHG emissions, the Statewide CASE Team disaggregated the value of avoided GHG emissions from the other economic impacts. The authors used the same monetary values that are used in the LSC hourly factors.

Table 26 presents the estimated first-year avoided GHG emissions of the proposed code change. During the first year, GHG emissions of 453 metric tons CO2e would be avoided.

Table 26: First-Year Statewide GHG Emissions Impacts

Measure	Electricity Savings[a] (GWh/yr)	Reduced GHG Emissions from Electricity Savings[a] (Metric Tons CO2e)	Natural Gas Savings[a] (Million Therms/yr)	Reduced GHG Emissions from Natural Gas Savings[a] (Metric Tons CO2e)	Total Reduced GHG Emissions[a] (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions[b] ($)
DCKV	6.41	453	0		453	$55,824.03

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

b. GHG emissions factors are included in the LSC hourly factors published by CEC.

3.5.3 Statewide Water Use Impacts

The proposed code change will not result in water savings.

3.5.4 Statewide Material Impacts

The proposed code change will not significantly impact the consumption of materials

3.5.5 Other Non-Energy Impacts

The proposed code change is expected to improve the kitchen workplace environment by increasing comfort through reduced noise levels. The increased prevalence of DCKV will lower fan speeds to match the demand requirements during period of reduced activity, such as during preparation and cleanup. Communication between staff members will be better facilitated, which may lead to higher productivity and greater workplace safety.

3.6 Addressing Energy Equity and Environmental Justice

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in disproportionately impacted populations (DIPs) and the role this history plays in the environmental justice issues that persist today. DIPs refers to the areas throughout California that most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes, as well as high incidence of asthma and heart disease. DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience

the world.[19] While the term disadvantaged communities (DACs) is often used in the energy industry and state agencies, the Statewide CASE Team chose to use terminology that is more acceptable to and less stigmatizing for those it seeks to describe (DC Fiscal Policy Institute 2017).

Including impacted communities in the decision-making process, ensuring that the benefits and burdens of the energy sector are evenly distributed, and grappling with the unjust legacies of the past are all critical steps to achieving energy equity. Code change proposals must be developed and adopted with intentional screening for unintended consequences, otherwise they risk perpetuating systemic injustices and oppression.

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

The Statewide CASE Team is still in the process of investigating the potential impacts of the proposed code changes on DIPs via both research and outreach with community-based organizations (CBOs). Final results of this research and outreach will be incorporated into the Final CASE Report.

3.6.1 Research Methods and Engagement

Potential impact for DIPs was explored during stakeholder engagement sessions, particularly with manufacturers such as Melink who see the wide range of people that interact with their systems during and after installation. The team discussed the different parties that would be primarily affected by DCKV adoption and the potential effects of the technology. This is important because participatory approach allows individuals to address problems, develop innovative ideas, and bring forth a different perspective.

3.6.2 Potentially Disproportionately Impacted Populations

Review focused on the potential impact on three main DIPs identified: small businesses, public institutions, and foodservice workers.

Given the 5000cfm threshold for DCKV to become a requirement, it is unlikely to have much impact on small businesses. Facilities that fall under the 5000cfm threshold are likely to be quick-service. In their interview with the Statewide CASE Team, Chipotle noted that their standard hood design only requires 3000cfm. Full-scale restaurants are also likely to reach the 5,000 cfm thresholds, but small business owners running such

[19] 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 and Bell 2021). Socioeconomic inequities, climate, energy, and other inequities are inextricably linked and often mutually reinforcing.

restaurants may be less likely to pursue new construction. Facilities that are likely to reach the 5,000 cfm threshold and also be new construction are generally institutional, such as cafeterias, hospitals, universities, hotels, schools, prisons, religious institutions, or facilities that provide meals to unhoused individuals

The proposed code change does affect larger institutions such as schools, which could impact lower income communities for publicly-funded institutions. For schools located in lower income communities who have a proportionately smaller tax base, this code change may negatively impact the number of schools that would be built or reduce incentives to upgrade schools if such alterations would trigger the code (Section 3.6.2), due to the added upfront cost of the unit. In this case, DIPs with existing schools or plans to build new schools may be negatively impacted by the proposed code change (Section 3.6.1). More support for these school districts along with other multi-policy interventions could prove helpful to support this implementation (Section 3.6.4).

The proposed code change would most directly impact foodservice workers, who are typically in lower income brackets. Interviews with end-users highlighted concerns about mandatory DCKV's impact on thermal comfort or air quality, but this should result in no change compared to the previous code provided that the modern DCKV systems are working properly. In worst case scenario, the DCKV system can be manually overridden for the hood to perform at maximum airflow. The workplace environment should actually improve with the noise reduction associated with lower fan speeds during non-peak periods of production, which may also increase workplace safety accordingly, the details for which are still being researched.

3.6.3 Potential Impacts

Potential positive impacts include energy and cost savings, noise reduction in the working environment, and continuous monitoring of the ventilation system to ensure proper performance is maintained. Ventilation energy comprises a significant chunk of total kitchen energy consumption, and DCKV installations have been shown to generally reduce energy by 30-60 percent. These savings come primarily from the beginning and end of each business day, along with the lulls in activity between peak meal periods. During these periods of low activity, DCKV lowers the airflow rate to just what is needed to provide ventilation to the idling appliances, which also significantly lowers the sound levels of the kitchen. With less sound pollution, the workplace becomes more amenable to staff conversation and teamwork, making the workplace a more efficient and pleasant environment. The lower volume levels could reduce the likelihood of safety incidents that result from miscommunication, such as collisions or trip hazards.

Most DCKV systems also provide continuous monitoring that is sent to the manufacturer and sometimes shared with the end user, detailing hood performance and providing alerts for any issues or recommended changes to the settings. The manufacturer

monitors and maintains the connectivity equipment to ensure proper performance of the DCKV system, with customer accessibility allowing for easy follow up should there be any manufacturer delays. This reduces the likelihood that the ventilation system ever fails to meet the requirements of the facility operations, unlike issues for a standard hood which would likely not be escalated and addressed until either the effects are causing a significant negative impact or the hood is inspected by an external party.

The primary negative potential impact would be higher upfront cost, which would be offset by the cost savings from the reduced energy consumption of an active DCKV system and pay itself back within the lifetime of the equipment.

3.6.4 Evolution of the Code Change Proposal and Future Opportunities

The code change proposal has evolved throughout the research process, based on stakeholder feedback and primarily in the definition of which facilities the code change would apply to. Early discussions with stakeholders identified key concerns as efficacy of systems, cost of DCKV, and potential difficulties in implementation.

One of the first questions the Statewide CASE Team dedicated special attention to was whether DCKV systems can perform well enough to be applicable to all facilities that would reach the 5000 cfm threshold. Engaging both manufacturers and end users, it appeared that the potential concerns about effluent capture that had arose during the initial advent of DCKV were no longer in issue due to advancements in technology.

Costs were another issue that was investigated, through a combination of stakeholder sourced price quotes and claim submissions from energy savings programs. Costs were determined to be significant but not a deal breaker, and would generally be made up well within the DCKV equipment's lifetime. For the low airflow cases where the payback was weaker, the code was adapted to provide that only 75 percent of the airflow needed to have DCKV controls.

Stakeholder engagement revealed that DCKV for new construction generally has very few issues, but retrofits could be particularly challenging in having to implement the system in spaces that were not conducive to the necessary airflow systems. The proposed code was adapted to apply to only new construction, to avoid the many issues that would be associated with retrofitting DCKV.

Future evolution of the code will also involve in-depth evaluation of the interactive effects between the other prescriptive options listed in 140.9(b)2B. Since these other options were not directly touched in this code cycle revision, they are currently approximated to be have minimal changes, with further investigation pending to fully quantify the energy implications of each of those options.

4. Proposed Revisions to Code Language

4.1 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). Language relocated within a 2022 document is marked with purple underlining (new location) and ~~strikethrough~~ (previous location).

4.2 Standards

SECTION 100.1 DEFINITIONS AND RULES OF CONSTRUCTION

QUICK-SERVICE COMMERCIAL KITCHEN is an establishment primarily engaged in providing food services where patrons generally order or select items and pay before eating. Food and drink may be consumed on premises, taken out, or delivered to the customer's location.

SECTION 120.6 MANDATORY REQUIREMENTS FOR COVERED PROCESSES

(k) Mandatory requirements for commercial kitchens.

1. **Kitchen Ventilation.** A kitchen/dining facility having a total ~~Type I and Type II~~ kitchen hood exhaust airflow rate greater than 5,000 cfm from all Type I and Type II hoods in the building combined shall ~~have one of the following~~:
    i. ~~ii.~~ Have a D~~d~~emand ventilation system(s) on at least 75 percent of the exhaust air. S Such systems shall:
        a. Include controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle; and
        b. Include failsafe controls that result in full flow upon cooking sensor failure; and
        c. Include an adjustable timed override to allow occupants the ability to temporarily override the system to full flow; and
        d. Be capable of reducing exhaust and replacement air system airflow rates to the larger of:
            (i) 50 percent of the total design exhaust and replacement air system airflow rates; or

(ii) The ventilation rate required as specified by Section 120.1(c)3.

ii. Have one of the following:

a. ~~i.~~ At least 50 percent of all replacement air is transfer air that would otherwise be exhausted; or

b. ~~iii.~~ Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on at least 50 percent of the total exhaust airflow; or

c. ~~iv.~~ A minimum of 75 percent of makeup air volume that is:

(i) ~~a.~~ Unheated or heated to no more than 60°F; and

(ii) ~~b.~~ Uncooled or cooled without the use of mechanical cooling.

2. **Kitchen Exhaust System Acceptance.** Before an occupancy permit is granted for a commercial kitchen subject to Section 120.6(k), the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.11.

3. Electric Readiness for Newly Constructed Quick-Service Commercial Kitchens

A. Systems using gas or propane cooking appliances shall include a dedicated branch circuit wiring and outlet that would be accessible to the cookline appliances. The branch circuit conductors shall be rated at 50 amps minimum.

B. Main electrical service panel shall be sized to accommodate an additional either 208v or 240v 50-amp breaker, as appropriate per kitchen design requirements.

EXCEPTION to Section 120.6(k): healthcare facilities.

SECTION 140.9 – Prescriptive Requirements for Covered Processes

(b) Prescriptive Requirements for Commercial Kitchens.

1. Kitchen exhaust systems.

A. Replacement air introduced directly into the hood cavity of kitchen exhaust hoods shall not exceed 10 percent of the hood exhaust airflow rate.

B. For kitchen/dining facilities having total Type I and Type II kitchen hood exhaust airflow rates greater than 5,000 cfm, each type I hood shall have an exhaust rate that complies with TABLE 140.9-A. If a single hood or hood section is installed

over appliances with different duty ratings, then the maximum allowable flow rate for the hood or hood section shall not exceed the TABLE 140.9-A values for the highest appliance duty rating under the hood or hood section. Refer to ASHRAE Standard 154-2011 for definitions of hood type, appliance duty and next exhaust flow rate.

EXCEPTION 1 to Section 140.9(b)1B: 75 percent of the total Type I and Type II exhaust replacement air is transfer air that would otherwise be exhausted.

EXCEPTION 2 to Section 140.9(b)1B: Existing hoods not being replaced as part of an addition or alteration.

TABLE 140.9-A MAXIMUM NET EXHAUST FLOW RATE, CFM PER LINEAR FOOT OF HOOD LENGTH

Type of Hood	Light Duty Equipment	Medium Duty Equipment	Heavy Duty Equipment	Extra Heavy Duty Equipment
Wall-mounted Canopy	140	210	280	385
Single Island	280	350	420	490
Double Island	175	210	280	385
Eyebrow	175	175	Not Allowed	Not Allowed
Backshelf / Passover	210	210	280	Not Allowed

2. **Kitchen ventilation.** ~~A.~~ Mechanically cooled or heated makeup air delivered to any space with a kitchen hood shall not exceed the greater of:

   A. ~~i.~~ The supply flow required to meet the space heating and cooling load; or

   B. ~~ii.~~ The hood exhaust flow minus the available transfer air from adjacent spaces. Available transfer air is that portion of outdoor ventilation air serving adjacent spaces not required to satisfy other exhaust needs, such as restrooms, not required to maintain pressurization of adjacent spaces, and that would otherwise be relieved from the building.

   EXCEPTION to Section 140.9(b)2~~A~~: Existing kitchen makeup air units not being replaced as part of an addition or alteration.

~~B. A kitchen/dining facility having a total Type I and Type II kitchen hood exhaust airflow rate greater than 5,000 cfm shall have one of the following:~~

~~i. At least 50 percent of all replacement air is transfer air that would otherwise be exhausted; or~~

~~ii. Demand ventilation system(s) on at least 75 percent of the exhaust air. Such systems shall:~~

~~a. Include controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle; and~~
~~b. Include failsafe controls that result in full flow upon cooking sensor failure; and~~
~~c. Include an adjustable timed override to allow occupants the ability to temporarily override the system to full flow; and~~
~~d. Be capable of reducing exhaust and replacement air system airflow rates to the larger of:~~

~~(i). 50 percent of the total design exhaust and replacement air system airflow rates; or~~

~~(ii). The ventilation rate required as specified by Section 120.1(c)3.~~

~~iii.. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on at least 50 percent of the total exhaust airflow; or~~

~~iv. A minimum of 75 percent of makeup air volume that is:~~

~~a. Unheated or heated to no more than 60°F; and~~
~~b. Uncooled or cooled without the use of mechanical cooling.~~

~~**EXCEPTION to Section 140.9(b)2B:** Existing hoods not being replaced as part of an addition or alteration.~~

3. Kitchen Exhaust System Acceptance. Before an occupancy permit is granted for a commercial kitchen subject to Section 140.9(b), the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.11.

EXCEPTION to Section 140.9(b): healthcare facilities.

4.3 Reference Appendices

There are no proposed changes to the Reference Appendices.

4.4 ACM Reference Manual

There are no proposed changes to the ACM Reference Manual.

4.5 Compliance Forms

Compliance document *Commercial Kitchen Exhaust System Acceptance* would need minor wording revisions to account for DCKV being a mandatory rather than optional system and for one of the other three options being additionally chosen. All functional tests would remain the same.

5. Bibliography

n.d. http://bees.archenergy.com/Documents/Software/CBECC-Com_2016.3.0_SP1_Prototypes.zip.

Association, National Energy Assistance Directors. 2011. "2011 National Energy Assistance Survey Final Report."

Building Decarbonization Coalition. 2019. "All Electric Commercial Kitchens." *Building Decarbonization Coalition.* May 31. Accessed March 20, 2023. https://buildingdecarb.org/resource/all-electric-commercial-kitchens-slide-deck.

BW Research Partnership. 2016. *Advanced Energy Jobs in California: Results of the 2016 California Advanced Energy.* Advanced Energy Economy Institute.

CA EnergyWise. 2023. "California Foodservice Instant Rebates." *California Foodservice Instant Rebates Program.* 5 15. Accessed 5 25, 2023. https://caenergywise.com/instant-rebates/qpl/.

CA.gov. 2022. "California Releases World's First Plan to Achieve Net Zero Carbon Pollution." *Office of Governor Gavin Newsom.* November 16. Accessed February 10, 2023. https://www.gov.ca.gov/2022/11/16/california-releases-worlds-first-plan-to-achieve-net-zero-carbon-pollution/.

California Air Resouces Board. 2019. "Global Warming Potentials." https://www.arb.ca.gov/cc/inventory/background/gwp.htm#transition.

California Department of Water Resources. 2016. "California Counties by Hydrologic Regions." Accessed April 3, 2016. http://www.water.ca.gov/landwateruse/images/maps/California-County.pdf.

California Energy Commission. 2015. *2016 Building Energy Efficiency Standards: Frequently Asked Questions.* http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2016_Building_Energy_Efficiency_Standards_FAQ.pdf.

—. 2022. "Energy Code Data for Measure Proposals." *energy.ca.gov.* https://www.energy.ca.gov/title24/documents/2022_Energy_Code_Data_for_Measure_Proposals.xlsx.

—. 2022. "Housing and Commercial Construction Data - Excel." https://ww2.energy.ca.gov/title24/documents/2022_Energy_Code_Data_for_Measure_Proposals.xlsx.

—. 2018. "Impact Analysis: 2019 Update to the California Energy Efficiency Standards for Residential and Non-Residential Buildings." *energy.ca.gov.* June 29.

https://www.energy.ca.gov/title24/2019standards/post_adoption/documents/2019_Impact_Analysis_Final_Report_2018-06-29.pdf.

California Public Utilities Commission (CPUC). 2015b. "Water/Energy Cost-Effectiveness Analysis: Revised Final Report." Prepared by Navigant Consulting, Inc. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5360.

California Public Utilities Commission. 2015a. "Water/Energy Cost-Effectiveness Analysis: Errata to the Revised Final Report." Prepared by Navigant Consulting, Inc. . http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5350.

CASE Team. 2021. "All-Electric Multifamily Compliance Pathway." *title24stakeholders.com.* April. Accessed 1 10, 2023. https://title24stakeholders.com/wp-content/uploads/2021/04/2022-T24-Final-CASE-Report_MF-All-Electric_updated_V2.pdf.

City of Berkeley. 2021. "Berkeley Existing Buildings Electrification Strategy." *City of Berkeley.* November. Accessed April 10, 2023. https://berkeleyca.gov/sites/default/files/2022-01/Berkeley-Existing-Buildings-Electrification-Strategy.pdf.

DC Fiscal Policy Institute. 2017. "Style Guide for Inclusive Language." *DCFPI.* December. https://www.dcfpi.org/wp-content/uploads/2017/12/Style-Guide-for-Inclusive-Language_Dec-2017.pdf.

Energy + Environmental Economics. 2016. "Time Dependent Valuation of Energy for Developing Building Efficiency Standards: 2019 Time Dependent Valuation (TDV) Data Sources and Inputs." Prepared for the California Energy Commission. July. http://docketpublic.energy.ca.gov/PublicDocuments/16-BSTD-06/TN212524_20160801T120224_2019_TDV_Methodology_Report_7222016.pdf.

2003. *Engineering ToolBox Fans - Efficiency and Power Consumption. .* https://www.engineeringtoolbox.com/fans-efficiency-power-consumption-d_197.html .

Ettenson, Lara , and Christa Heavey. 2015. *California's Golden Energy Efficiency Opportunity: Ramping Up Success to Save Billions and Meet Climate Goals.* Natural Resources Defense Council & Environmental Entrepreneurs (E2).

Federal Reserve Economic Data (FRED). n.d. Accessed Sepember 14, 2022. https://fred.stlouisfed.org/release/tables?eid=258470&rid=144 .

—. n.d. *Data series relied on: Net Domestic Private Investment, Corporate Profits After Taxes.* Accessed September 18, 2022. https://fred.stlouisfed.org .

Gable, Jessica. 2023. *California's Cities Lead the Way on Pollution-Free Homes and Buildings.* February 14. Accessed April 1, 2023. https://www.sierraclub.org/articles/2021/07/californias-cities-lead-way-pollution-free-homes-and-buildings.

Galarza, Chef Chris, interview by Kiri Coakley. 2022. *Discussing Kitchen Electrification with Chef Galarza* (October 21).

Goldman, Charles, Merrian C. Fuller, Elizabeth Stuart, Jane S Peters, Marjorie McRay, Nathaniel Albers, Susan Lutzenhiser, and Mersiha Spahic. 2010. *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth.* Lawrence Berkeley National Laboratory.

Goldsmith, Leo, and Michelle L. Bell. 2021. "Queering Environmental Justice: Unequal Environmental Health Burden on the LGBTQ+ Community." *American Journal of Public Health.* https://ajph.aphapublications.org/doi/10.2105/AJPH.2021.306406.

Hedrick, Russell. 2023. "Demand Control Kitchen Ventilation (DCKV)." February 9.

Katz, Cheryl. 2012. "People in Poor Neighborhoods Breathe More Hazardous Particles." *Scientific American* 6.

Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan.* Publication Number: CEC- 400-2019-010-CMF , California Energy Commission. Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. 2019 California Energy Efficiency Action Plan. California Energy Commission. Publication Number: CEC- 400-2019-010-CMF .

Kuck, Paul, interview by Kiri Coakley. 2022. *Foodservice Business Trends Towards Electrification* (November 28).

Kuck, Paul, interview by Kiri Coakley. 2022. *Preparing Kitchens for Electrification* (November 8).

Livchak, Denis. 2020. *Demonstration of High Efficiency Commercial Cooking Equipment and Kitchens.* California Energy Commission.

Livchak, Denis. 2020. *Demonstration of High-Efficiency Comeercial Cooking Equipment and Kitchens.* California Energy Commission.

Monsur, Joe, Paul Kuck, and Scott Honegger. 2022. "All-Electric Commercial Kitchen Electrical Requirements Study: Final Report." *CalNEXT.* December 21. Accessed February 16, 2023. https://calnext.com/wp-content/uploads/2023/02/ET22SWE0010_All-Electric-Commercial-Kitchen-Electrical-Requirements-Study_Final-Report.pdf.

NAICS Association. 2022. *NAICS Code Description.* Accessed March 20, 2023. https://www.naics.com/naics-code-description/?code=722513.

National Energy Assistance Directors' Association. 2011. *2011 National Energy Assistance Survey Final Report.* http://www.appriseinc.org/reports/Final%20NEADA%202011%20Report.pdf.

Rashkin, Sam. 2016. *Improving Air Quality in the Kitchen.* November 7. Accessed April 10, 2023. https://www.probuilder.com/improving-air-quality-kitchen.

Saldivar, Andre, interview by Kiri Coakley. 2022. *SCE Kitchen Electrification Studies* (September 7).

SBW Consulting, Inc. 2022. *Water-Energy Calculator 2.0 Project Report.* Project Report, San Francisco: California Public Utility Commission.

Southern California Edison. n.d. "Commercial Kitchen Exhaust Hood Demand Controlled Ventilation." Workpaper.

State of California. n.d. *Employment Development Department, Quarterly Census of Employment and Wages (data search tool).* Accessed September 1, 2022. https://www.labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=industry.

State of California, Employment Development Department. n.d. *Quarterly Census of Employment and Wages (data search tool).* Accessed September 1, 2022. https://www.labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=industry.

Statewide CASE Team. 2023. "Nonresidential Commercial Kitchens and Controlled Environment Horticulture Utility-Sponsored Stakeholder Meeting Resources." *title24stakeholders.com.* February 9. Accessed February 17, 2023. https://title24stakeholders.com/event/nonresidential-commercial-kitchens-and-controlled-environmental-horticulture-utility-sponsored-stakeholder-meeting/.

Stone, Nehemiah, Jerry Nickelsburg, and William Yu. 2015. *Codes and Standards White Paper: Report - New Home Cost v. Price Study.* Pacific Gas and Electric Company. Accessed February 2, 2017. http://docketpublic.energy.ca.gov/PublicDocuments/Migration-12-22-2015/Non-Regulatory/15-BSTD-01/TN%2075594%20April%202015%20Codes%20and%20Standards%20White%20Paper%20-%20Report%20-%20New%20Home%20Cost%20v%20Price%20Study.pdf.

n.d. *The Engineering Toolbox.* https://www.engineeringtoolbox.com/fans-efficiency-power-consumption-d_197.html.

Thornberg, Christopher, Hoyu Chong, and Adam Fowler. 2016. *California Green Innovation Index - 8th Edition.* Next 10.

U.S. Census Bureau, Population Division. 2014. "Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014." http://factfinder2.census.gov/bkmk/table/1.0/en/PEP/2014/PEPANNRES/0400000US06.05000.

U.S. Energy Information Administration. 2022. "2018 Commercial Buildings Energy Consumption Survey, Consumption and Expenditures Highlights." *COMMERCIAL BUILDINGS ENERGY CONSUMPTION SURVEY (CBECS).* December. Accessed April 6, 2023. https://www.eia.gov/consumption/commercial/data/2018/pdf/CBECS%202018%20CE%20Release%202%20Flipbook.pdf.

U.S. EPA (United States Environmental Protection Agency). 2011. "Emission Factors for Greenhouse Gas Inventories." Accessed December 2, 2013. http://www.epa.gov/climateleadership/documents/emission-factors.pdf.

United States Census Bureau. n.d. *Quick Facts 2019 and 2021.* Accessed September 12, 2022. United States Census Burhttps://data.census.gov/cedsci/table?t=Housing%20Units&g=0400000US06&tid=ACSCP5Y2020.CP04.

United States Environmental Protection Agency. 1995. "AP 42, Fifth Edition Compilation of Air Pollutant Emissions Factors, Volume 1: Stationary Point and Area Sources." https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors#5thed.

United States Environmental Protection Agency. 2018. "Emissions & Generation Resource Integrated Database (eGRID) 2016." https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

Zabin, Carol, and Karen Chapple. 2011. *California Workforce Education & Training Needs Assessment: For Energy Efficiency, Distributed Generation, and Demand Reponse.* University of California, Berkeley Donald Vial Center on Employment in the Green Economomy. Accessed February 3, 2017. http://laborcenter.berkeley.edu/pdf/2011/WET_Appendices_ALL.pdf.

Engineering ToolBox, (2003). *Fans - Efficiency and Power Consumption*. [online] Available at: https://www.engineeringtoolbox.com/fans-efficiency-power-consumption-d_197.html [Accessed Day Mo. Year]

Appendix A: Statewide Savings Methodology

Kitchen Electrification Readiness

The measure has no statewide impact for energy or GHG.

Demand Control Kitchen Ventilation

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 Housing and Commercial Construction Data - Excel 2022, California Energy Commission 2022). The CEC provided the construction estimates on March 27, 2023.

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 will be in effect (2026). The nonresidential new construction forecast is presented in Table 27 and nonresidential existing statewide building stock is presented in Table 28.

The Statewide CASE Team made assumptions about the percentage of newly constructed floorspace that would be impacted by the proposed code change. Table 29 presents the assumed percentage of floorspace that would be impacted by the proposed code change by building type. 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 30 resents percentage of floorspace assumed to be impacted by the proposed change by climate zone. Based on stakeholder outreach, the Statewide CASE Team determined that 100 percent of schools and hospitals would be affected by the code change and about 50 percent of restaurants would be affected. Smaller restaurants and quick-service restaurants were unlikely to reach the 5000 cfm ventilation threshold to be affected by the proposed code. Prototypes of each facility type were used to determine the ratio of kitchen floorspace to total floorspace, with each kitchen conservatively assumed to feature a single 3HP ventilation system operating at 5,000 cfm.

Table 27: Estimated New Nonresidential Construction in 2026 (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0	0	3.234	1.578	0	1.422	0.825	2.288	4.152	0.3916	0.1088	0.5747	0	0.2002	0.01303	0.04995	14.83728
Medium Office	0.1302	0.4761	1.372	0.7442	0.3705	1.201	0.8046	1.646	3.184	1.174	0.2685	2.799	0.5859	0.3482	0.2629	0.102	15.4691
Small Office	0.01306	0.4369	0.1869	0.02019	0.06423	0.1481	0.2339	0.1594	0.36	0.4167	0.0933	0.5443	0.3852	0.04404	0.1051	0.03313	3.24445
Large Retail	0	0	1.097	0.5497	0.1491	0.6978	0.3746	0.8316	1.664	0.6327	0.2997	1.303	0.3564	0.1442	0.1803	0.05547	8.33557
Medium Retail	0.08421	0.348	0.7947	0.4459	0.08574	0.6027	0.2856	0.8641	1.424	0.8224	0.142	0.6274	0.379	0.18	0.1242	0.08122	7.29117
Strip Mall	0.001146	0.1543	0.504	0.2256	0.007439	0.5629	0.4878	0.9855	1.065	1.345	0.07164	0.5928	0.3253	0.3206	0.1001	0.0602	6.809325
Mixed-use Retail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large School	0.006476	0.1273	0.8761	0.4418	0.03636	0.5941	0.6084	0.9052	1.421	0.8535	0.3545	1.152	0.6149	0.1661	0.08573	0.0681	8.311566
Small School	0.0665	0.2698	0.4566	0.2294	0.1395	0.3155	0.2944	0.3516	0.6581	0.3481	0.09881	0.7763	0.3025	0.107	0.03728	0.04489	4.49628
Non-refrigerated Warehouse	0.06177	0.3672	2.16	1.118	0.1776	1.363	0.7108	1.948	3.01	1.36	0.6315	2.844	0.8203	0.3618	0.3673	0.1381	17.43937
Hotel	0.03627	0.2154	1.033	0.5306	0.1095	0.5527	0.4822	0.7835	1.183	0.5716	0.1534	0.8029	0.2557	0.1375	0.1248	0.04395	7.01602
Assembly	0.01028	0.3935	1.583	0.5574	0.05869	0.7868	0.7991	1.431	1.824	1.144	0.1669	1.414	0.3043	0.2453	0.118	0.08429	10.92056
Hospital	0.02939	0.1746	0.8416	0.4358	0.07972	0.3285	0.549	0.4412	0.7894	0.8128	0.1459	0.8253	0.2729	0.1417	0.115	0.04813	6.03094
Laboratory	0.0008188	0.0531	0.6313	0.3632	0.02078	0.07327	0.05265	0.1017	0.1214	0.06227	0.008372	0.04996	0.009723	0.01063	0.006101	0.003518	1.5687928
Restaurant	0.0139	0.08256	0.3269	0.1667	0.03403	0.3365	0.2036	0.4933	0.8189	0.4129	0.07099	0.3135	0.1414	0.1015	0.04739	0.0296	3.59367
Enclosed Parking Garage	0.0001757	0.009137	1.83	1.245	0.004558	2.585	0.7059	2.265	1.527	0.05053	0.001585	0.04116	0.002972	0.0152	0.003691	0.007247	10.2941557
Open Parking Garage	0.002272	0.1182	2.474	1.682	0.05894	3.648	1.201	3.197	2.155	0.6535	0.0205	0.5323	0.03843	0.1965	0.04773	0.09372	16.119092
Grocery	0.006871	0.04512	0.1048	0.06175	0.01187	0.04649	0.01716	0.0519	0.09145	0.0494	0.00891	0.03876	0.02276	0.01081	0.007629	0.006042	0.581722
Refrigerated Warehouse	0	0	0.06098	0.05067	0.01431	0.02204	0	0.00683	0.01322	0.03874	0	0.06849	0.1181	0.007633	0.007893	0.00517	0.414076
Controlled-environment Horticulture	0.09265	0.07749	0.3197	0.03986	0.2021	0.2578	0.001464	0.02342	0.02606	0.278	0.3027	0.3053	0.09011	0.01079	0.04796	0.004662	2.080066
Vehicle Service	0.001921	0.07746	0.5473	0.3582	0.02914	0.5513	0.3416	0.7989	1.809	0.5735	0.02149	0.3892	0.2476	0.1954	0.05667	0.04908	6.047761
Manufacturing	0.00564	0.1329	0.4035	0.1914	0.05985	0.1284	0.08885	0.1075	0.095	0.1144	0.06035	0.1555	0.02059	0.02453	0.01736	0.01262	1.61839
Unassigned	0	0	0.0002525	0.4212	0	0	0	0	0	0	0	0.000774	0	0	0	0	0.4222265
Totals	0.5642011	3.659567	28.81863	14.66157	1.748967	19.0753	11.169624	25.5077	35.02253	13.21704	3.116189	17.970244	5.375325	3.420773	1.917546	1.235519	186.480678

Table 28: Estimated Existing Floorspace in 2026 (Million Square Feet)

Building Type	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16	All CZs
Large Office	0.1275	3.102	139.8	72.35	1.832	99.54	72.71	162.6	303.1	58.48	2.608	78.61	9.264	20.27	4.434	4.663	1033.4905
Medium Office	3.379	30.99	78.79	42.28	13.32	47.81	43.87	59.11	86.34	66.69	16.94	101.7	25.18	13.33	10.25	4.063	644.042
Small Office	4.178	12.75	22.19	11.33	7.504	13.22	8.516	13.28	20.88	24.43	10.6	43.94	21.47	4.987	6.181	2.676	228.132
Large Retail	1.002	8.665	58.68	26.9	4.2	31.96	25.34	43.46	66.53	53.31	11.4	58.16	22.51	10.91	9.402	3.207	435.636
Medium Retail	1.176	13.11	44.52	25.74	5.433	44.27	34.66	66.72	108.2	66.89	10.37	60.5	24.15	15.53	8.769	5.17	535.208
Strip Mall	3.336	9.842	37.42	18.43	5.095	40.23	28.29	55.76	83.7	66.92	12.25	48.37	24.18	15.27	8.696	4.591	462.38
Mixed-use Retail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large School	0.7589	8.02	34.83	13.95	2.071	28.37	22.54	42.91	73.58	56.01	10.13	53.38	26.41	12.06	7.621	3.589	396.2299
Small School	2.23	11.13	25.57	9.979	6.06	25.69	14.96	34.44	54.31	33.03	13.5	42.08	23.44	8.72	4.251	3.645	313.035
Non-refrigerated Warehouse	3.33	20.22	108.3	53.43	9.802	89.98	51.48	128.4	207.3	182.7	33.73	148.3	51.08	38.87	29.05	11.63	1167.602
Hotel	1.771	10.52	48.1	24.73	5.011	30.49	32.66	41.97	66.01	37.09	7.218	40.53	13.08	8.006	5.876	2.439	375.501
Assembly	4.328	18.18	91.34	45.06	6.594	57.25	40.9	89.14	120.2	91.75	16.35	69.72	30.13	18.95	11.83	6.439	718.161
Hospital	1.866	11.09	48.33	24.67	5.055	28.25	27.15	40.77	69.88	39.6	11.11	53.18	22.49	8.802	5.034	3.234	400.511
Laboratory	0.1782	4.01	36.93	28.06	1.531	12.21	17.19	15.61	19.31	10.81	0.679	12.14	4.396	1.723	0.387	0.5716	165.7358
Restaurant	0.6087	3.616	14.72	7.494	1.546	16.46	10.73	23.78	40	32.41	3.515	16.95	7.742	6.859	3.453	1.897	191.7807
Enclosed Parking Garage	0.01696	0.5432	40.71	30.94	0.2988	29.15	20.67	58.41	72.53	2.673	0.345	3.09	0.4883	0.8543	0.1666	0.4343	261.32046
Open Parking Garage	0.2193	7.024	55.03	41.82	3.864	41.14	35.17	82.44	102.4	34.57	4.461	39.96	6.314	11.05	2.155	5.616	473.2333
Grocery	0.09598	1.7	5.869	3.564	0.7523	3.415	2.082	4.008	6.951	4.018	0.6502	3.737	1.45	0.9323	0.5386	0.3846	40.14798
Refrigerated Warehouse	0.004721	0.4556	0.9104	0.2123	0.3863	0.4566	0.02334	0.4213	0.7865	0.6521	0.2629	2.146	3.907	0.1842	0.1939	0.1444	11.147561
Controlled-environment Horticulture	0.6988	0.4569	2.62	1.072	6.327	8.264	1.072	0.7413	1.599	3.609	2.513	4.533	5.36	0.4681	0.6443	0.2349	40.2133
Vehicle Service	0.9073	6.184	33.65	15.98	2.971	33.73	23.08	49.52	81.78	56.54	6.296	38.32	18.24	15.09	6.18	3.543	392.0113
Manufacturing	4.105	16.89	61.93	79.55	5.59	73.33	33.27	122.7	168.1	49.58	12.86	57.01	25.97	16.98	5.146	9.273	742.284
Unassigned	0.3582	6.575	9.025	6.318	0.2196	2.575	0.7716	3.778	7.868	2.551	3.367	14.35	2.935	0.7699	0.4029	1.026	62.8902
Totals	**34.809529**	**208.203**	**1150.3344**	**636.6293**	**96.1428**	**807.1406**	**605.37494**	**1240.7386**	**1905.9045**	**1004.1331**	**193.3021**	**1020.383**	**371.7292**	**239.2368**	**131.8425**	**82.9918**	**9728.89617**

Table 29: Percentage of Nonresidential Floorspace Impacted by DCKV Proposed Code Change in 2026, by Building Type

Building Type	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
Large Office	0%	0%
Medium Office	0%	0%
Small Office	0%	0%
Large Retail	0%	0%
Medium Retail	0%	0%
Strip Mall	0%	0%
Mixed-use Retail	0%	0%
Large School	1%	0%
Small School	12%	0%
Non-refrigerated Warehouse	0%	0%
Hotel	0%	0%
Assembly	0%	0%
Hospital	4%	0%
Laboratory	0%	0%
Restaurant	25%	0%
Enclosed Parking Garage	0%	0%
Open Parking Garage	0%	0%
Grocery	0%	0%
Refrigerated Warehouse	0%	0%
Controlled-environment Horticulture	0%	0%
Vehicle Service	0%	0%
Manufacturing	0%	0%
Unassigned	0%	0%

Table 30: Percentage of Nonresidential Floorspace Impacted by Proposed DCKV Measure, by Climate Zone

Climate Zone	New Construction Impacted (Percent Square Footage)	Existing Building Stock (Alterations) Impacted (Percent Square Footage)
1	100%	0%
2	100%	0%
3	100%	0%
4	100%	0%
5	100%	0%
6	100%	0%
7	100%	0%
8	100%	0%
9	100%	0%
10	100%	0%
11	100%	0%
12	100%	0%
13	100%	0%
14	100%	0%
15	100%	0%
16	100%	0%

Appendix B: Embedded Electricity in Water Methodology

There are no on-site water savings associated with the proposed commercial kitchen code changes.

Appendix C: California Building Energy Code Compliance (CBECC) Software Specification

Introduction

The purpose of this appendix is to present proposed revisions to CBECC for commercial buildings (CBECC) along with the supporting documentation that the CEC staff and the technical support contractors would need to approve and implement the software revisions.

All text in this appendix refers to DCKV. The Statewide CASE Team does not propose any updates with respect to Electrification.

Technical Basis for Software Change

The proposed code change would require a DCKV system for all ventilation systems over 5000cfm, requiring the CBECC software to have a note for DCKV upon hitting this threshold. This should be a minor change, require an update to mandatory controls upon threshold and a subsequent change to the operational schedule based on DCKV.

There will be an update to CBECC. Details are to be determined based on future conversation with CEC staff and the software development team.

Description of Software Change

Background Information for Software Change

The proposed code change would require controls on a kitchen that is over 5000 cfm.

This is currently an optional control in CBECC

Existing CBECC Building Energy Modeling Capabilities

CBECC currently allows for Fixed or CO2 sensors.

The update will need to make the DCKV required at 5000 cfm threshold. This can no longer be optional as in the current version of the software. Contant flow should not be an option for exhaust over this limit.

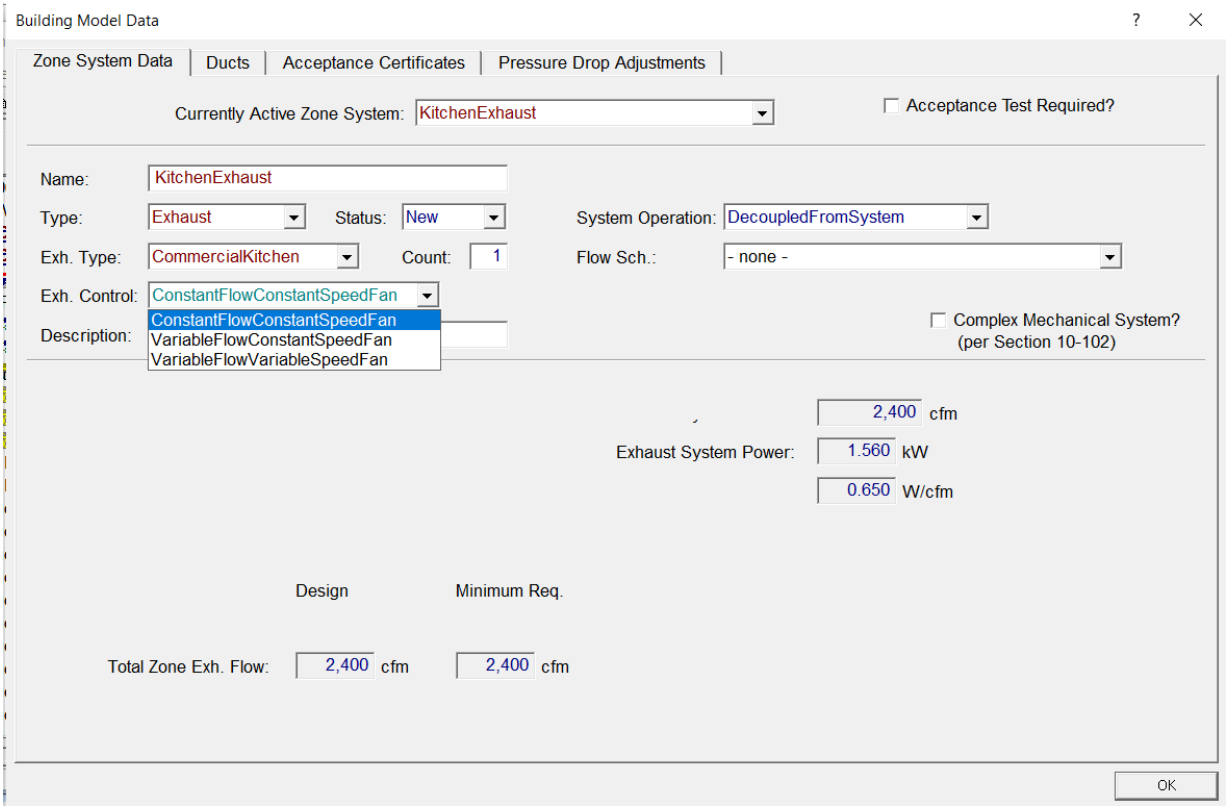

Figure 1: Screenshot of mechanical zone system data in kitchen (small restaurant prototype)

User Inputs to CBECC

When a kitchen exhaust system is 5,000 cfm or greater, DCKV should be required as method of control.

Simulation Engine Inputs

EnergyPlus/California Simulation Engine Inputs

The Statewide CASE Team will work with the CEC software development team to determine the appropriate updates to CSE inputs.

Calculated Values, Fixed Values, and Limitations

Simulation Engine Output Variables

There will be no updates necessary to simulation engine output variables

Compliance Report

There will be no changes made to the Compliance report.

Testing and Confirming CBECC Building Energy Modeling

Because DCKV is already incorporated into CBECC, testing and confirmation can be based on existing testing processes.

Description of Changes to ACM Reference Manual

There will not be any changes needed to the ACM Reference Manual

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.

Direct Environmental Impacts

Direct environmental benefits are the energy savings associated with DCKV reducing fan energy during periods of low demand and GHG emission reductions associated with reduced heating energy for conditioning the makeup air.

Direct Environmental Benefits

Case studies referenced in the bibliography demonstrate the direct environmental benefits, such as those shown below:

- (Livchak, Demonstration of High Efficiency Commercial Cooking Equipment and Kitchens 2020)
- (Southern California Edison n.d.)
- (Building Decarbonization Coalition 2019)
- (Monsur, Kuck and Honegger 2022)

Direct Adverse Environmental Impacts

There are no adverse environmental impacts currently expected with the code update.

Indirect Environmental Impacts

The Statewide CASE Team did not determine this measure would result in significant indirect environmental impacts.

Indirect Environmental Benefits

Some recent research on indoor air quality (IAQ) has shown a relationship between the presence of natural gas equipment and reduced air quality. There are associated safety risks and compounds that can contribute to asthma and allergies (Rashkin 2016). This effect has not been extensively studied in commercial foodservice kitchens, but kitchen electrification could positively impact working conditions (Monsur, Kuck and Honegger 2022).

Direct Adverse Environmental Impacts

There are no known studies that demonstrate adverse environmental impacts of the proposal.

Mitigation Measures

The Statewide CASE Team has considered opportunities to minimize the environmental impact of the proposal, including an evaluation of "specific economic, environmental, legal, social, and technological factors." (Cal. Code Regs., tit. 14, § 15021.) The Statewide CASE Team did not determine this measure would result in significant direct or indirect adverse environmental impacts and therefore, did not develop any mitigation measures.

Reasonable Alternatives to Proposal

The Statewide CASE Team has considered alternatives to the proposal and believes that no alternative achieves the purpose of the proposal with less environmental effect. The alternatives and Statewide CASE Team's justification for not proposing them are included below.

Water Use and Water Quality Impacts Methodology

There are no impacts to water quality or water use.

Embodied Carbon in Materials

Accounting for embodied carbon emissions is important for understanding the full picture of a proposed code change's environmental impacts. The embodied carbon in materials analysis accounts specifically for emissions produced during the "cradle-to-gate" phase: emissions produced from material extraction, manufacturing, and transportation. Understanding these emissions ensures the proposed measure considers these early stages of materials production and manufacturing instead of emissions reductions from energy efficiency alone.

The Statewide CASE Team determined that there would not be any significant change in materials as a result of the proposed measure, thus resulting in no change in embodied carbon. The total emissions reductions from this measure are the total GHG emissions reductions as calculated in Section 3.5.2.

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

This appendix discusses how the recommended compliance process, which is described in Sections 2.1.5 and 3.1.5, could impact various market actors. Table 31 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 31 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. The proposed compliance process will not affect the current compliance and enforcement process.

Table 31 identifies the market actors who will play a role in complying with the proposed change, the tasks for which they will be responsible, their objectives in completing the tasks, how the proposed code change could impact their existing workflow, and ways negative impacts could be mitigated.

Table 31: 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
Kitchen Designer	• Coordinate with design team • Complete compliance documentation or use energy consultant • Review submittals during construction • Coordinate with commissioning agent or ATT	• Would need to document compliance of the new requirements for commercial kitchens	Would work with energy consultants and end users to design for compliance path	• Increased coordination with mechanical designers or engineers • Software training on any updates • No additional documentation necessary, just updates to existing
Plans Examiner	• Identifies relevant requirements • Confirms plans/specifications match data on documents • Confirms data on documents are compliant • Provides correction comments if necessary	• Match data on documents • Confirms data on documents are compliant • Provides correction comments if necessary	• Would need to verify data fields and calculations are compliant • Would need to verify calculations match plans	• Revise compliance forms to automate data field QC/check for compliance with standards • Modeling software would queue applicable compliance forms to simplify process
CEC	Ensure that compliance process is feasible	N/a	N/a	Incorporate updated mandatory requirements into compliance documents
Contractors	• Conduct installations as design drawings dictate • Populate and sign the Certificate of Installations	• Install the system as designed • Completion and submission of compliance forms	Would need to certify that system installations meet design plans and code requirements	Training to understand code requirements
Inspector	Inspect the construction to ensure that kitchen is built to plan	Ensure that system was designed as planned and meets the new code	Would need to verify that designs match construction and are compliant	Training to understand code requirements
Restaurant Owners	• Work with other stakeholders to understand requirements • Review design	Will need to understand new requirements	Would need to hire contractors and designers that keep up to date on the code	Support from trained contractors and designers to understand and meet code requirements
Energy Consultant	• Performs compliance modeling and coordinates with team members, including designers • Completes compliance document for permit application	• Minimal impact • Would need to be aware of new Title 24 requirements	• Would work with designer to iterate on system designs for compliance purposes • Would need to manage and submit compliance forms for performance path	• Revise compliance forms to automate data field QC/check for compliance with standards • Modeling software would queue applicable compliance forms to simplify process for performance path • Software model training helps accurate use of features and accelerate learning curve

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 one stakeholder meetings for DCKV via webinar described in Table 32. 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 32: Utility-Sponsored Stakeholder Meetings

Meeting Name	Meeting Date	Event Page from Title24stakeholders.com
First Round of DCKV Utility-Sponsored Stakeholder Meeting	Thursday, February 9, 2023	https://title24stakeholders.com/event/commercial-kitchen-products-utility-sponsored-stakeholder-meeting/

The first round of utility-sponsored stakeholder meetings occurred from 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.

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 33.

Table 33: Engaged Stakeholders

Organization/Individual Name	Market Role
Spring Air	Manufacturer
Halton	Manufacturer
Dipak Negandhi	Consultant
North American Kitchen Solutions	Manufacturer
Melink	Manufacturer
Restaurant Consultation and Design	Consultant
Chef Chris Galarza	End User, Consultant
Chipotle	End User
Vacaville School District	End User
CKE Restaurant Holdings	End User

Engagement with DIPs

The team connected with Vacaville School District to better understand the viewpoint and potential impact of the code on school communities. Topics such as funding, costs, value priorities, technology benefits and proposal impacts were discussed in depth.

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 Table 23: 2026 PV LSC Energy Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction. This appendix presents energy cost savings in nominal dollars.

Table 34: Nominal Life Cycle Energy Cost Savings Over 30-Year Period of Analysis – Per Square Foot – New Construction - DCKV

Climate Zone	30-Year LSC Electricity Savings (Nominal $)	30-Year LSC Natural Gas Savings (Nominal $)	Total 30-Year LSC Savings (Nominal $)
1	12.4	0	12.4
2	67.0	0	67.0
3	257.7	0	257.7
4	130.9	0	130.9
5	29.8	0	29.8
6	161.8	0	161.8
7	171.1	0	171.1
8	225.7	0	225.7
9	380.3	0	380.3
10	250.5	0	250.5
11	65.0	0	65.0
12	316.4	0	316.4
13	137.0	0	137.0
14	53.5	0	53.5
15	29.8	0	29.8
16	19.6	0	19.6