Codes and Standards Enhancement (CASE) Initiative

2025 California Energy Code

Elevator Energy Efficiency

Number:
Nonresidential Covered Process

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Draft CASE Report

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Executive Summary

The goal of this Draft CASE Report is to present a cost-effective code change proposal for elevator energy efficiency, with pertinent information supporting the code change.

This is a draft report. The Statewide CASE Team encourages readers to provide comments on the proposed code changes and presented analyses, which should be sent to *info@title24stakeholders.com*. Comments will not be released for public review or will be anonymized if shared. When possible, please provide supporting data and justifications in addition to comments.

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) 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.

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in disproportionately impacted populations (DIPs) and the role this history plays in the environmental justice issues that persist today. While the term disadvantaged communities (DACs) is often used in the energy industry and state agencies, the Statewide CASE Team chose to use terminology that is more acceptable to and less stigmatizing for those it seeks to describe (DC Fiscal Policy Institute 2017). Similar to the California Public Utilities Commission (CPUC) definition, DIPs refer to the populations throughout California that "most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes, as well as high incidence of asthma and heart disease" (CPUC n.d.). DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience the world.[1]

Including impacted communities in the decision-making process, ensuring that the benefits and burdens of the energy sector are evenly distributed, and facing the unjust legacies of the past serve as critical steps to achieving energy equity. To minimize the

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

risk of perpetuating inequity, code change proposals are being developed with intentional consideration of the unintended consequences of proposals on DIPs.

Proposal Description

Proposed Code Change

The proposal would add requirements as a new subsection to 120.6(f) of the California Energy code's mandatory requirement for elevators. The changes would add energy efficiency requirements for the power conversion system, which moves the elevator cab. Existing requirements for elevator lighting and ventilation would not be affected.

The scope of the power conversion system requirements are limited to those systems that:

- Are for new traction elevators in new buildings.
- Are for passenger service and include service elevators but not freight elevators.
- Serves three more landings.
- Have a load capacity equal to or less than 4,000 lbs.
- Use traction technology (hydraulic elevators are exempt)

Those elevators meeting the above criteria are required to have a regenerative drive that recovers potential energy and returns it to the building electrical system. The drive would have to meet or exceed a 96 percent power factor.

The elevator controls and the electrical system must meet California Electrical Code and ASME A17.1-2016 Safety Code for Elevators requirements. Together these ensure that regenerated power during a power outage does not exceed emergency power circuit capacity to absorb it. When the elevators are running on emergency power, the controls can limit the amount of regenerated power by reducing how many units operate at one time and their speed.

Justification

Elevator operation accounts for 2-5 percent of electricity usage in modern buildings,[2] and more than 1,000 commercial traction elevators are constructed in California each year.[3] Requiring the use of regenerative drives would provide building owners with significant savings over the 30-year period of analysis. Regenerative drives are already

[2] a1501ACEEE-elevators2015.pdf

[3] Average of 2017-2021 data compiled from the California Occupational Safety and Health Administration (CAL/OSHA) Elevator Database.

found on most high-rise traction elevators and some low-rise elevators. This proposal would expand the use of regeneration to all elevators serving more than three landings. The cost of adding a regenerative drive and enabling its use is small ($3,000 to $4,000 per elevator) and the lifecycle savings is significantly higher so that the benefit-to-cost ratios range from 10 to 18 (see Table 19).

The European Union commissioned an effort to establish a framework (VITO, Fraunhofer ISI n.d.) for setting efficiency requirements for elevators. The effort started in 2017 and lasted two years. The final report examined existing elevator standards and a feasibility and cost-effective analysis of approaches to elevator efficiency.

Background Information

The market is ready for regenerative drives to be required on all new traction elevators. Manufacturers have calculated that using regenerative drives can reduce an elevator's net energy usage by up to 75 percent in the tallest buildings although 25-45 percent savings can be achieved across many scenarios. Because of these large savings, New York City has mandated the use of regenerative drives for traction elevators with over 75 feet of rise since 2020.

Scope of Code Change Proposal

Table 1 summarizes the scope of the proposed changes and which sections of the standards, reference appendices, or compliance documents would be affected.

Table 1: Scope of Code Change Proposal

Proposal Name	Affected Documents
Type of Requirement	Mandatory
Applicable Climate Zones	All
Modified Section(s) of Title 24, Part 6	120.6(f)
Modified Title 24, Part 6 Appendices	Nonresidential Appendix 7, section NA7.14
Would Compliance Software Be Modified	No
Modified Compliance Document(s)	NRCC-PRC-E, NRCA-PRC-12-F, NRCI-PRC-E

Market Analysis and Regulatory Assessment

Current Market Structure

The elevator market involves many market actors including designers, architects, manufacturers, installation and maintenance companies, construction companies, and certification/compliance specialists. This code change proposal would cause very little disruption to the market because any activities it would generate are already standard practice.

Technical Feasibility and Market Availability

This measure does not have barriers due to technical feasibility or market availability. No new technologies or processes would be necessary for the measure success. The addition of regenerative drives to traction elevators has no major feasibility or market barriers.

The Statewide CASE Team did identify that the Electrical Engineer of Record would have to ensure the building load would be able to absorb the regenerated power, particularly during standby power events. However, elevator manufacturers commonly provide estimated regenerated power for projects, and this was not considered a barrier. There are several methods of assuring the elevator does not generate too much power during standby operation. These include adding resistor banks in the emergency circuit, reducing the number of elevators operating at once, and reducing speed.

Regenerative drives are common on traction elevators because they are relatively inexpensive, save energy, and produce less heat that must be removed. The Statewide CASE Team assumed a current market penetration rate of 80 percent for high-rise buildings, and 50 percent for mid-rise and low-rise buildings.

Cost Effectiveness

The benefit-to-cost (B/C) ratio over the 30-year period of analysis ranged between 10 and 18 across the building prototypes, with higher ratios for taller buildings (see Table 19.) Climate zones do not affect the measure since elevators are typically within the building envelope and are isolated from outside conditions.

Statewide Energy and Greenhouse Gas Impacts

Table 2 presents the estimated impacts of the proposed code change during the first 12 months of being in effect. See 3.5.1 for more details on the first-year statewide impacts.

Table 2: Statewide First-Year Impacts

Building Prototype	LSC Electricity Savings per Prototype (2026 PV$)	Impacted in 2026 (# Bldgs)	First-Year LSC Savings (Million 2026 PV$)	First-Year Electricity Savings (GWh/yr)	First-Year Peak Demand Reduction (MW)	First-Year Source Energy (million kBtu/yr)
Loaded Corridor Apt	42,000	122	5.1	1.0	0	1.3
Office Medium	36,000	72	2.6	0.6	0	0.5
Parking Garage	53,000	22	1.2	0.2	0	0.3
Hotel Small	43,000	64	2.8	0.5	0	0.7
Mid-Rise Multifamily	84,000	123	10.3	2.1	0	2.3
High-rise Multifamily	110,000	5	0.6	0.1	0	0.1
Office Large	400,000	5	2.0	0.5	0	0.5
Total		413	24.6	5.0	0	5.7

The statewide GHG emissions reduction would be 110 Metric Tons CO_2e, as presented in Section 3.5.2.

Compliance and Field Verification

Compliance and field verification for this code change proposal would be the responsibilities of elevator designers, installers, building inspectors, field technicians, and building departments. This code change proposal would not significantly change any of their basic activities.

Addressing Energy Equity and Environmental Justice

The Statewide CASE Team recognizes the history of prejudice and inequality in disproportionately impacted populations (DIPs). This measure is unlikely to have significant impact on these populations.

The Statewide CASE Team assessed the potential impacts of the proposed measure, and based on a preliminary review, the measure is unlikely to have significant impacts on energy equity or environmental justice, therefore reducing the impacts of disparities in DIPs. Adding a regenerative drive to a traction elevator is relatively low-cost, has an attractive benefit-to-cost ratio and does not impact the amenity of riding in an elevator. The Statewide CASE Team does not recommend further research or action at this time but is open to receiving feedback and data that may prove otherwise. Please reach out to Zyg Kunczynski (zkunczynski@energy-solution.com) and Marissa Lerner (mlerner@energy-solution.com) for further engagement. Refer to Section 2 for more details addressing energy equity and environmental justice.

1. Introduction

This is a draft report intended to perspective and history on the efforts related to the 2025 CASE report cycle for Elevators, and will be used to inform the 2028 CASE report. 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 not be issued for 2025 cycle.

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 CEC's 2025 Title 24, Part 6 website for information about the rulemaking schedule and how to participate in the process.

The goal of this Draft CASE Report is to present a code change proposal for elevator energy efficiency. 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 manufacturers, builders, elevator consultants, Title 24, Part 6 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 May 23, 2023.

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

- Section 3 – Elevator Energy Efficiency
    - Section 3.1 – Measure Description of this Draft CASE Report provides a description of the measure and its background. This section also presents a detailed description of how this code change is accomplished in the various sections and documents that make up the Title 24, Part 6 Standards.
    - Section 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 Long-term Systemwide Cost savings associated with the proposed code change. This section also describes the methodology that the Statewide CASE Team used to estimate per-unit energy, demand reduction, and Long-term Systemwide Cost savings.
    - Section 3.4 – 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 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 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 documents.

- 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 LSC savings over the period of analysis in nominal dollars.

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

2. Addressing Energy Equity and Environmental Justice

2.1 General Equity Impacts

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in disproportionately impacted populations (DIPs) and the role this history plays in the environmental justice issues that persist today. While the term disadvantaged communities (DACs) is often used in the energy industry and state agencies, the Statewide CASE Team chose to use terminology that is more acceptable to and less stigmatizing for those it seeks to describe (DC Fiscal Policy Institute 2017). Similar to the California Public Utilities Commission (CPUC) definition, DIPs refer to the populations throughout California that "most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes, as well as high incidence of asthma and heart disease" (CPUC n.d.). DIPs also incorporate race, class, and gender since these intersecting identity factors affect how people frame issues, interpret, and experience the world.[4]

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

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

[4] 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.

beyond.[5] To minimize the risk of perpetuating inequity, code change proposals are being developed with intentional consideration of the unintended consequences of proposals on DIPs. The Statewide CASE Team identified potential impacts via research and stakeholder input. While the listed potential impacts should be comprehensive, they may not yet be exhaustive. As the Statewide CASE Team continues to build relationships with CBOs, these partnerships will inform and further improve the identification of potential impacts. The Statewide CASE Team is open to additional peer-reviewed studies that contribute to or challenge the information on this topic presented in this report. The Statewide CASE Team is currently continuing outreach with CBOs and EEEJ partners. Results of that outreach as well as a summary of the 2025 code cycle EEEJ activities will be documented in the 2025 EEEJ Summary Report that is expected to be published on title24stakeholders.com by the end of 2023.

2.1.1 Procedural Equity and Stakeholder Engagement

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

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

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

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

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

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

2.1.2 Potential Impacts on DIPs in Nonresidential Buildings

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

Cost: People historically impacted by poverty and other historic systems of wealth distribution can be affected more severely by the incremental first cost of proposed code changes. Costs can also create an economic burden for DIPs that does not similarly affect other populations. See section(s) 3.4.2 for an estimate of energy cost savings from the current proposals.

Health: Any potential health burdens from proposals could more severely affect DIPs that can have limited access to healthcare and live in areas affected by environmental and other health burdens. Several of the potential negative health impacts from buildings on DIPs are addressed by energy efficiency (Norton 2014., Cluett 2015, Rose 2020). For example, indoor air quality (IAQ) improvements through ventilation or removal of combustion appliances can lessen the incidents of asthma, chronic obstructive pulmonary disease (COPD), and some heart problems. Black and Latinx people are 56 percent and 63 percent more likely to be exposed to dangerous air pollution than white people, respectively (Tessum, et al. 2019). Water heating and building shell improvements can lower stress levels associated with energy bills by lowering utility bill costs. Electrification can reduce the health consequences resulting from NOx, SO_2, and $PM_{2.5}$.

Resiliency: DIPs are more vulnerable to the negative consequences of natural disasters and extreme weather events due to climate change. For example, better energy efficiency measures such as insulation and tighter building envelopes can reduce the health impacts from intrusion of dampness and contaminants, as well as providing a measure of resilience during extreme conditions. Proposals that improve buildings' resiliency to natural disasters and extreme weather could positively impact DIPs.

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

2.1.2.1 Potential Impacts by Building Type

The proposed requirement would have negligible impact on DIPS by building type.

2.2 Specific Impacts of the Proposal

This measure is unlikely to have significant impact on DIPs. Also, as shown in Section 3.4.5, the measure is forecast to be cost effective over time because it would lower utility bills.

3. Elevator Energy Efficiency

3.1 Measure Description

3.1.1 Proposed Code Change

Under this proposal, traction elevators would be required to have a regenerative drive with a power factor of at least 96 percent. The new requirement would be a new subsection to 120.6(f) of the California Energy code's mandatory requirement for elevators. Existing elevator requirements for lighting, ventilation, and controls would not change.

The scope of the power conversion system requirements is limited to those systems that:

- Are for new elevators in new buildings
- Are for passenger service
- Serve three or more landings
- Have a capacity equal to or less than 4,000 lbs.
- Use traction technology (hydraulic elevators are exempt)

3.1.2 Justification and Background Information

3.1.2.1 Justification

Elevator operation accounts for 2-5 percent of electricity usage in modern buildings.[6] More than 1,400 commercial traction elevators are constructed in California each year, of which this proposed code change would affect over 400 (see Table 20.) Requiring the use of regenerative drives would save 5 GWh/yr and provide building owners significant savings over time (see Table 21).

3.1.2.2 Background Information

The market is ready for regenerative drives to be required on all new traction elevators. Manufacturers have calculated that using regenerative drives can reduce an elevator's net energy usage by up to 75 percent in the tallest buildings, and that 20 percent savings can be achieved across many scenarios. Because of these large savings, New

[6] a1501ACEEE-elevators2015.pdf

York City has been requiring regenerative drives for elevators with over 75 feet of rise since 2020.

Regenerative drives save energy by capturing some of the energy used for braking, which occurs anytime the counterweight is heavier than the cab. The braking is done through the motor, which converts the mechanical energy from the load imbalance to electrical energy. Historically, this energy was shunted across a braking resistor and dissipated as heat. Regenerative drives capture this energy and return it to the building grid.

From discussions with manufacturers, the regenerative drive (the combination of the motor and the electronics controlling the motor) are able to produce electricity with a power factor, the ratio of real power (in units of kW) and apparent power (in units of kVA) of 96 percent or greater. High power factor drives are desirable as this specification helps maintain acceptable power quality for the power added into the building electrical system.

The current elevator requirements in the Title 24, Part 6 Standards roughly align with ASHRAE 90.1-2022 Standards for lighting, ventilation, and stand-by power use. As the Statewide CASE Team began researching further standards for elevators, one consideration was to align with ASHRAE on motor efficiency as well. However, it was found that stakeholders were reluctant to adopt the ASHRAE measures on motor efficiency, which led it to set the efficiency bar quite low (ISO efficiency class E.). Stakeholders found that higher ISO efficiency classes depended too much upon the circumstances of the building rather than the elevator equipment provided. The Statewide CASE Team therefore began researching other means of encouraging more efficient motors.

Through its research, the Statewide CASE Team found that New York State and New York City are good models. New York State Energy Research and Development Authority (NYSERDA) has elevator energy efficiency reach codes, which New York City, with its high concentration of high-rise buildings, adopted as requirements. See Appendix I for an excerpt of the elevator efficiency code language from the model ASHRAE 90.1-2022 Standards and from the 2020 New York City Energy Conservation Code.

The proposed measure would only affect traction elevators, but low-rise elevators can also use hydraulic technology. This is generally less energy efficient and becoming less common in California. The Statewide CASE Team developed a measure proposal to require passenger elevators to be traction with regeneration, to hasten the market shift. However, this was found to not be cost effective. The average lifetime of an elevator is about 25 years, but code change proposals are analyzed over a 30-year period. Therefore, at Year 25 the Statewide CASE Team assumed all elevators must be modernized. The incremental measure cost of modernization was zero for traction to traction-with-regeneration. However, it was found to be quite high for hydraulic to traction-with-regeneration, and created enough uncertainty that the Statewide CASE decided to not pursue the proposal.

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 documents would be modified by the proposed change.[7] See Section 0 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: 120.6(f)

Specific Purpose:

The specific purpose of the changes is to add new energy efficiency requirements for elevator conveyance type, regenerative drive, and machine selection for a new elevator in new buildings.

Necessity:

These changes are necessary to increase energy efficiency via mandating the use of more efficient elevator types and equipment.

3.1.3.2 Specific Purpose and Necessity of Changes to the ACM Reference Manuals

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

3.1.3.3 Summary of Changes to the Nonresidential Compliance Manuals

The proposed code change would require that documentation showing regenerative drive has been specified or installed or documentation showing an exception for the regenerative drive is on file.

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

3.1.3.4 Summary of Changes to Compliance Documents

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

- CEC-NRCC-PRC-E Process Systems Certificate of Compliance – Change the Elevator checkbox under Section B Project Scope to read “Elevator Energy Efficiency Requirements” and update Section K to read “Elevator Energy Efficiency” and modify the table to include requirements for regenerative drives.
- CEC-NRCA-PRC-12-F Elevator Light & Vent Ctrl – Update the title of this document to “Elevator Energy Efficiency Requirements” and update construction inspection requirements so they include ensuring the plans on file call for regenerative drives on traction elevators.
- NRCI-PRC-E Process System Certificate of Installation – Update Table B (Installer Scope) Section under Specialty to include Elevator Regenerative Drives.

3.1.4 Regulatory Context

3.1.4.1 Regulatory Approach

Elevator total energy efficiency was introduced in ASHRAE 90.1-2019 *Energy Standard For Sites And Buildings Except Low-Rise Residential Buildings*. This standard required that the designers document the A through G efficiency grade of the elevator in accordance with ISO 25745-2:2015 *Escalators and Moving Walks Part 2: Energy Calculation and Classification for Lifts (Elevators).”* Addendum CF to ASHRAE 90.1-2019 updated the requirements to require at least an E rating.

The Statewide CASE Team considered basing its requirements on ISO 25745-2:2015 as ASHRAE did but found that the industry was not in favor of a ratings approach. Rating presumes one knows the usage class of the building, and rating calculations can be fairly complex, so it would be difficult to enforce. Therefore, the Statewide CASE Team opted for a design standard instead that would be applicable regardless of usage class.

Motor efficiency and transmission efficiency requirements were not pursued due to enforceability issues. IEC EN 60034-30 is difficult to apply because it uses steady state conditions, which are rare for elevators. Transmission efficiency for traction elevators is already high.

3.1.4.2 Similarity of Proposed Change to Existing Regulations

The existing regulations most similar to those being proposed are the power conversion system requirements for elevators in the 2020 New York City Energy Conservation Code. New York's requirements are not limited to new buildings, and apply to rises of 75 feet of more. This proposal is limited to new buildings, and to all traction elevators with three landings or more.

Elevator efficiency excerpts from the 2020 New York City Energy Conservation Code and the ASHRAE 90.1-2022 Energy Standard can be found in Appendix I.

3.1.4.3 Compatibility with Existing State Laws and Regulations

All equipment required under this measure is currently compliant with the existing ASME A17.1 model code. The building's electrical system would have to comply with Article 620.91 (A) of the California Electrical Code, which in turn references ASME A17.1-2016 Safety Code for Elevators. These standards have detailed requirements for making sure the elevator controls and the design of the emergency power system are coordinated so that regenerated energy is sufficiently absorbed by the emergency power circuit. See Appendix J for excerpts from these two codes.

3.1.4.4 Duplication or Conflicts with Federal Laws and Regulations

There are no relevant federal laws or regulations.

3.1.5 Compliance and Enforcement

Compliance and enforcement for this code change proposal would be the responsibilities of elevator designers, installers, building inspectors, field technicians, and building departments. This code change proposal would not significantly change any of their current activities. Section 3.5 describes the slight changes that would be made to the compliance documents. Appendix E presents how the proposed changes could impact various market actors.

The compliance verification activities related to this measure are described below:

- **Design Phase:** An elevator designer would determine if the elevator would have to be a traction design based on rise, building type, and expected occupants. If yes, the designer would collaborate with the Electrical Engineer of Record to determine if there would be sufficient building load to absorb any regenerated power under normal or standby power operation. If so, the designer would specify a regenerative drive which the electrical engineer would incorporate into the building's electrical system design.

- **Permit Application Phase:** This proposal would not meaningfully change the permit application process.
- **Construction Phase:** This proposal would not meaningfully change the construction process. Installers are already familiar with installing traction elevators with regeneration.
- **Inspection Phase:** There would be slight modifications to the compliance documents. Completing the modified documents to confirm elevator and drive type would be certified by the installing contractor as part of the construction inspection portion of the acceptance test for elevators.

3.2 Market Analysis

3.2.1 Current Market Structure

The Statewide CASE Team performed a market analysis to identify 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 held on January 31, 2023.

The elevator market involves many market actors including designers, architects, manufacturers of components such as motors, machines, drives, and controllers, original equipment manufacturers, installation and maintenance companies, construction companies, and certification/compliance specialists. This measure would have some impact on all these. Designers and architects would have to be aware of the new code changes and design to those requirements. Examiners would need to verify that the project meets new elevator equipment requirements; builders would need to build to the correct specifications; and inspectors would need to verify that the elevator design meets what is listed in the specifications. However, all of these activities are standard practice, and the code change proposal would cause very little disruption to the market if any.

3.2.2 Technical Feasibility and Market Availability

This measure does not have barriers due to technical feasibility and market availability. No new technologies or processes are necessary for measure success. Traction elevators with regenerative drives are commonly installed today, both in low-rise and high-rise buildings.

3.2.3 Market Impacts and Economic Assessments

3.2.3.1 Impact on Builders

For businesses in the construction industry, it is part of normal practice to adjust to changes in the building code. When necessary, builders engage in continuing education and training to remain compliant with changes to design practices and building codes.

The requirement to use regenerative drives on traction elevators with three or more landings would have little impact on builders, since the equipment is readily available.

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

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.

While building designers and energy consultants may need to adjust what elevator systems are chosen for a project, these systems are readily available and common in the market today. This measure would have minimal effect on building designers and energy consultants.

3.2.3.3 Impact on Occupational Safety and Health

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

3.2.3.4 Impact on Building Owners and Occupants

This code change would have minimal impact on building owners and occupants, but they would benefit from lower energy bills.

3.2.3.5 Impact on Elevator Component Retailers

The Statewide CASE Team anticipates no material impact on California component retailers.

3.2.3.6 Impact on Building Inspectors

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.

2.2.3.7 Impact on Statewide Employment

As described in Sections 3.2.3.1 through 3.2.3.6, the Statewide CASE Team does not anticipate significant employment or financial impacts to any particular sector of the California economy. The energy savings associated with the proposed change in elevator requirements would lead to modest ongoing financial savings that would 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,[8] along with economic information from published sources, and professional judgement to develop estimates of the economic impacts associated with each of the proposed code changes. Conceptually, IMPLAN estimates jobs created as a function of incoming cash flow in different sectors of the economy due to implementing a code or a standard. The jobs created are typically categorized into direct, indirect, and induced employment. For example, cash flow into a manufacturing plant captures direct employment (jobs created in the manufacturing plant), indirect employment (jobs created in the sectors that 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

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

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.

This proposal does not greatly change the work these professionals currently do. Through discussion with elevator industry consultants, the Statewide CASE Team assumed four additional hours per project, for building designers only.

The economic impacts shown in Table 3 through Table 5 below represent lower-bound estimates of the benefits associated with this proposed code change. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2025 code cycle regulations would result in additional spending by those businesses.

Table 3.Estimated Impact that Adoption of the Proposed Measure would have on the California Commercial Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Commercial Builders)	66.7	$5.17	$75.98	$10.19
Indirect Effect (Additional spending by firms supporting Commercial Builders)	16.3	$1.41	$2.21	$4.07
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	27.7	$1.89	$3.38	$5.39
Total Economic Impacts	110.7	**$8.48**	**$11.58**	**$19.65**

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

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

Table 4: 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)	0.8	$0.089	$0.088	$0.014
Indirect Effect (Additional spending by firms supporting Bldg. Designers & Energy Consultants)	0.3	$0.026	$0.036	$0.059
Induced Effect (Spending by employees of firms experiencing "direct" or "indirect" effects)	0.5	$0.033	$0.059	$0.0.94
Total Economic Impacts	**1.6**	**$0.14**	**$0.19**	**$0.29**

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

Table 5: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income (Million)	Total Value Added (Million)	Output (Million)
Direct Effects (Additional spending by Building Inspectors)	0.1	$0.005	$0.006	$0.080
Indirect Effect (Additional spending by firms supporting Building Inspectors)	0.0	$0.0005	$0.0008	$0.01
Induced Effect (Spending by employees of Building Inspection Bureaus and Departments)	0.0	$0.001	$0.003	$0.05
Total Economic Impacts	**0.1**	**$0.007**	**$0.010**	**$0.014**

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 3.2.4 would lead to a modest increase in existing types of jobs.

3.2.4.2 Creation or Elimination of Businesses in California

As stated in Section 3.2.4.1, 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 elevators, which would not excessively burden or competitively disadvantage California businesses – nor would it necessarily lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not foresee any new businesses being created, nor does the Statewide CASE Team think any existing businesses would be eliminated due to the proposed code changes.

3.2.4.3 Competitive Advantages or Disadvantages for Businesses in California

The proposed code changes would apply to all businesses incorporated in California, regardless of whether the business is located inside or outside of the state.[10] Therefore, the Statewide CASE Team does not anticipate that these measures proposed for the 2025 code cycle regulation would have an adverse effect on the competitiveness of California businesses. Likewise, the Statewide CASE Team does not anticipate businesses located outside of California would be advantaged or disadvantaged.

3.2.4.4 Increase or Decrease of Investments in the State of California

The Statewide CASE Team analyzed national data on corporate profits and capital investment by businesses that expand a firm's capital stock (referred to as net private domestic investment, or NPDI).[11] As Table 6 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.

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

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

Table 6: Net Private Domestic Investment (NPDI) 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 the proposed code changes in this report would increase proprietor income by $484,348. Using the average found in Table 6, this would create a reinvestment of 26 percent of $1,828,237 (Total Estimated Proprietor Income from this measure).

3.2.4.5 Incentives for Innovation in Products, Materials, or Processes

The proposed measure would require the market trend towards traction elevators with regenerative drives. This could cause the cost of these technologies to decrease as competition and sales volume increase.

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. State buildings that undergo expansion and new elevator shafts and new state buildings could be impacted by this measure, dependent on elevator rise height. However, the measure has been shown to be cost effective across all nonresidential building prototypes that the proposal affects.

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 3.1.5 and Appendix E, the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

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. This measure would not have any distinct or focused impact on any groups or peoples, as the measure focuses on building types and elevators above a certain height. Impacts instead would be felt by those responsible for first costs and operating costs, but those effects have been addressed by ensuring the proposal is cost effective. Refer to Section **Error! Reference source not found.** for more details addressing energy equity and environmental justice.

3.2.5 Fiscal Impacts

The proposed regulations would increase the initial cost of elevators and save money through lower electric utility bills over the 25-year life of the elevators. For any applications, these incremental costs to purchases would most likely arise in the July 1, 2025–June 30, 2026, fiscal year. The incremental costs of the elevators are more than offset by the resulting reduced electric utility bills. These costs are not targeted specifically at state or local governments, but rather more broadly at which elevators can be offered for sale to any entity in California.

3.2.5.1 Mandates on Local Agencies or School Districts

This proposed measure would impact various types of buildings and facilities, including schools with elevators that meet the proposal criteria. It is possible that this proposed measure could impose a mandate on school districts that install new passenger elevators in new buildings. However, the extent of the mandate would depend on the specific circumstances of each district. Therefore, there may be relevant mandates to local agencies or school districts. Local agencies may be affected by this measure, depending on the elevator rise height for any new construction.

3.2.5.2 Costs to Local Agencies or School Districts

There may be added costs to local agencies or school districts due to the proposed measure, which could potentially require reimbursement pursuant to California Constitution, Government Code sections 17500 et seq. If the school district installs an elevator within the scope of the proposal, they may incur costs to comply with the proposed measure. However, the extent of the costs would depend on the specific circumstances of each district.

3.2.5.3 Costs or Savings to Any State Agency

This measure could have first impact costs for new construction building projects by any state agency, but the analysis has shown that the measures are cost effective across the board for all impacted building prototypes.

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

There are no added non-discretionary costs or savings to local agencies as this measure impacts only new construction projects.

3.2.5.5 Costs or Savings in Federal Funding to the State

There are no costs or savings to federal funding to the state as this measure does not impact any existing federal funding projects, nor does it require one.

3.3 Energy Savings

The objective of this section is to present the methodology, assumptions, and results of the energy savings analysis.

3.3.1 Energy Savings Methodology

The elevator traffic in each prototype building was modeled using Elevate, an elevator industry standard traffic analysis software by Peters Research, Ltd. Elevate is used to estimate elevator movement frequency in a specific situation based on standard industry design practices[12] and input from elevator consultants and contactors with recent experience designing and constructing elevators in these building types throughout California. These inputs include:

[12] The Vertical Transportation Handbook, 2010 4th Edition. George Strakosh, published by Wiley

- Number of landings
- Floor Elevation
- Population on each floor
- Number of elevators
- Speed of elevators
- Size of elevators
- Door type and size of elevators
- Acceleration rate of elevations

In each template, initial building type and population assumptions are used to establish the average waiting time a passenger would find acceptable. This determines the number of elevators.

Within Elevate, a traffic pattern is selected to simulate the movement of passengers over a defined period. For the purpose of this study, the defined period was 24 hours. A modern office building and a residential building will have significantly different profiles/traffic patterns during an average day. For instance, a large office building will see a morning peak in up traffic as workers arrive. At lunch time, there is a large two-way peak as workers leave the building and return, and then a peak in down traffic at days' end when workers depart. The average frequency of passenger movement must be established through the selection of a specific traffic profile. For the purpose of this study. the traffic pattern template used for office buildings was 'Siikonen full day' and the templates used for residential, school and hotel buildings were the respective 'Strakosch' templates. The assumed capacity was 3,500 lbs, ensuring compliance with requirements of California Building Code, Title 24 Chapter 30, 3002.4 Elevator Car to Accommodate Ambulance Gurney.

The Statewide CASE Team used Elevate simulations to create estimated traffic and energy usage profiles to provide the time period inputs for the CASE tables. To validate these estimates, the Statewide CASE Team asked two OEM's to confidentially compare them to their own calculations, and also used input from one drive manufacturer and one manufacturer of elevator motors and machines.

The Statewide CASE Team also estimated the amount of heat released by the elevator equipment into the elevator machine room for each scenario. If the heat is excessive, cooling is needed to maintain an acceptable operating temperature for the microprocessor-based control systems. Heat release values used were based on industry experience and validated through comparison of various recent OEM project submittals in California.

3.3.1.1 Key Assumptions for Energy Savings Analysis

Modeling elevator movement requires an understanding of passenger behaviors and expectations, equipment performance characteristics and traffic analysis standards. The primary performance criteria for elevator design are Average Interval and Handling Capacity.

Average Interval is defined as the average time in seconds between elevator departures from the primary lobby and represents elevator system performance quality. The Interval is calculated by dividing the average round-trip time by the number of cars in the group. The average round-trip time includes the actual running time of the elevators, including acceleration and deceleration times, the time to operate the doors, passenger transfer times and any other lost time that may apply to the system being analyzed. The average waiting time can be approximated as 65 percent of the Average Interval.

Handling Capacity is expressed as the percentage of the peak building population that can be carried by the elevators. The handling capacity is calculated by dividing 300 seconds (5 minutes) by the Interval and multiplying the result by the number of passengers in the elevator.

Table 7 summarizes the key assumptions used for traffic studies. Only prototypes with at least three landings are included.

Table 7: Traffic Study Assumptions

	Large Office	Med. Office	High Rise Multi-family	Mid Rise Multi-family	Loaded Corridor Apt	Hotel Small	Parking Garage
Capacity (lbs)	3500	3500	3500	3500	3500	3500	3500
Speed (feet/min)	500	200	350	200	200	200	200
Target Interval (Seconds)	30	30	45	45	45	45	45
Target Handling Capacity	10%	10%	8%	8%	8%	8%	8%
Number of Elevators	7	2	2	2	2	2	2
Stair Use	0%	0%	0%	0%	0%	0%	0%
Entrance Bias to 1st Floor	100%	100%	100%	100%	100%	100%	100%
Destination Dispatching	Yes	No	No	No	No	No	No

The key assumptions required by the elevator traffic analysis software are listed in Table 8. Traffic patterns over a full day (24-hour period) were produced based on available models for modern office buildings and residential buildings. The resulting simulations provided graphical patterns of elevator usage and estimated total energy usage over time.

Table 8: Protype Building Assumptions

Prototype Building	Est. Pop	# Landings	Other Assumptions	Number of Elevators
Loaded Corridor Apt	90	3	Two-Way traffic analysis	2
Office Medium	267	3	Two-Way traffic analysis	2
Parking Garage	918	3	Two-Way traffic analysis	2
Hotel Small	114	4	Two-Way traffic analysis	2
Mid-Rise Multifamily	215	5	Two-Way traffic analysis	2
High-rise Multifamily	260	10	Two-Way traffic analysis	2
Large Office	2436	12	No Elevator-using population on 1st floor	7

Energy savings from regeneration are affected by load in each direction, travel distance, and time between trips. To quantify savings estimates, the Statewide CASE Team used the publicly available calculator from KEB, a major drive manufacturer, and TK Elevator's online calculator. The Statewide CASE team then verified its estimates separately with several OEM's. For buildings with five landings or less, the average savings from adding regenerative drives was estimated at 27 percent. For taller buildings, the average savings was estimated at 45 percent, due to the longer runs. These estimates are conservative compared to the 35-50 percent savings advertised by the industry.

The savings estimates mentioned above are for active duty. For annual savings estimates, the Statewide CASE Team discounted the active duty values to account for time spent in standby mode, such as during the early morning or on weekends, when there are no regeneration savings. For analysis, the average savings from adding regenerative drives was estimated at 25 percent for Loaded Corridor Apt and Office Medium, and 26 percent for Parking Garage and Hotel Small. For taller buildings, the average savings was estimated at 43 percent. Table 9 shows both active duty and average annual savings.

Table 9: Active Duty and Annual Average Percent Savings (with heat rejection) from Adding Regenerative Drives to Traction Elevators by Prototype

Building Prototype	Active Duty Savings	Annual Savings, Including Standby Time	Base Case Elevator + Cooling Energy (kWh/yr)	Proposed Elevator + Cooling Energy (kWh/yr)	Savings Elevator + Cooling Energy (kWh/yr)
Loaded Corridor Apt	27%	25%	32,536	24,283	8,253
Office Medium	27%	25%	31,543	23,732	7,811
Parking Garage	27%	26%	39,339	29,196	10,143
Hotel Small	27%	26%	31,046	23,036	8,010
Mid-Rise Multifamily	45%	43%	40,366	23,176	17,190
High-rise Multifamily	45%	43%	51,850	29,404	22,447
Office Large	45%	43%	199,566	114,188	85,378

The Statewide CASE Team recognizes that savings estimates can be highly variable. The most relevant third-party study that the Statewide CASE Team encountered was that done for (Electrical and Mechanical Services Department (EMSD) 2015) Kong's Electrical and Mechanical Services Department (EMSD) for Tamar Central Government

Offices.[13] This measured the savings for elevators with different speeds serving portions of buildings with different heights. As seen in Table 10, the range of savings was 17 percent to 28 percent with more savings in taller zones with higher-speed elevators.

Table 10: Fraction of Regeneration Savings - Tamar Central Government Offices (EMSD, 2015)

Lift No. (Speed)	Item	Energy from 16 Aug to 16 Dec 2013 (kWh)	% of Electricity Saving
East Wing High Zone (6 m/s)	Energy Consumed	45,913	25.7%
	Energy Regenerated	15,847	
East Wing Low Zone (5 m/s)	Energy Consumed	29,311	22.4%
	Energy Regenerated	8,459	
West Wing High Zone (5 m/s)	Energy Consumed	43,518	27.0%
	Energy Regenerated	16,072	
West Wing Low Zone (2.5 m/s)	Energy Consumed	24,640	18.9%
	Energy Regenerated	5,760	
East Wing Passenger (High + Low Zone) (3 m/s)	Energy Consumed	9,405	23.3%
	Energy Regenerated	2,852	
West Wing Passenger (High + Low Zone) (3.5 m/s)	Energy Consumed	16,181	26.4%
	Energy Regenerated	5,796	
East Wing Services (High + Low Zone) (2.5 m/s)	Energy Consumed	7,361	22.4%
	Energy Regenerated	2,120	
West Wing Services (1 to 3/F) (1.75 m/s)	Energy Consumed	2,505	17.1%
	Energy Regenerated	565	

The Statewide CASE Team considers the results from Hong Kong to be a reasonable lower limit on estimated savings, assuming that usage patterns in this bustling city with a very dense population are more aggressive than they are throughout California. Even if the Statewide CASE Team adopted the lowest savings fraction from this study (17 percent), the measure would still be cost effective over all applicable prototypes.

[13] Electrical and Mechanical Services Department (EMSD), Hong Kong Special Administrative Region Government. 2015, Study Report on Application of Lift Regenerative Power. Accessed 7/17/2023. March 2015. https://www.emsd.gov.hk/filemanager/en/content_764/applctn_lift_rgnrt_pwr.pdf.

3.3.1.2 Energy Savings Methodology per Prototypical Building

The Statewide CASE Team calculated several benefits from the proposal. First electricity savings were measured in terms of both energy usage and peak demand reduction. Second, the Statewide CASE Team calculated Source Energy Savings. Source Energy represents the total amount of raw fuel required to operate a building. In addition to all energy used from on-site production, source energy incorporates all transmission, delivery, and production losses. The hourly Source Energy values provided by CEC are strongly correlated with GHG emissions.[1]Finally, the Statewide CASE Team calculated Long-term Systemwide Cost (LSC) Savings, formerly known as Time Dependent Valuation (TDV) Energy Cost Savings. LSC Savings were calculated using hourly LSC factors provided by the CEC. These LSC hourly factors are projected over the 30-year life of the building and incorporate the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade-based CO2 emissions.[14]

Using the CEC's approved methodology, the Statewide CASE Team modeled the energy impacts using specific prototypical building models that represent typical building geometries for different types of buildings.[15] The prototype buildings the Statewide CASE Team used are presented in Table 11.

[14] See Hourly Factors for Source Energy, Long-term Systemwide Cost, and Greenhouse Gas Emissions at https://www.energy.ca.gov/files/2025-energy-code-hourly-factors

[15] Prototype documentation and construction forecasts are available in the CEC's Measure Proposal Template here: https://www.energy.ca.gov/media/3538

Table 11: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Number of Landings	Elevators per Prototype	Baseline Elevator Equipment	Measure Elevator Equipment
Loaded Corridor Apt	3	2	Traction without regeneration	Traction with regenerative drive
Office Medium	3	2	Traction without regeneration	Traction with regenerative drive
Parking Garage	3	2	Traction without regeneration	Traction with regenerative drive
Hotel Small	4	2	Traction without regeneration	Traction with regenerative drive
Mid-Rise Multifamily	5	2	Traction without regeneration	Traction with regenerative drive
High-rise Multifamily	10	2	Traction without regeneration	Traction with regenerative drive
Office Large	12	7	Traction without regeneration	Traction with regenerative drive

The Statewide CASE Team estimated LSC, Source Energy Savings, peak demand, and GHG impacts by simulating the proposed code change in Elevate with hourly usage profiles for each of the prototypes listed above.

There are no existing requirements in Title 24, Part 6 that cover the building system in question. The Statewide CASE Team modified the Standard Design so that it calculated energy impacts of the most common current design practice. The Proposed Design was identical to the Standard Design in all ways except for the elevator drive type.

The energy impacts of the proposed code change do not vary by climate zone. Therefore, the Statewide CASE Team used the statewide LSC hourly factors when calculating energy and energy cost impacts.

In the CEC's methodology annual energy, GHG and peak demand impacts are presented in savings per building prototype. To arrive at these units, the energy impacts of all the elevators in each prototype building were divided by the prototype's square footage. The common units allow savings to be compared across building types.

3.3.1.3 Statewide Energy Savings Methodology

Statewide impact was calculated by multiplying the impact per square foot of each prototype by the corresponding number of square feet in the Statewide Construction Forecasts provided by the CEC. The Statewide Construction Forecasts estimate new construction/additions that would occur in 2026, the first year that the 2025 Title 24, Part 6 requirements would be in effect.

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

3.3.2 Energy Impacts Results Per Prototype Building

The addition of regeneration to traction elevators applies to all building types with three landings or more. It was assumed savings do not vary by climate zone, since elevators are generally not exposed to outside ambient temperatures.

Energy savings and peak demand reductions per one unit of each building prototype are presented in Table 13 through

Table 16, for new construction only. Peak time operation depends on building type but is generally not intense for elevators so peak demand savings are modest, as seen in Table 14.

The Statewide CASE team assumed a minimally compliant traction elevator motor with regeneration. Further energy savings could be gained as more efficient traction motors and regenerative drives enter the market.

Table 12: Protype Building Assumptions

Building Prototype	Landings	Elevation (ft)	Population per Floor	Units	Speed (ft/sec)	Capacity (lbs.)	Acceleration rate (ft/sec^2)
Loaded Corridor Apt	3	10	30	2	200	3500	1.3
Office Medium	3	14	200	2	200	3500	1.3
Parking Garage	3	11.5	306	2	200	3500	1.3
Hotel Small	4	11	29	2	200	3500	1.3
Mid-Rise Multifamily	5	10	43	2	350	3500	1.3
High-rise Multifamily	10	10	26	2	350	3500	2.8
Large Office	12	14	203	7	500	3500	3.5

Table assumes all elevators have 42” door with single-speed side opening.

Table 13: Annual Electricity Savings (kWh) Per Building Prototype

Prototype	Annual Electricity Savings per Building(kWh) All Climate Zones
High-rise Multifamily	22,000
Hotel	8,000
Large Office	85,000
Loaded Corridor	8,300
Medium Office	7,800
Mid-rise Multifamily	17,000
Open Parking Garage	10,000

Table 14: Peak Demand Reduction (MW) Per Building Prototype, Statewide

Prototype	First-Year Peak Demand Reduction (MW) All Climate Zones
High-rise Multifamily	0.002
Hotel	0.016
Large Office	0.006
Loaded Corridor	0.018
Medium Office	0.004
Mid-rise Multifamily	0.019
Open Parking Garage	0.007

Table 15: Source Energy Savings (kBtu) Per Building Prototype, Statewide

Prototype	First-Year Source Energy Savings (kBtu)
High-rise Multifamily	25,000
Hotel	11,000
Large Office	85,000
Loaded Corridor	10,000
Medium Office	7,200
Mid-rise Multifamily	19,000
Open Parking Garage	13,000

Table 16: Long-term Systemwide Cost (LSC) Savings Per Prototype, Statewide

Prototype	Per Unit LSC Electricity Savings (2026 PV$)
High-rise Multifamily	110,000
Hotel	43,000
Large Office	400,000
Loaded Corridor	42,000
Medium Office	36,000
Mid-rise Multifamily	84,000
Open Parking Garage	53,000

3.4 Cost and Cost Effectiveness

3.4.1 Benefits Calculation 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 3.3.1. LSC hourly factors allow energy cost savings to be normalize and to account for the cost of electricity and natural gas for each hour of the year, and expected changes over the 30-year period of analysis.

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

3.4.2 Energy Cost Savings Results

Per-unit energy cost savings in terms of LSC savings realized over the 30-year period of analysis are shown in 2026 present value dollars (2026 PV$) in Table 17. The LSC methodology allows peak electricity savings to be valued more than electricity savings during non-peak periods.

Table 17: 2026 PV Systemwide Lifecycle Cost Savings Over 30-Year Period of Analysis – Per Building Prototype – New Construction and Additions– High-rise Multi-Family

Prototype	30-Year LSC Electricity Savings (2026 PV$) Average Across Climate Zones	30-Year LSC Natural Gas Savings (2026 PV$) Average Across Climate Zones	Total 30-Year LSC Savings (2026 PV$) Average Across Climate Zones
High-rise Multifamily	110,000	N/A	110,000
Hotel	43,000	N/A	43,000
Large Office	400,000	N/A	400,000
Loaded Corridor	42,000	N/A	42,000
Medium Office	36,000	N/A	36,000
Mid-rise Multifamily	84,000	N/A	84,000
Open Parking Garage	53,000	N/A	53,000

3.4.3 Incremental First Cost

Incremental first costs depend on the vertical rise of each prototype building, motor size, speed, and number of stops. There is little difference in labor costs and essentially no difference in acceptance testing cost. To obtain the values shown in Table 18, the Statewide CASE Team worked with a consulting firm that specializes in elevators and has deep knowledge of the California market. Costs are the same for all low-rise building types and are the largest for large offices. They are driven primarily by equipment, because there is little difference in labor costs and essentially no difference in acceptance testing cost.

Table 18: Incremental First Costs by Building Prototype

Prototype Name	Base Case	Proposed	Incremental Cost
Loaded Corridor Apt	$480,000	$483,000	$3,000
Office Medium	$550,000	$553,000	$3,000
Parking Garage	$550,000	$553,000	$3,000
Hotel Small	$550,000	$553,000	$3,000
Mid-Rise Multifamily	$640,000	$648,000	$8,000
High-rise Multifamily	$700,000	$708,000	$8,000
Office Large	$2,800,000	$2,828,000	$28,000

3.4.4 Incremental Maintenance Costs

The analysis assumes no incremental maintenance cost or incremental modernization cost. This was per the recommendation of the Statewide CASE Team's elevator industry consultant.

3.4.5 Cost Effectiveness

This measure proposes a mandatory 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, as were the LSC savings. The Statewide CASE team concluded that for the purposes of cost-effectiveness calculations, there are no increased design or compliance verification costs.

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 the present values of costs and savings assuming 2026 as year one.

Results of the per-unit cost-effectiveness analyses are presented in Table 19. The code change proposal applies to new elevators only, and savings are not affected by climate zone.

Table 19: 30-Year Cost-Effectiveness Summary Per Building Prototype – New Construction/Additions- High-rise Multifamily

Building Prototype	Benefits LSC Savings + PV of Incremental Modernization (2026 PV$)[a]	Costs Total Incremental PV Costs (2026 PV$)	Benefit-to-Cost Ratio
Loaded Corridor Apartment	42,000	3,000	14
Office Medium	36,000	3,000	12
Parking Garage	53,000	3,000	18
Small Hotel	43,000	3,000	14
MidRise Multi-family	84,000	8,000	10
HighRise Multi-family	110,000	8,000	14
Office Large	400,000	28,000	14

a. Benefits are from lower electricity and demand charge costs, discounted at 3 percent with 2026 as year one.

3.5 First-Year Statewide Impacts

3.5.1 Statewide Energy and Energy Cost Savings

The first-year energy impacts represent the total theoretical first-year annual savings. To estimate first-year savings, the Statewide CASE Team made assumptions about how many projects would be designed differently due to the code change, shown in Table 20. For example, for low rise buildings it was assumed 36 percent of new projects would have traction elevators, and that of these 70 percent would not have regenerative drives in absence of the code change, which equates to 36 percent x 70 percent = 25 percent of all such new elevators. Therefore, of the 1,433 new buildings built per year of all applicable types, about 413 would add a regenerative drive due to code.

Table 20: New Buildings Impacted by Code Change in 2026

Building Prototype	New Construction (Bldg/yr)[a]	Traction	Traction without regeneration, in absence of code change[b]	Elevators Affected by New Code	Statewide Impact (Bldg/yr)
Loaded Corridor Apt	488	36%	70%	**25%**	122
Office Medium	288	36%	70%	**25%**	72
Parking Garage	88	36%	70%	**25%**	22
Hotel Small	165	56%	70%	**39%**	64
Mid-Rise Multifamily	351	88%	40%	**35%**	123
High-rise Multifamily	23	100%	20%	**20%**	5
Office Large	30	100%	20%	**20%**	5
Totals	**1,433**				**413**

a. CEC construction forecast (see Appendix A.)

b. Elevator consultant estimate based on project experience

Table 21 shows anticipated first-year impacts. The Statewide CASE Team calculated the first-year statewide savings by multiplying the per-unit savings from Table 13 by the number of units that would be impacted during the first year from Table 20. 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.

Table 21: Statewide First-Year Impacts

Building Prototype	LSC Electricity Savings per Prototype (2026 PV$)	Impacted in 2026 (# Bldgs)	1First-Year LSC Savings (Million 2026 PV$)	First-Year Electricity Savings (GWh/yr)	First-Year Peak Demand Reduction (MW)	First-Year Source Energy (million kBtu/yr)
Loaded Corridor Apt	42,000	122	5.1	1.0	0	1.3
Office Medium	36,000	72	2.6	0.6	0	0.5
Parking Garage	53,000	22	1.2	0.2	0	0.3
Hotel Small	43,000	64	2.8	0.5	0	0.7
Mid-Rise Multifamily	84,000	123	10.3	2.1	0	2.3
High-rise Multifamily	110,000	5	0.6	0.1	0	0.1
Office Large	400,000	5	2.0	0.5	0	0.5
Total		413	24.6	5.0	0	5.7

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 ton of carbon dioxide equivalent emissions (metric tons CO2e). (California Energy Commission 2020).

The monetary value of avoided GHG emissions is based on a proxy for permit costs (not social costs).[16] The Cost-Effectiveness Analysis presented in Section 3.4 of this report does not include the cost savings from avoided GHG emissions. To demonstrate the cost savings of avoided GHG emissions, the Statewide CASE Team disaggregated the value of avoided GHG emissions from the other economic impacts.

Table 22 presents the estimated first-year avoided GHG emissions of the proposed code change. During the first year, GHG emissions of 300 metric tons CO2e would be avoided.

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

Table 22: First-Year Statewide GHG Emissions Impacts

Measure	Electricity Savings[a] (GWh/yr)	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2e)	Total Monetary Value of Reduced GHG Emissions[c] ($)
Elevator Energy Efficiency	5.0	300	37,000
TOTAL	**5.0**	**110**	**37,000**

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

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

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

3.5.3 Statewide Water Use Impacts

This measure would not significantly impact statewide water usage.

3.5.4 Statewide Material Impacts

This measure would not significantly impact statewide materials usage.

3.5.5 Other Non-Energy Impacts

No other impacts have been identified.

[17] (DC Fiscal Policy Institute 2017).

[17] 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.

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).

4.2 Standards

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

LANDING, ELEVATOR is that portion of a floor, balcony, or platform used to receive and discharge passengers or freight.

120.6(f) Mandatory requirements for elevators. Elevators shall meet the following requirements:

1. Power conversion system. In new buildings, passenger traction elevators with capacities of 4,000 pounds or less and serving three or more landings, shall have a regenerative drive. Under normal power operation, potential energy released during motion shall be recovered with a regenerative drive that supplies electrical energy to the building electrical system. Drives must meet or exceed a 96 percent power factor. The regenerative drive system shall comply with Article 620.91 (A) of the California Electrical Code.

2 ~~1~~. The light power density for the luminaires inside the elevator cab shall be no greater than 0.6 watts per square foot.

Exception to Section 120.6(f)2 ~~1~~: Interior signal lighting and interior display lighting are not included in the calculation of lighting power density.

3 ~~2~~. Elevator cab ventilation fans for cabs without space conditioning shall not exceed 0.33 watts per cfm as measured at maximum speed.

4 ~~3~~. When the elevator cab is stopped and unoccupied with doors closed for over 15 minutes, the cab interior lighting and ventilation fans shall be switched off until elevator cab operation resumes.

5 4. Lighting and ventilation shall remain operational in the event that the elevator cabin gets stuck when passengers are in the cabin.

6 ~~5~~. Elevator Regenerative Drive, Lighting and Ventilation Control Acceptance. Before an occupancy permit is granted for elevators subject to 120.6(f), the following equipment and systems shall be certified as meeting the Acceptance Requirement 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 NA7.14.

EXCEPTION to Section 120.6(f): Elevators located in healthcare facilities.

4.3 Reference Appendices

Nonresidential Appendix NA7

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

NA7.14 Elevator Regenerative Drive, Lighting and Ventilation Controls

NA7.14.1 Construction Inspection

Verify and document the following prior to functional testing:

a) Elevator has regenerative drive enabled

b) The occupancy sensor has been located to minimize false signals, and the elevator cab does not have any obstructions that could adversely affect the sensor's performance.

~~b~~ c) For PIR sensors, the sensor pattern does not enter into the elevator lobby.

~~c~~ d) For ultrasonic sensors, the sensor does not emit audible sound.

Note that some elevators are able to use weight sensors to provide occupancy sensing. In this case, document that the elevator uses weight sensing to provide occupant sensing and proceed to the functional test.

NA7.14.2 Functional Testing

For each elevator cab being tested, confirm the following:

a) Verify that the lighting and ventilation controlled inside the elevator cab turn off after 15 minutes from the start of an unoccupied condition.

b) Verify that the signal sensitivity is adequate to achieve desired control. The sensor should not detect motion in the elevator lobby.

c) Verify that lighting and ventilation immediately turn "on" when an unoccupied condition becomes occupied.

d) Verify that the lighting and ventilation will not shut off when occupied. Stand in the elevator with the door closed.

4.4 ACM Reference Manual

Elevators are covered under the mandatory section of Title 24, Part 6 so there are no trade-offs associated with elevator efficiency. The proposed heat gains and electricity consumption from elevators in the proposed model shall equal the heat gains in the standard design model. Ergo, there are no proposed changes to the ACM Reference Manual.

4.5 Compliance Documents

The documents that currently apply to the elevators addressed in this code change proposal are the 2022 Nonresidential & High-rise Multifamily Energy Code Forms for Process Systems:[18]

Certificate of Compliance: 2022-NRCC-PRC-E: Process Systems

Certificate of Installation: 2022-NRCI-PRC-E: Process Systems

Certificate of Acceptance: 2022-NRCA-PRC-12-F: Elevator Lighting and Ventilation Controls

CEC-NRCC-PRC-E would be expanded beyond lighting and fan power requirements to allow the inspector to confirm that a passenger elevator serving three or more landings which is a traction elevator, shall have an enabled regenerative drive. 2022-NRCI-PRC-E is generic and would not require any specific changes.

2022-NRCA-PRC-12-F: Elevator Lighting and Ventilation Controls would need a title change to make it less specific and would include a checklist for the installing field technician to confirm that if a passenger elevator is a traction elevator and is serving 3 or more landings, that it has a regenerative drive.

Note: the NRCV (Nonresidential Certificates of Verification) form does not apply because the proposed code changes do not affect areas that require verification testing (duct leakage, airflow, fan efficacy or indoor air quality.)

[18] See EnergyCodeAce

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Appendix A: Statewide Savings Methodology

The Statewide CASE Team estimated statewide impacts for the first year by multiplying per-unit savings estimates by statewide construction forecasts that the CEC provided (California Energy Commission 2022). The CEC provided the construction estimates on March 27, 2023 at the Staff Workshop on Triennial California Energy Code Measure Proposal Template.

The Statewide CASE Team followed guidance provided in the Energy Commission's New Measure Proposal Template (developed by the Energy Commission) to calculate statewide energy savings using the Energy Commission's construction forecasts, including a request to assume a statewide weighting as follows: Low-Rise Garden (four percent), Loaded Corridor (33 percent), Mid-Rise Mixed-Use (58 percent) and High-Rise Mixed Use (two percent). See Section 3.3.2 of the CEC's New Measure Proposal Template.

The Statewide CASE Team did not make any changes to the CEC's construction estimates.

The Statewide CASE Team estimated statewide impacts for the first year by multiplying per-unit savings estimates by the Energy Commission's statewide construction forecasts. The Statewide CASE Team made assumptions about the percentage of buildings in each climate zone that would be impacted by the proposed code change. Table 23 presents the number of buildings, newly constructed that the Statewide CASE Team assumed would be impacted by the proposed code change during the first year the 2025 code is in effect. Since the proposed code only applies to new buildings, no savings for existing buildings were calculated.

The Statewide CASE Team assumed all new buildings that have passenger elevators with at least three landings and capacities of 4,000 lbs. or less would be impacted. The Statewide CASE Team examined description of building prototypes to identify what building would be impacted by the proposed code change.

Table 23:Estimated New Construction for Multifamily Buildings by Climate Zone (Loaded Corridor, Mid-rise Multifamily, and High-rise Multifamily)

Building Climate Zone	Total Dwelling Units Completed in 2026 (New Construction) [A]	Percent of New Dwelling Units Impacted by Proposal [B]	New Dwelling Units Impacted by Proposal in 2026 C = A x B
1	138	100%	138
2	1,335	100	1,335
3	7,391	100	7,391
4	3,280	100	3,280
5	274	100	274
6	2,153	100	2,153
7	4,950	100	4,950
8	8,256	100	8,256
9	9,890	100	9,890
10	4,134	100	4,134
11	1,126	100	1,126
12	5,316	100	5,316
13	969	100	969
14	1,388	100	1,388
15	358	100	358
16	180	100	180
TOTAL	**51,137**		**51,137**

To calculate first-year statewide savings, the Statewide CASE Team multiplied the per-building prototype savings by statewide construction estimates for the first year the standards would be in effect (2026). The nonresidential new construction forecast is presented in Table 24. The projected nonresidential new construction that would be impacted by the proposed code change in 2026 is presented in Table 24. This section describes how the Statewide CASE Team developed these estimates.

The CEC Building Standards Office provided the nonresidential construction forecast, which is available for public review on the CEC's website:https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency .

The construction forecast presents total floorspace of newly constructed buildings in 2026 by building type and climate zone. The building types included in the CECs' forecast are summarized in Table 24.

The Statewide CASE Team made assumptions about the percentage of newly constructed floorspace that would be impacted by the proposed code change to calculate the quantity of building prototypes. Table 26 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 27 presents percentage of floorspace assumed to be impacted by the proposed change by climate zone.

Table 24: Estimated New Nonresidential Construction in 2026 (Million Square Feet)

Building Type	Climate Zone																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	All
Large Office	0.00	0.00	2.90	1.42	0.00	1.28	0.74	2.05	3.72	0.35	0.10	0.52	0.00	0.18	0.01	0.04	13.31
Medium Office	0.13	0.48	1.37	0.74	0.37	1.20	0.80	1.65	3.18	1.17	0.27	2.80	0.59	0.35	0.26	0.10	15.47
Small Office	0.01	0.43	0.19	0.02	0.06	0.15	0.23	0.16	0.36	0.41	0.09	0.54	0.38	0.04	0.10	0.03	3.22
Large Retail	0.00	0.00	1.10	0.55	0.15	0.70	0.37	0.83	1.66	0.63	0.30	1.30	0.36	0.14	0.18	0.06	8.34
Medium Retail	0.08	0.35	0.79	0.45	0.09	0.60	0.29	0.86	1.42	0.82	0.14	0.63	0.38	0.18	0.12	0.08	7.29
Strip Mall	0.00	0.15	0.50	0.23	0.01	0.56	0.49	0.99	1.07	1.35	0.07	0.59	0.33	0.32	0.10	0.06	6.81
Mixed-use Retail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large School	0.01	0.11	0.77	0.39	0.03	0.52	0.54	0.80	1.25	0.75	0.31	1.01	0.54	0.15	0.08	0.06	7.32
Small School	0.07	0.27	0.46	0.23	0.14	0.32	0.29	0.35	0.66	0.35	0.10	0.78	0.30	0.11	0.04	0.04	4.50
Non-refrigerated Warehouse	0.06	0.37	2.16	1.12	0.18	1.36	0.71	1.95	3.01	1.36	0.63	2.84	0.82	0.36	0.37	0.14	17.44
Hotel	0.04	0.22	1.03	0.53	0.11	0.55	0.48	0.78	1.18	0.57	0.15	0.80	0.26	0.14	0.12	0.04	7.02
Assembly	0.01	0.39	1.58	0.56	0.06	0.79	0.80	1.43	1.82	1.14	0.17	1.41	0.30	0.25	0.12	0.08	10.92
Hospital	0.03	0.17	0.81	0.42	0.08	0.32	0.53	0.43	0.76	0.79	0.14	0.80	0.26	0.14	0.11	0.05	5.83
Laboratory	0.01	0.19	1.29	0.71	0.07	0.42	0.27	0.46	0.84	0.35	0.13	0.43	0.12	0.08	0.04	0.03	5.44
Restaurant	0.01	0.08	0.33	0.17	0.03	0.34	0.20	0.49	0.82	0.41	0.07	0.31	0.14	0.10	0.05	0.03	3.59
Enclosed Parking Garage	0.00	0.01	1.83	1.25	0.00	2.59	0.71	2.27	1.53	0.05	0.00	0.04	0.00	0.02	0.00	0.01	10.29
Open Parking Garage	0.00	0.12	2.47	1.68	0.06	3.65	1.20	3.20	2.16	0.65	0.02	0.53	0.04	0.20	0.05	0.09	16.12
Grocery	0.01	0.05	0.10	0.06	0.01	0.05	0.02	0.05	0.09	0.05	0.01	0.04	0.02	0.01	0.01	0.01	0.58
Refrigerated Warehouse	0.00	0.00	0.06	0.05	0.01	0.02	0.00	0.01	0.01	0.04	0.00	0.07	0.12	0.01	0.01	0.01	0.41

Building Type	Climate Zone																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	All
Controlled-environment Horticulture	0.09	0.08	0.32	0.04	0.20	0.26	0.00	0.02	0.03	0.28	0.30	0.31	0.09	0.01	0.05	0.00	2.08
Vehicle Service	0.00	0.08	0.55	0.36	0.03	0.55	0.34	0.80	1.81	0.57	0.02	0.39	0.25	0.20	0.06	0.05	6.05
Manufacturing	0.00	0.02	0.21	0.07	0.02	0.01	0.05	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
Unassigned	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
TOTAL	0.56	3.56	20.84	11.46	1.71	16.22	9.07	19.68	27.39	12.11	3.03	16.15	5.29	2.97	1.88	1.02	**152.9**

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

Table 25: Estimated New Nonresidential Construction Impacted by Proposed Code Change in 2026, by Climate Zone and Building Type (Million Square Feet)

Building Type	Climate Zone																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	All
Large Office	0.00	0.00	2.90	1.42	0.00	1.28	0.74	2.05	3.72	0.35	0.10	0.52	0.00	0.18	0.01	0.04	13.31
Medium Office	0.13	0.48	1.37	0.74	0.37	1.20	0.80	1.65	3.18	1.17	0.27	2.80	0.59	0.35	0.26	0.10	15.47
Small Office	0.01	0.43	0.19	0.02	0.06	0.15	0.23	0.16	0.36	0.41	0.09	0.54	0.38	0.04	0.10	0.03	3.22
Large Retail	0.00	0.00	1.10	0.55	0.15	0.70	0.37	0.83	1.66	0.63	0.30	1.30	0.36	0.14	0.18	0.06	8.34
Medium Retail	0.08	0.35	0.79	0.45	0.09	0.60	0.29	0.86	1.42	0.82	0.14	0.63	0.38	0.18	0.12	0.08	7.29
Strip Mall	0.00	0.15	0.50	0.23	0.01	0.56	0.49	0.99	1.07	1.35	0.07	0.59	0.33	0.32	0.10	0.06	6.81
Mixed-use Retail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large School	0.01	0.11	0.77	0.39	0.03	0.52	0.54	0.80	1.25	0.75	0.31	1.01	0.54	0.15	0.08	0.06	7.32
Small School	0.07	0.27	0.46	0.23	0.14	0.32	0.29	0.35	0.66	0.35	0.10	0.78	0.30	0.11	0.04	0.04	4.50
Non-refrigerated Warehouse	0.06	0.37	2.16	1.12	0.18	1.36	0.71	1.95	3.01	1.36	0.63	2.84	0.82	0.36	0.37	0.14	17.44
Hotel	0.04	0.22	1.03	0.53	0.11	0.55	0.48	0.78	1.18	0.57	0.15	0.80	0.26	0.14	0.12	0.04	7.02
Assembly	0.01	0.39	1.58	0.56	0.06	0.79	0.80	1.43	1.82	1.14	0.17	1.41	0.30	0.25	0.12	0.08	10.92

Building Type	Climate Zone																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	All
Hospital	0.03	0.17	0.81	0.42	0.08	0.32	0.53	0.43	0.76	0.79	0.14	0.80	0.26	0.14	0.11	0.05	5.83
Laboratory	0.01	0.19	1.29	0.71	0.07	0.42	0.27	0.46	0.84	0.35	0.13	0.43	0.12	0.08	0.04	0.03	5.44
Restaurant	0.01	0.08	0.33	0.17	0.03	0.34	0.20	0.49	0.82	0.41	0.07	0.31	0.14	0.10	0.05	0.03	3.59
Enclosed Parking Garage	0.00	0.01	1.83	1.25	0.00	2.59	0.71	2.27	1.53	0.05	0.00	0.04	0.00	0.02	0.00	0.01	10.29
Open Parking Garage	0.00	0.12	2.47	1.68	0.06	3.65	1.20	3.20	2.16	0.65	0.02	0.53	0.04	0.20	0.05	0.09	16.12
Grocery	0.01	0.05	0.10	0.06	0.01	0.05	0.02	0.05	0.09	0.05	0.01	0.04	0.02	0.01	0.01	0.01	0.58
Refrigerated Warehouse	0.00	0.00	0.06	0.05	0.01	0.02	0.00	0.01	0.01	0.04	0.00	0.07	0.12	0.01	0.01	0.01	0.41
Controlled-environment Horticulture	0.09	0.08	0.32	0.04	0.20	0.26	0.00	0.02	0.03	0.28	0.30	0.31	0.09	0.01	0.05	0.00	2.08
Vehicle Service	0.00	0.08	0.55	0.36	0.03	0.55	0.34	0.80	1.81	0.57	0.02	0.39	0.25	0.20	0.06	0.05	6.05
Manufacturing	0.00	0.02	0.21	0.07	0.02	0.01	0.05	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
Unassigned	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
TOTAL	0.56	3.56	20.84	11.46	1.71	16.22	9.07	19.68	27.39	12.11	3.03	16.15	5.29	2.97	1.88	1.02	152.9

Table 26: Percentage of Nonresidential Floorspace Impacted by Proposed Code Change in 2026, by Building Type

Building Type	New Construction Impacted (Percent Square Footage)
Large Office	100%
Medium Office	100%
Small Office	100%
Large Retail	0%
Medium Retail	0%
Strip Mall	0%
Mixed-use Retail	0%
Large School	**0%**
Small School	0%
Non-refrigerated Warehouse	0%
Hotel	100%
Assembly	0%
Hospital	0%
Laboratory	0%
Restaurant	0%
Enclosed Parking Garage	0%
Open Parking Garage	100%
Grocery	0%
Refrigerated Warehouse	0%
Controlled-environment Horticulture	0%
Vehicle Service	0%
Manufacturing	0%
Unassigned	0%

Table 27: Percentage of Nonresidential Floorspace Impacted by Proposed Measure, by Climate Zone

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

Table 28: Quantity of Building Prototypes

CEC Construction Forecast name	Landings	Prototype Area [ft^2]	Dwelling Units [#]	Elevator per Prototype	New Construction Prototype per Year
Loaded Corridor Apt	3	39,264	36	2	476
Office Medium	3	53,628		2	288
Parking Garage	3	183,750	N/A	2	144
Hotel Small	4	42,554	77 guest rooms	2	165
Mid-rise Multifamily	5	112,641	88	3	343
High-rise Multifamily	10	125,400	117	4	22
Large Office	12	498,589	N/A	12	30

Appendix B: Embedded Electricity in Water Methodology

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

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

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

Appendix D: Environmental Analysis

Potential Significant Environmental Effect of Proposal

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

The Statewide CASE Team has considered the environmental benefits and adverse impacts of its proposal including, but not limited to, an evaluation of factors contained in the California Code of Regulations, Title 14, section 15064 and determined that the proposal would not result in a significant effect on the environment.

Direct Environmental Impacts

Direct Environmental Benefits

The Statewide CASE Team concludes after careful consideration of the project that there would be no direct environmental benefits or impacts due to the proposed Building Energy Efficiency Standards for elevators. The proposed regulations would not affect the health and welfare of California residents, worker safety, or the state’s environment. The most probable means to achieve the standards would not require the use of materials that are hazardous to the environment.

Indirect Environmental Impacts

Indirect Environmental Benefits

The Statewide CASE Team found that this proposal would provide significant environmental benefits through the reduced use and demand for electricity. The production of electricity generates GHG emissions. The reduction in electricity production would reduce the production of GHG emissions.

Indirect Adverse Environmental Impacts

The Statewide CASE Team concludes after careful consideration of the project that there would be no indirect adverse environmental impacts due to the proposed Building Energy Efficiency Standards for elevators.

Mitigation Measures

The Statewide CASE Team did not determine this measure would result in significant direct or indirect adverse environmental impacts and therefore, did not develop any mitigation measures.

Reasonable Alternatives to Proposal

The Statewide CASE Team has considered alternatives to the proposal and 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.

The Statewide CASE Team considered proposing a standard similar to the elevator requirements in ASHRAE 90.1 standard. The Statewide CASE team did not choose this option since it would have had no environmental impact while less stringent and yielding less environmental benefits.

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 calculated emissions impacts associated with embodied carbon from the change in materials as a result of the proposed measure. The calculation builds off the materials impacts outlined in section 3.5.4. See section 3.5.4 for more details on the materials impact analysis.

After calculating the materials impacts, the Statewide CASE Team applied average embodied carbon emissions for each material. The embodied carbon emissions are based on industry-wide environmental product declarations (EPDs).[19, 20] These industry-wide EPDs provide global warming potential (GWP) values per weight of specific materials.[21] The Statewide CASE Team chose the industry-wide average for GWP values in the EPDs because the materials accounted for in the statewide calculation will have a range of embodied carbon; i.e. some materials like concrete have a wide range of embodied carbon depending on the manufacturer's processes, source of the materials, etc. The Statewide CASE Team assumes that most building projects would not specify low embodied carbon products. Therefore, an average is appropriate for a statewide estimate.

First-year statewide impacts per material (in pounds) were multiplied by the GWP impacts for each material. This provides the total statewide embodied carbon impact for each material. If a material's use is increased, then there is an increase in embodied carbon impacts (additional emissions). If a material's use is decreased, then there is a decrease in embodied carbon impacts (emissions reduced). The total emissions reductions from this measure are the total GHG emissions reductions from section 3.5.2 combined with emissions reductions (or additional emissions) from embodied carbon in section 3.5.4.

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[19] EPDs are documents which disclose a variety of environmental impacts, including embodied carbon emissions. These documents are based on lifecycle assessments on specific products and materials. Industry-wide EPDs disclose environmental impacts for one product for all (or most) manufacturers in a specified area and are often developed through the coordination of multiple manufacturers and/or associations. A manufacturer specific EPD only examines one product from one manufacturer. Therefore, an industry-wide EPD discloses all the environmental impacts from the entire industry (for a specific product/material) but a manufacturer specific EPD only factors one manufacturer.

[20] An industry wide EPD was not used for mercury, lead, copper, plastics, and refrigerants. Global warming potential values of mercury, lead and copper are based on data provided in a Life Cycle Assessment (LCA) conducted by Yale University in 2014. The GWP value for plastic is based on a LCA conducted by Franklin Associates, which capture roughly 59% of the U.S.' total production of PVC and HDPE production. The GWP values for refrigerants are based on data provided by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report.

[21] GWP values for concrete and wood were in units of kg CO2 equivalent by volume of the material rather than by weight. An average density of each material was used to convert volume to weight.

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

This appendix discusses how the recommended compliance process, which is described in section 3.1.5, could impact various market actors. Table 29 identifies the market actors who would 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 work flow, and ways negative impacts could be mitigated. The information contained in Table 29 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.

This code change proposal would create a modest change in the compliance process for the market actors since the elevators are previously regulated under Title 24, Part 6. Elevators are also regulated under, Title 8, Div. 1, Chap 4, Subchapter 6, and ASME reference standards A17.1 and A17.7. Completion of compliance documents is essential step to ensure compliance and elevator designers, building facility owners, and contractors may need guidance on how to comply with the proposed requirements.

To facilitate an efficient compliance process under the proposed code change, collaboration among a variety of individuals is important. General, electrical and HVAC contractors would need to closely collaborate with the design team and ensure the relevant documents are shared with one another. Field inspectors would need to work with elevator technicians in the verification of the proposed elevator power conversion system requirements.

- **Permit Application Phase:** The installer of the elevator shall be responsible for obtaining the permit from the local building department. The elevator installer would provide design documentation. Plans may be reviewed by the building department along with field inspections performed by a building inspector.
- **Construction Phase:** No compliance or enforcement changes are anticipated as the installers would follow the construction plans specifying the elevator components and installation.
- **Inspection Phase:** The permit approval process may trigger an inspection by the local building department. Since CEC-NRCA-PRC-12 is applicable to non-HERS registered projects, an approved HERS provider data registry approach is not needed for this form. Instead, the completed document shall be posted onsite for review by the local enforcement agency’s inspector. The elevator field technician

would confirm compliance with the proposed changes along with the existing elevator ventilation, controls, and lighting efficacy.

Table 29 identifies the market actors who would play a role in complying with the proposed change, the tasks for which they would 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 29: Roles of Market Actors in the Proposed Compliance Process

Market Actor	Task(s) in current compliance process relating to the CASE measure	How would the proposed measure impact the current task(s) or workflow?	How would the proposed code change impact compliance and enforcement?	Opportunities to minimize negative impacts of compliance requirement
Elevator Designer	• Perform analysis and design of elevator power conversion systems to meet facility and occupant needs based upon expected traffic and demand.	• Would need to document compliance of the new requirements for conveyance type, machine efficiency and regenerative drive.	• Would have to document compliance with the proposed requirements	• The Statewide CASE Team recommends including the following in the Nonresidential Compliance Manual: • Examples showing facilities that are compliant with Title 24, Part 6. • Examples showing facilities that are not compliant with Title 24, Part 6 with explanations as to why.
Building Electrical System Designer	• Perform analysis of building electrical load to ensure adequacy under different operating conditions, including building power outage and standby power modes.	• Produce documentation if needed to show necessity of the exception to the regenerative drive requirements due to insufficient building load.	• Would have to document compliance with the proposed requirements	• The Statewide CASE Team recommends including the following in the Nonresidential Compliance Manual: • Examples showing facilities that are compliant with Title 24, Part 6. • Examples showing facilities that are not compliant with Title 24, Part 6 with explanations as to why.
Mechanical HVAC Designer	• Serve as an expert for specifying HVAC system	• Collaborate with elevator designer as needed for reduction in	• None	• None

Market Actor	Task(s) in current compliance process relating to the CASE measure	How would the proposed measure impact the current task(s) or workflow?	How would the proposed code change impact compliance and enforcement?	Opportunities to minimize negative impacts of compliance requirement
		elevator machine room cooling needs due to more efficient elevator power conversion system.		
Enforcement Agency Plans Examiner	• Validate the elevator meets current Title 24, Part 6 requirements based on submitted plans.	• Validate the elevator meets additional proposed Title 24, Part 6 requirements based on submitted plans	• Impact is expected to be minimal relative to current processes.	• Consolidation of all new tasks (i.e., new fields in existing form) with existing inspection and approval practices.
California Energy Commission	• Issuance of compliance documentation such as manuals and forms for existing elevator energy efficiency requirements.	• Modifications to compliance documentation for proposed code change.	• Impact is expected to be minimal relative to current processes. • Additional efforts are required to develop or modify the CF1R and CF2R forms, but CEC also has the option of invoking the Statewide CASE team's assistance on this scope of work.	• Consolidation of all new tasks into existing compliance document.
Elevator Certified Conveyance Mechanic	• Perform inspection to support compliance to Title 24, Part 6 and Elevator Safety orders requirements.	• Perform an inspection to verify applicable traction elevators have regenerative drives.	• Would have to verify compliance with proposed elevator requirements for Title 24, Part 6	• Develop training for elevator certified conveyance mechanics to handle new code requirements.
Enforcement Agency Field Inspector	• Coordinate final inspection with the permit applicant.	• Validate with assistance from the Elevator Certified Conveyance Mechanic compliance with proposed Title 24, Part 6 requirements	• Would have to verify compliance with proposed elevator requirements for Title 24, Part 6	• Develop training for building department officials to handle new code requirements.

Appendix F: Summary of Stakeholder Engagement

Collaborating with stakeholders that might be impacted by proposed changes is a critical aspect of the Statewide CASE Team's efforts. The Statewide CASE Team aims to work with interested parties to identify and address issues associated with the proposed code changes so that the proposals presented to the CEC in this Draft CASE Report are generally supported. Public stakeholders provide valuable feedback on draft analyses and help identify and address challenges to adoption including: cost effectiveness, market barriers, technical barriers, compliance and enforcement challenges, or potential impacts on human health or the environment. Some stakeholders also provide data that the Statewide CASE Team uses to support analyses.

This appendix summarizes the stakeholder engagement that the Statewide CASE Team conducted when developing and refining the recommendations presented in this report.

Utility-Sponsored Stakeholder Meetings

Utility-sponsored stakeholder meetings provide an opportunity to learn about the Statewide CASE Team's role in the advocacy effort and to hear about specific code change proposals that the Statewide CASE Team is pursuing for the 2025 code cycle. The goal of stakeholder meetings is to solicit input on proposals from stakeholders early enough to ensure the proposals and the supporting analyses are vetted and have as few outstanding issues as possible. To provide transparency in what the Statewide CASE Team is considering for code change proposals, during these meetings the Statewide CASE Team asks for feedback on:

- Proposed code changes
- Draft code language
- Draft assumptions and results for analyses
- Data to support assumptions
- Compliance and enforcement, and
- Technical and market feasibility

The Statewide CASE Team hosted two stakeholder meetings for Elevator Efficiency measure via webinar described in Table 30. 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 30: Utility-Sponsored Stakeholder Meetings

Meeting Name	Meeting Date	Event Page from Title24stakeholders.com
First Round of Nonresidential and Multifamily Elevators Utility-Sponsored Stakeholder Meeting	Tuesday, January 31, 2023	https://title24stakeholders.com/event/nonresidential-industrial-insulation-labs-refrigeration-and-elevators-utility-sponsored-stakeholder-meeting/
Second Round of Nonresidential and Multifamily Elevators Utility-Sponsored Stakeholder Meeting	Tuesday, May 23, 2023	https://title24stakeholders.com/event/nonresidential-elevators-utility-sponsored-stakeholder-meeting/

The first round of utility-sponsored stakeholder meetings occurred from January 2023 and were important for providing transparency and an early forum for stakeholders to offer feedback on measures being pursued by the Statewide CASE Team. The objectives of the first round of stakeholder meetings were to solicit input on the scope of the 2025 code cycle proposals; request data and feedback on the specific approaches, assumptions, and methodologies for the energy impacts and cost-effectiveness analyses; and understand potential technical and market barriers. The Statewide CASE Team also presented initial draft code language for stakeholders to review.

The second round of utility-sponsored stakeholder meetings occurred from May 2023 and provided updated details on proposed code changes. The second round of meetings introduced early results of energy, cost-effectiveness, and incremental cost analyses, and solicited feedback on refined draft code language.

Utility-sponsored stakeholder meetings were open to the public. For each stakeholder meeting, two promotional emails were distributed from info@title24stakeholders.com One email was sent to the entire Title 24 Stakeholders listserv, totaling over 3,000 individuals, and a second email was sent to a targeted list of individuals on the listserv depending on their subscription preferences. The Title 24 Stakeholders' website listserv is an opt-in service and includes individuals from a wide variety of industries and trades, including manufacturers, advocacy groups, local government, and building and energy professionals. Each meeting was posted on the Title 24 Stakeholders' LinkedIn page (and cross-promoted on the CEC LinkedIn page) two weeks before each meeting to reach out to individuals and larger organizations and channels outside of the listserv. The Statewide CASE Team conducted extensive personal outreach to stakeholders identified in initial work plans who had not yet opted into the listserv. Exported webinar meeting data captured attendance numbers and individual comments, and recorded outcomes of live attendee polls to evaluate stakeholder participation and support.

Statewide CASE Team Communications

The Statewide CASE Team conducted personal communications over email and phone with numerous stakeholders when developing this report, as documented in Table 31. Key organizations and influential individuals were identified for their potential contributions to the proposal. Multiple professional organizations within the Elevator Industry, from design contractors to construction safety, were found. The individuals and the organizations contacted by the Statewide CASE Team are listed in the table below.

Table 31: Engaged Stakeholders

Organization/Individual Name	Market Role
Elevator Research & Manufacturing (ERM) - Dewhurst Group plc	Elevator Design Consulting Company
Barbre Consulting, Inc	Elevator Design Consulting Company
Urban Elevator Service	Elevator Design Consulting Company
Valley Elevator Inc.	Elevator Design Consulting Company
McKinley Elevator	Elevator Design Consulting Company
Consolidated Elevator Company	Elevator Design Consulting Company
Next Level Elevator	Elevator Design Consulting Company
Capitol Elevator Company	Elevator Design Consulting Company
Atlas Elevator Company	Elevator Design Consulting Company
Delta Elevator Co., INC	Elevator Design Consulting Company
Dwan Elevator Co.	Elevator Design Consulting Company
Pac West Elevator Inc.	Elevator Design Consulting Company
Advanced Elevator Solutions, Inc.	Elevator Design Consulting Company
Geraldine Burdeshaw; ASME	American Society of Mechanical Engineers influences Codes, Std works and influence designs
National Electrical Manufacturers Association (NEMA)	NEMA influences Codes, Std works & influence designs
Kevin L. Brinkman, PE (NEII)	National Elevator Industry, Inc. influences Codes, Std works and influence designs
Michael Vlaming, CECA	Construction Elevator Contractors Association
Rená Cozart, National Association of Elevator Contractors (NAEC)	Contractors Association
Laurie Dueitt, Elevator Escalator Safety Foundation (EESF)	Elevator Escalator Safety Foundation
Andrew Reistetter, NEEA	National Elevator and Escalator Association
James (Jim) Borwey, NAESAI	National Association of Elevator Safety Authorities Intl.
Sheila Swett, IAEC	International Association of Elevator Consultants
IMEG Corp./ Nick D. Ferzacca	Mechanical Engineers

Appendix G: Energy Cost Savings in Nominal Dollars

The CEC requested energy cost savings over the 30-year period of analysis in both 2026 present value dollars (2026 PV$) and nominal dollars. The cost-effectiveness analysis uses energy cost values in 2026 PV$. Costs and cost effectiveness using and 2026 PV$ are presented in section 3.4 of this report. This appendix presents energy cost savings in nominal dollars.

Table 32: Nominal Lifecycle Energy Cost Savings Over 30-Year Period of Analysis – Per Building Prototype – New Construction

Climate Zone	30-Year Lifecycle Electricity Cost Savings (Nominal $)	30-Year Lifecycle Natural Gas Cost Savings (Nominal $)	Total 30-Year Lifecycle Energy Cost Savings (Nominal $)
High Rise Multi-family	250,000	0	250,000
Small Hotel	97,000	0	97,000
Loaded Corridor Apt	96,000	0	96,000
Mid-rise Multi-Family	190,000	0	190,000
Large Office	910,000	0	910,000
Medium Office	82,000	0	82,000
Parking Garage	120,000	0	120,000

Appendix H: Trends in Elevator Conveyance

The Statewide CASE Team requested California Occupational Safety and Health Administration (CAL/OSHA) Elevator Database. The Statewide CASE Team received the database in July of 2022. The database had 3 parts, Northern California, Southern California and the City of Los Angeles that is separate jurisdiction from CAL/OSHA. The follow figures combine the three database parts to illustrate the trend the installation of hydraulic and traction elevators over the years. The results of each figure are filtered by the number of landings for the elevators. The figures show the prevalence of hydraulic elevators for elevators with fewer landings. The figures also show the trend toward more traction elevators being installed more recently than hydraulic elevators.

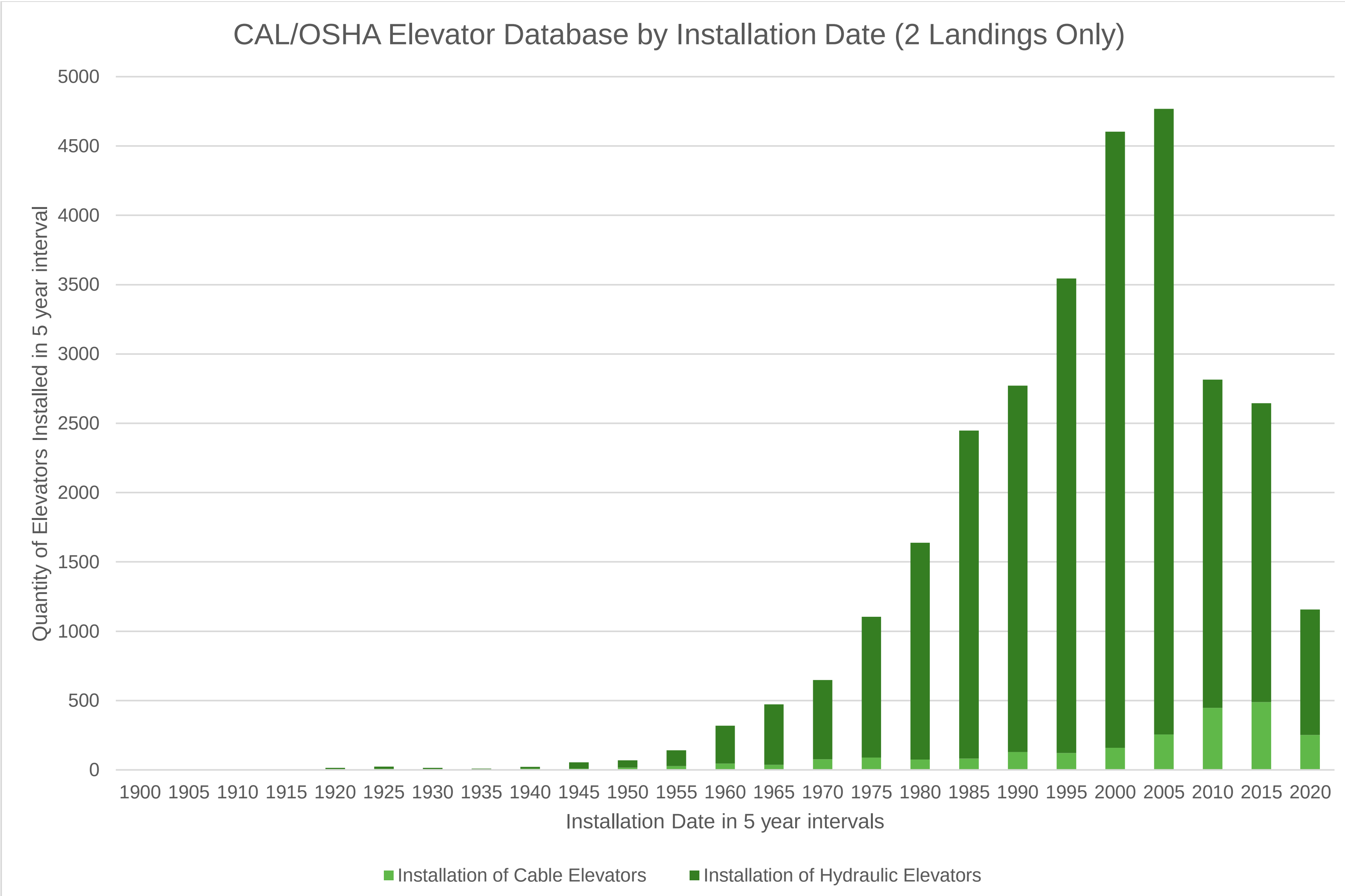

Figure 1: CAL/OSHA elevator database by installation date (2 landings only).

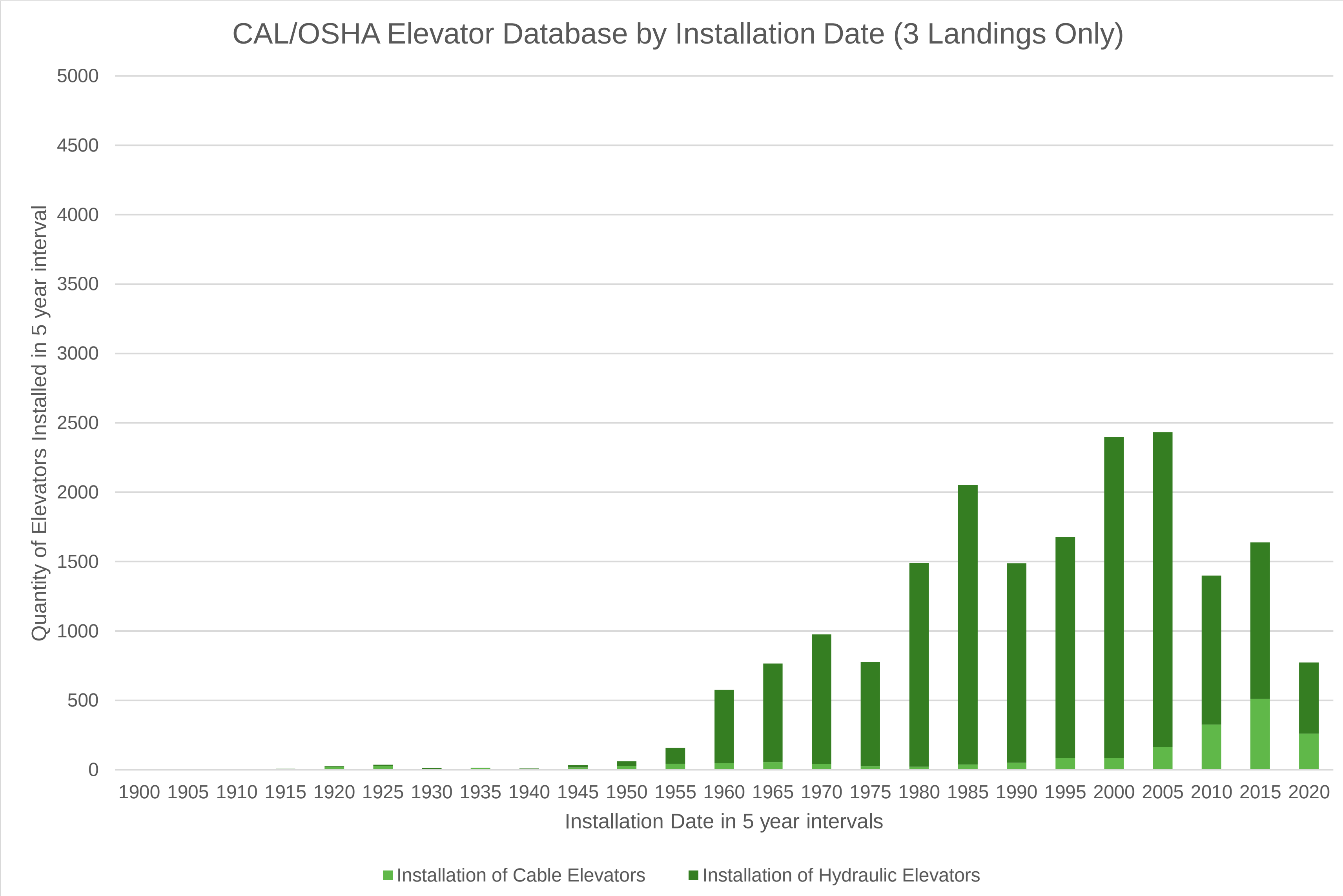

Figure 2: CAL/OSHA elevator database by installation date (3 landings only)

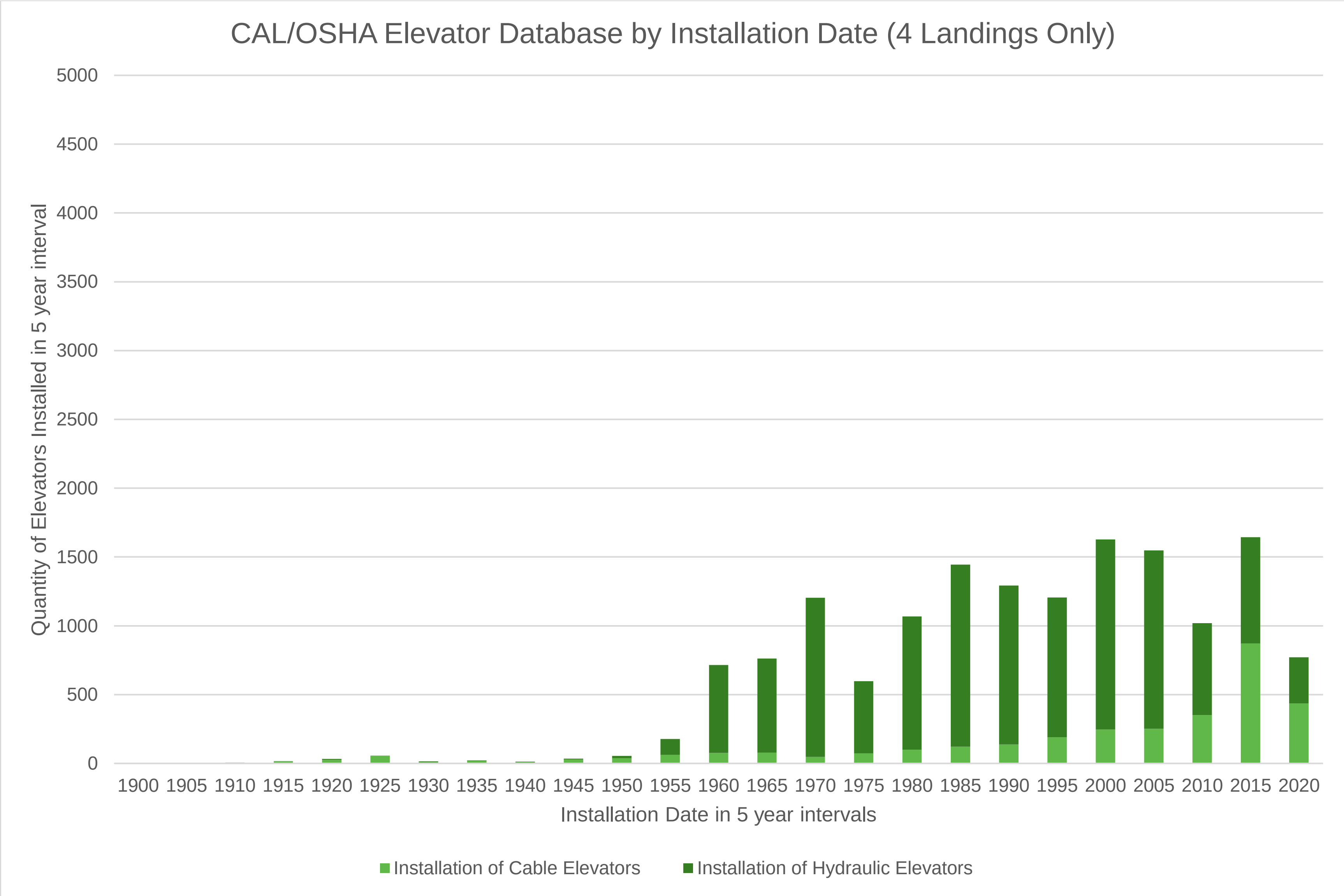

Figure 3: CAL/OSHA elevator database by installation date (4 landings only).

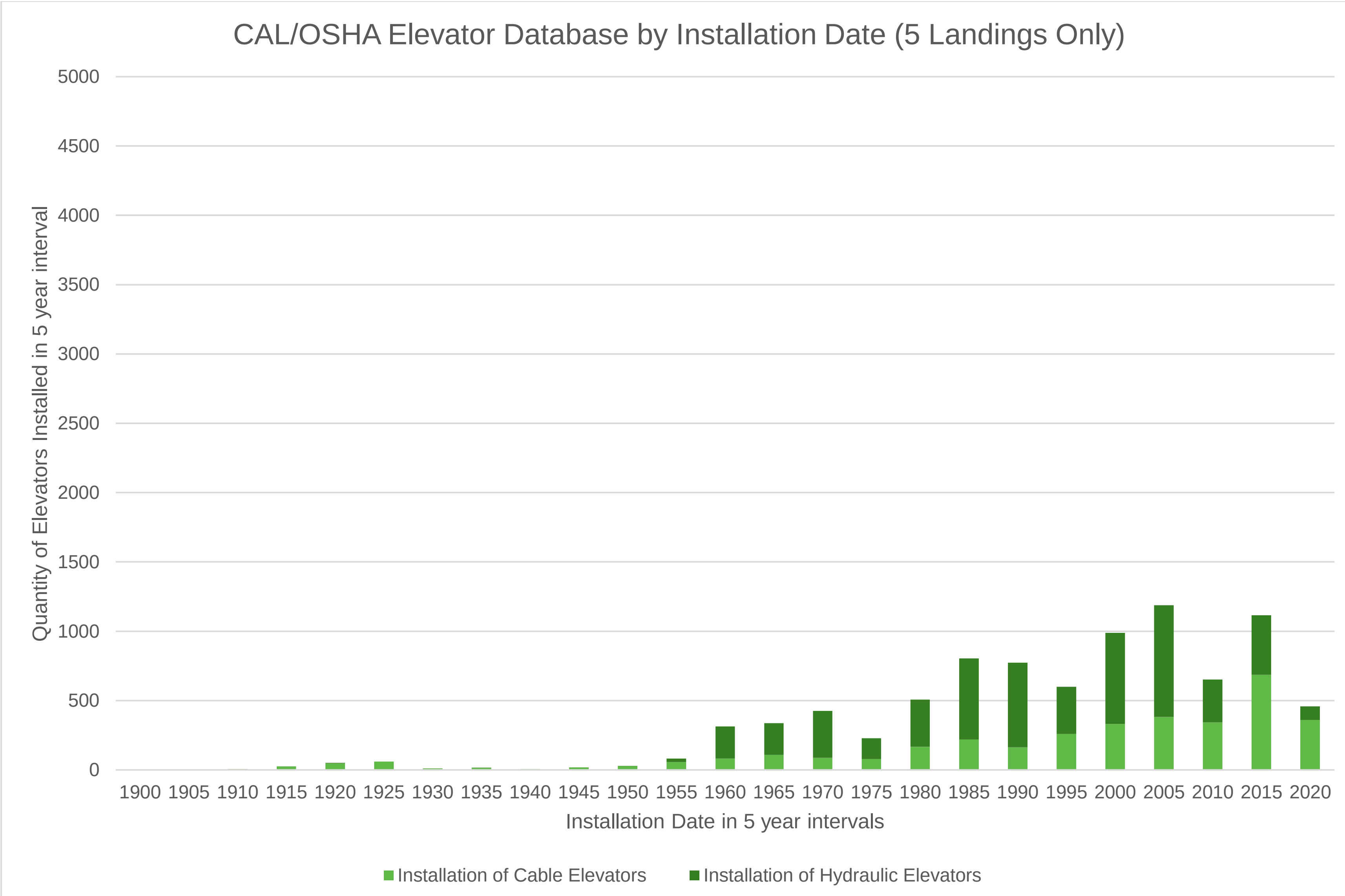

Figure 4: CAL/OSHA elevator database by installation date (5 landings only).

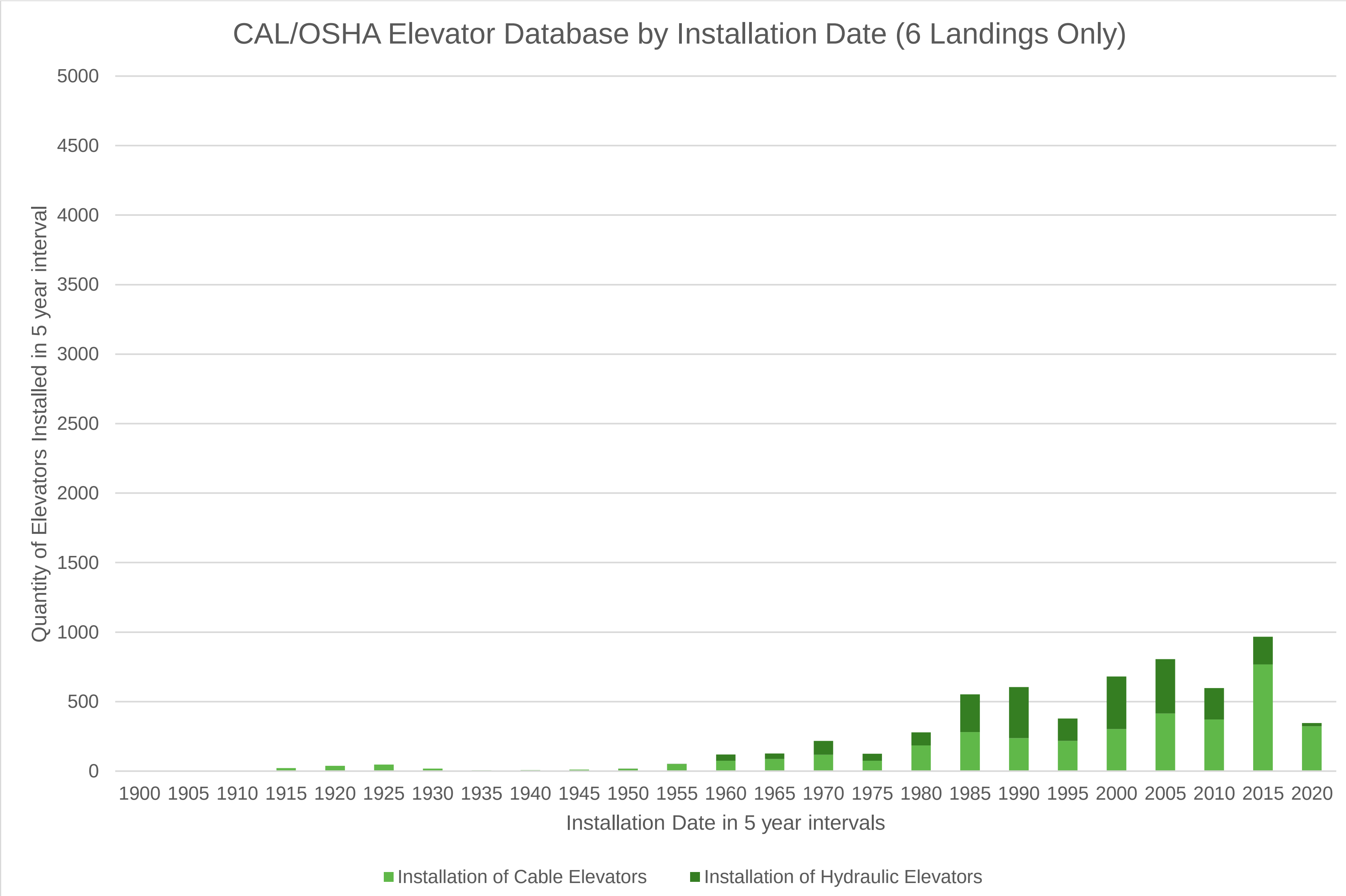

Figure 5: CAL/OSHA elevator database by installation date (6 landings only).

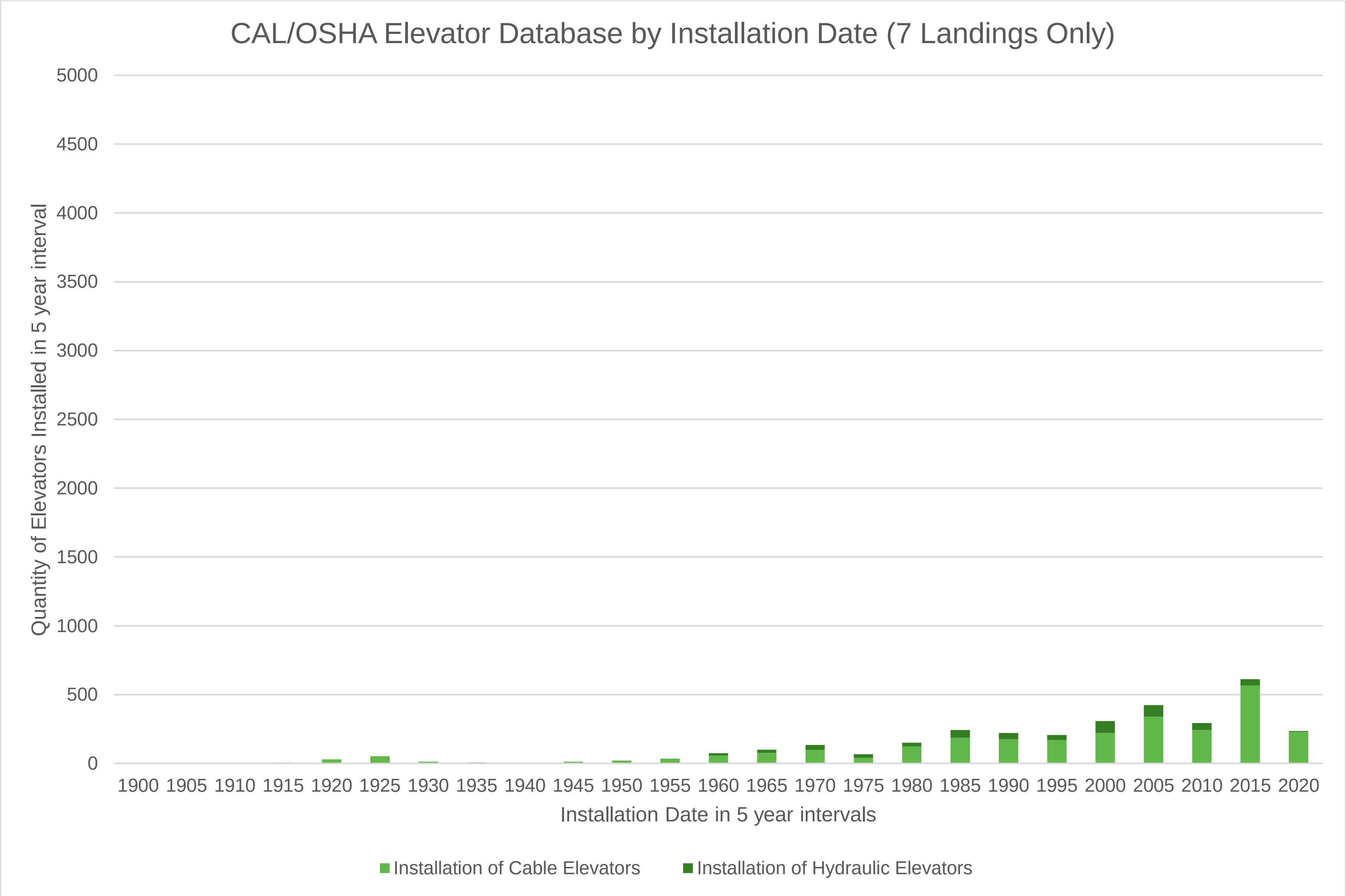

Figure 6: CAL/OSHA elevator database by installation date (7 landings only).

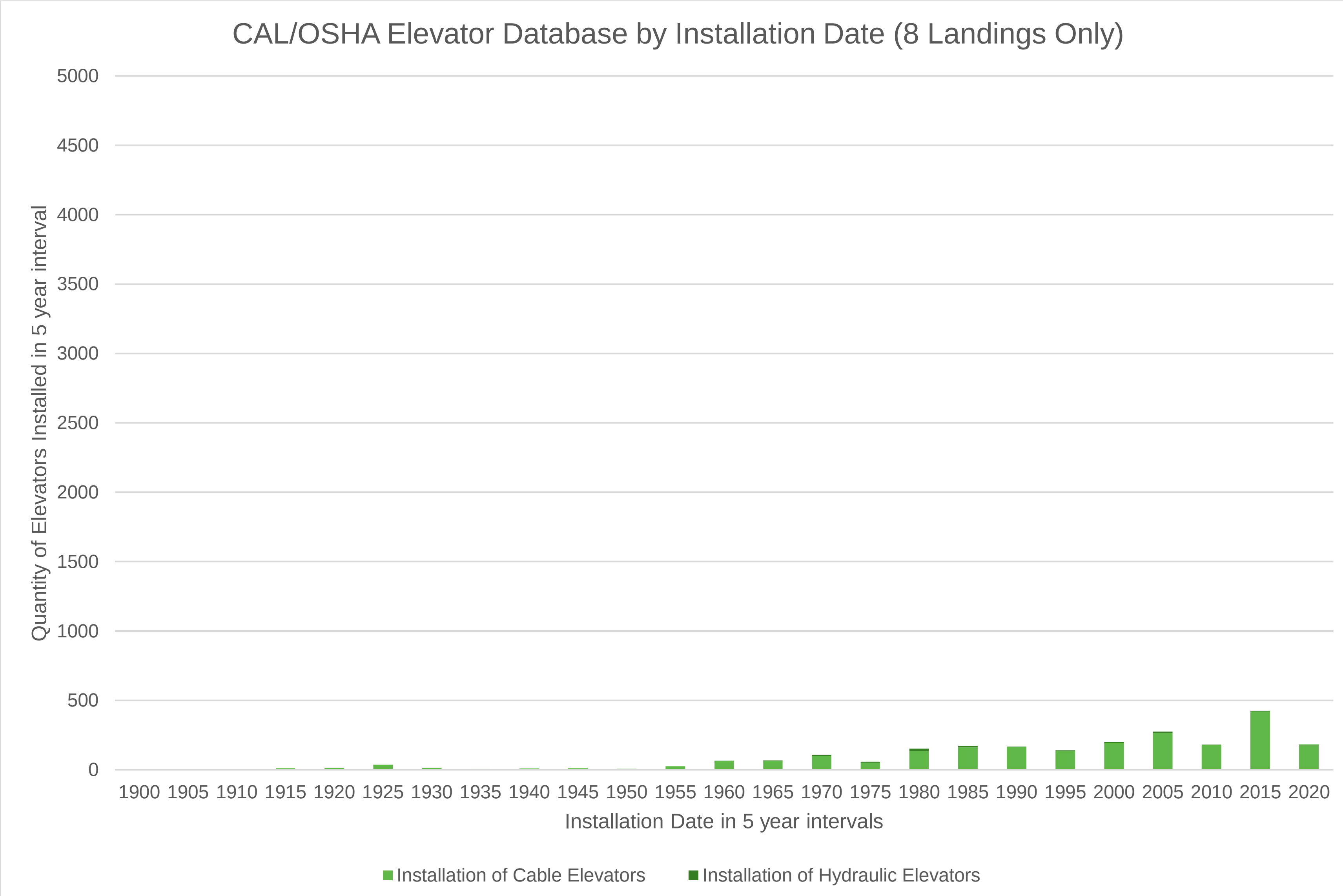

Figure 7: CAL/OSHA elevator database by installation date (8 landings only).

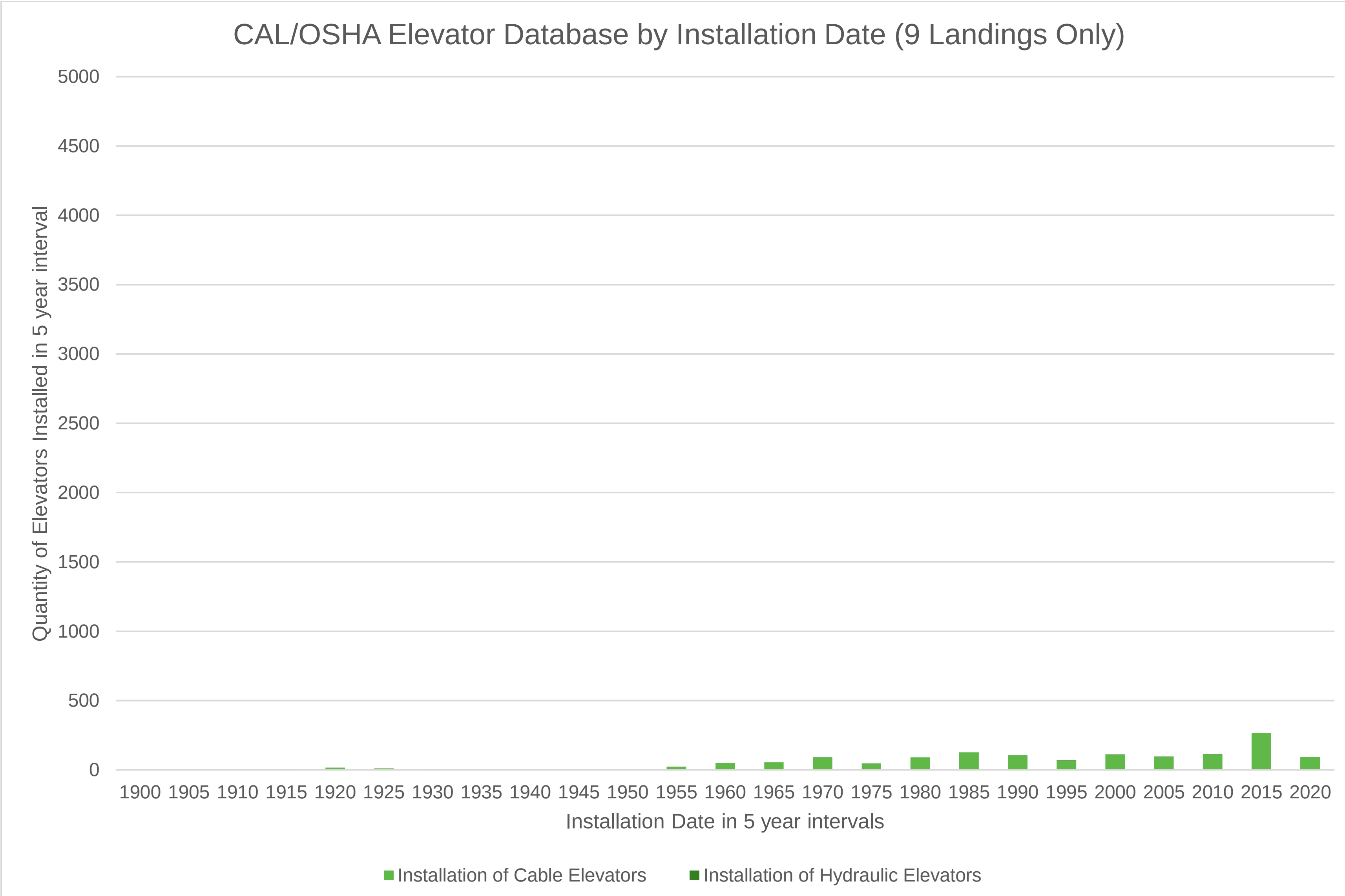

Figure 8: CAL/OSHA elevator database by installation date (9 landings only).

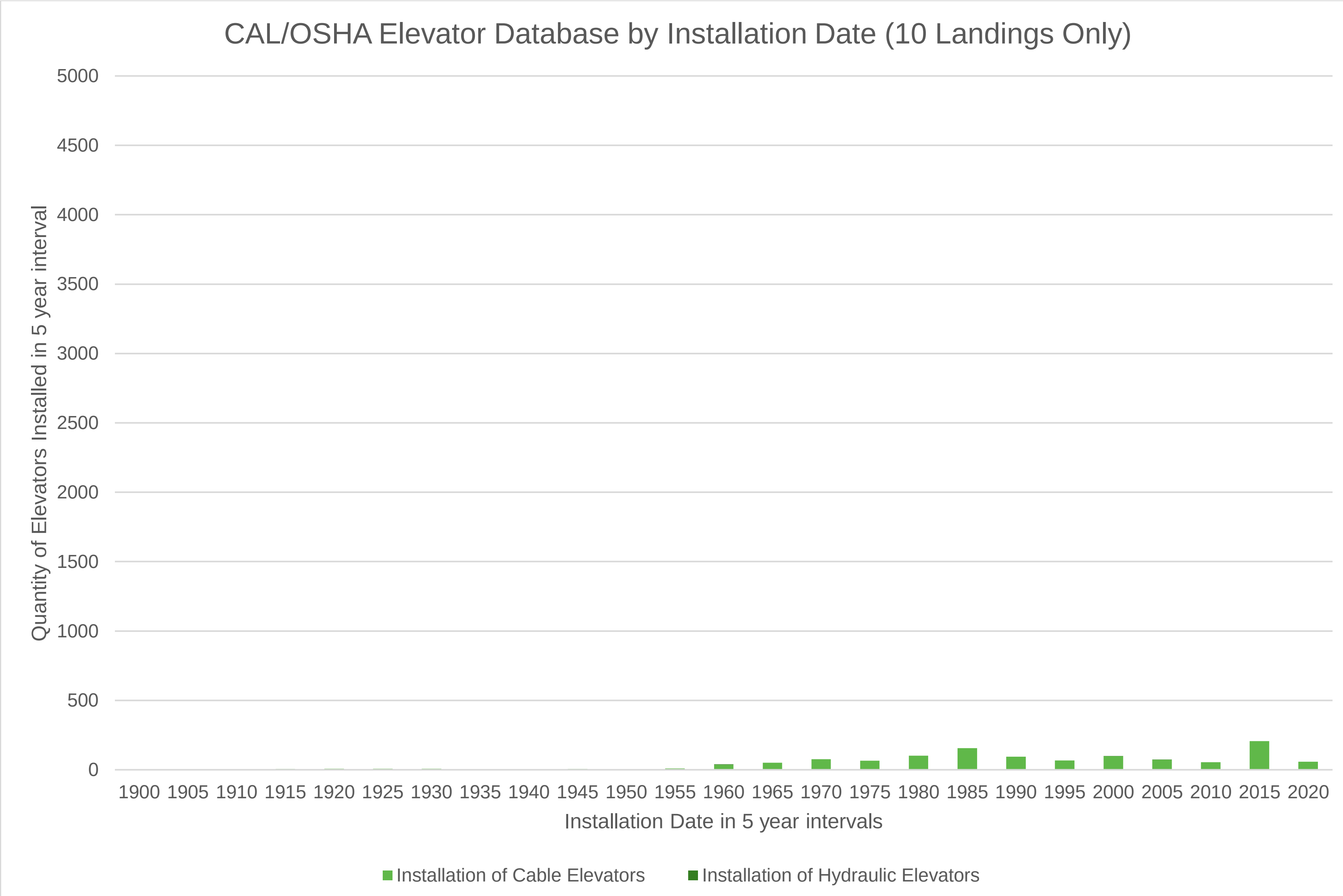

Figure 9: CAL/OSHA elevator database by installation date (10 landings only).

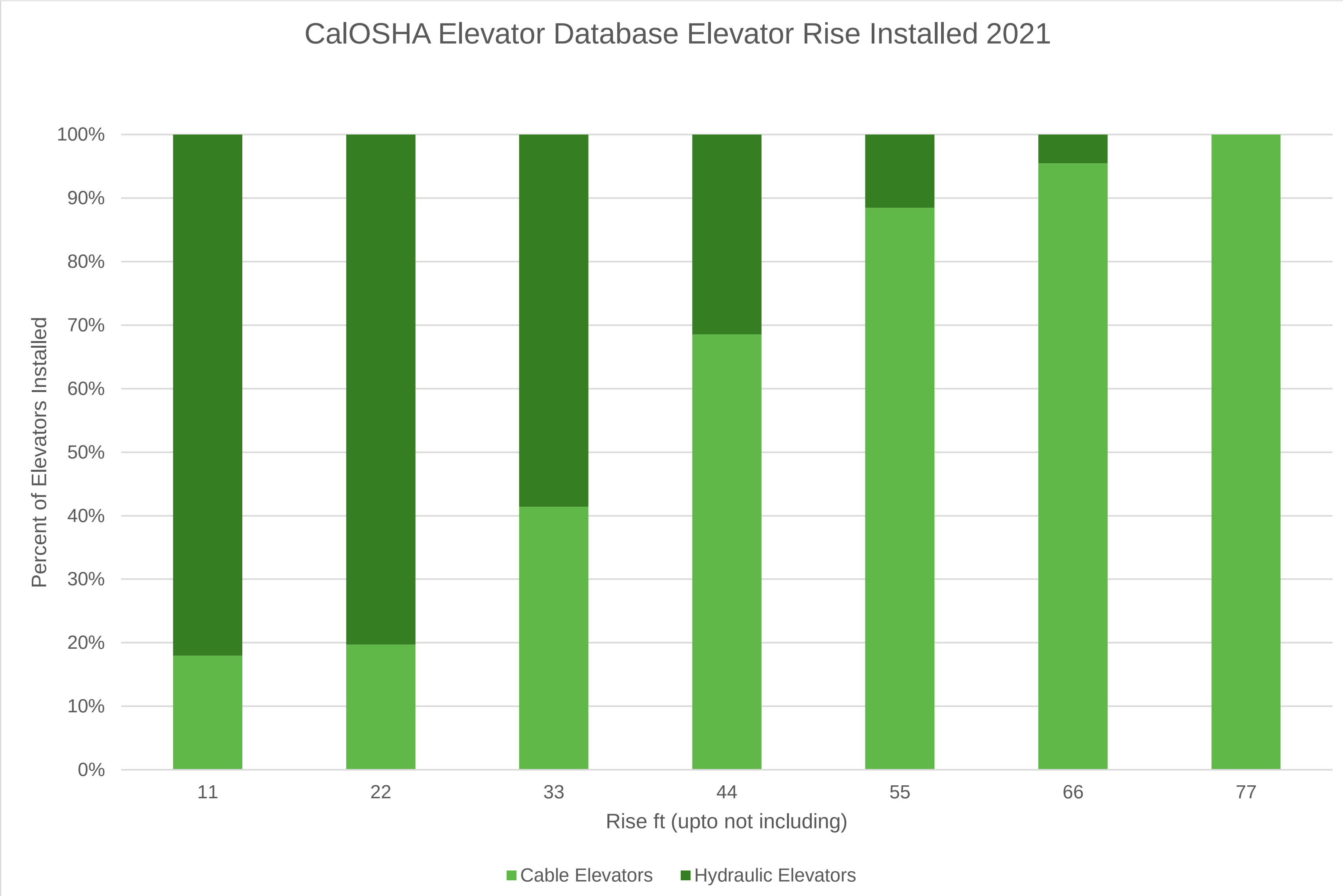

Figure 10: CAL/OSHA elevator database 2021 installations rise vs. elevator conveyance type.

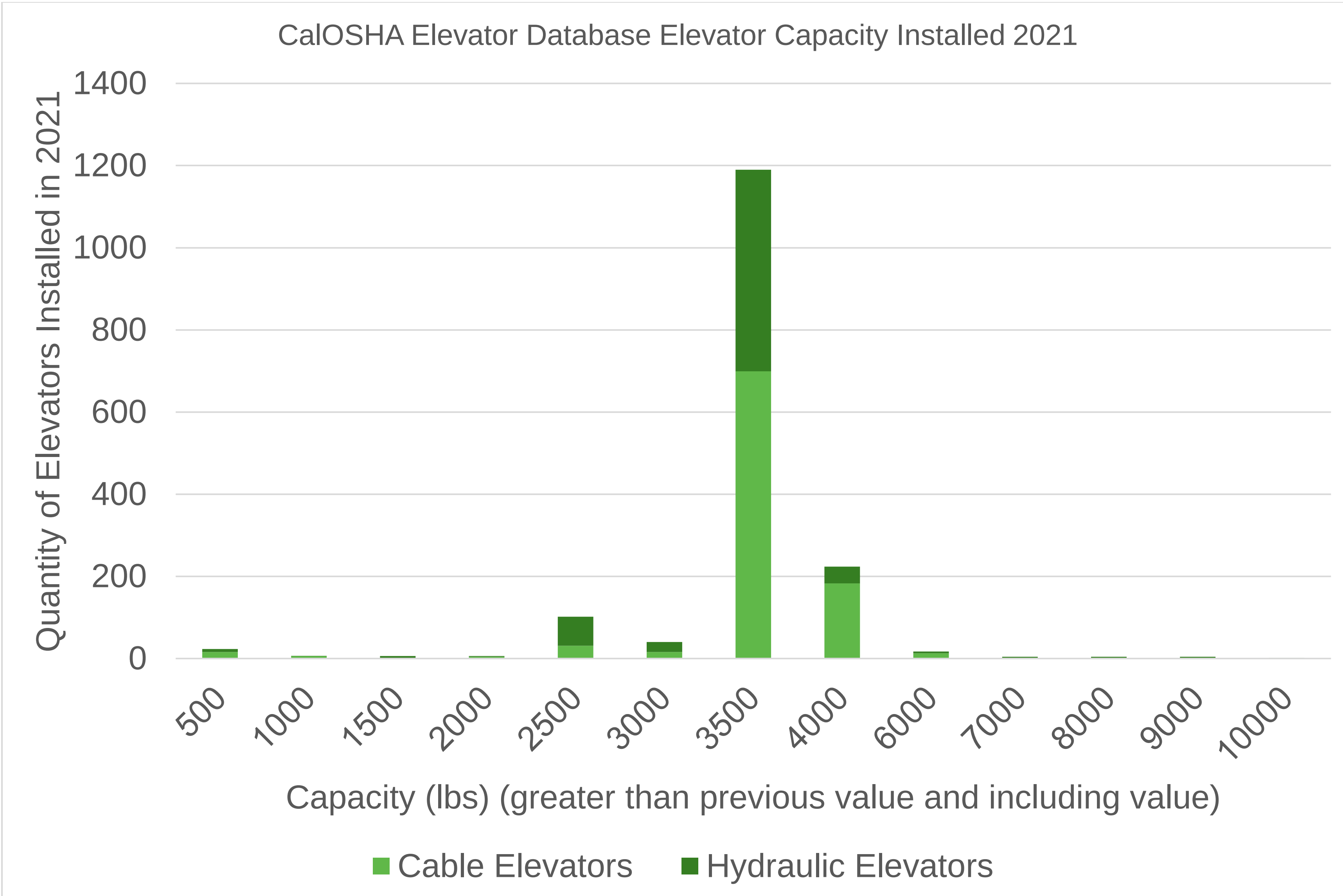

Figure 11: CAL/OSHA Elevator Database 2021 installations capacity vs. elevator conveyance type.

Appendix I: Other Elevator Efficiency Codes

2020 New York City Energy Conservation Code[22]

C405.8 Vertical and horizontal transportation systems and equipment. Vertical and horizontal transportation systems and equipment shall comply with this section.

C405.8.1 Elevator equipment and cabs. For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be not less than 35 lumens per watt. Ventilation fans in elevators that do not have their own air-conditioning system shall not consume more than 0.33 watts/cfm at the maximum rated speed of the fan. Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for over 15 minutes.

C405.8.1.1 Power conversion system. New traction elevators with a rise of 75 feet (23 m) or more in new buildings shall have a power conversion system that complies with Sections C405.8.1.1.1 through C405.8.1.1.3.

C405.8.1.1.1 Motor. Induction motors with a **Class IE2 efficiency rating, as defined by IEC EN 60034-30**, or alternative technologies, such as permanent magnet synchronous motors that have equal or better efficiency, shall be used.

C405.8.1.1.2 Transmission. Transmissions shall not reduce the efficiency of the combined motor/transmission below that shown for the Class IE2 motor for elevators with capacities below 4,000 pounds (1814 kg). Gearless machines shall be assumed to have a 100 percent transmission efficiency.

C405.8.1.1.3 Drive. Potential energy released during motion shall be recovered with a regenerative drive that supplies electrical energy to the building electrical system.

[22] See Chapter C4 "Commercial Energy Efficiency" of the 2020 NYC Energy Conservation Code https://www.nyc.gov/site/buildings/codes/2020-energy-conservation-code.page

ASHRAE 90.1-2022 Energy Standard For Sites And Buildings Except Low-Rise Residential Buildings.

Elevator total energy efficiency was introduced in ASHRAE 90.1-2019. This standard required that the designers document the A through G efficiency grade of the elevator in accordance with ISO 25745-2:2015 *"Energy Performance of Lifts, Escalators and Moving Walks Part 2: Energy Calculation and Classification for Lifts (Elevators)."* Addendum CF[23] to ASHRAE 90.1-2019 updated the requirements to require at least an E rating.

10.4.3 Elevators. Elevator *systems* shall comply with the requirements of this section.

10.4.3.1 Cab Lighting Power. For the *luminaires* in each elevator cab, not including power for germicidal function, signals, and displays, the sum of the lumens divided by the sum of the watts (as described in Section 9.1.4) shall be no less than 50 lm/W.

Exception to 10.4.3.1: This requirement does not apply to elevators in an *essential facility* where special lighting needs are required.

10.4.3.2 Ventilation Efficacy. Cab *ventilation* for elevators, except elevators with air conditioning or MERV 13 or greater filters, shall have an efficacy of at least 4.0 cfm/W at maximum speed.

10.4.3.3 Standby Mode. The elevator cab lighting shall be *automatically* de-energized in accordance with ASME A17.1/CSA B44 Requirement 2.14.7.2.2. Cab *ventilation* fans for elevators without air conditioning shall also be de-energized. When stopped and unoccupied with *doors* closed for over 15 minutes, cab interior lighting and *ventilation*

shall be de-energized until required for operation.

Exception to 10.4.3.3: Forced *ventilation* shall meet the requirements of ASME A17.1/CSA B44 Requirement 2.14.2.3.3.

10.4.3.4 Energy Use. New elevators shall meet the following requirements:

a. Usage category as defined in ISO 25745-2 between 1 and 6. The usage category shall be in accordance with Annex B.

b. The *energy efficiency* class shall be E or better per ISO 25745-2, Table 7.

…

10.9.3 Documentation. Design documents shall list the following for new elevators:
a. The usage category as defined in ISO 25745-2 between 1 and 6. The usage category shall be in accordance with Annex B.

b. The *energy efficiency* class per ISO 25745-2, Table 7.

[23] Addendum CF to ASHRAE 90.1-2019 https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90_1_2019_cf_20220429.pdf

Appendix J: Excerpts of CA Electrical Code & ASME A17.1-2016 Safety Code for Elevators and Escalators

California Electrical Code 2022 (Title 24, part 3)

620.91 Emergency and Standby Power Systems

Elevators shall be permitted to be powered by an emergency or standby power system.

Informational Note No. 1: See ASME A17.1-2016/CSA B44-16, Safety Code for Elevators and Escalators, 2.27.2, for additional information.

Informational Note No. 2: When an elevator is classified as a fire service access elevator or occupant evacuation operation elevator, some building codes require the elevator equipment, elevator hoistway lighting, ventilation and cooling equipment for elevator machine rooms, control rooms, machine spaces, and control spaces as well as elevator car lighting to be supplied by standby power systems in compliance with Article 701.

(A) Regenerative Power

For elevator systems that regenerate power back into the power source that is unable to absorb the regenerative power under overhauling elevator load conditions, a means shall be provided to absorb this power.

(B) Other Building Loads

Other building loads, such as power and lighting, shall be permitted as the energy absorption means required in 620.91(A), provided that such loads are automatically connected to the emergency or standby power system operating the elevators and are large enough to absorb the elevator regenerative power.

(C) Disconnecting Means

The disconnecting means required by 620.51 shall disconnect the elevator from both the emergency or standby power system and the normal power system.

Where an additional power source is connected to the load side of the disconnecting means, which allows automatic movement of the car to permit evacuation of passengers, the disconnecting means required in 620.51 shall be provided with an auxiliary contact that is positively opened mechanically, and the opening shall not be solely dependent on springs. This contact shall cause the additional power source to be disconnected from its load when the disconnecting means is in the open position.

ASME A17.1-2016/CSA B44-16, Safety Code for Elevators and Escalators

2.27.2 Emergency or Standby Power System

Elevators provided with an emergency or standby power system to operate the elevator in case the normal power supply fails shall comply with the requirements of 2.27.2.1 through 2.27.2.5.

NOTE (2.27.2): Requirements for emergency or standby power systems are addressed in the building code. Requirements for health care facilities are addressed in NFPA 99 and NFPA 70, Article 517.

2.27.2.1

The emergency or standby power system shall be capable of operating the elevator(s) with rated load (see 2.16.8), at least one at a time, unless otherwise required by the building code.

2.27.2.2

The transfer between the normal and the emergency or standby power system shall be automatic.

2.27.2.3

An illuminated signal(s) marked "ELEVATOR EMERGENCY POWER" shall be provided in the elevator lobby at the designated level for each group of elevators or for any single elevator not in a group. The signal(s) shall indicate that the normal power supply has failed, and the emergency or standby power is in effect for one or more of the cars in that group of elevators or that single elevator.

2.27.2.4

Where the emergency or standby power system is not capable of operating all elevators simultaneously, the elevators shall conform to requirements 2.27.2.4.1 through 2.27.2.4.6.

2.27.2.4.1

A selector switch(es) marked "ELEVATOR EMERGENCY POWER" in red lettering a minimum of 5 mm (0.25 in.) in height, that is key-operated or under a locked cover (see 2.27.8), shall be provided to permit the selection of the elevator(s) to operate on the emergency or standby power system. The key shall be Group 3 Security (see Section 8.1).

2.27.2.4.2

The selector switch(es) positions shall be marked to correspond with the elevator identification number (see Section 2.29) and a position marked "AUTO."

2.27.2.4.3

The selector switch(es) shall be located at the designated level in view of all elevator entrances, or if located elsewhere means shall be provided adjacent to the selector switch(es) to indicate that the elevator is at the designated level with the doors in the normally open position.

2.27.2.4.4

An automatic means shall be provided to select each elevator one or more at a time. The selection shall be transferred from one elevator to another until all the elevators have been selected. After all elevators have been selected, the process shall repeat for any cars that failed to move, to give them a second opportunity. The operation, when selected, shall be as follows:

(a) An elevator that is not on designated attendant operation, hoistway access operation, inspection operation, Firefighters' Phase I Emergency Recall Operation, or Firefighters' Phase II In-Car Emergency Operation shall return to the designated level where the power-operated doors at the landing where the illuminated signal (see 2.27.2.3) is located shall open and remain open. Where more than one entrance is provided at the designated level, the other doors are permitted to open. Once the selected car has returned to the designated level or fails to move within 30 s, the selection shall be automatically transferred to another elevator.

(b) An elevator on designated attendant operation, hoistway access operation, inspection operation, or Firefighters' Phase II In-Car Emergency Operation shall operate in accordance with those requirements and shall remain selected until the car is stopped for a period of not less than 2 min and not more than 3 min, before the selection shall be automatically transferred to another elevator. For cars on Firefighters' Phase II In-Car Emergency Operation, the in-car visual signals [see 2.27.3.1.6(h) and 2.27.3.3.8] shall activate only while the car is selected.

(c) An elevator that is on Firefighters' Phase I Emergency Recall Operation shall return to the recall level in accordance with 2.27.3.1 or 2.27.3.2. Once recall is complete, or the selected car fails to move within 30 s, the selection shall be automatically transferred to another elevator.

2.27.2.4.5

After all cars have been recalled, moved to a floor, or failed to move after a second opportunity, one or more of the elevators, identified by the manual selection switch(es) (see 2.27.2.4.1), shall be selected to remain in operation. If no elevator(s) has been manually selected [switch(es) in "AUTO" position], it shall be permissible to automatically select the elevator(s) to remain in operation. Preference shall be given to cars on Hospital Service followed by cars on Firefighters' Phase II Emergency In-Car Operation.

The manual selection switch(es) shall not override the automatic power selection until

(a) the automatic return sequence is complete (see 2.27.2.4.4); or

(b) a "FIRE RECALL" switch is in the "ON" position (see 2.27.3.1)

Operation of the manual selection switch(es) shall not cause a car to be deselected until the elevator is stopped.

2.27.2.4.6

A visual means, located adjacent to the manual selector switches, shall be provided to indicate which elevator(s) is currently selected.

2.27.2.5

When the emergency or standby power system is designed to operate only one elevator at a time, the energy absorption means (if required) shall be permitted to be located on the supply side of the elevator power disconnecting means, provided all other requirements of 2.26.10 are conformed to when operating any of the elevators the power might serve. Other building loads, such as power and lights that can be supplied by the emergency or standby power system, shall not be considered as a means of absorbing the regenerated energy for the purposes of conforming to 2.26.10, unless such loads are normally powered by the emergency or standby power system.

2.26.10 Absorption of Regenerated Power

When a power source is used that, in itself, is incapable of absorbing the energy generated by an overhauling load, means for absorbing sufficient energy to prevent the elevator from attaining governor tripping speed or a speed in excess of 125% of rated speed, whichever is less, shall be provided on the load side of each elevator power supply line disconnecting means (see 2.16.8).