TITLE 24, PART 6 | 2028 CODE CYCLE

Nonresidential Fenestration

Codes and Standards Enhancement (CASE) Proposal

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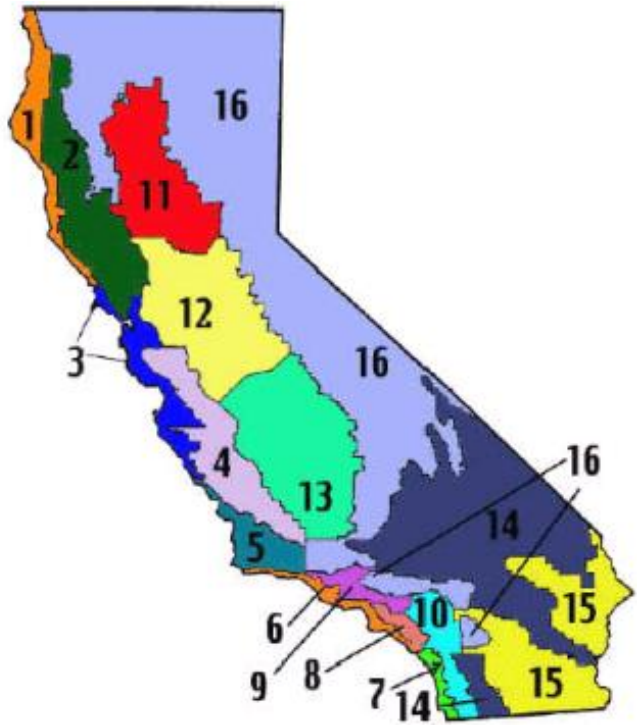
CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Proposal Description

- Code Change Proposal
- Benefits
- Background Information

Proposed Code Change A – New Construction

- **WINDOW U-FACTORS – NEW CONSTRUCTION – CZs 1 & 16**
  - In alignment with changes planned for the 2027 IECC, this proposal would revise the maximum required U-factors for fixed and operable windows.



See Title24stakeholders.com for proposal description, justification, draft code language, and requested data

Marked-up Code Language – New Construction

See Title24stakeholders.com for marked-up code language

Title 24, Part 6

- **SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES**

Fenestration – Vertical (Area-Weighted Performance Rating)	CZ 1	CZ 16
Fixed Window (Max U-factor)	~~0.36~~ 0.32	~~0.36~~ 0.34
Fixed Window (Max RSHGC)	0.25	0.25
Operable Window (Max U-Factor)	~~0.46~~ 0.39	~~0.46~~ 0.43
Operable Window (Max RSHGC)	0.25	0.25

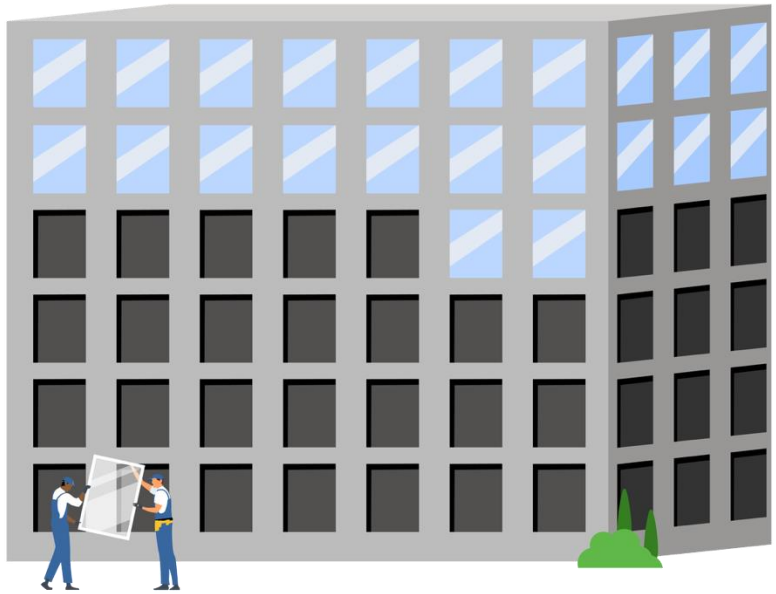
Note that Max RSHCG is unchanged

Considerations

- Six other CA CZs use the proposed U-factor for fixed windows
- The proposed U-factors for operable windows are not currently required in CA

Proposed Code Change B - Alterations

- **WINDOW U-FACTORS – ALTERATIONS – ALL CZs**
  - This proposal would require that replacement windows meet the U-factor and RSHGC values required for new construction when more than 50% of the windows on a single façade or floor are replaced.



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Poll

Let's talk about this proposed trigger for alterations. What would be the best way to get higher performance window replacements without negative impacts on building aesthetics?

a. Percentage of the square feet of all windows

b. Percentage of the number of all windows

c. Add a definition for "major renovations" (for all building component alterations)

d. Other ideas (Please put them into the chat!)

Marked-up Code Language – Alterations

See Title24stakeholders.com for marked-up code language

Title 24, Part 6

- **SECTION 141.0(b) – Alterations**
- 2. A. Fenestration alterations other than repair and those subject to Section 141.0(b)2 shall meet the requirements below:

  i. Window alterations replacing fifty percent or more of the windows on any single façade or floor shall meet the requirements in Table 140.3-B.

  ~~i.~~ii. All other vertical ~~Vertical~~ fenestration alterations shall meet the requirements in Table 141.0-A.

  ~~ii.~~iii. Added vertical fenestration shall meet the requirements of Table 140.3-B, C, or D.

  ~~iii.~~iv. All altered or newly installed skylights shall meet the requirements of Table 140.3-B, C, or D.

  (Exceptions remain unchanged)

Considerations

- Allow exception for vacuum insulating glazing replacement in existing frame
- Allow exception for permanent interior secondary windows

Benefits of the Proposed Changes

WINDOW U-FACTORS – NEW CONSTRUCTION – CZ 1 & 16

- This change would keep the envelope requirements of Title 24, Part 6 in alignment with the national model codes (IECC-2027 and ASHRAE 90.1-2025).
- The upgrade will save energy and improve occupant comfort in the two climate zones impacted.

WINDOW U-FACTORS – ALTERATIONS – ALL CZs

- This change would bring the requirements for window replacements in Title 24, Part 6 into alignment with existing provisions in the national model codes.
- This change will save energy and improve occupant comfort in all climate zones when major window replacement projects are undertaken.

Market and Technical Considerations

- Current Conditions and Trends
- Potential Barriers and Solutions
- Technical feasibility

Current Market Conditions

WINDOW U-FACTORS – NEW CONSTRUCTION – CZ 1 & 16

- The CASE Team assumes that some new construction projects in Climate Zones 1 and 16 may opt for higher-performing windows than the code requires, as those windows are readily available in the state and may be cost-neutral. But we estimate that that would be a very low percentage of projects, as many nonresidential projects in CA use the Performance Path for Title 24 compliance and are likely to trade off envelope stringency for higher efficiency equipment.

WINDOW U-FACTORS – ALTERATIONS – ALL CZs

- The modeling assumption for window replacements in existing buildings is 3% of windows are replaced each year. The CASE Team will use this assumption while surveying the market for a more accurate estimate of major window replacement projects.

Market Barrers and Solutions – New Construction

Market Barriers	Potential Solutions
1. Barrier 1: Incremental cost of update 2. Barrier 2: Perception of product availability	1. Solution 1: Show cost-effectiveness and potential savings for HVAC sizing 2. Solution 2: • For fixed windows, show that the product is widely available in other CA climate zones. • For operable windows, investigate product availability from regional distributors

Market Barrers and Solutions – Alterations

Market Barriers	Potential Solutions
1. Barrier 1: Incremental cost of update 2. Barrier 2: Aesthetics – replaced windows will not match existing windows to remain	1. Solution 1: Show cost-effectiveness 2. Solution 2: • Conditions identified where only large scope projects are required to use the new construction standard • Offer alternatives such as interior secondary windows

Current Market Share

Market share: percentage of buildings that already use the proposed technology or design practice (at or above the proposed stringency level)

Current Market Share

New Construction and Additions	**0%**	• Proposed operable windows may not yet be available in CA • Proposed fixed windows unlikely to be upgraded using the performance path
Alterations	**0%**	• Proposed window U-factors are considerably lower (more efficient) than currently required • Aesthetic concerns with single window replacements

Poll

What percentage of annual new construction (including additions) in California CZs 1 and 16 currently install *fixed* windows with better-than-code U-factors?

a. 1% – 25%
b. 26% - 50%
c. 51% - 75%
d. 76% - 100%

Poll

What percentage of annual new construction (including additions) in California CZs 1 and 16 currently install *operable* windows with better-than-code U-factors?

a. 1% – 25%
b. 26% - 50%
c. 51% - 75%
d. 76% - 100%

Poll

What is the current market share for alterations? That is, what percentage of window replacement projects in California currently install better-than-code windows?

a. 1% – 25%
b. 26% - 50%
c. 51% - 75%
d. 76% - 100%

Poll

What is the current market share for major alterations? That is, what percentage of window replacement projects in California replace over 50% of the building's windows?

a. 1% – 25%
b. 26% - 50%
c. 51% - 75%
d. 76% - 100%

Technical Considerations

- Some stakeholders have raised concerns that there may be structural problems replacing windows with certain types of new higher-performance windows.

- Other stakeholders refute this claim and state that new windows will not pose structural modifications when replacing windows in older buildings.

Poll

Is the question regarding structural issues with window replacements something we will need to address? Please direct us to resources to support your response.

Open ended response

Poll

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What else should we know? Are there other market or technical barriers or solutions we should consider?

Open ended response

Per Unit Energy and Cost Impacts

Methodology and Assumptions

- Energy and Energy Cost Savings
- Incremental Costs

Energy and Energy Cost Savings Methodology

- Using CEC's methodology and metrics
- New Construction
  - Baseline model using current Title-24-2025 requirements
  - Energy savings calculated from proposed U-factor and RSHGC updates
- Alterations
  - Baseline model set to Title 24's Table 141.1-A
  - Proposed cases modeled based on meeting the current prescriptive Title-24-2025 U-factor and RSHGC
  - Proposed requirements: replacing 50% or more of windows in any single façade or floor.
    - Assuming 3% of the EB sector construction as the impacted population

Energy Modeling Assumptions

- Simulating energy savings in EnergyPlus with CBECC rulesets
- Simulating using the following prototypical buildings and climate zones

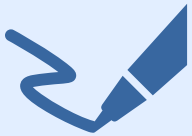
Prototypical Buildings	Climate Zones
▪ **All CBECC NR Prototypes**	▪ **New Construction: Simulating in CA Climate Zones 1 and 16** ▪ **Alterations: Simulating in all CA Climate Zones (1 – 16)**

Key Modeling Assumptions (New Construction, CZ 1 & 16)

Prototype: Small Office

Standard Design

1. 2025 Title 24 Baseline (Table 140.3-B)
2. Fixed Window U-Factor = 0.36 (CZ 1 & 16)
3. Operable Window U-Factor = 0.46
4. SHGC = 0.25 (CZ 1), 0.22 (CZ 16)
5. WWR = 40%



Proposed Design

1. 2028 Code Proposal
2. Fixed Window U-Factor = 0.32 (CZ 1), 0.34 (CZ 16)
3. Operable Window U-Factor = 0.39 (CZ 1), 0.43 (CZ 16)
4. SHGC = same as baseline (0.25 CZ 1, 0.22 CZ 16)
5. WWR = 40%

Key Modeling Assumptions (Alterations, all CZs, >50% replacement)

Prototype: Small Office

Standard Design

1. 2025 Title 24 Alteration Baseline (Table 141.0-A)
2. Fixed Window U-Factor = 0.58 (CZ 3 & 5), 0.47 (all other CZs)
3. Operable Window U-Factor = 0.58 (CZ 3 & 5), 0.47 (all other CZs)
4. SHGC = 0.41 (CZs 1, 3, 5, 16), 0.31 (CZs 2, 4, 6-15)
5. WWR = 40%

Proposed Design

1. 2028 Code Proposal
2. Fixed Window U-Factor = 0.32 (CZ 1), 0.34 (CZ 16), 0.36 (CZ 2 – 15)
3. Operable Window U-Factor = 0.39 (CZ 1), 0.43 (CZ 16), 0.46 (all others)
4. SHGC = 0.25 (CZ 1-8, 10, 16), 0.22 (CZ 9, 11 – 15)
5. WWR = 40%

Incremental Cost Framework

Prototype(s): Small Office

Baseline

First Cost

1. Equipment
2. Installation

30-Year Maintenance Costs

1. Regular Maintenance

Proposed

First Cost

1. Equipment
2. Installation

30-Year Maintenance Costs

1. Regular Maintenance

Approach for Gathering Costs

- **The CASE Team will seek accurate cost information through the following sources:**
  - Contractor and distributor surveys
  - Engaging with industry stakeholders and associations
  - National average costs

- **THE CASE TEAM ASKS FOR COST DIFFERENCES FOR THE FOLLOWING:**
  - **Fixed window U-0.34 and U-0.32 vs. U-0.36**
  - **Operable window U-0.43 and U-O.39 vs. U-0.46**
  - **Values of new construction windows in all climate zones vs U-0.58**

PLEASE REACH OUT TO THE CASE TEAM IF YOU CAN PROVIDE ANY OF THIS DATA

Compliance Verification

- Key Aspects of Compliance Verification
- Barriers and Solutions
- Revisions to Compliance Software

Key Aspects of Compliance Verification

- **The proposed measure for New Construction will not change any aspect of the verification process**
  - As with the current standard, the critical aspect for window performance is verification of the quality of the installation.

- **The proposed measure for Alterations will provide some challenges for verification**
  - Introduction of a new trigger for major window replacement projects will require more information provided for permit than is typically required.

Compliance Barriers and Solutions

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Compliance Verification Barriers	Potential Solutions
1. Barrier 1 2. Barrier 2	1. Solution 1 – exclude x building 2. Conduct additional research

Compliance Software Updates

- Update will require revising the code baseline/reference building model fenestration requirements to align with the proposed change.
- No algorithmic or user-interface will be changed to support this code change in the performance approach.

Compliance Forms Updates

- Updates to the forms for nonresidential envelope components (CEC-NRCC-ENV-E) will need to be made.

Planned as Memos for 2026

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- Recommendations for language clarifications to improve compliance
- Flexible air sealing requirement at penetrations through the building thermal envelope
- Clarify language for window-to-HVAC interlocks
- Address inconsistencies with fenestration definitions

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More information on
CEC's 2028 proceeding website.

We want to hear from you!

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Cost Effectiveness Results

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Climate Zone	Benefits *30-year Energy Cost Savings + Other PV Savings* (2029 PV$)	Costs *Total Incremental PV Costs* (2029 PV$)	Benefit-to-Cost Ratio
1	$#,### – $#,###	$#,### – $#,###	#.# – #.#
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

Results vary by prototypical building

134.79

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