



TITLE 24, PART 6

2028 CODE CYCLE

Nonresidential Fenestration

Codes and Standards Enhancement (CASE) Proposal

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Energy Solutions

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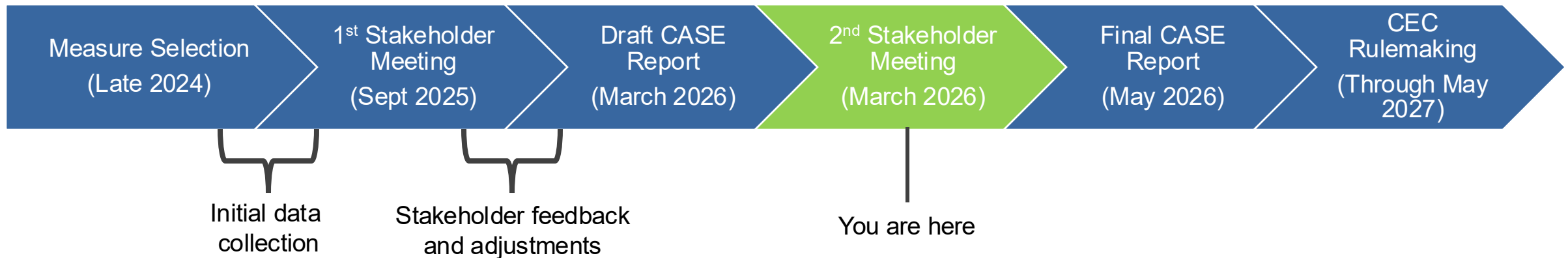
What's New Since Our Last Stakeholder Meeting?

New / Updated

- ✓ Added Climate Zones to New Construction proposal
- ✓ Modified Alterations proposal trigger from 50% to 100%
- ✓ Replaced Table 141.0-A with modified and expanded version

In Progress

- Incremental First & Maintenance Costs
- Cost-Effectiveness Results & Benefit-to-Cost Ratio
- Statewide Energy & Energy Cost Savings

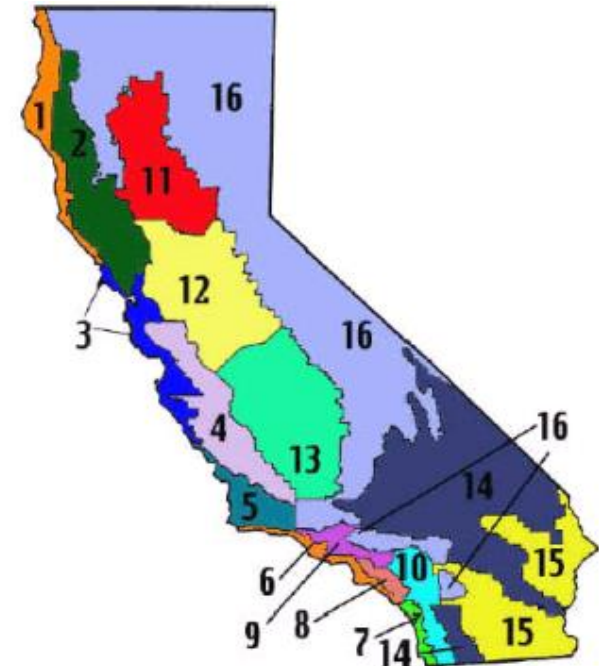


Proposed Code Change A – New Construction/Additions

WINDOW U-FACTORS: NEW CONSTRUCTION & ADDITIONS

- Update maximum allowable prescriptive U-factors for windows in nonresidential buildings
 - Apply to fixed windows in CZs 1- 4, and 16
 - Apply to operable windows in CZs 1-5, 9, and 11-16

See [Title24stakeholders.com](https://www.title24stakeholders.com) for proposal description and **requested data** (Note that data reflected in this presentation has been updated from the draft report)



Marked-up Code Language – New Construction

Title 24, Part 6

Table 140.3-B – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

| Fenestration – Vertical (Area-Weighted Performance Rating) | CZ 1 | CZ 2 | CZ 3 | CZ 4 | CZ 5 | CZ 6 | CZ 7 | CZ 8 | CZ 9 | CZ 10 | CZ 11 | CZ 12 | CZ 13 | CZ 14 | CZ 15 | CZ 16 |
|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------|------|------|--------------------------------|-------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Fixed Window (Max U-factor) | 0.36 <u>0.34</u> | 0.36 <u>0.34</u> | 0.36 <u>0.34</u> | 0.36 <u>0.34</u> | 0.36 | 0.36 | 0.36 | 0.36 | 0.34 | 0.36 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.36 <u>0.34</u> |
| Fixed Window (Max RSHGC) | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.22 | 0.25 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.25 |
| Operable Window (Max U-Factor) | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 | 0.46 | 0.46 | 0.46 <u>0.43</u> | 0.46 | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> | 0.46 <u>0.43</u> |
| Operable Window (Max RSHGC) | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |

Considerations

- Note that Max RSHGC and Min VT remain unchanged
- Analysis using \$0.58/window SF determined which CZs can be updated

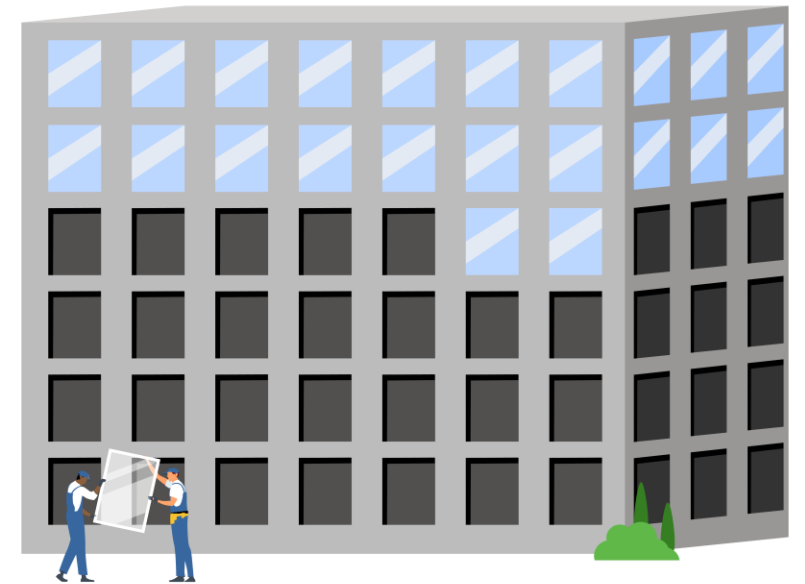
Proposed Code Change B - Alterations

WINDOW U-FACTORS: ALTERATIONS – ALL CZs

- Would require that replacement windows meet the U-factor and RSHGC values required for new construction when 100% of any one fenestration type (windows, curtainwall, storefront, or glazed doors) is replaced
- Replaces existing Table 141.0-A which indicates U-factors and RSHGC values for replacement of fewer than 100% of a fenestration type

See [Title24stakeholders.com](https://www.title24stakeholders.com)
for proposal description and
requested data

(Note that data reflected in this
presentation has been updated
from the draft report)



Marked-up Code Language – Alterations

SECTION 141.0(b) – Alterations

Exception to Section 141.0(b)2: The requirements of Section 120.2(i) shall not apply to alterations of space-conditioning systems or components.

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

i. Vertical fenestration alterations replacing one hundred percent of any single fenestration type (windows, storefront, curtainwall, spandrel, glazed doors) shall meet the requirements of Section 140.3(a)5

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

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

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

(Exceptions remain unchanged)

Existing Table 141.0-A is deleted and replaced.

Marked-up Code Language – Alterations, cont.

Title 24, Part 6

Table 141.0-A - Altered Vertical Fenestration Maximum U-Factor and Maximum RSHGC

| Requirement | CZ 1 | CZ 2 | CZ 3 | CZ 4 | CZ 5 | CZ 6 | CZ 7 | CZ 8 | CZ 9 | CZ 10 | CZ 11 | CZ 12 | CZ 13 | CZ 14 | CZ 15 | CZ 16 |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Fixed Window (Max U-factor) | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 |
| Curtain Wall or Storefront (Max U-factor) | 0.41 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.41 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 |
| Operable Window (Max U-factor) | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 |
| Glazed Doors (Max U-factor) | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 |

Considerations

- Values match Draft CASE Report but are not final
- Note that Max RSHGC and Min VT are not determined
- **CASE Team seeking input on U-factors and incremental costs**

Benefits of the Proposed Changes

WINDOW U-FACTORS – NEW CONSTRUCTION

- This change would bring the envelope requirements of Title 24, Part 6 more closely into alignment with the national model codes (IECC-2027 and ASHRAE 90.1-2025) where cost effective.
- The upgrade will save energy and improve occupant comfort across the affected climate zones.

WINDOW U-FACTORS – ALTERATIONS

- The current requirement for fenestration alterations does not distinguish among fenestration types.
- The alteration requirements have not changed since 2013.
- This change will save energy and improve occupant comfort in all climate zones when window replacement projects are undertaken.



Market and Technical Considerations

- Current Conditions and Trends
- Technical feasibility

Current Market Conditions

WINDOW U-FACTORS – NEW CONSTRUCTION

- **Fixed windows** requirement proposed for new construction in CZ 1-4 and 16 are already required in all other climate zones and are readily available.
- **Operable windows** requirement proposed is new for all climate zones, and product is readily available across California.

WINDOW U-FACTORS – ALTERATIONS

- Projects replacing less than 100% of a given fenestration type follow the alterations pathway, while projects replacing 100% of a fenestration type are subject to new construction requirements.
- Windows proposed for this measure are the same windows already required for new construction in most climate zones and are readily available across CA.
- 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.

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 practice for major alterations?

That is during window replacement projects in California, what percentage of projects replace 100% of any one type of vertical fenestration?

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

Poll

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 updates
- **Alterations**
 - Baseline model set to existing altered fenestration requirements in Title 24's Table 141.0-A (<100% replacement)
 - Proposed cases modeled using tightened altered fenestration requirements (proposed U-factor and RSHGC, where applicable)
 - EnergyPlus simulations represent alterations projects replacing less than 100% of a given fenestration type
 - **Projects replacing 100% of any single fenestration type are treated as new construction.**
 - Not separately simulated
 - Impacts represented using default new construction prototypes (Table 140.3-B) and applied through MeasureSET post-processing
 - Assuming 3% of the existing building sector undergoes window replacement annually

Energy Modeling Assumptions

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

Prototypical Buildings

- All CBECC NR Prototypes

Climate Zones

- **New Construction: Simulating in CA Climate Zones 1-4 and 16**
- **Alterations: Simulating in all CA Climate Zones (1 – 16)**

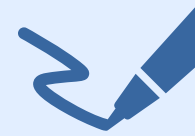
Key Modeling Assumptions (New Construction CZ 1-4 and 16 and 100% Replacement Alterations)

Prototype: Nonresidential Commercial



Standard Design

1. 2025 Title 24 Baseline (Table 140.3-B)
2. Fixed Window U-Factor = 0.36
3. Operable Window U-Factor = 0.46
4. RSHGC = 0.25 and 0.22



Proposed Design

1. 2028 Code Proposal
2. Fixed Window U-Factor = 0.34
3. Operable Window U-Factor = 0.43
4. RSHGC = 0.25 and 0.22 (same as baseline)

- New construction prototypes also represent alteration projects replacing 100% of any single fenestration type, consistent with Title 24 Section 140.3(a)5

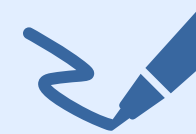
Key Modeling Assumptions (Alterations, all CZs, less than 100% replacement)

Prototype: Nonresidential Commercial



Standard Design

- 2025 Title 24 Alteration Baseline (Table 141.0-A)
- Fixed Window U-Factor
 - 0.58 (CZs 3, 5), 0.47 (all other CZs)
- Operable Window U-Factor
 - 0.58 (CZs 3, 5), 0.47 (all other CZs)
- Curtain Wall / Storefront U-Factor
 - 0.47 (all CZs)
- Glazed Door U-Factor
 - 0.58 (CZs 3, 5), 0.47 (all other CZs)
- RSHGC (all vertical fenestration types)
 - 0.41 (CZs 1, 3, 5, 16), 0.31 (CZs 2, 4, 6–15)



Proposed Design

- 2028 Code Proposal
- Fixed Window U-Factor
 - 0.43 (all CZs)
- Fixed Window RSHGC
 - 0.41 (CZs 1, 3, 5, 16), 0.31 (CZs 2, 4, 6–15)
- Curtain Wall / Storefront U-Factor
 - 0.41 (CZs 1, 7), 0.43 (all other CZs)
- Curtain Wall / Storefront RSHGC
 - 0.25 (CZs 1, 7), 0.26 (all other CZs)
- Operable Window and Glazed Door U-Factor
 - 0.47 (all CZs)
- Operable Window and Glazed Door RSHGC
 - 0.31 (all CZs)

Incremental Cost Framework

Prototype(s): Nonresidential Commercial



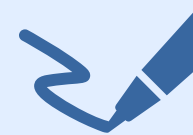
Baseline

First Cost

1. Equipment
2. Installation

30-Year Maintenance Costs

1. Regular Maintenance



Proposed

Incremental Cost Assumptions

1. Assuming \$0.58/window sf
 - NC Fixed and Operable
 - Alterations Fixed
2. Assuming \$0.90/window sf
 - Alterations Operable
 - Alterations Curtainwall/Storefront
 - Alterations Glazed Doors
3. Installation

30-Year Maintenance Costs

1. Regular Maintenance

Approach for Gathering Costs

The CASE Team is seeking accurate cost information via the following sources:

- Contractor and distributor surveys
- Engaging with industry stakeholders and associations
- National average costs

PLEASE REACH OUT TO THE CASE TEAM IF YOU CAN PROVIDE INCREMENTAL COSTS FOR THESE PROPOSED CHANGES.

We appreciate your input!

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More information on

[CEC's 2028 proceeding website.](#)

**We want to
hear from you!**