



TITLE 24, PART 6

2025 CODE CYCLE



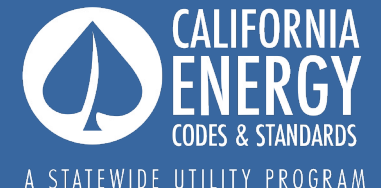
High Performance Windows

Codes and Standards Enhancement (CASE) Proposal
Multifamily | Vertical Fenestration



Avani Goyal
May 17, 2023

Utility Sponsored Stakeholder Meeting – Round 2



Agenda

Overview of Code Change Proposal

Summary of Stakeholder Feedback

Cost-effectiveness, Energy Savings and Statewide Impacts

Discussion and Additional Feedback





Code Change Proposal

- Code Change Proposal
- Code Change Language
- EEEJ considerations

Measure Overview

Improved vertical fenestration performance (U-factor and RSHGC)

Lock in passive energy savings, reducing heating/cooling loads

Better thermal comfort, especially in extreme weather conditions

Drive the market of efficient window products and reduce cost



RSHGC – Relative Solar Heat Gain Coefficient

(accounts for an external shading correction from exterior shading devices and overhangs)

In the prescriptive requirements for fenestration in Table 170.2-A:

- All-Other Window
 - **U-factor reduction to 0.28**
- All Window Types across all multifamily buildings
 - **“NR” - No RSHGC requirement** [Updated since Round 1]

Evolution of the Measure

2022 Requirement	Previous 2025 Proposal	Current 2025 Proposal
Three stories or less		
U-factor 0.30 for "all other" windows	U-factor 0.28 for "all other" windows in select CZs	U-factor 0.28 for "all other" windows in select CZs
No RSGHC requirement in CZ 1, 3, 5, and 16 for all window categories <i>(Standard design 0.35 in performance approach)</i>	Min <u>0.35 RSHGC</u> in CZs 1,3,5,16 for all window categories	No change proposed (Keep 2022 requirement)
Four stories or more		
U-factor 0.30 for "all other" windows	U-factor 0.28 for "all other" windows in select CZs	U-factor 0.28 for "all other" windows in select CZs
Max RSHGC requirement varies by window type and Climate Zone (0.35 in CZ 1, 0.23-0.26 in CZ 3, 5, and 16)	Min <u>0.35 RSHGC</u> in CZs 1,3,5,16 all window categories	No RSGHC requirement in CZ 1, 3, 5, and 16 for all window categories <i>(Standard design 0.35 in performance approach)</i>

“NR” in <=3 stories is extended to >=4 stories as well

Draft Code Change Language – New Construction

Section 170.2 – Prescriptive Approach. Section 170.2 (a) 1. TABLE 170.2-A

TABLE 170.2-A ENVELOPE COMPONENT PACKAGE – Multifamily Standard Building Design																	
Multifamily		Climate Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Curtain Wall/ Storefront ⁵	Maximum U-factor	0.38	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.38
	Maximum RSHGC three or less habitable stories	NR	0.26	NR	0.26	NR	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.26	NR
	Maximum RSHGC, four or more habitable stories	0.35	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.26	0.25
	Minimum VT, four or more habitable stories	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
NAFS 2017 Performance Class AW ⁵⁶	Maximum U-factor	0.38	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.38
	Maximum RSHGC three or less habitable stories	NR	0.24	NR	0.24	NR	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	NR
	Maximum RSHGC, four or more habitable stories	0.35	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
	Minimum VT, four or more habitable stories	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
All Other Fenestration	Maximum U-factor	0.3 0.28	0.3	0.3 0.28	0.3 0.28	0.3 0.28	0.34	0.34	0.3	0.3	0.3	0.3 0.28	0.3	0.3 0.28	0.3 0.28	0.3 0.28	0.3 0.28
	Maximum RSHGC three or less habitable stories	NR	0.23	NR	0.23	NR	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	NR
	Maximum RSHGC, four or more habitable stories	0.35	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Maximum Window to Floor Ratio		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Maximum Window to Wall Ratio		40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Maximum Skylight Roof Ratio		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

Footnotes to TABLE 170.2-A

5: Requirements apply to doors included in the Curtainwall/Storefront construction

56: Product must be certified to meet the North American Fenestration Standard/Specification for an Architectural Window (AW).

Refer to Title24stakeholders.com OR Handouts Tab in GotoWebinar.

Draft Code Change Language – Additions/Alterations

Section 180.1 – ALTERATIONS. Section 180.1 1

Table 180.2-B Altered Fenestration Maximum U-Factor and Maximum RSHGC

Table 180.2-B Altered Fenestration Maximum U-Factor and Maximum RSHGC																	
Climate Zone		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Curtainwall / Storefront / Window Wall and Glazed Doors ₁	U-factor	0.38	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.38
Curtainwall / Storefront / Window Wall and Glazed Doors ₁	RSHGC	0.35 NR	0.26	0.26 NR	0.26	0.26 NR	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25 NR
Curtainwall / Storefront / Window Wall and Glazed Doors ₁	VT ₂	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
NAFS 2017 Performance Class AW Window – Fixed _±	U-factor	0.38	0.38	0.38	0.38	0.38	0.47	0.47	0.41	0.41	0.38	0.38	0.38	0.38	0.38	0.38	0.38
NAFS 2017 Performance Class AW Window – Fixed _±	RSHGC	0.35 NR	0.25	0.25 NR	0.25	0.25 NR	0.31	0.31	0.26	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25 NR
NAFS 2017 Performance Class AW Window – Fixed _±	VT ₂	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
NAFS 2017 Performance Class AW Window – Operable _±	U-factor	0.43	0.43	0.43	0.43	0.43	0.47	0.47	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
NAFS 2017 Performance Class AW Window – Operable _±	RSHGC	0.35 NR	0.24	0.24 NR	0.24	0.24 NR	0.31	0.31	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24 NR
NAFS 2017 Performance Class AW Window – Operable _±	VT ₂	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
All Other Windows and Glazed Doors _±	U-factor	0.3 0.28	0.3	0.3 0.28	0.3 0.28	0.3 0.28	0.3	0.34	0.3	0.3	0.3	0.3 0.28	0.3	0.3 0.28	0.3 0.28	0.3	0.3 0.28
All Other Windows and Glazed Doors _±	RSHGC	0.35 NR	0.23	0.23 NR	0.23	0.23 NR	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23 NR
Skylights, 3 habitable stories and fewer	U-factor	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Skylights, 3 habitable stories and fewer	RSHGC	NA	0.23	NA	0.23	NA	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	NA
Skylights, 4 habitable stories and greater	U-factor	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
Skylights, 4 habitable stories and greater	RSHGC	0.35	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Skylights, 4 habitable stories and greater	VT ₂	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49

Footnotes to TABLE 180.2-B

1. For fenestration installed in buildings with three or fewer habitable stories, there is no SHGC requirement in Climate Zones 1, 3, 5, and 16.

1: Requirements apply to doors included in the Curtainwall/Storefront construction

2. Minimum VT requirements to not apply to multifamily buildings 3 habitable stories or less

Refer to Title24stakeholders.com OR Handouts Tab in GotoWebinar

Impact on EEEJ Citizens and Communities

Potential impacts include:

- Increase in construction costs could impact housing affordability.
- The utility bill savings may alleviate any additional economic burden related to increased construction cost.
- Efficient window construction may reduce adverse impacts such as noise transfer.



Summary of Stakeholder Feedback

Summary of Feedback Received

Comments for U-factor update from 0.3 to 0.28 in select CZs for 'All-Other' fenestration category:

- Aligns with ENERGY STAR Version 7
- Product availability supports the proposed change
- Consider more efficient 0.2-0.22 U-factor with triple-pane windows, that are market supported
- Consider moderate statewide change to streamline production and reduce costs

CASE Team Recommendation:

Keep proposed U-factor at 0.28 in select CZs for 2025 code.

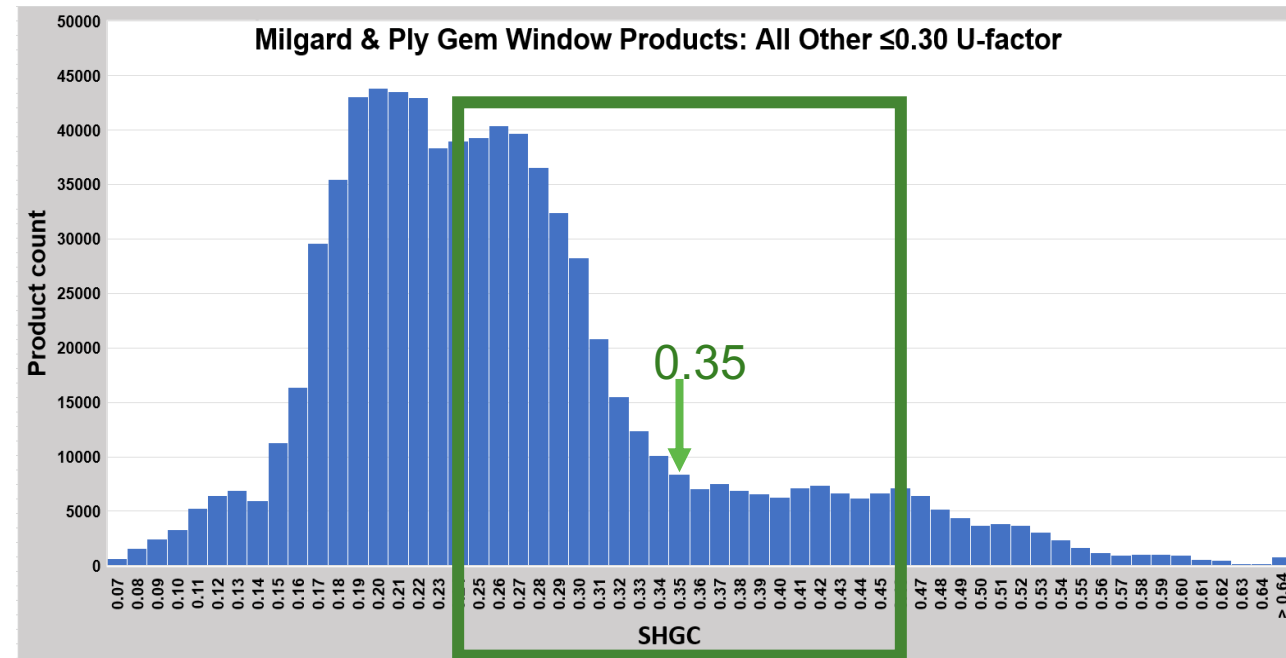
Summary of Feedback Received

Comments for 0.35 Minimum RSHGC in CZs 1,3,5,16, streamlined across window categories and multifamily building sizes:

- Limited alignment with ENERGY STAR Version 7
- Infeasible for glazed doors
- Overheating or thermal discomfort in summer, increased cooling loads
- Added complexity in requirements
- Limited product supply for high SHGC products

CASE Team Proposal:

Change to align "NR" RSHGC requirement across all window types and number of stories in CZ 1, 3, 5, and 16.



Additional Market Studies

CalCERTS Data (Three Habitable Stories or Less)				
CZ	U-factor	SHGC Median	SHGC Min	SHGC Max
1	0.30	0.35	0.35	0.35
2	0.32	0.25	0.21	0.25
3	0.31	0.41	0.16	0.5
4	0.30	0.23	0.23	0.23
5	0.30	0.35	0.23	0.63
6	0.30	0.23	0.19	0.64
7	0.30	0.23	0.16	0.67
8	0.31	0.23	0.17	0.26
9	0.30	0.22	0.13	0.73
10	0.29	0.22	0.22	0.25
11	0.31	0.23	0.2	0.25
12	0.29	0.21	0.18	1.00
13	0.30	0.23	0.22	0.25
14	0.30	0.21	0.21	0.25
15	0.30	0.20	0.16	0.25
16	-	-	-	-

CalCERTS data (2020-22) for low-rise multifamily buildings:
Window products installed in new construction have SHGC around 0.35 in CZs 1,3,5

(No projects in available CalCERTS data from CZ16)

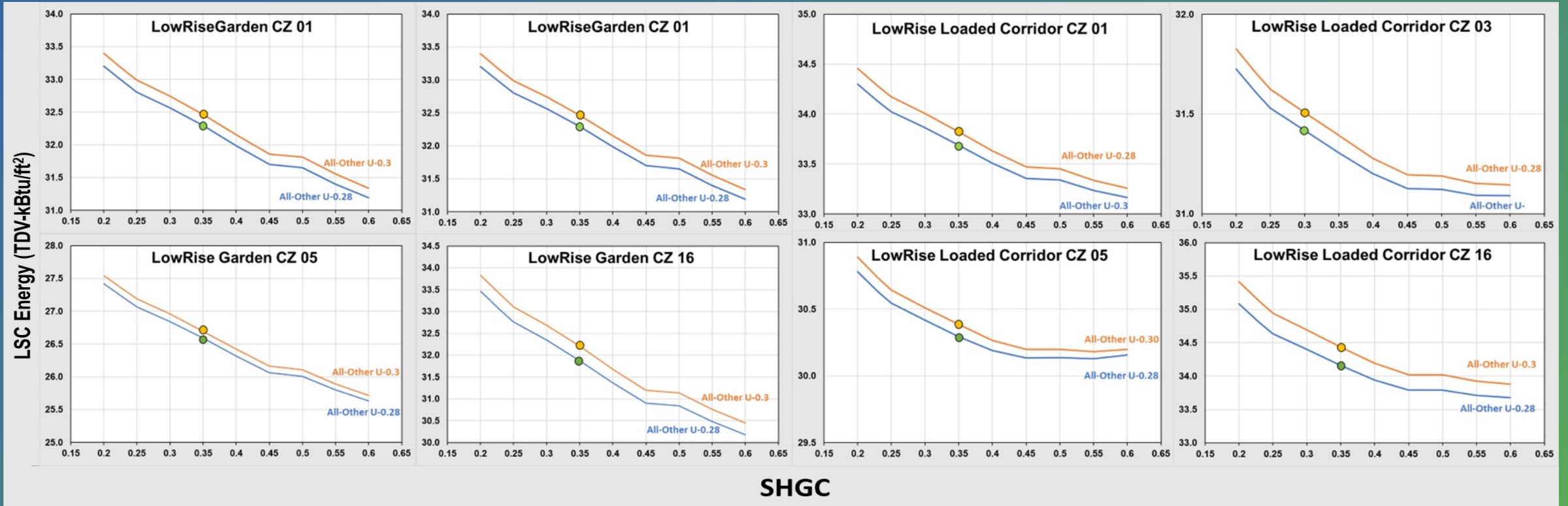
Cost Effectiveness and Energy Savings

Methodology and Assumptions

- Energy Savings Methodology and Results
- Cost Impacts Methodology and Results
 - Incremental costs
 - Energy cost savings



LSC Energy Consumption by U-Factor & SHGC Three Stories or Less



LSC Energy decreases continuously with increase in SHGC

LEGEND

- 2022 Code
- 2025 Proposed Code

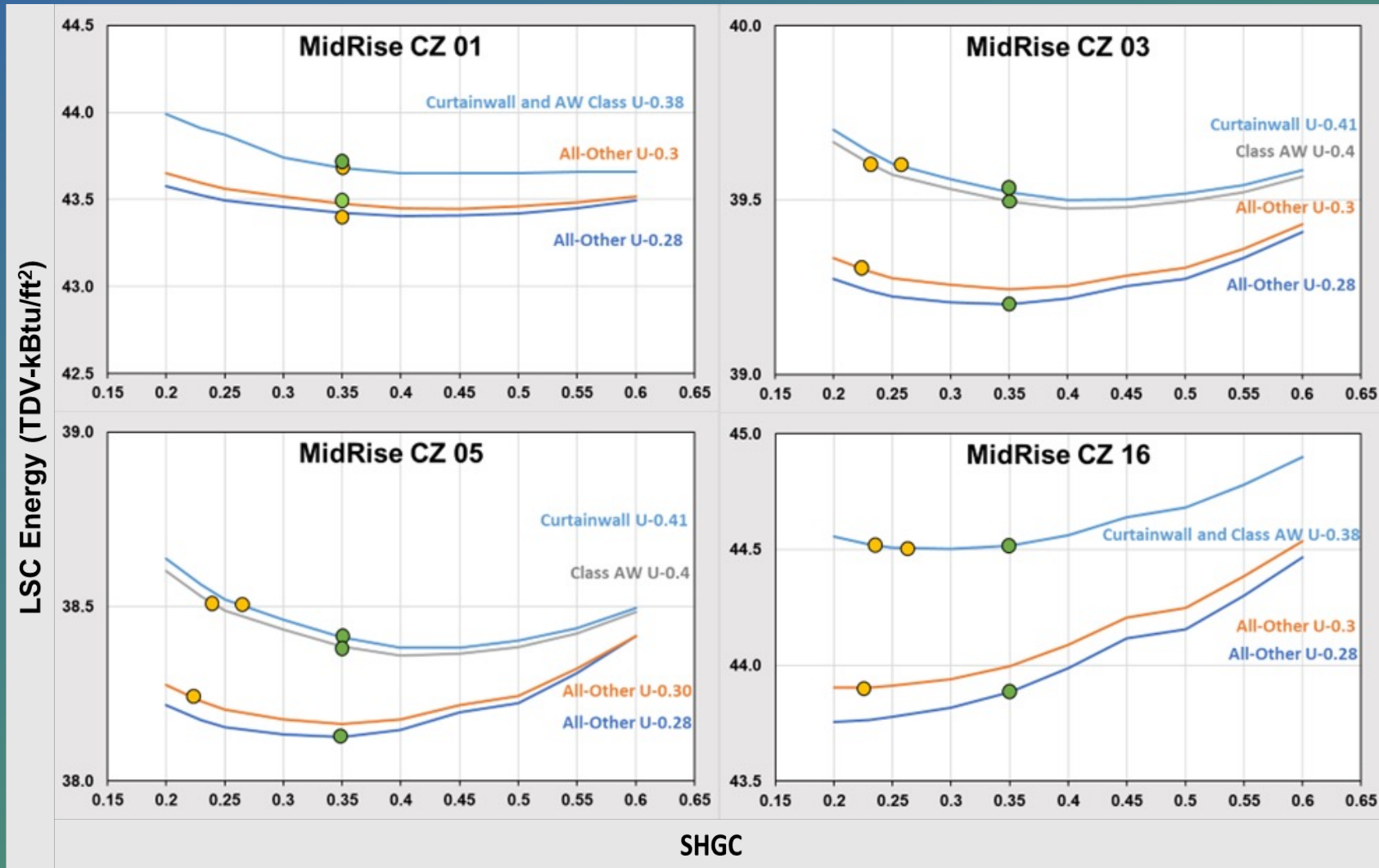
Poll

Do you agree that multifamily buildings **up to three habitable stories** in CZs 1, 3, 5, and 16 should remain without a prescriptive RHSGC requirement?

- a) Yes
- b) No
- c) Not sure

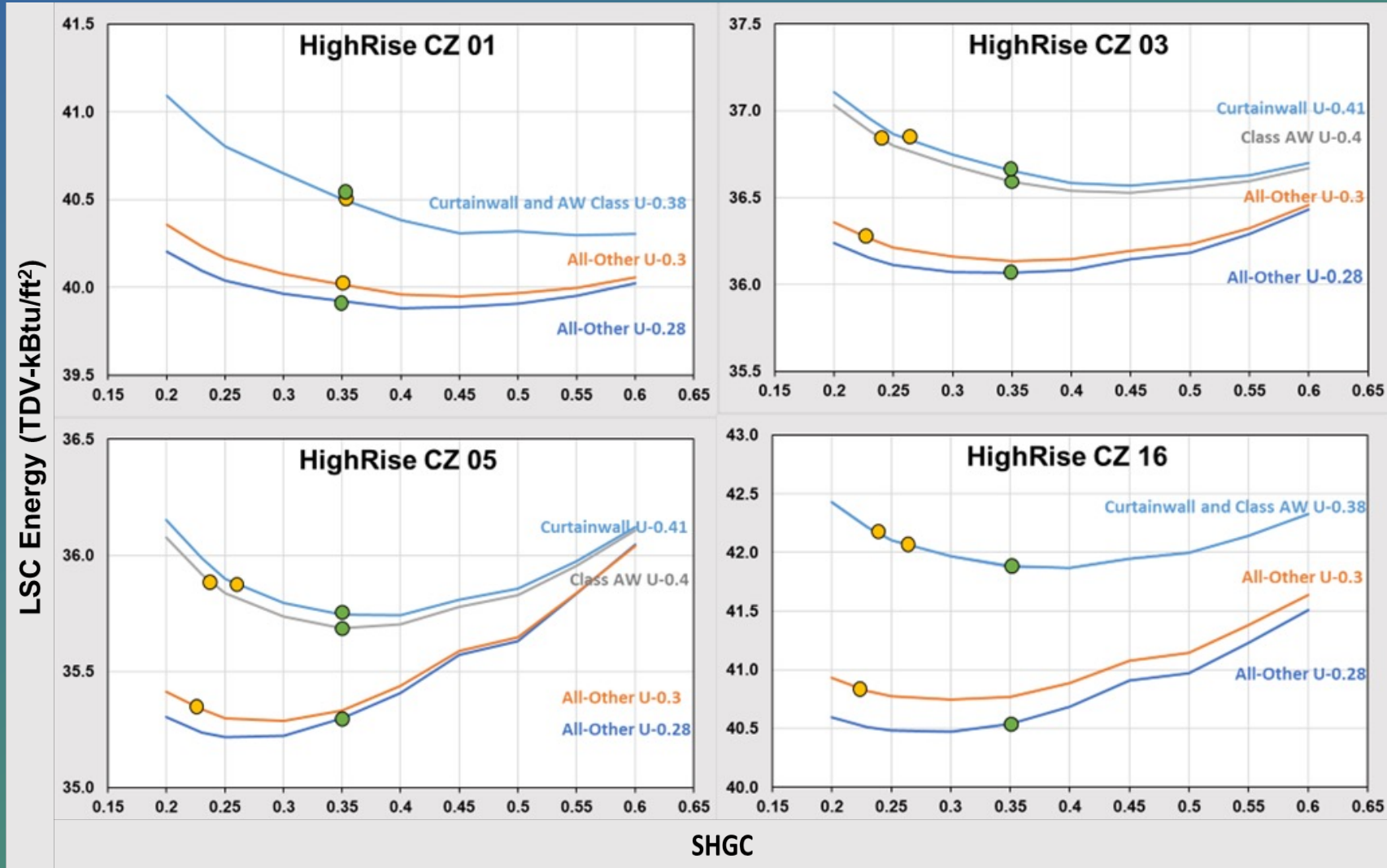
LSC Energy Consumption by U-Factor & SHGC

Four Habitable Stories or More



LSC Energy Consumption by U-Factor & SHGC

Four Habitable Stories or More



Poll

Do you support removal of the prescriptive RSGHC requirement for multifamily buildings with **four or more habitable stories** in CZs 1, 3, 5, and 16?

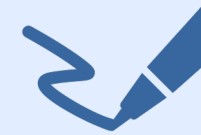
- a) Yes
- b) No
- c) Not sure

Assumptions for Standard and Proposed Designs



Standard Design

- Minimally compliant with 2022 prescriptive Code for all building systems.
- Fenestration U-factor: "All Other" windows, U-factor 0.30/0.34
- Fenestration RSHGC: Varies, based on Table 170.2-A 0.35 CZ1, 0.23-0.26 in CZs 3,5,16



Proposed Design

- Minimally compliant with 2022 Prescriptive Code for all building systems.
- Fenestration U-factor: "All Other" windows 0.28
- Fenestration RSHGC: 0.35 CZ 1, 3 , 5, 16

Preliminary Energy Savings Estimates Per Dwelling Unit (DU)

- **CZ 1,3,5,16:** U-factor decrease and NR in RSHGC
\$112 – \$118 per DU savings
- **CZ 4,11,13-15:** U-factor decrease only
\$68 – \$111 per DU savings

Energy and Energy Cost Impacts - New Construction					
Climate Zone	First-Year Electricity Savings (kWh)	First-Year Peak Electrical Demand Reduction (W)	First-Year Natural Gas Savings (therms)	First-Year Source Energy Savings (kBtu)	30-Year Present Valued Energy Cost Savings (2026 PV\$)
CZ01	8.56	2.30	0.24	47.93	99.23
CZ03	11.26	8.51	0.00	69.02	112.68
CZ04	13.60	5.29	0.00	49.95	110.63
CZ05	12.17	8.93	0.00	71.18	118.04
CZ11	12.87	4.44	0.00	42.46	108.40
CZ13	9.16	2.89	0.00	26.55	78.40
CZ14	13.40	4.62	0.00	42.99	107.89
CZ15	9.96	0.58	0.00	10.28	67.91
CZ16	(46.40)	0.59	3.04	234.91	115.97

Incremental Cost Information

Collected cost information of base case technology and proposed technology from EPA Product Cost database

- Cost impacts were reviewed during Manufacturer, Designer, and Builder interviews
- **Material costs only.** No change in labor/installation; proposed changes do not impact installation methods.

Window type	Measure Description	2022 T24 Base Case	2025 T24 Proposed	Incremental Cost (\$/dwelling unit)
All-other	U-factor decrease	0.3/0.23	0.28/0.23	~\$56
All-other	U-factor decrease & RSHGC increase	0.3/0.23	0.28/0.35	~\$0.43

Cost Effectiveness Per Dwelling Unit - New Construction

A benefit-to-cost ratio >1 shows cost-effectiveness. Result weighted across multifamily prototypes.

- **CZ 3,5,16:** U-factor decrease and NR in RSHGC
8.02 – 8.62 B/C ratio
- **CZ 1,4,11,13-15:** U-factor decrease only
1.21 – 1.92 B/C ratio
- **CZ 2,6-10,12:**
Not cost-effective

Climate Zone	Benefits <i>Life Cycle Energy Cost Savings + Other PV Savings (2026 PV\$)</i>	Costs <i>Total Incremental PV Costs (2026 PV\$)</i>	Benefit-to-Cost Ratio
1	\$99	\$56	1.76
3	\$112	\$14	8.02
4	\$111	\$59	1.88
5	\$118	\$15	8.07
11	\$92	\$59	1.57
13	\$78	\$61	1.28
14	\$108	\$56	1.92
15	\$68	\$57	1.21
16	\$116	\$13	8.62



Discussion and Next Steps

Poll

Are there special circumstances in alterations that complicate RSGHC or U-factor compliance?

- a) Yes
- b) No
- c) Not sure

Poll

Is a mandatory backstop (maximum) RSHGC needed?

- a) Yes
- b) No
- c) Not sure

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the GoTo Webinar Questions Pane
- More information on pre-rulemaking for the 2025 Energy Code at <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency>

Comments on this measure are due by May 31, 2023. Please send comments to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

Avani Goyal

Statewide IOU CASE Team

510-403-9343

agoyal@trccompanies.com

Michael Mutmanskyy

Statewide IOU CASE Team

916-844-1093

mmutmanskyy@trccompanies.com

