Welcome to the California Statewide Codes and Standards Enhancement (CASE) Team's Stakeholder Meeting on

Multifamily HVAC and Envelope Measures

We'll get started shortly.

In the meantime, please fill out the polls below.

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Pacific Gas and Electric Company

SOUTHERN CALIFORNIA EDISON
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SoCalGas
A Sempra Energy utility

SDGE
A Sempra Energy utility

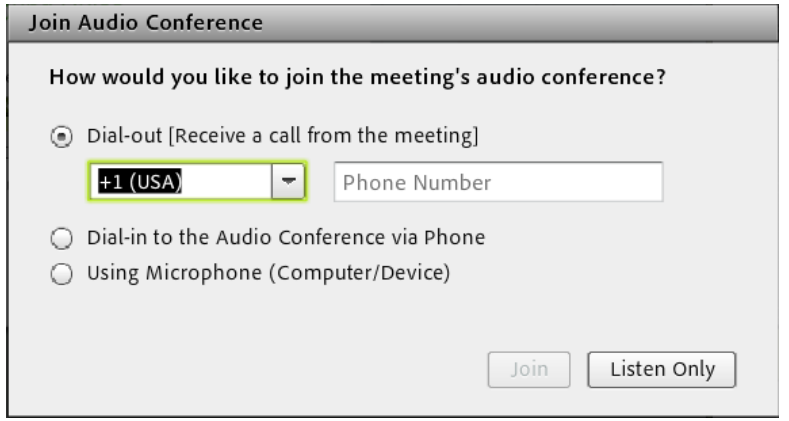
LA DWP Los Angeles Department of Water & Power

Welcome: Connect Your Audio

Audio – there are **three** options for connecting to the meeting audio:

To view options, click on the  icon on the top ribbon, then select *Connect My Audio.*

1. **Dial-out:** receive a call from the meeting. *Please note this feature **requires a direct line.***
2. **Dial-in:** dial-in to the conference via phone. Conference phone number and room number code provided. *Please then **identify your line** by entering your unique user ID on your phone.*
3. Use the **microphone** from your computer/device.



***Above**: audio conference settings pop-up box*

2022 TITLE 24 CODE CYCLE, PART 6

First Utility-Sponsored Stakeholder Meeting

Multifamily HVAC and Envelope

Statewide CASE Team

August 22, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Meeting Guidelines

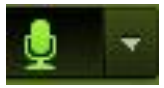
Muting Guidelines

Once you turn on your preferred audio connection please **MUTE** your microphone.

- Please keep yourself **MUTED.**
- Wait for instructions and/or permission to unmute yourself during designated Q&A periods.

Phone users – please mute your phone line.

Computer/device users – please mute your microphone by clicking on the microphone icon on your top ribbon.



NOT MUTED

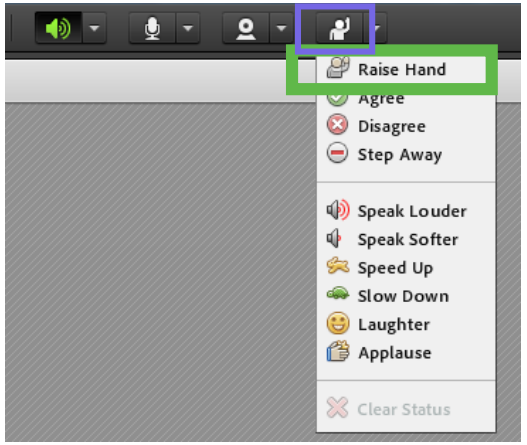
MUTED

Meeting Guidelines

Participation Guidelines

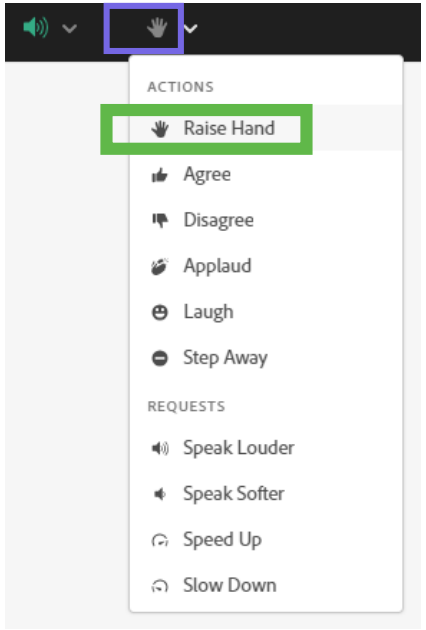
- **Questions & Comments**
  - Click **“*Raise Hand*”** if you would like to speak. Those with a hand raised will be called on by the speaker.
  - All questions and comments are also welcome via the chat window.

- **Other Meeting Feedback**
  - Provide live meeting feedback from the **top toolbar drop-down**.



***Above**: feedback view for Adobe Connect app users.*

***Below**: feedback view for HTML users.*



Meeting Ground Rules

- **We want to hear your thoughts**
  - Supporting and opposing viewpoints are welcome
- **When making comments**
  - Unmute yourself
  - Clearly state your name and affiliation prior to speaking
  - Speak loudly for the phone audio
  - Place yourself back on mute
- **Calls are recorded** for note development, recordings will not be publicized
- Notes and presentation material will be posted on Title24Stakeholders.com

Agenda

1	**Meeting Guidelines**	*8:30 am*
2	**Opening Remarks** from the California Energy Commission	*8:35 am*
3	**Overview & Welcome** from the Statewide Utility Team	*8:40 am*
4	**Presentation I:** Multifamily Indoor Air Quality Proposal	*8:45 am*
5	**Presentation II:** Multifamily High Performance Envelope Proposal	*9:45 am*
6	Wrap Up and Action items	*10:45 am*
7	Closing	*11:00 am*

Opening Remarks: California Energy Commission

Payam Bozorgchami
Project Manager
California Energy Commission

Policy Drivers: Building Standards

The following policy documents establish the goal for new building standards:

- **2008 CPUC/CEC Energy Action Plan** – ZNE for Residential buildings by 2020 and nonresidential buildings by 2030
- **SB 100** – Clean electricity by 2045
- **B-55-18** – Governor Jerry Brown's Executive Order to achieve carbon neutrality
- **AB 3232** – Assess the potential for the state to reduce the emissions of greenhouse gases from the state's residential and commercial building stock by at least 40% below 1990 levels by January 1, 2030

2022 Standards Schedule

ESTIMATED DATE	ACTIVITY OR MILESTONE
November 2018 - April 2019	Updated Weather Data Files
November 2018 - July 2019	Measures Identified and Approved (Internal at the Energy Commission)
November 2018 - July 2019	Compliance Metrics Development
April 24, 2019	Efficiency Measure Proposal Template for public to submit measures
September 18, 2019	Compliance Metrics and Climate Data workshop
November, 2019	Final Metrics Workshop
November, 2019	Research Version of CBECC Available with new weather data files and updated Metrics
July 2019 - March 2020	Utility-Sponsored Stakeholder Workshops
March, 2020	All Initial CASE/PUBLIC Reports Submitted to Commission
March - August 2020	Commission-Sponsored Workshops
July, 2020	All Final CASE/PUBLIC Reports Submitted to the Commission
July - September 2020	Express Terms Developed
January, 2021	45-Day Language posted and set to list serve, Start of 45-Day review/comment period
January, 2021	Lead Commissioner Hearing
April, 2021	Adoption of 2022 Standards at Business Meeting
May - November 2021	Staff work on Software, Compliance Manuals, Electronic Documents
May - November 2021	Final Statement of Reasons Drafted and Approved
October, 2021	Adoption CalGREEN (energy provisions) - Business Meeting
December, 2021	CBSC Approval Hearing
January, 2022	Software, Compliance Manuals, Electronic Documents Available to Industry
January - December 2022	Standards Training (provided by 3rd parties)
June 1, 2022	6 Month Statutory Wait Period Deadline
January 1, 2023	Effective Date

2022 Standards Contact Info

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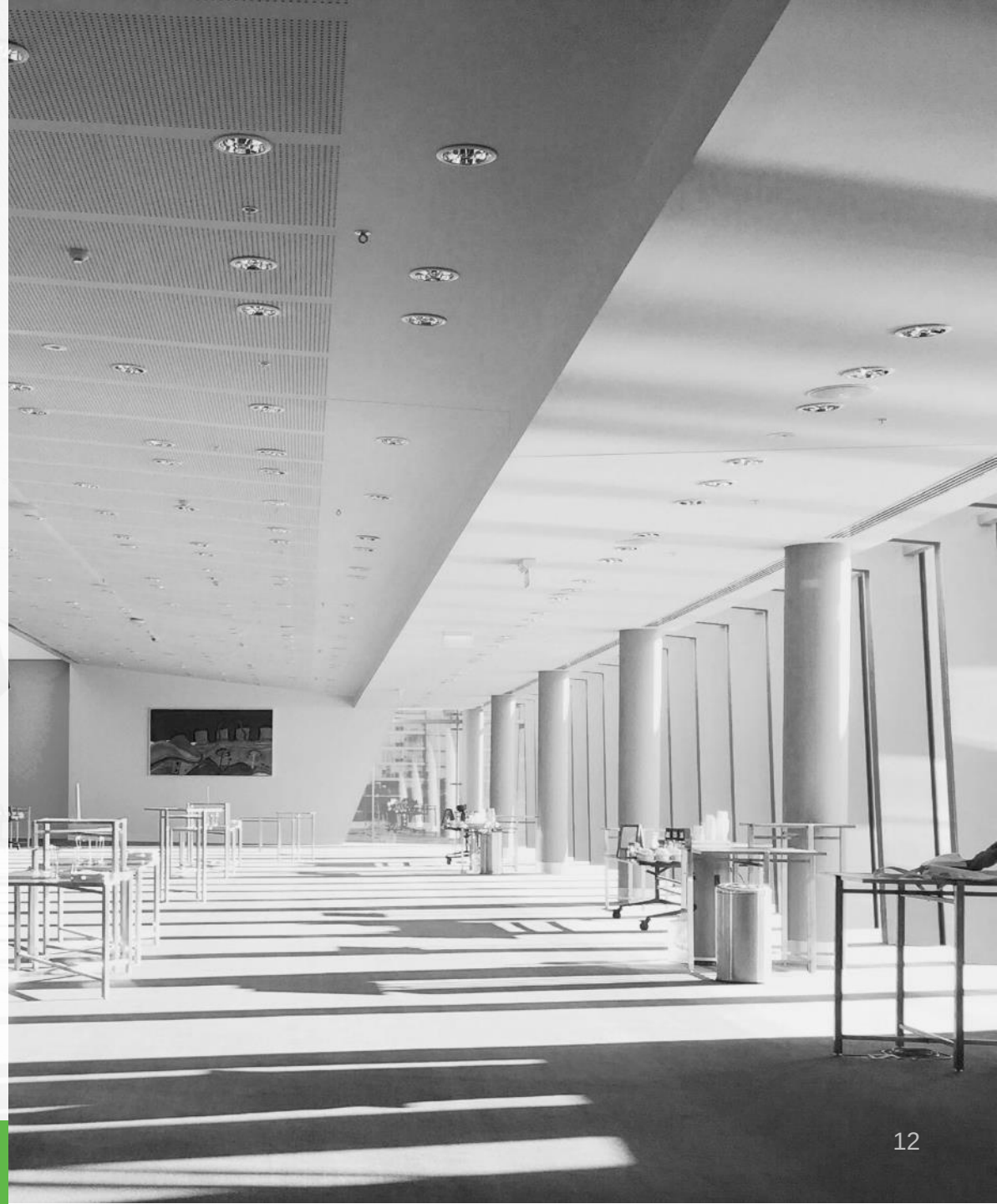
More information on pre-rulemaking for the 2022 Energy Code at:
https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Title 24, Part 6 Overview

Kelly Cunningham
Codes and Standards
Pacific Gas & Electric



Statewide Utility Codes and Standards Team

- **Actively supporting the California Energy Commission** in developing proposed changes to the California Energy Code (Title 24, Part 6)
- Achieve significant energy savings through the development of **feasible**, **enforceable**, **cost-effective, and non-proprietary** code change proposals for the 2022 code update, and beyond

Requirements for a Successful Code Change Proposal

The utilities support the California Energy Commission by proposing changes to the Energy Code that are:

Feasible | Cost effective | Enforceable | Non-proprietary

Utility-Sponsored Stakeholder Meetings

- All meetings can be attended **remotely**
- Check Title24Stakeholders.com/events for information about meetings and topic updates
- Sign up to receive email notifications

First Round Utility-Sponsored Stakeholder Meetings

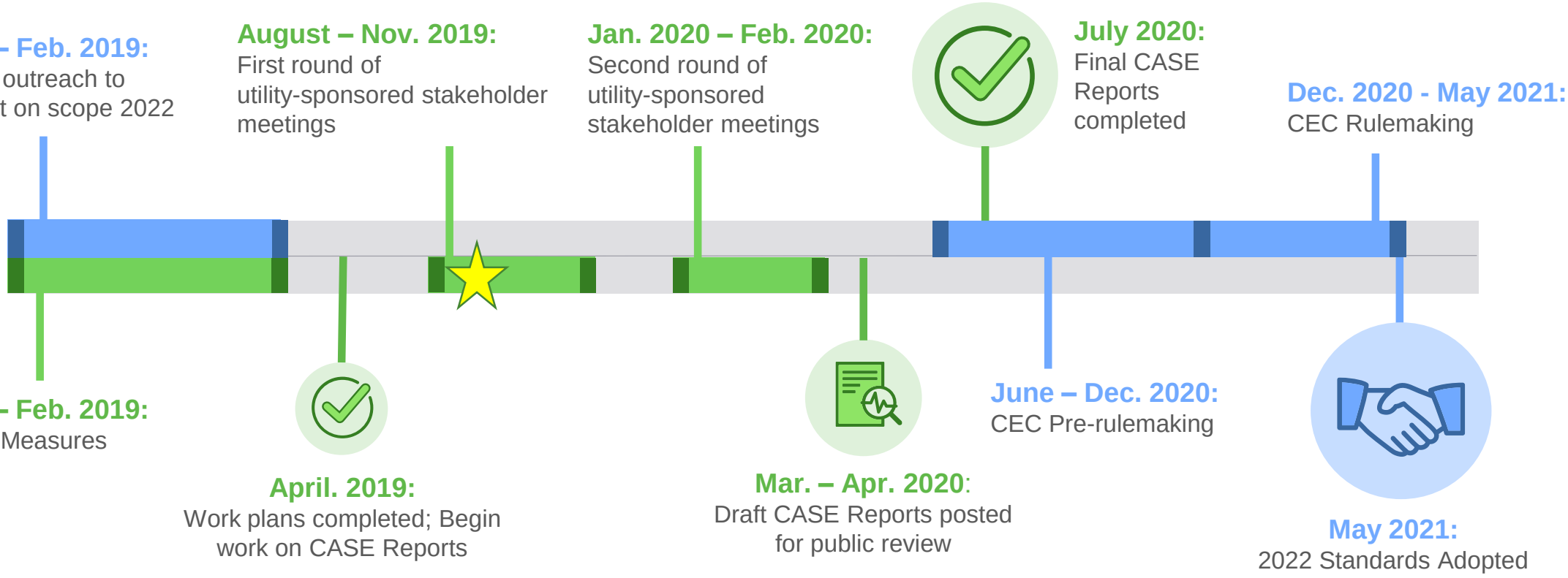
Meeting	Building Type	Date
Multifamily HVAC and Envelope	MF	Thursday, August 22, 2019
Lighting	MF, NR	Thursday, September 5, 2019
Grid Integration	MF, NR, SF	Tuesday, September 10, 2019
Covered Processes	NR	Thursday, September 19, 2019
Multifamily and Nonresidential Water Heating	MF, NR	Thursday, October 3, 2019
Single Family HVAC	SF	Thursday, October 10, 2019
Nonresidential HVAC	NR	Thursday, October 17, 2019
Nonresidential Envelope	NR	Thursday, October 24, 2019
Single Family Whole Building and Nonresidential Software Improvements	NR, SF	Tuesday, November 12, 2019

Sign up for all meetings at title24stakeholders.com/events/

2022 Code Cycle – Key Milestones

CEC Milestone

Utility Team Milestone



SDGE A Sempra Energy utility® SoCalGas A Sempra Energy utility® Southern California Edison An Edison International Company Pacific Gas and Electric Company®

This program is funded by California utility customers and administered by Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E®), Southern California Edison Company (SCE), and Southern California Gas Company (SoCalGas®) under the auspices of the California Public Utilities Commission.

EnergyCode Ace™
Helping you play your cards right

The **Codes and Standards Reach Codes Program** provides technical support to local jurisdictions considering adopting a local energy efficiency ordinance, including:

- Cost-effectiveness Studies, Model Language;
- Training;
- Presentation Templates, Implementation Guides, Handouts;
- Checklists; and
- Other Resources to facilitate ordinance adoption and implementation.

www.LocalEnergyCodes.com

This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

Thank You

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CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Multifamily Indoor Air Quality

Codes and Standards Enhancement (CASE) Proposal

Multifamily | Envelope

Marian Goebes, TRC

August 22, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

1	Heat or Energy Recovery Ventilation (HRV or ERV) in Select Climate Zones	*10-15 min*
2	Central Ventilation Shaft Sealing	*10-15 min*
3	Kitchen Range Hood Capture Efficiency	*10-15 min*
4	Discussion and Next Steps	*15 min*

Submeasure A: Heat or Energy Recovery Ventilation in Select Climate Zones

Submeasure B: Central Ventilation Shaft Sealing

Submeasure C: Kitchen Range Hood Capture Efficiency

Background: HRV/ERV

- Context and History
- 2019 Code Requirements
- Code Change Proposal

2022 Focus on Multifamily

Reorganize requirements into a standalone chapter of Title 24, Part 6

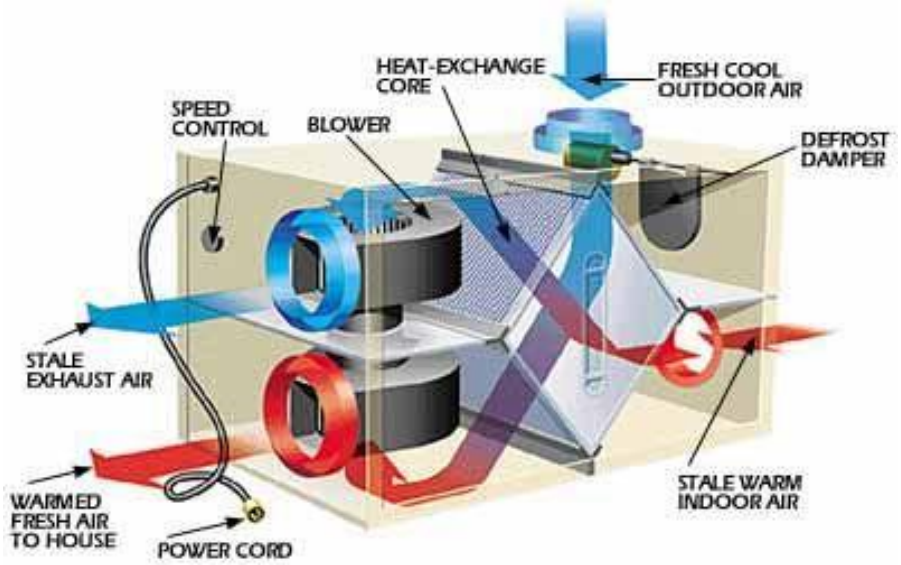
Increase uniformity across low-rise and high-rise requirements and other sections of the building code

Improve modeling accuracy through software improvements and proposed prototypes

- **Mimic residential chapter structure:**
  - 160.0 Mandatory Features and Devices
  - 160.1 Performance and Prescriptive Compliance Approaches
  - 160.2 Additions and Alterations
- **Include common area spaces**
- **Reference to:**
  - Section 110 for mandatory measures
  - Sections 120, 130, and 140 for nonresidential spaces not exclusive to residents

Context and History: HRV/ERV

- **Why are we proposing this measure?**
  - Energy savings from pre-heating/ cooling ventilation supply with conditioned air



Popular Mechanics. August 1, 2000. https://www.popularmechanics.com/home/interior-projects/how-to/a149/1275121/

2019 Code Requirements: HRV/ERV

Title 24, Part 6	ASHRAE 90.1-2016	Proposal for IECC-2021*
Performance credit for heat or energy recovery ventilation, but no requirement.	Section 6.5.6.1 Exhaust Air Energy Recovery, requires an enthalpy recovery ratio of at least 50 percent • Applies to all ASHRAE climate zones except Climate Zone 3C (spans coastal area from Ventura County to northern Bay Area). • Function of percent outside air and supply airflow.	Requires energy recovery ventilation for all non-transient buildings – including multifamily units – in all climate zones except Climate Zone 3C.

*currently undergoing public review

Related requirement: 2019 Title 24, Part 6 requires new construction multifamily units to *either*

- Provide balanced ventilation, *or*
- Compartmentalize units: seal dwelling units and test leakage of a sample of units

Code Change Proposal: HRV/ERV

Building Types	System Type	Type of Change	Software Updates Required?
Multifamily (all) in non-mild climate zone	Ventilation	Mandatory	Yes

- **Mandatory requirement** for multifamily units
  - If pursuing balanced ventilation path (instead of compartmentalization): must have heat or energy recovery ventilation (HRV or ERV) in certain climate zones.
    - Climate zone to be determined by cost effectiveness
    - Draft analysis considering Climate Zones 1-2, and 10-16 (more moderate and extreme climates)

Code Change Proposal: HRV/ERV

- **For both high-rise multifamily Section 120.1(b)2b1 and low-rise multifamily; 150.0(o)E:** For multifamily units that use balanced ventilation path (instead of compartmentalization):
  - Would require exhaust air heat or energy recovery for certain climate zones
  - Projects could choose to use individual dwelling unit HRV/ERVs or central HRV/ERVs
  - Would specify minimum heat or enthalpy recovery effectiveness. Requirements for central exhaust systems may mimic ASHRAE 90.1-2016 Section 6.5.6.1 Exhaust Air Energy Recovery, which requires an enthalpy recovery ratio of at least 50 percent

Image Source: Green Building Advisor, 2018. https://www.greenbuildingadvisor.com/article/six-steps-to-success-with-heat-recovery-ventilation

Market Overview

- Current Market
- Trends
- Barriers

Market Overview and Analysis: HRV/ERV

- **Current Market and Trends**
  - HRV/ ERV: Few multifamily buildings use them now, but HRVs/ERVs may become more common to meet balanced ventilation path under 2019 Title 24, Part 6.
- **Market Barriers**
  - HRV/ ERV:
    - Incremental first cost of equipment
    - Maintenance concerns, particularly if one system per dwelling unit (accessibility for filter replacement)

Do you agree with this description? What else should we know?

MERV 13 replacement air filter. Source: Airfilters.com

Technical Considerations: HRV/ERV

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations: HRV/ERV

- **Technical Considerations**
  - Central HRV/ERV requires a centralized ventilation distribution system, but leads to easier maintenance
  - Individual HRV/ERVs (one per dwelling unit) allows for unitized ductwork, but means more systems to maintain
- **Technical Barriers and Potential Solutions**
  - Projects could choose individual HRVs/ERVs, central HRV/ERV, or something in between (e.g., one HRV/ERV per floor) based on project needs

Energy and Cost Impacts: HRV/ERV

Methodology and Assumptions

- Energy Impacts
- Cost Impacts
  - Incremental Costs
  - Energy Cost savings

Incremental Cost Information: HRV/ERV

- **Base cost:**
  - Low-rise: Balanced ventilation system using inline fan (one per dwelling unit)
  - High-rise: Balanced ventilation system using central ventilation
- **Proposed cost:** cost for HRV or ERV equipment
  - Material and labor costs from RS Means, online retailers, and manufacturer quotes
  - Developing mock-up of MF unit for duct length and other assumptions

Methodology for Energy Savings Estimates Baseline and Proposed Conditions: HRV/ERV

Baseline Conditions

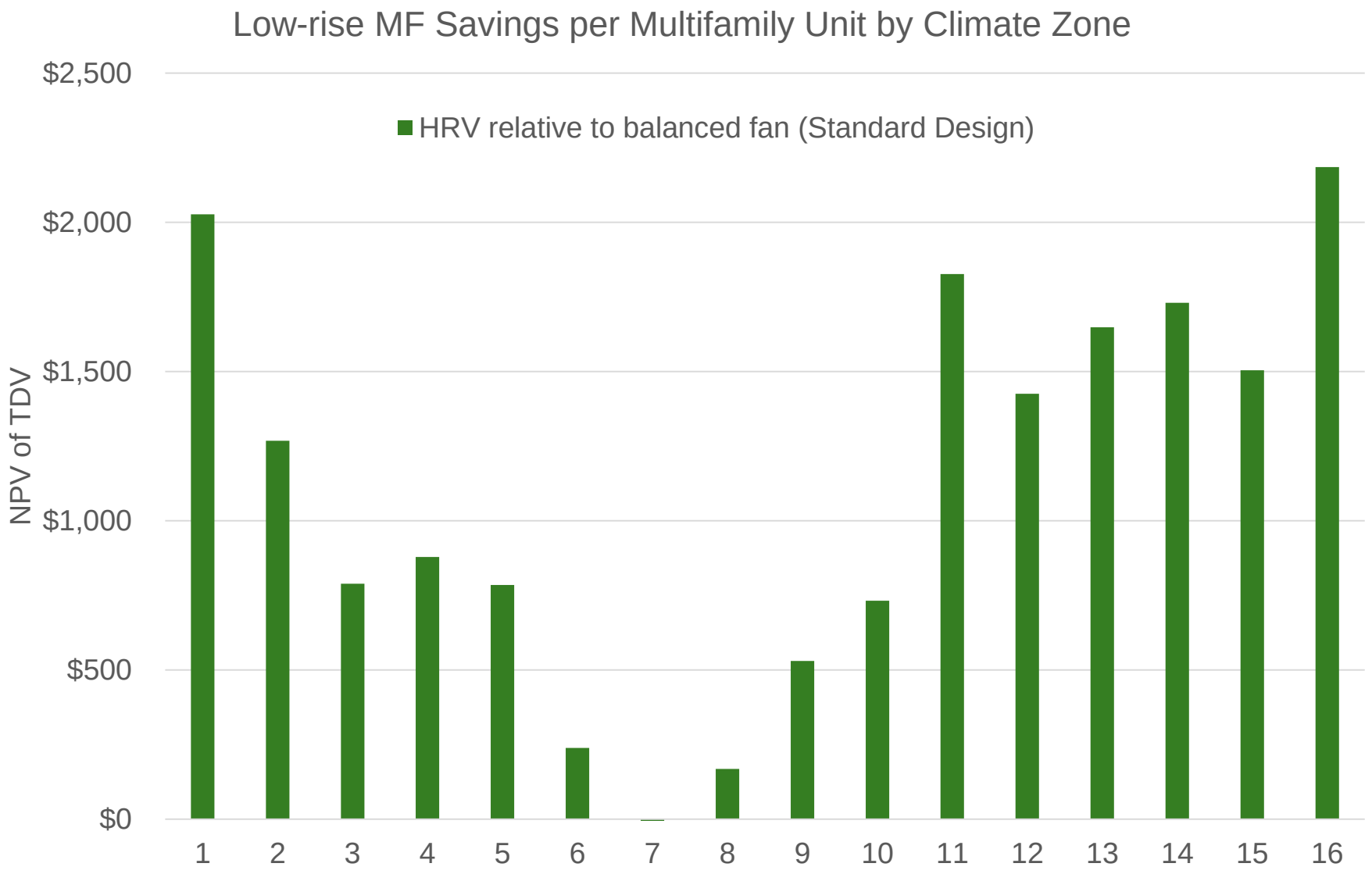
- Ventilation strategy:
  - CBECC-Res (low-rise): balanced using individual dwelling unit ventilation
  - CBECC-Comm (high-rise): balanced using central ventilation
- No heat recovery

Will model in all multifamily prototypes

Proposed Conditions

- Ventilation strategy:
  - CBECC-Res: individual dwelling unit ERV
  - CBECC-Com: HRV or ERV serving multiple units (central)
- Heat recovery
  - Minimum effectiveness TBD based on cost effectiveness results
  - May follow ASHRAE 90.1: 50 percent enthalpy recovery

Preliminary Energy Savings Estimates: HRV/ERV



Assumes 70% heat recovery effectiveness

Savings may change under new weather file

Source: Statewide CASE Team

Compliance and Enforcement: HRV/ERV

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process: HRV/ERV

1. Design Phase

- Project team:
  - Identifies if project is in a climate zone where requirement applies
  - If so, specifies make and model of HRV or ERV equipment and ensures it meets minimum recovery efficiency via compliance documentation

2. Permit Application Phase

- Project team submits design documents showing make and model of HRV or ERV equipment supported by compliance documentation

Compliance Verification Process: HRV/ERV

3. Construction phase

- If applicable, install ERV or HRV equipment

4. Inspection Phase

- Code official visually confirms ERV or HRV installed and captures make and model number of equipment
- HERS Rater confirms that equipment recovery efficiency meets requirement using cut sheet or online information

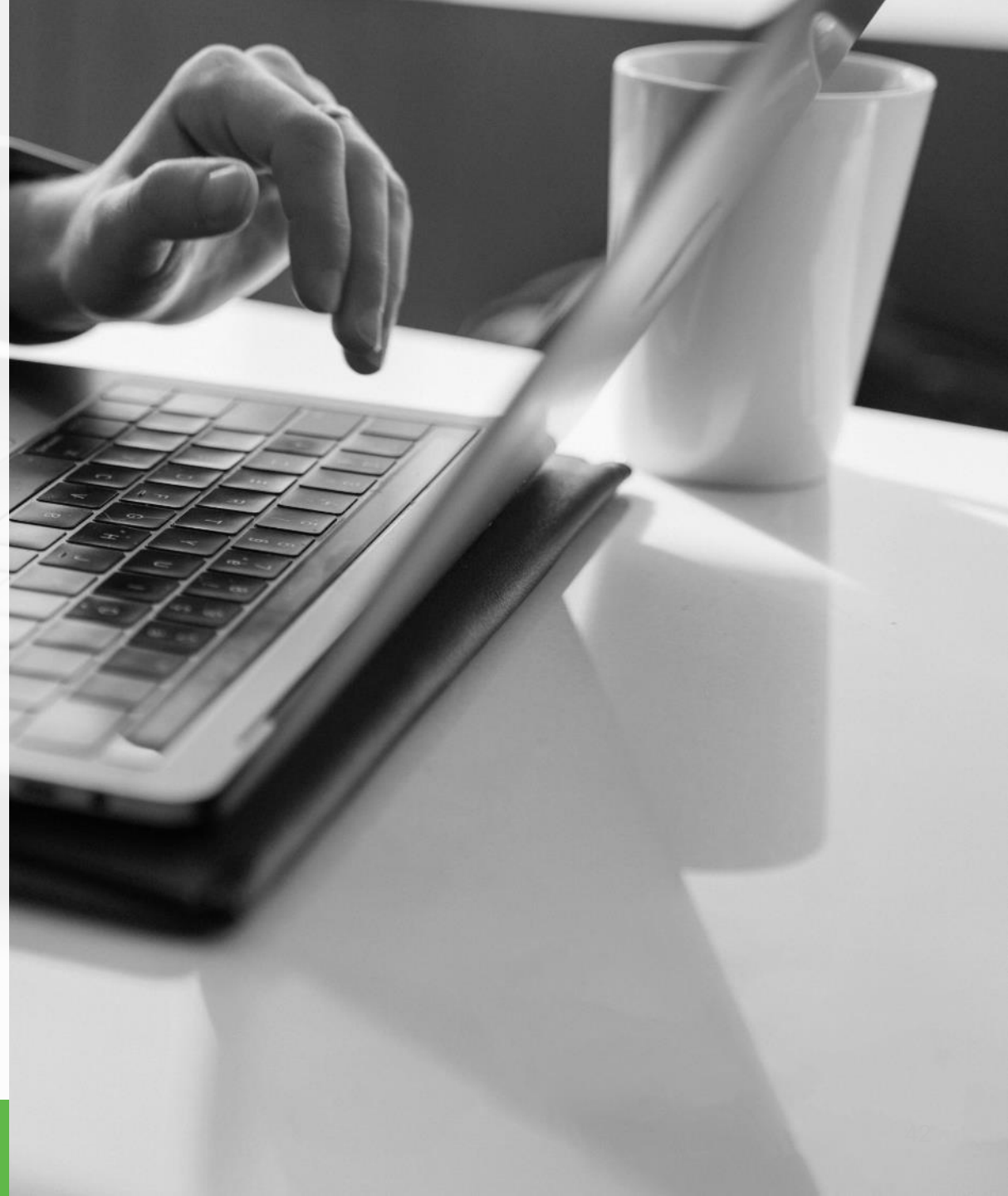
Market Actors: HRV/ERV

Market actors involved in implementing this measure include:

- Project Team: Identifies infiltration compliance path: identifies and installs ERV/HRV (if applicable)
- HERS Rater: Confirms compliance
- Code Official: Confirms ERV/HRV installed where applicable

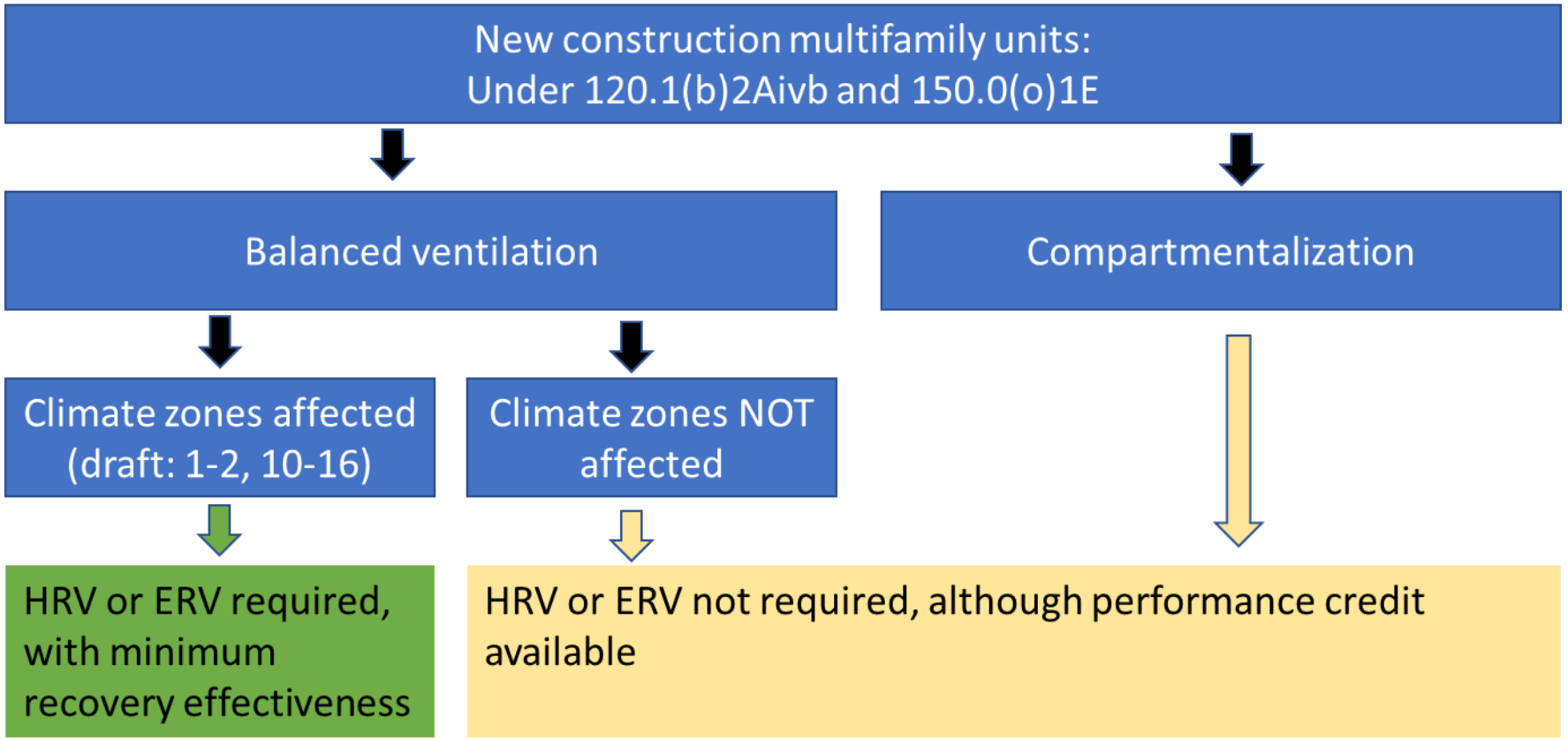
Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language: HRV/ERV

- Draft code language for this submeasure is available in the **resources tab**
- Flowchart shows overview of scope



Poll

In the climate zones where this will apply, how do you think your projects will most often meet the proposed requirement for multifamily units **WITHOUT** common corridors (“garden-style”)? Select one**.**

A. Balanced ventilation with individual ERV/HRV
B. Balanced ventilation with central ERV/HRV
C. Compartmentalization
D. It depends: *In chat, identify what it depends on*

Poll

In the climate zones where this will apply, how do you think your projects will most often meet the proposed requirement for multifamily units **WITH** common corridors? Select one**.**

A. Balanced ventilation with individual ERV/HRV
B. Balanced ventilation with central ERV/HRV
C. Compartmentalization
D. It depends: *In chat, identify what it depends on*

Submeasure A: Heat or Energy Recovery Ventilation in Select Climate Zones

Submeasure B: Central Ventilation Shaft Sealing

Submeasure C: Kitchen Range Hood Capture Efficiency

Background: Central Shaft Sealing

- Context and History
- 2019 Code Requirements
- Code Change Proposal

Context and History: Central Shaft Sealing

- **Why are we proposing this measure?**
  - Improved IAQ for multifamily residents:
    - Central exhaust shafts: Improves removal of bathroom and cooking pollution
    - Central supply ventilation shafts: Helps ensure supply air is evenly distributed
  - Energy savings:
    - Reduce ventilation fan power
    - Reduce heating and cooling energy from less air leakage from conditioned space

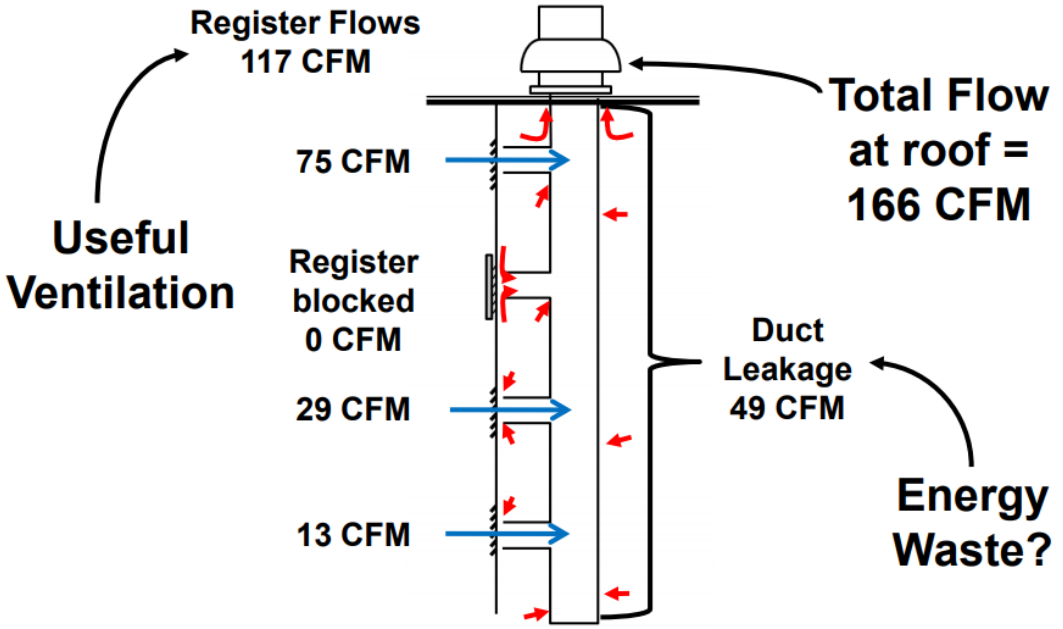


Image: Duct leakage. Source Steven Winter Associates, 2013. https://www.energy.gov/sites/prod/files/2013/12/f5/carb_ventilation_webinar.pdf

2019 Code Requirements: Central Shaft Sealing

- **2019 Code Requirements in Title 24, Part 6:** No requirement for central shaft sealing or testing
- **Relevant references**
  - Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) has shaft sealing guidelines, but they are not required by code
  - ASHRAE Standard 215: "Method of Test to Determine Leakage of Operating HVAC Air-Distribution Systems," was recently published for testing leakage

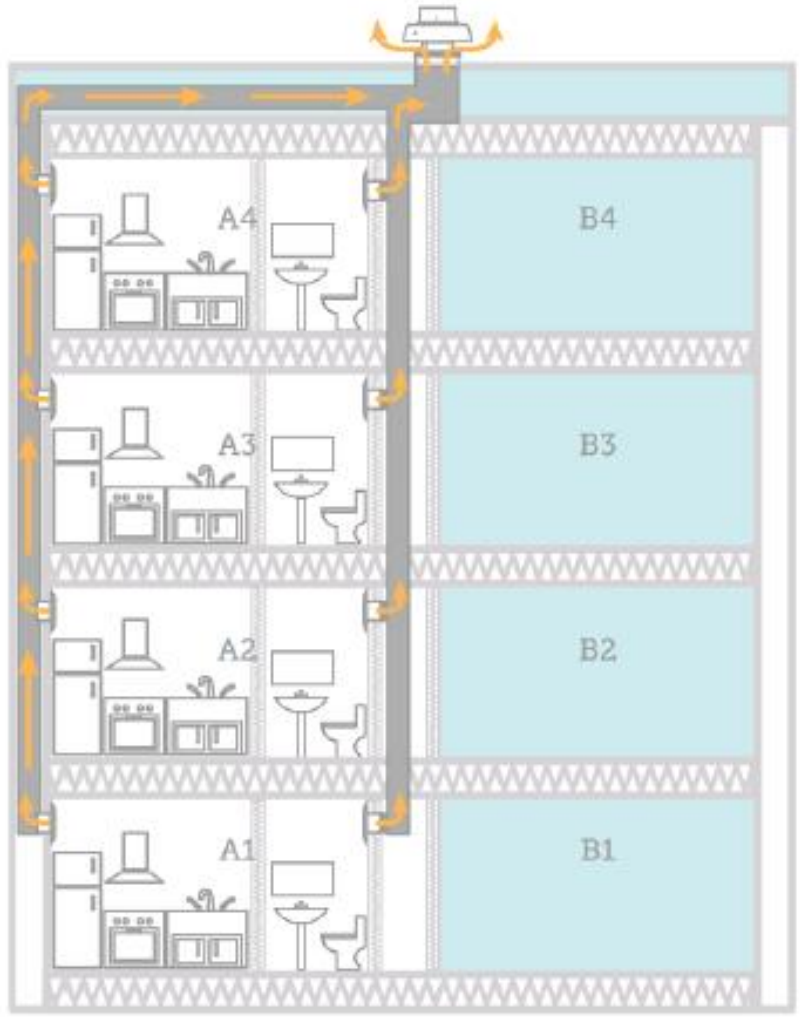


Image: Central exhaust shaft. Source: Center for Energy and Environment. https://www.mncee.org/getattachment/Resources/Projects/Reducing-the-Energy-Cost-of-Effective-Ventilation/V15-Multifamily-Ventilation-Assessment-Training_Feb-2016_cbastian.pdf.aspx

Overview of ASHRAE 215

- Method of Test to Determine Leakage of Operating HVAC Air-Distribution Systems
- Methodology overview for each ventilation shaft
  1. Measure rooftop fan airflow
  2. Measure flow at each supply or exhaust grille
  3. Measure air temperature and relative humidity, and identify altitude
  4. Use ASHRAE spreadsheet to calculate leakage

ASHRAE Standard 215-2018. Source: ANSI. https://webstore.ansi.org/standards/ashrae/ansiashraestandard2152018

Code Change Proposal: Central Shaft Sealing

Building Types	System Type	Type of Change	Software Updates Required?
Multifamily (all)	Ventilation	Mandatory	Yes

- Mandatory requirement for sealing and testing of **central ventilation shafts** in new multifamily buildings
  - Applies to central exhaust shafts and central ventilation shafts
  - Allowable leakage TBD, but likely 5 percent of rooftop fan flowrate
  - Conduct test using ASHRAE Standard 215-2018

Market Overview: Central Shaft Sealing

- Current Market
- Trends
- Barriers

Market Overview and Analysis: Central Shaft Sealing

- **Current Market and Trends**
  - Measuring airflow of rooftop fan and through each exhaust grill is typical through "TAB" (Testing and Balancing)
  - Some buildings are sealing ventilation shafts, but few are testing leakage
- **Market Barriers**
  - Project teams not accustomed to sealing to a maximum leakage value
  - Market not familiar with ASHRAE Standard 215, although generally uses same methods as TAB with additional calculations

Poll

Which of the following practices do your projects typically follow for sealing, testing and balancing central ventilation shafts? Select all that apply.

A. Seal longitudinal seams
B. Seal transverse seams
C. Seal connections including boot to drywall
D. Measure rooftop fan airflow rate
E. Measure airflow at each exhaust grille
F. Measure airflow at sample of exhaust grilles
G. Other: *provide details in chat box*

Technical Considerations: Central Shaft Sealing

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations: Central Shaft Sealing

- **Technical Considerations**
  - Sealing to 5 percent can be achieved with traditional sealing (mastic)
- **Potential Barriers and Solutions**
  - HERS Rater can provide visual inspection of shaft and sealing at multiple points during construction, to identify leakage points

Sealing with mastic. Source: Green building advisor. https://www.greenbuildingadvisor.com/article/sealing-ducts-whats-better-tape-or-mastic

Technical Feasibility: Central Shaft Sealing

- Statewide CASE Team conducted interviews during the 2019 code cycle that found that sealing ventilation shafts:
  - To 5 percent (compared to rooftop fan flowrate) was feasible using traditional sealing techniques
  - Below 5 percent was feasible using more advanced strategies, such as aerosealing

Aeroseal process

LBL. September 17, 2009. https://www2.lbl.gov/tt/success_stories/articles/carrier.html

Energy and Cost Impacts: Central Shaft Sealing

Methodology and Assumptions

- Energy Impacts
- Cost Impacts
  - Incremental Costs
  - Energy Cost savings

Methodology for Energy Impacts Analysis: Central Shaft Sealing

- Conduct energy savings estimates in **EnergyPlus:**
  - Use EnergyPlus because changes in central shaft leakage cannot be modeled in CBECC-Comm
  - Model in high-rise prototype only
- Initial estimate assumes:
  - Reduction in central shaft leakage from 25 percent (standard) to 5 percent (proposed)
  - Uses older version of high-rise prototype, but will be updated to new version

Incremental Cost Information: Central Shaft Sealing

- **Assume costs for:**
  - Sealing ducts: RS Means estimates compared against cost estimates from contractors on costs of duct sealing on new projects. Can be extrapolated from sealing methods used on higher pressure class ducts
  - Testing: Assume 20 percent additional cost on top of traditional TAB: approximately $500 per 150 ft shaft
- Material, Labor and mark-up costs from RS Means

Definition of Baseline and Proposed Conditions

Baseline Conditions

- 25 percent leakage

Proposed Conditions

- TBD based on cost effectiveness: likely around 5 percent leakage

Compliance and Enforcement: Central Shaft Sealing

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process: Central Shaft Sealing

1. Design Phase

- Project team identifies location of central ventilation shafts and specifies sealing materials and sealing strategies
- Project team to develop details and specifications supporting a tight air barrier

2. Permit Application Phase

- Project team submits design documents showing location of central ventilation shafts and sealing materials
- Verification requirements included in energy compliance documentation

Compliance Verification Process: Central Shaft Sealing

3. Construction phase

- Project team seals each central ventilation shaft documenting installation and verification procedures via compliance documentation
- *Best practice but not required:* HERS Rater conducts visual inspection of shafts during construction to identify sources of leakage

4. Inspection Phase

- HERS Rater conducts leakage test, verifies leakage does not exceed permissible value
- Code official confirms leakage results are submitted and meet requirement

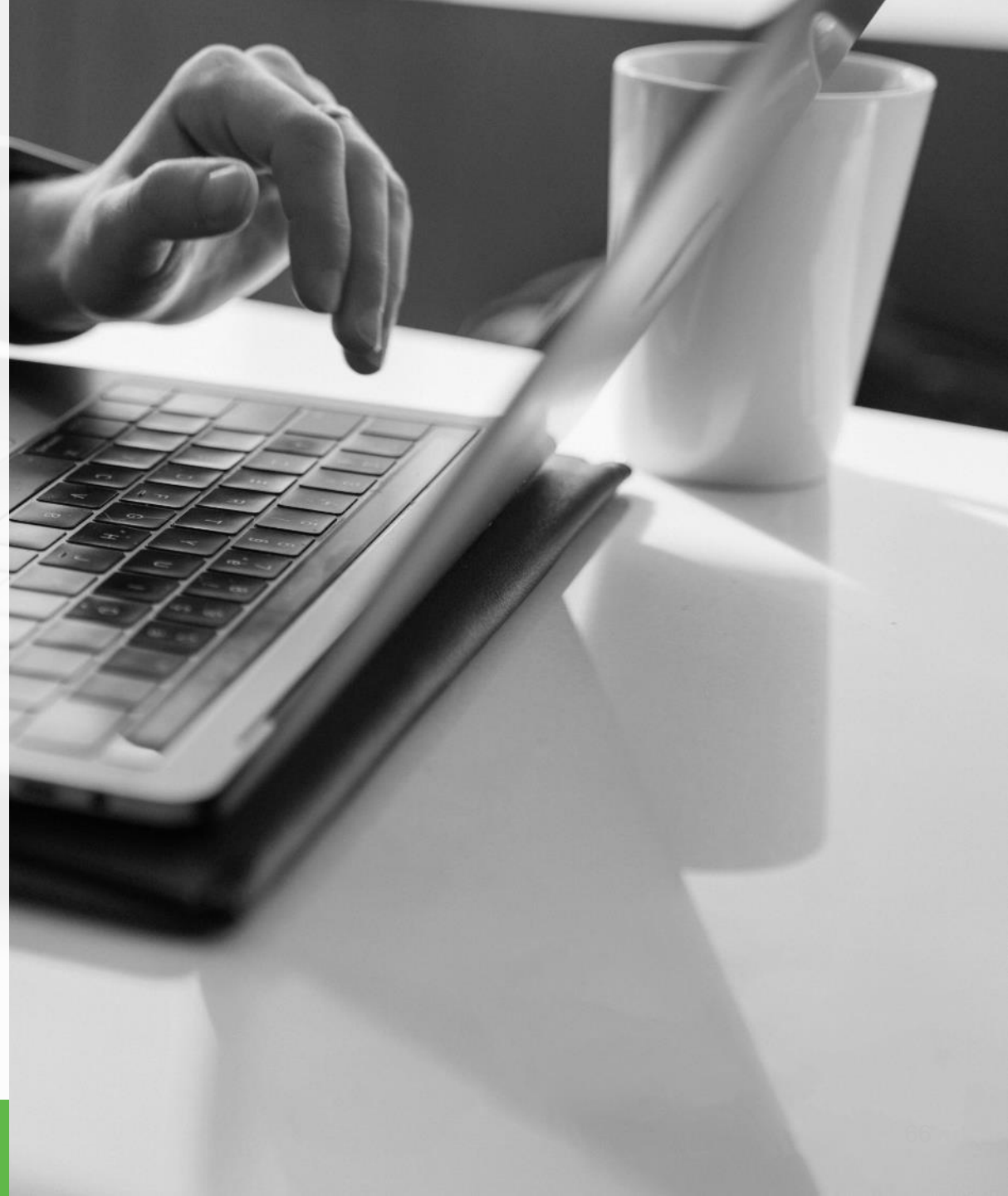
Market Actors: Central Shaft Sealing

Market actors involved in implementing this measure include:

- Project Team: develops and implements central shaft sealing plan
- HERS Rater: conducts shaft sealing test and records results
- Code Official: reviews shaft sealing test result

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language: Central Shaft Sealing

- Draft code language for this submeasure is available in the **resources tab**
- Proposal overview:
  - Affects Section 120.1(b)2Av
  - Central ventilation shafts shall have a maximum air leakage rate of no more than 5 percent of rooftop fan flowrate, confirmed through field verification and diagnostic testing, specified in Reference Nonresidential Appendix NA1.6XX

Submeasure A: Heat or Energy Recovery Ventilation in Select Climate Zones

Submeasure B: Central Ventilation Shaft Sealing

Submeasure C: Kitchen Range Hood Capture Efficiency

Background: Kitchen Range Hood Capture Efficiency

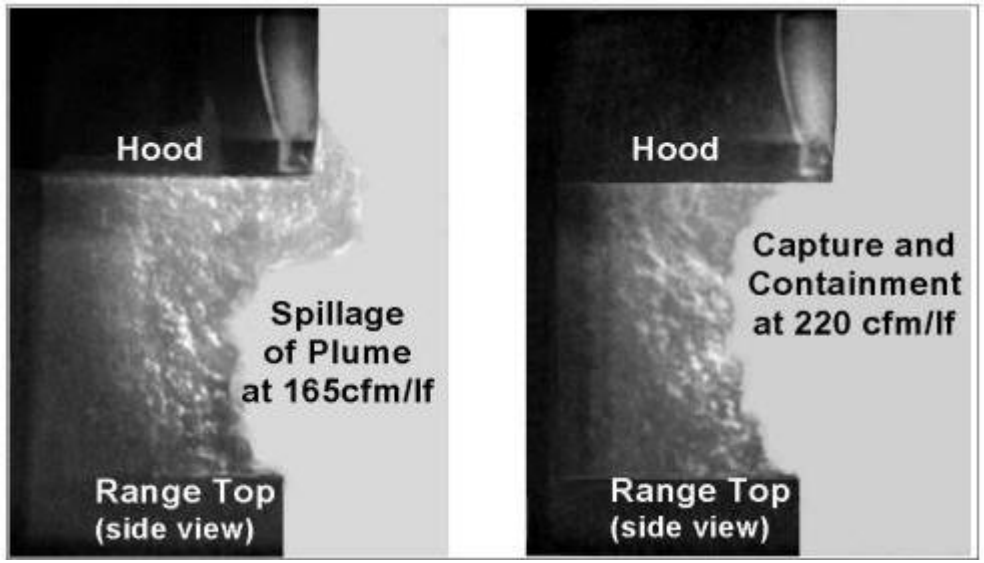
- Context and History
- 2019 Code Requirements
- Code Change Proposal

Context and History: Kitchen Range Hood Capture Efficiency

- **Why are we proposing this measure?**
  - Improved IAQ for multifamily residents:
    - Address major indoor pollutant source within unit
    - Reduce potential for pollutant transfer
  - Saves energy: less conditioned air exhausted per gram of pollutants removed from space, and less airflow rate per gram of pollutants removed from space

Context and History: Kitchen Range Hood Capture Efficiency

- "**Capture efficiency**" measures a kitchen range hood's capability in removing contaminants generated during cooking
  - Ratio of captured pollutant to total pollutant released, expressed as percent
  - Manufacturer would be responsible for measuring capture efficiency, using ASTM method E3087-18



Capture efficiency from same hood at 165 cubic feet per minute (cfm) and 220 cfm. Source: ASHRAE HVAC Applications Handbook, 2011, Chapter 33, Kitchen Ventilation

Current Code Requirements: Kitchen Range Hood Capture Efficiency

Title 24, Part 6	Model Codes
Maximum sound rating at 100 cfm	Similar sound requirement
No requirement for range hood capture efficiency	No capture efficiency requirement in other codes, because ASTM E3087-18 test method (measuring capture efficiency) is new

Code Change Proposal: Kitchen Range Hood Capture Efficiency

Building Types	System Type	Type of Change	Software Updates Required
Multifamily (all)	Ventilation	Mandatory	Yes

- Install kitchen range hood that meets minimum capture efficiency, based on manufacturer reporting

Code Change Proposal: Kitchen Range Hood Capture Efficiency

- **Section 120.1(b)2Avi and Section 150.0(o)G**: Range hoods would be required to have minimum rated capture efficiency at the design flow rate above some defined value in addition to the current maximum sound rating
- **ASTM E3087-18**, "*Standard Test Method for Measuring Capture Efficiency of Domestic Range Hoods*": lays out minimum rated capture efficiency based on manufacturer's measurement

Market Overview: Kitchen Range Hood Capture Efficiency

- Current Market
- Trends
- Barriers

Market Overview and Analysis: Kitchen Range Hood Capture Efficiency

- **Current Market and Trends:** Currently kitchen range hoods installed, but capture efficiency of equipment unknown
- **Market barriers:**
  - Manufacturers haven’t started reporting capture efficiency, because not yet required: e.g., databases such as Heating and Ventilating Institute (HVI) do not yet reference ASTM standard
  - Project teams do not know the capture efficiency of their specified equipment

Technical Considerations: Kitchen Range Hood Capture Efficiency

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations: Kitchen Range Hood Capture Efficiency

- **Technical Considerations**
  - Review product materials (databases, cut sheets) to identify manufacturers' reported capture efficiency before specifying
- **Technical Barriers and Potential Solutions**
  - Since HVI has not yet referenced ASTM test method, manufacturers are not yet reporting capture efficiency
  - HVI is in process of referencing ASTM test method. 2022 Title 24, Part 6 requirement will ensure manufacturers report capture efficiency, and encourage development of compliant equipment
  - Statewide CASE Team may conduct tests and publish results from some of the largest selling products to understand market baseline for capture efficiency

Technical Feasibility: Kitchen Range Hood

- Statewide CASE Team investigated measure for the 2019 code cycle, and main barrier was lack of test method
- ASTM test method addresses this barrier
- Current barrier is good understanding of capture efficiency in current products on the market.
- Capture efficiency testing of products or HVI database of capture efficiency rating serving various residential applications will address this barrier

Energy and Cost Impacts: Kitchen Range Hood Capture Efficiency

Methodology and Assumptions

- Energy and IAQ Impacts
- Cost Impacts
  - Incremental Costs
  - Energy Cost savings

Methodology for Energy and IAQ Impacts Analysis: Kitchen Range Hood Capture Efficiency

- Energy impacts from shorter run time of range hoods
- Main driver: IAQ benefits
  - Literature shows pollutants released from cooking and their health impacts
  - Cooking generates
    - Small particulate matter ($PM_{2.5}$)
    - Nitrogen oxide (NO) and nitrogen dioxide (NO_2) from natural gas burners

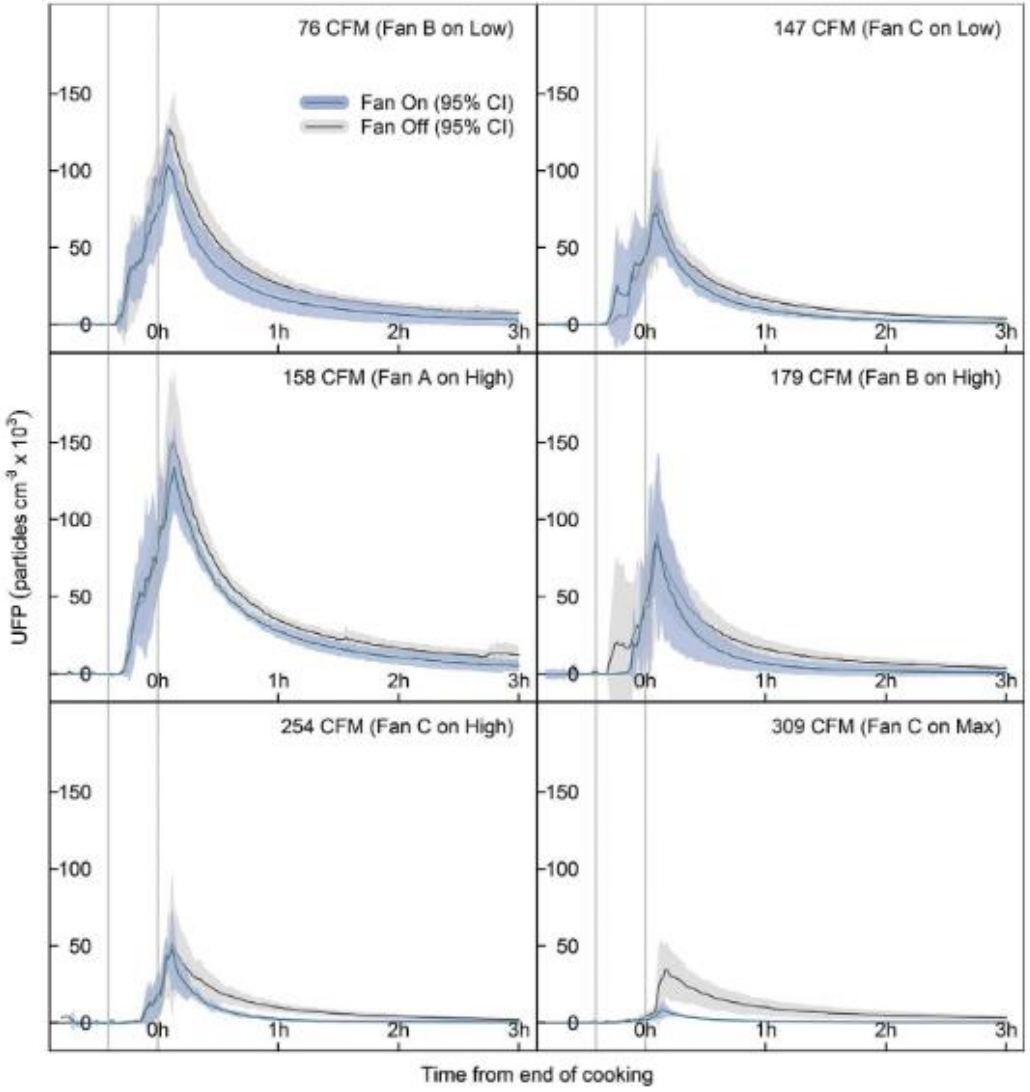


Image: Ultra-fine particle (ULP) concentration with fans on different settings. Source: Dobbin et al, 2018, "The benefit of kitchen exhaust fan use after cooking", Building and Environment Volume 135

Incremental Cost Information: Kitchen Range Hood Capture Efficiency

- Cost of equipment that meets the minimum capture efficiency requirement compared with non-compliant equipment
- Additional labor assumed to be zero

Compliance and Enforcement: Kitchen Range Hood Capture Efficiency

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process: Kitchen Range Hood Capture Efficiency

1. Design Phase

- Project team specifies kitchen hood equipment using product information (cut sheet, online database) to confirm it meets capture efficiency requirements

2. Permit Application Phase

- Project team submits design documents showing proposed kitchen hood equipment via compliance documentation

Compliance Verification Process: Kitchen Range Hood Capture Efficiency

3. Construction phase

- Project team installs compliant kitchen hood documenting with compliance documentation

4. Inspection Phase

- HERS Rater
  - conducts visual inspection to identify range hood model
  - confirms compliance using online information that equipment meets minimum capture efficiency

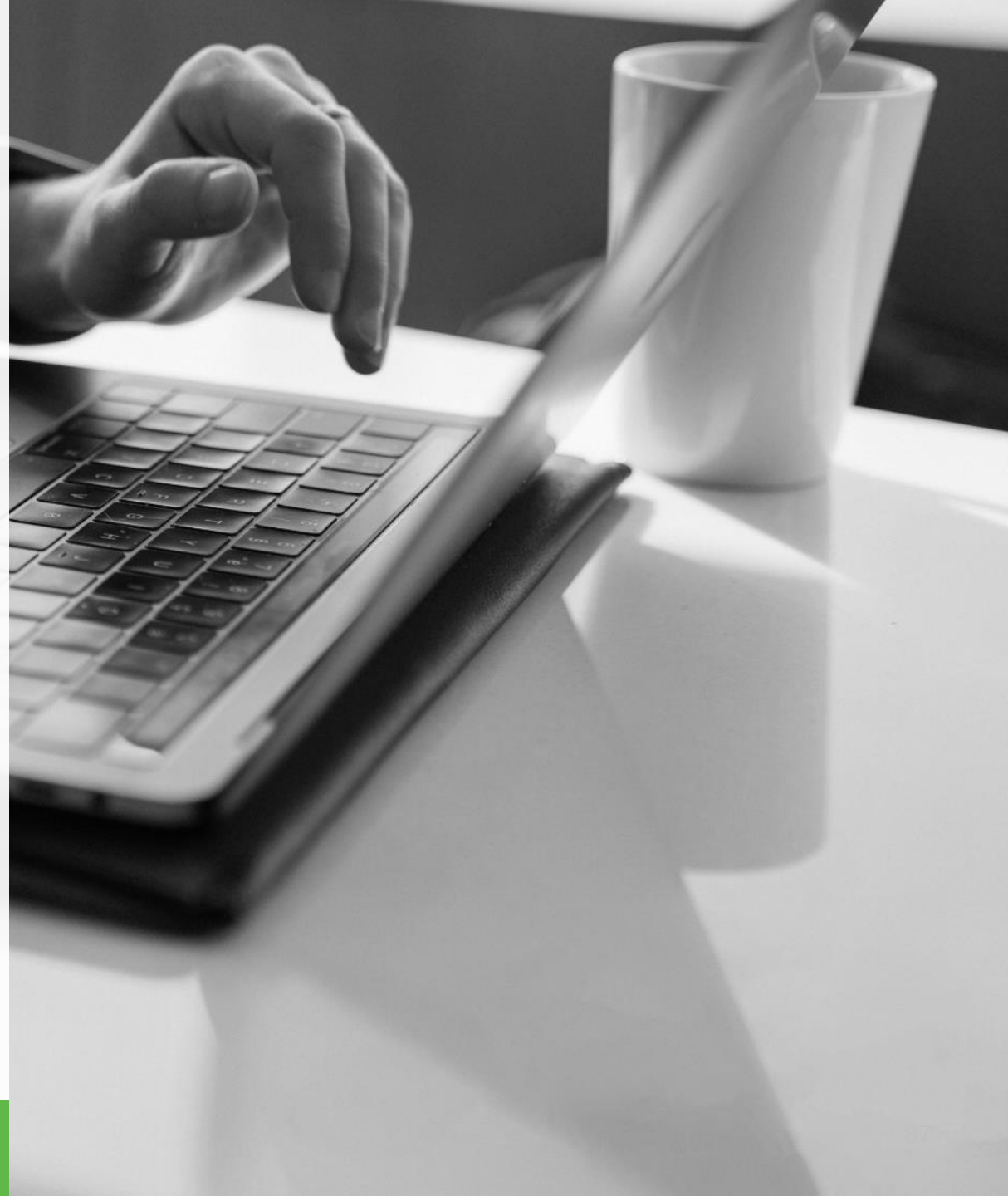
Market Actors: Kitchen Range Hood Capture Efficiency

Market actors involved in implementing this measure include:

- Manufacturers: report capture efficiency of equipment
- Project Team: installs kitchen hood equipment with compliant capture efficiency
- HERS Rater: confirms compliance
- Code Official: reviews kitchen hood capture efficiency for compliance

Proposed Code Changes: Kitchen Range Hood Capture Efficiency

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language: Kitchen Range Hood Capture Efficiency

- Draft code language for this submeasure is available in the **resources tab**
- Proposal overview:
  - Requires installation of kitchen range hood that meets minimum capture efficiency requirements in new construction multifamily units
    - Minimum capture efficiency level TBD
    - Exception for existing multifamily units where vented range hood not feasible

Poll

How supportive would you be for a proposal that specifies **two** requirements for capture efficiency: **(1)** Lower capture efficiency at lower airflow, and **(2)** Higher capture efficiency at higher airflow. Select one.

A. Not supportive

B. Somewhat supportive

C. Very supportive

D. Don’t know – *please comment in chat*

2023 Construction Forecasts by Building Prototype

Building Prototype	Percent of New Construction Impacted by Proposed Requirement		
	HRV/ERV	Central Shaft Sealing	Range Hood Capture Efficiency
Low-Rise Garden Style	~40-60%	0%	100%
Low-Rise Loaded Corridor	~40-60%	0%	100%
Mid-Rise Mixed Use	~40-60%	10%	100%
High-Rise Mixed Use	~40-60%	50%	100%

Discussion and Next Steps

Feedback Requested

- We want to hear from you!
  - **Provide verbal feedback** now or over the chat
  - Send an **email** to info@title24stakeholders.com
    - **Email** the CASE Author(s)
    - **Email** the Statewide Utility Team
  - More information on pre-rulemaking for the 2022 California Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency
  - Submit a public comment to the California Energy Commission's docket
- Requesting input on this measure by **September 5, 2019**

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to help you decode Title 24, Part 6 and Title 20

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Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Multifamily
High Performance Envelope

Codes and Standards Enhancement (CASE) Proposal

Multifamily | Envelope

Matthew Christie, TRC

August 22, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

1	Background	*5 min*
2	Market Overview and Analysis	*10 min*
3	Technical Feasibility	*10 min*
4	Cost and Energy Methodology	*10 min*
5	Compliance and Enforcement	*5 min*
6	Proposed Code Changes	*5 min*
7	Discussion and Next Steps	*15 min*

Background

- Context and History
- 2019 Code Requirements
- Code Change Proposal

2022 Focus on Multifamily

Reorganize requirements into a standalone chapter of Title 24, Part 6

Increase uniformity across low-rise and high-rise requirements and other sections of the building code

Improve modeling accuracy through software improvements and proposed prototypes

- **Mimic residential chapter structure**
  - 160.0 Mandatory Features and Devices
  - 160.1 Performance and Prescriptive Compliance Approaches
  - 160.2 Additions and Alterations
- **Include common area spaces**
- **Reference to**
  - Section 110 for mandatory measures
  - Sections 120, 130, and 140 for nonresidential spaces not exclusive to residents

Code Change Proposal – Summary

Building Types	System Type	Type of Change	Software Updates Required
Multifamily (all)	Envelope	Prescriptive	Yes

- **Improved Fenestration U-factor, Solar Heat Gain Coefficient (SHGC), and Visible Transmittance (VT)** – align requirements by construction/fenestration type. Update prescriptive requirements
- **Window area limits and metrics** – align requirements and metrics
- **Quality insulation installation (QII)** – apply prescriptively to all multifamily buildings. Revise protocols.
- **Reduced thermal bridging** – including; wall-roof intersections, wall-floor intersections, wall-fenestration intersections, and wall-exterior projections such as balconies.
- **Improved wall assemblies** – re-categorize by construction type. Update assembly U-factor requirements

- **Support a unified multifamily energy code**
- **Define envelope requirements in relation to construction type, not number of stories**
- **Update code requirements where cost-effective**

Context and History

Multifamily envelope requirements currently differ based on number of stories

Low-Rise
Residential Code

High-Rise
Nonresidential code

Source: https://www.proudgreenbuilding.com/articles/icfs-featured-in-multifamily-housing-project/

Context and History

- **Why are we proposing this measure?**
  - Harmonize multifamily code requirements based on construction type rather than the current low-rise vs. high-rise split
    - Perhaps using fire-code construction types, perhaps descriptive labels (e.g. metal-framed)
  - Align energy code's construction-type definitions with fire and structural codes
  - Increase envelope efficiency across construction assemblies
    - Extend quality insulation installation (QII) requirements to all multifamily, with new protocols as deemed practical and cost effective
    - Include thermal bridging requirements
    - Increase stringency of window and wall thermal properties

2019 Code Requirements

Submeasure	High-rise Residential prescriptive requirements | 4+ habitable stories			Residential prescriptive requirements| 3 habitable stories or fewer		
Fenestration, by window type and climate zone	U-factor	SHGC	VT	U-factor	SHGC	VT
	0.36-0.46	0.22-0.26	0.17-0.46	0.30	0.23 or NR	NR
Fenestration Area Metric	Window to wall area – max 40% overall			Window to floor area – max 20% overall, 5% west facing		
QII	No requirements or performance option in 2019 code			Prescriptive requirement using a verification protocol designed for single-family residences		
Reduced thermal bridging	No requirements in 2019 code			No requirements in 2019 code		
Wall assembly U-factor	0.042-0.105 by wall type and climate zone			0.051-0.065 by climate zone		

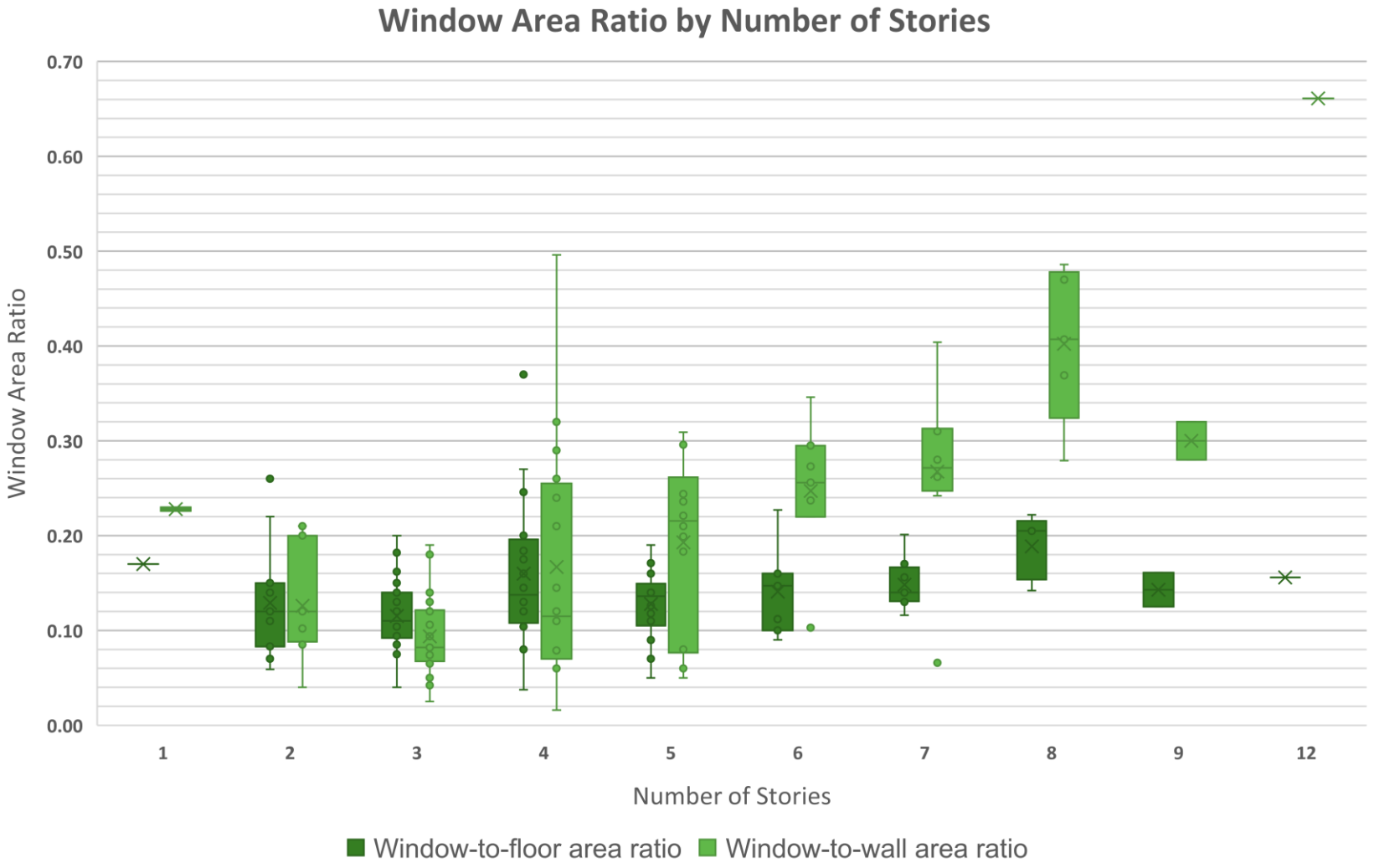
Proposed Code Change Overview

- Draft code language for this submeasure is available in the **resources tab**
- Improved fenestration U-factor, SHGC, and VT
  - Align requirements based on construction type, and whether the fenestration is factory-assembled versus site-assembled
  - Evaluate VT requirements
  - Address high performance fenestration options including triple-pane where feasible
  - Increase prescriptive stringency for U-factor, SHGC, and VT

Vs.

Proposed Code Change Overview

- Window area limits and metrics
  - Define window area limits using a single metric across all multifamily buildings
  - Align window area limits by orientation and total window area
  - Will consider:
    - Window-to-floor area
    - Window-to-wall area
    - Dwelling-window-to-dwelling-floor/wall area



Source: SCE Multifamily Prototype Development Study

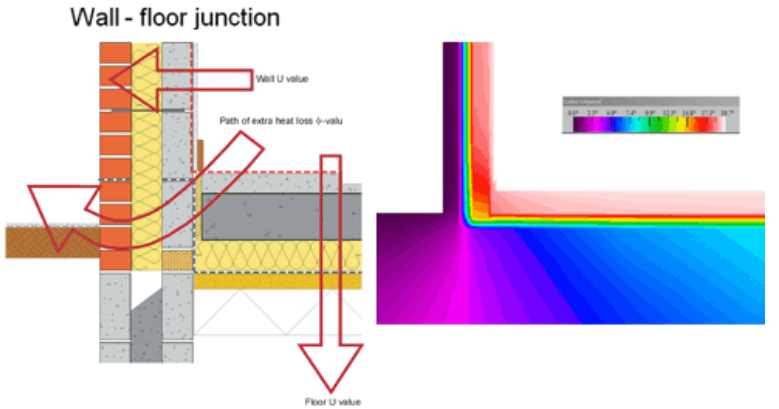
Proposed Code Change Overview

- Quality Insulation Installation
  - QII as required for 2019 low-rise multifamily is *not* proposed to be changed
  - Review QII requirements and protocols for application to high-rise multifamily
    - Cavity air sealing
    - Cavity insulation
    - External insulation
    - Accessibility and logistics
  - Stakeholders have expressed an interest in narrowing QII's focus to basic insulation installation

Source: https://www.aeropaca.org/editv2.php

Proposed Code Change Overview

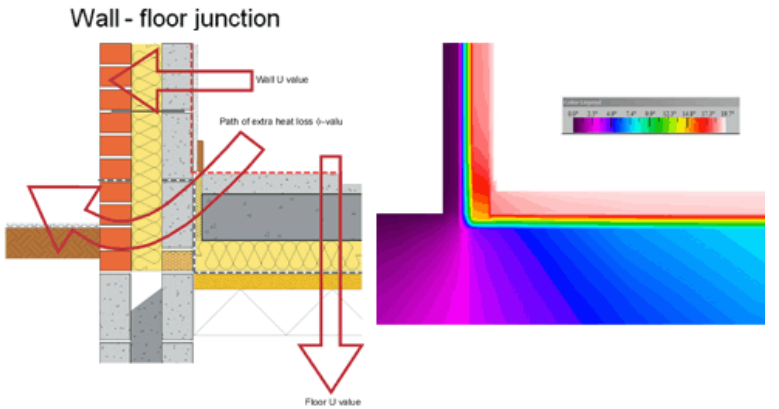
- Reduced Thermal Bridging
  - Add a new code requirement that will mitigate heat transfer across a building's major thermal-bridges locations:
    - Wall-roof intersections
    - Wall-floor intersections
    - Wall-fenestration intersections
    - Wall-exterior projections (e.g. balconies, overhangs, architectural features)
  - Leverage nonresidential thermal bridging CASE topic
    - Potentially based on ASHRAE 90.1 proposal (addendum AV to 90.1-2016)



Sources: https://www.constructionspecifier.com/enhancing-energy-performance-with-balcony-thermal-breaks/, https://darrenevansblog.wordpress.com/2013/02/18/thermal-bridging-a-primer-and-an-update/

Proposed Code Change Overview

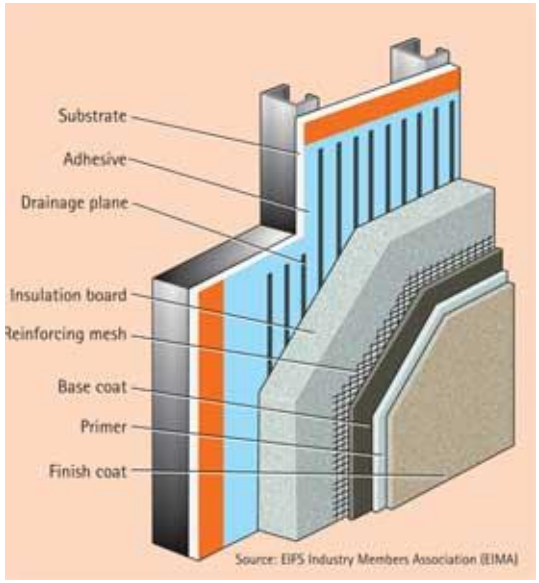
- Reduced Thermal Bridging (continued)
  - Potential implementation methods include:
    - Adjust assembly U-factor calculation methods
    - **Prescribe acceptable construction details and acceptable insulation offsets**
    - Establish use of UA budgets that include the impact of thermal bridging
  - Exceptions are anticipated

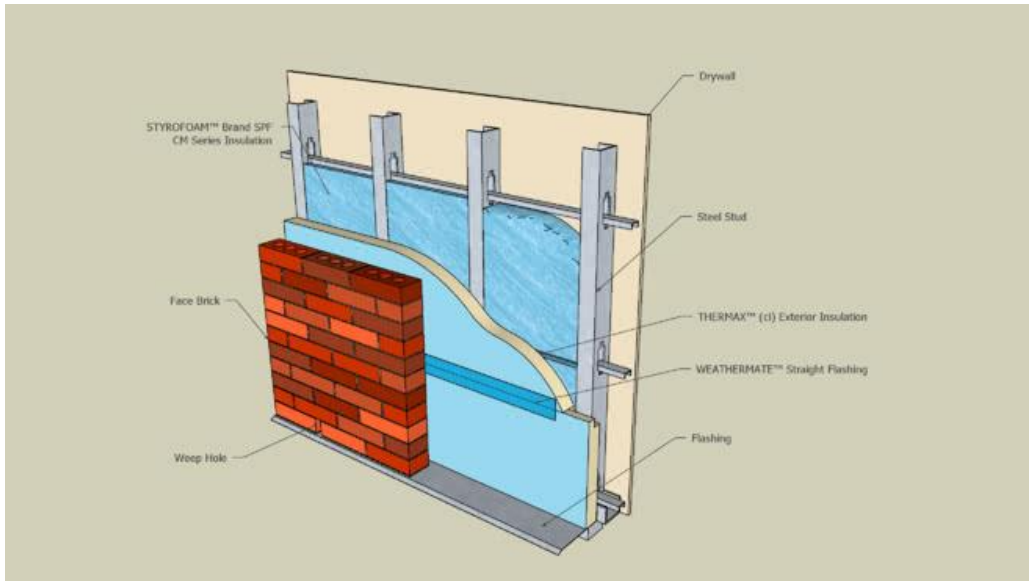


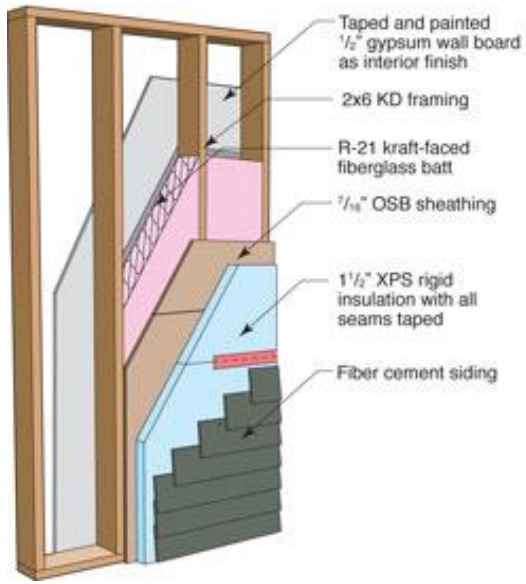
Sources: https://www.constructionspecifier.com/enhancing-energy-performance-with-balcony-thermal-breaks/, https://darrenevansblog.wordpress.com/2013/02/18/thermal-bridging-a-primer-and-an-update/

Proposed Code Change Overview

- Improved wall assemblies
  - Align wall assembly requirements across multifamily buildings based on construction type, not number of stories
  - Update wall-assembly U-factors, or contributing aspects such as wall-framing ratios
  - Address potential conflicts with fire code for exterior wall insulation or dense wall insulation





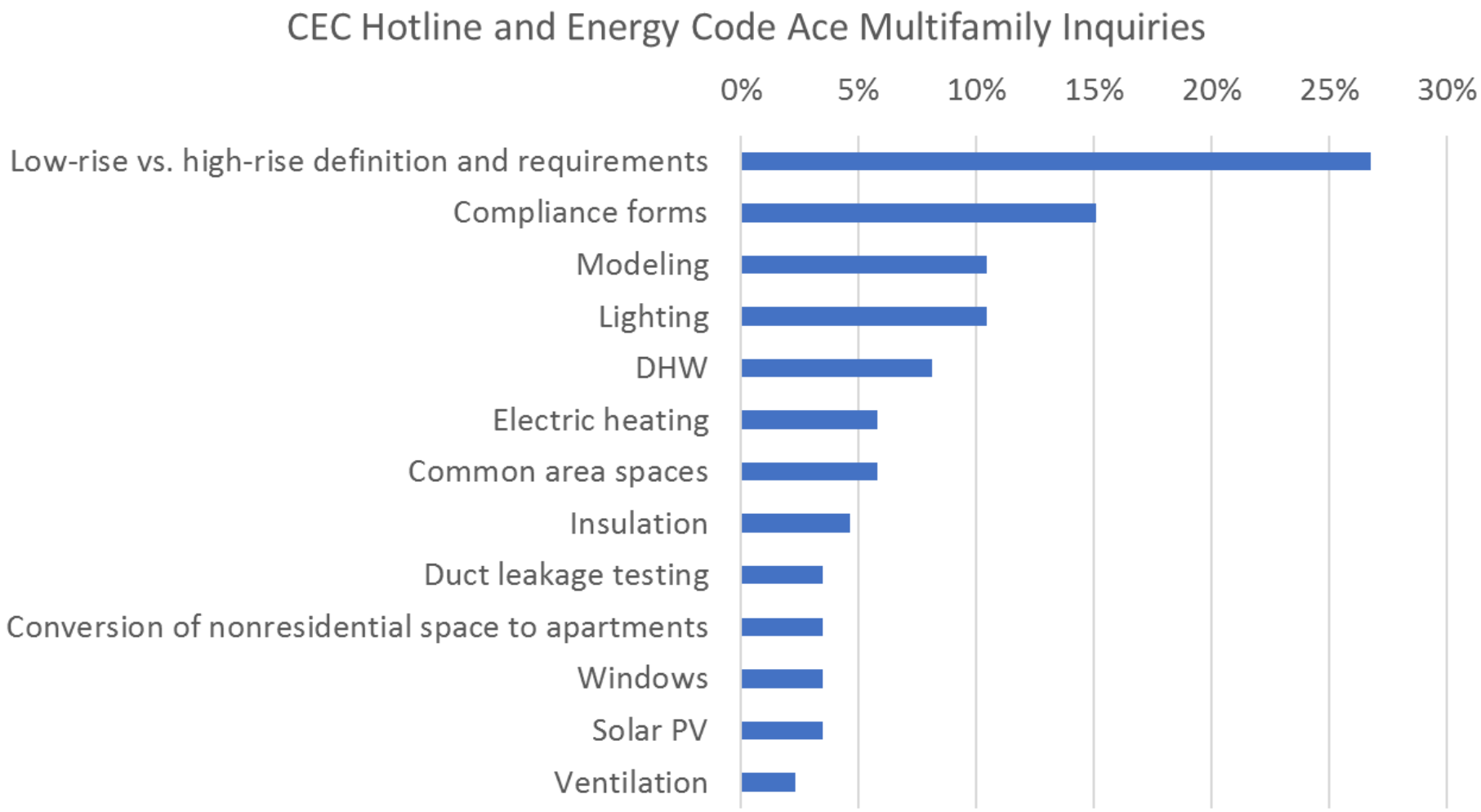


Sources: https://www.buildingscience.com/documents/special/vancouver-test-hut-documents/vancouver-test-hut-phase4wall-assemblies, http://modernfirebehavior.com/firefighting-and-exterior-insulation-finishing-systems/, https://3dwarehouse.sketchup.com/model/f38acb6d017207f75739c76d36b1b256/06-Dow-THERMAX-Wall-System-Exterior-Wall-Insulation-Steel-Studs?hl=pl

Market Overview

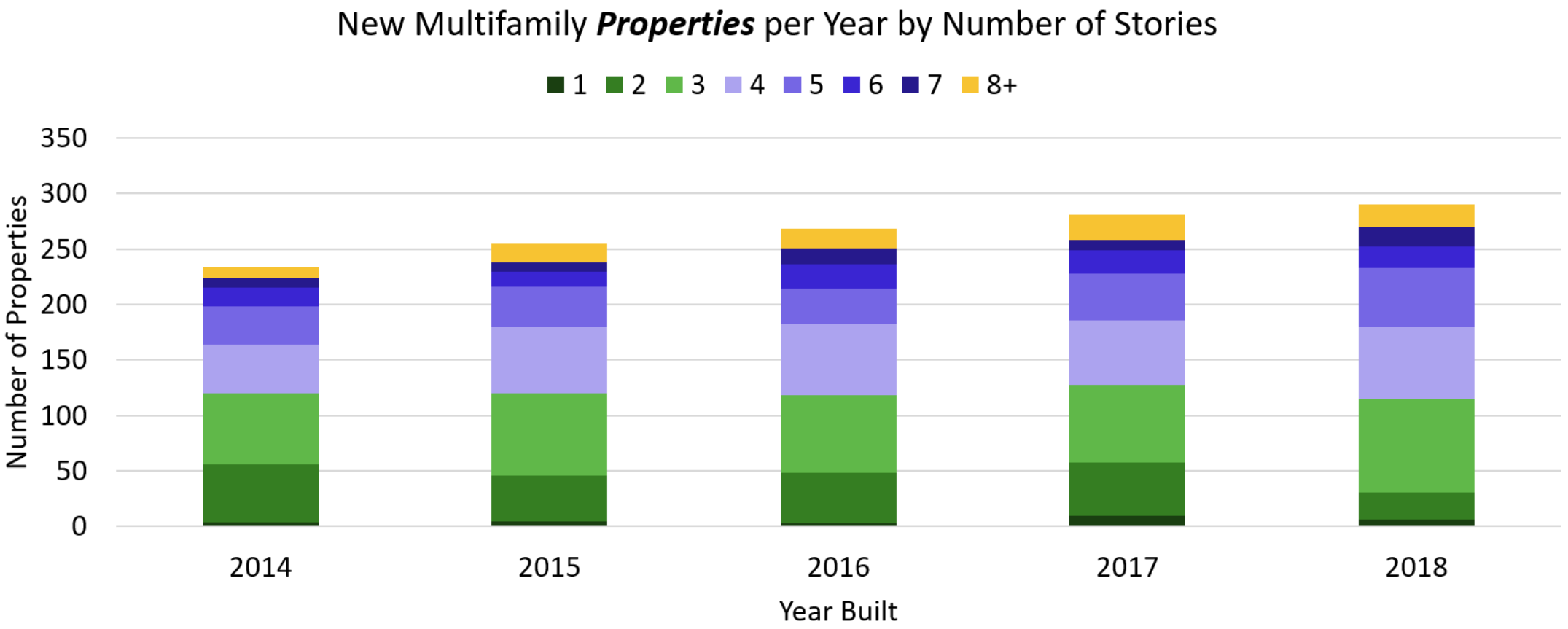
- Current Market
- Market Trends
- Market Barriers and Solutions

Evidence for Need: Code Compliance Confusion



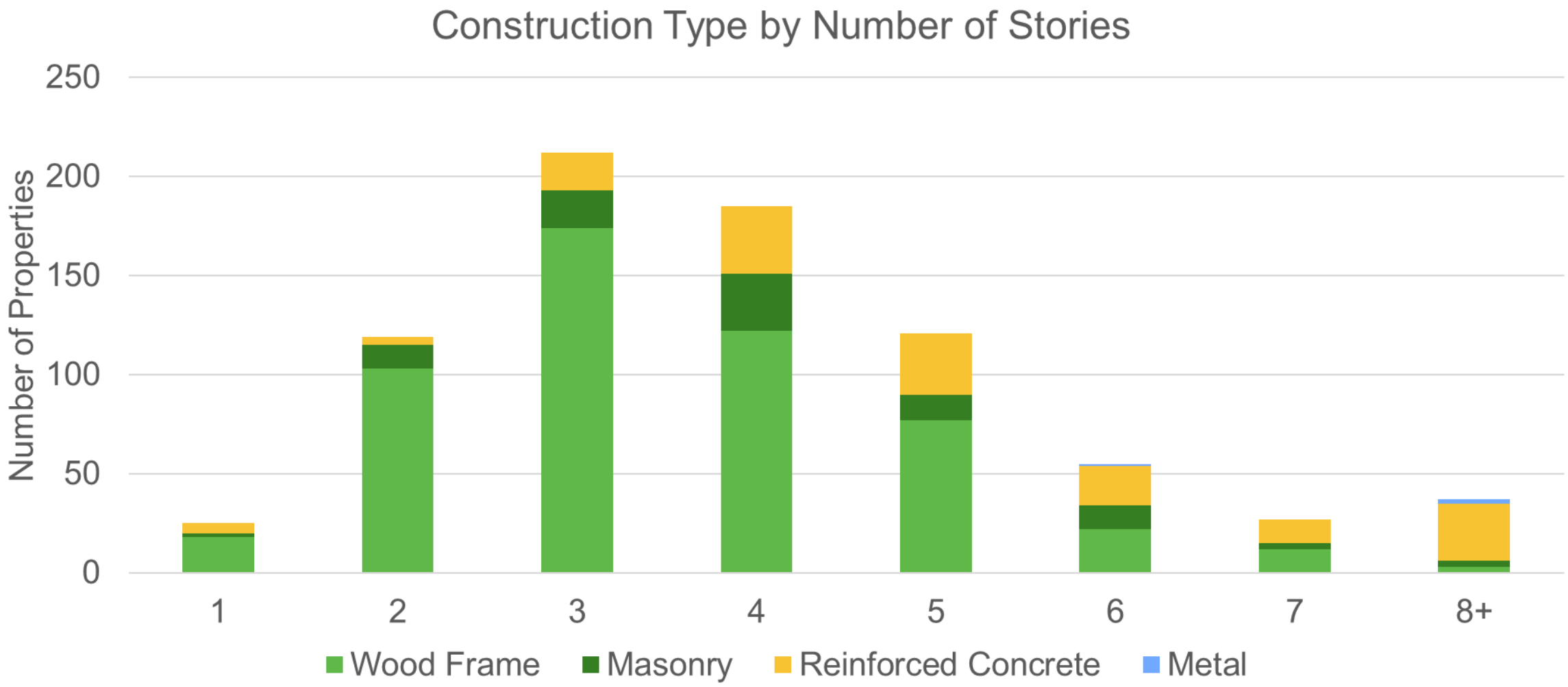
Source: NORESCO

New Multifamily Construction in CA



Source: CoStar Multifamily Properties Built 2014-2018

Construction Assembly Type



Source: CoStar Multifamily Properties Built 2014-2018

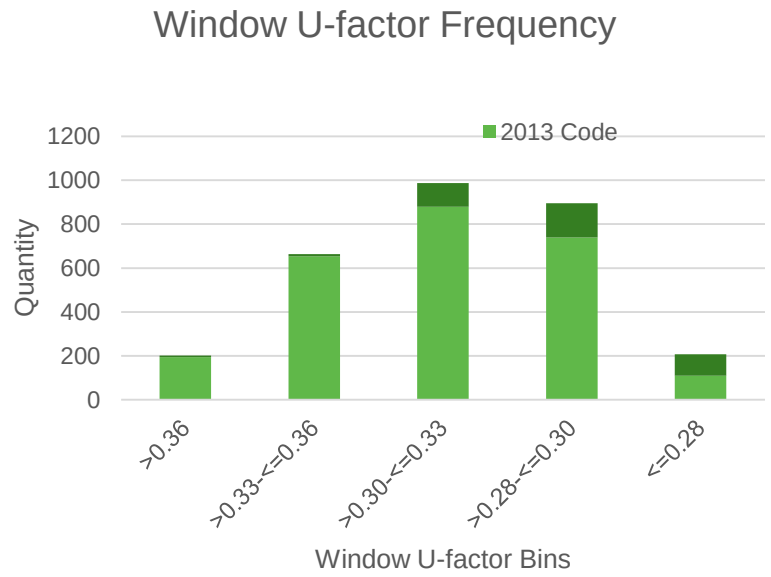
Market Overview and Analysis – MF Harmonization

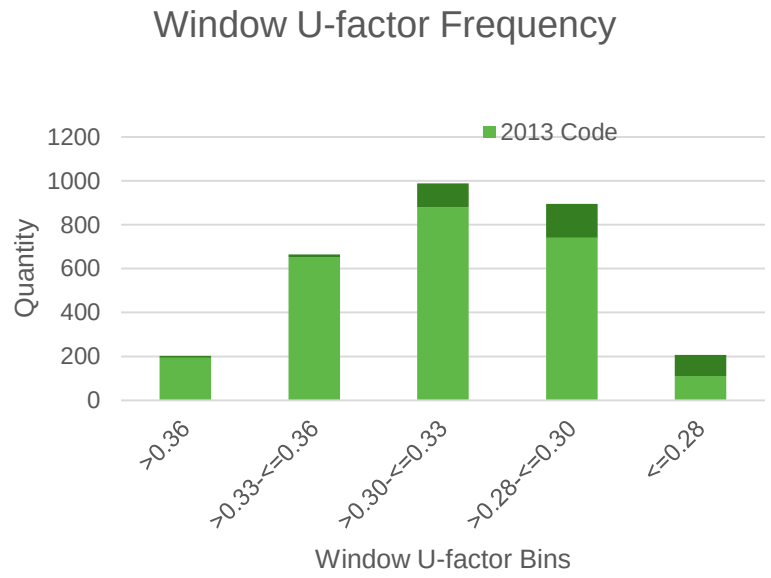
- **Current Market**
  - Multifamily buildings are increasing market share of new construction
  - Mid-rise/high-rise construction on the rise
  - IOU incentive programs for multifamily new construction are promoting efficient envelopes
- **Market Trends**
  - Multifamily prototype study[1] outlined several prototypes that differ from the standard assumption of a stick-frame construction low-rise multifamily building
  - Mixed-use buildings being encouraged by several local jurisdictions resulting in podium style multifamily buildings
- **Market barriers**
  - Adherence to fire code requirements typically takes precedent over energy code in the eyes of building departments
  - High performance envelopes require better coordination among designers and trades
- **Do you agree with this description? What else should we know?**

[1] SCE sponsored study, not yet publicly available

Market Overview and Analysis – Window Thermal Properties

- **Current Market**
  - 37 percent of buildings meet beat the 0.30 U-factor limit
  - 44 percent of buildings meet or beat the 0. 23 SHGC limit
- **Market Trends**
  - 66 percent of 2016 Code buildings meet beat the 0.30 U-factor limit
  - 58 percent of 2016 Code buildings meet or beat the 0.23 SHGC limit
  - Advanced window products available from manufacturers
- **Market barriers**
  - Current cost of advanced windows
  - Weight and associated installation challenges of triple pane, or skinny-triple windows
  - Lack of understanding to specify high SHGC windows in certain colder climates (Climate Zones 1, 3, 5, and 16)
    - 36 percent of buildings use an SHGC greater than 0.32 in these climate zones
- **Do you agree with this description? What else should we know?**



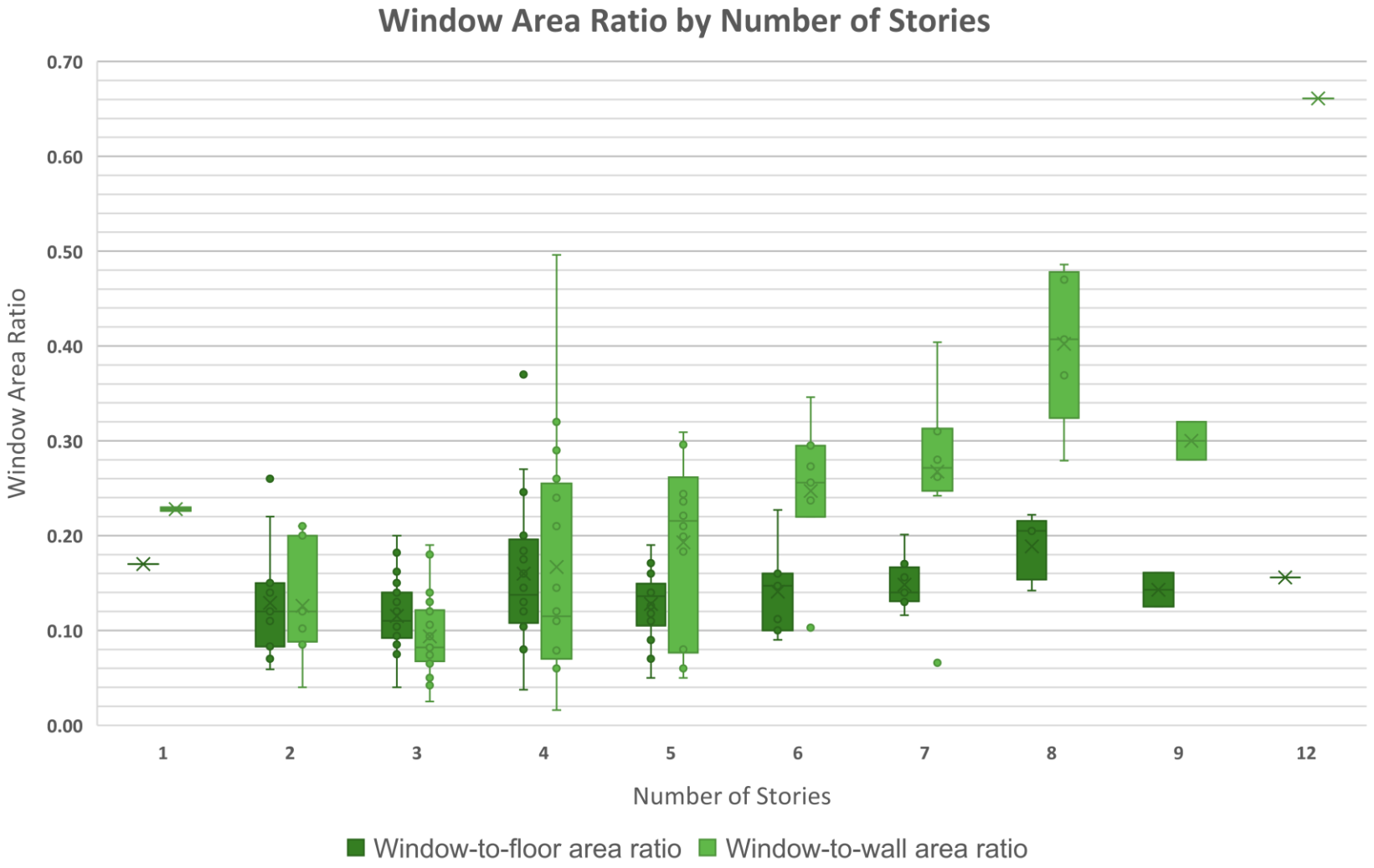


[1] Source: CalCERTS 2013 & 2016 Code Registry Data as of 1.16.19

Market Overview and Analysis – Window Area Limits

- **Current Market**
  - Window-to-wall area ratios escalate with number of stories
  - Window-to-floor area ratios stay within a similar range
- **Market Trends**
  - Indifference to energy code limits
- **Market barriers**
  - Desire for glass curtain walls with high-rise
  - Desire for west-facing views
  - Window-to-wall area more commonly used by high-rise designers

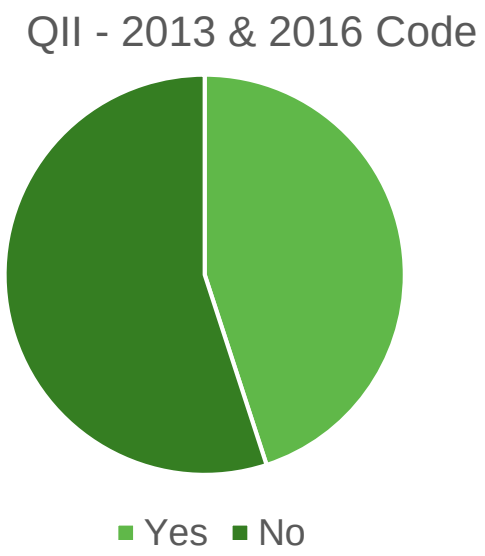
Do you agree with this description? What else should we know?



Source: SCE Multifamily Prototype Development Study

Market Overview and Analysis – Quality Insulation Installation (QII)

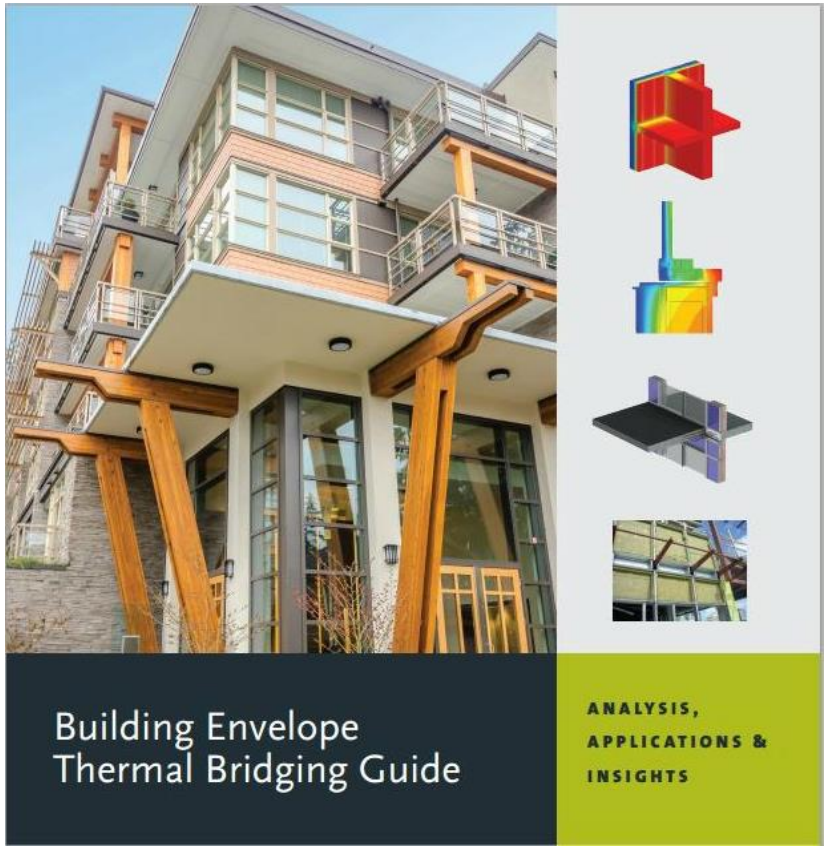
- **Current Market**
  - No experience with QII for high-rise buildings
  - Only 45 percent of multifamily low-rise take QII for performance credit[1]
  - QII will be prescriptively required for multifamily low-rise in 2019 Code, excluding Climate Zone 7
- **Market Trends**
  - Static rates between 2013 to 2016 codes
- **Market barriers**
  - QII new to the construction industry
  - QII perceived as more challenging in multifamily low-rise construction
  - QII requires better coordination among designers and trades
- **Do you agree with this description? What else should we know?**



[1]Source: CalCERTS 2013 & 2016 Code Registry Data as of January 16, 2019

Market Overview and Analysis – Thermal Bridging

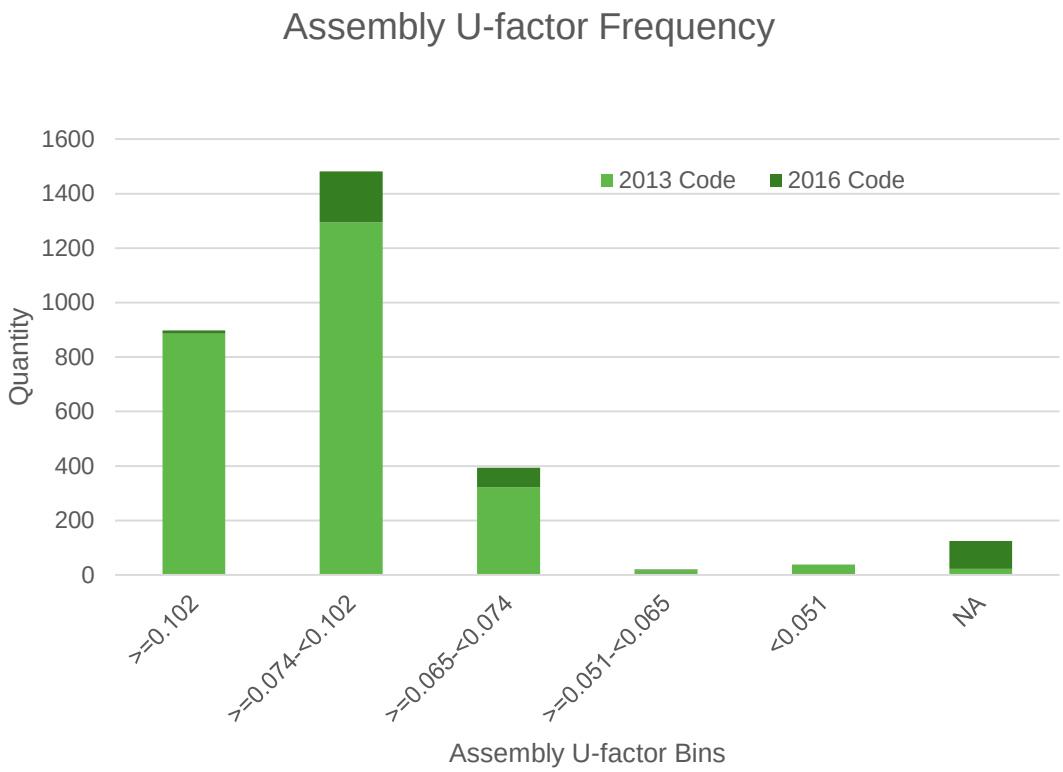
- **Current Market**
  - No thermal bridging requirements by code
  - Some use of ‘best practices’ thermal bridging consideration
- **Market Trends**
  - Unknown because not measured
- **Market barriers**
  - No simple metrics available or in common use
  - Proper thermal bridging assessments require 3 dimensional modeling
  - Thermal bridging mitigation new to the construction industry
- **Do you agree with this description? What else should we know?**



Source: https://www.bdcnetwork.com/new-guide-prevention-thermal-bridging-commercial-buildings

Market Overview and Analysis – Wall Assemblies

- **Current Market**
  - 16 percent achieve below 0.074 assembly U-factor (R-19 cavity fill)
  - >2 percent achieve below 0.065 assembly U-factor (R-13 cavity plus R-4 continuous)
  - 56 percent use 2x4 construction
  - 3.6 to 7 percent use some form of continuous insulation
- **Market Trends**
  - 27 percent of the 2016 Code market achieves below 0.074 assembly U-factor
  - 2.1 percent used continuous insulation in 2013 Code, 13.7 percent in 2016 Code
- **Market barriers**
  - Fire code requirements complicate use of cost-effective continuous insulation for high-rise buildings
  - Thicker wall assemblies reduce conditioned floor area
- **Do you agree with this description? What else should we know?**



[1]Source: CalCERTS 2013 & 2016 Code Registry Data as of 1.16.19

Technical Considerations

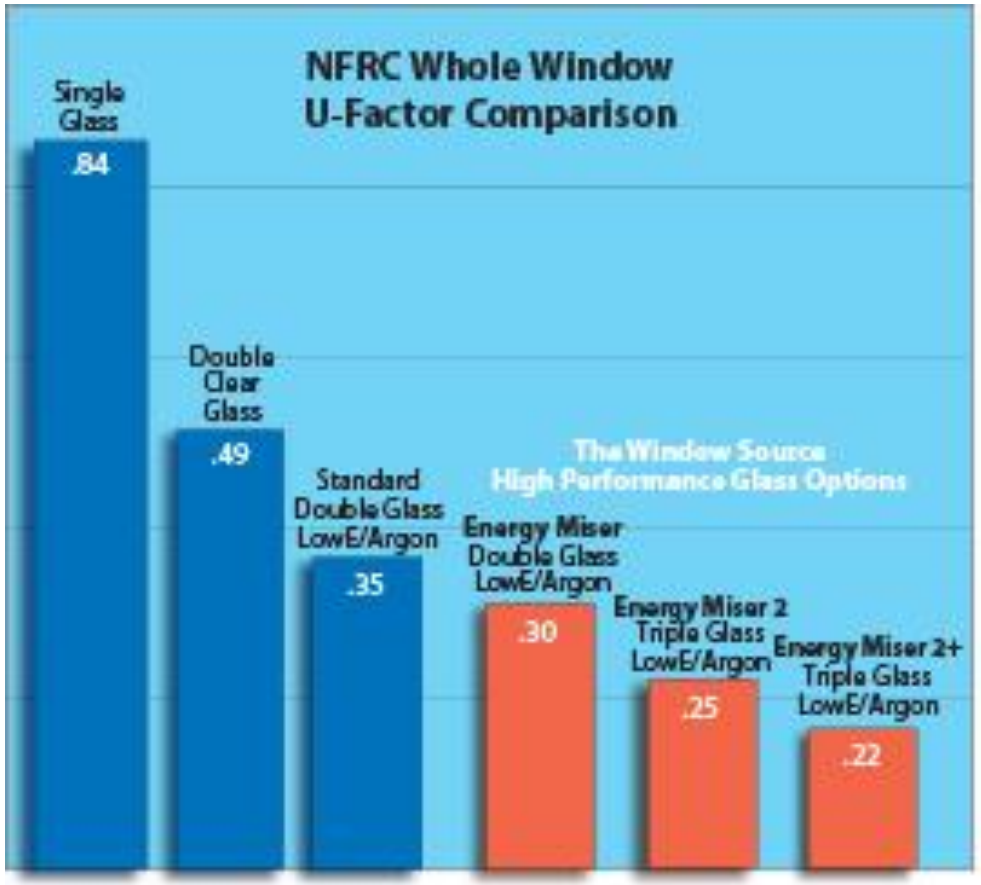
- Technical Considerations
- Potential Barriers and Solutions

Technical Feasibility

Submeasure	Technical Feasibility Considerations
Fenestration thermal properties	Updated U-factor, SHGC, and VT requirements *could,* but are not expected to, verge on technical feasibility (or market availability) limits for certain window types
Fenestration area metric	No technical feasibility challenges.
QII	Updated QII protocols will consider technical, and logistical, feasibility challenges for cavity air-sealing and insulation installation quality for all construction types
Reduced thermal bridging	Will require careful assessment of technical feasibility across all construction types. Is thermal bridge impact information available and readily calculable for all relevant thermal bridge types?
Wall assembly U-factor	Updated assembly U-factors will require technical feasibility confirmation, as well as fire and structural code-compliance interactions for all construction types

Technical Feasibility – Fenestration U-factors

- U-factors <0.30 require argon-fill, advanced LowE coatings, triple-pane, ‘skinny-triple’, advanced framing materials, or thermal breaks
- Can site-assembled windows reach lower limits?
- Are low U-factor, but high SHGC windows (for Climate Zones 1, 3, 5, & 16) technically feasible?
- Could residential style windows (plastic frames instead of aluminum) be the basis of U-factors for Type V and Masonry construction?
- 2019 T-24 U-factor requirements
  - Residential windows U-factor ≤ 0.30 Btu/hr-sf-ºF
  - NR windows U-factor ≤ 0.36 – 0.46 Btu/hr-sf-ºF
- **What else should we consider?**



Source: http://thewindowsourceofathens.com/products/energy-saving-lowe-glass/

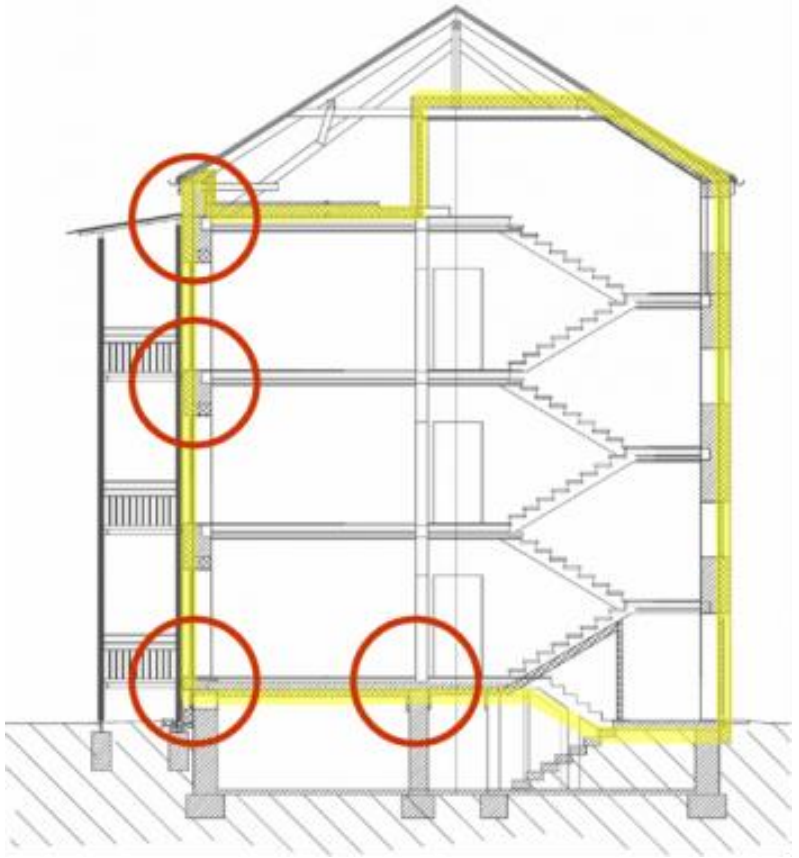
Technical Feasibility – QII

- Physical access to insulation
  - Especially exterior shell insulation
- Scheduling and timing with staged construction
- **What else should we consider?**

Source: https://www.rockwoolgroup.com/newsroom/2018/fixing-the-uks-broken-fire-safety-system/

Technical Feasibility – Thermal Bridging

- Simple calculation methodologies and metrics do not exist
- Data may not be available
- High variety of thermal bridging situations and mitigation options – difficult to write consistent, direct, and fair code language
- **What else should we consider?**



Source:
https://passipedia.org/planning/refurbishment_with_passive_house_components/thermal_envelope/improving_thermal_bridges_and_airtightness_in_existing_buildings

Technical Feasibility – Wall Assemblies

- Fire-code compliance interactions
  - Can low-U-factor and fire code compliance co-exist?
- What rigid exterior options applicable to high-rise?
- Reasonable rigid-exterior thickness and fastener limitations?
- **What else should we consider?**

Image Source: https://www.finehomebuilding.com/2009/05/01/which-rigid-insulation-should-i-choose

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts
- Cost Impacts
  - Incremental Costs
  - Energy Cost savings

Methodology for Energy Impacts Analysis

- **Methodology for energy and demand impacts**
  - Based on 2019 CBECC-Res and CBECC-Com prototype energy models, using new multifamily prototypes developed for 2022 CASE analysis
  - Modeling and results will be climate-zone specific
  - Measures that cannot be modeled in 2019's CBECC platforms will be estimated by engineering calculations and spreadsheet analysis

Submeasure	Primary Energy Impact Methodology
Fenestration thermal properties	CBECC based energy modeling
Fenestration Area Metric	CBECC energy modeling for re-classified building types based on market analysis
QII	Engineering analysis on de-rate reduction for new multifamily QII
Reduced thermal bridging	Engineering analysis on thermal bridge reduction measure impact. Informed by ASHRAE 90.1 addendum av findings.
Wall assembly U-factor	CBECC based energy modeling

Assumptions for Energy Impacts Analysis

- Statewide CASE Team to calculate energy savings estimates based on the following:
  - **Upgrades to efficiency standards**, such as window thermal properties (U-factor, SHGC, VT), wall assembly U-factor
  - **New code requirements**, (or current code requirements being newly applied to certain buildings), such as thermal bridging requirements, QII, VT
  - **Changing code requirements** such as any proposed changes to the QII protocols as it applies to multifamily buildings, or changing metrics for window-area ratios
  - **Reclassification** between 2019 code's high- and low-rise compliance definitions, and 2022's construction type definitions

Assumptions for Energy Impacts Analysis

- **Baseline** – minimally prescriptively compliant with 2019 Title 24, Part 6 Energy Code
- **Proposed case**
  - Upgraded prescriptive requirements (specific levels TBD – for example updated fenestration SHGC limits, fenestration U-factor, or wall assembly U-factor)
  - New or newly-applied code requirements (specific definitions TBD – for example thermal bridging rules, high-rise QII impact)
  - Updated code definitions (TBD – for example applying the window-to-floor area metric newly to high-rise buildings)
  - New minimally prescriptively compliant baseline after reclassification
- **Period of evaluation** – 30 years

Incremental Cost Information

- Statewide CASE Team to collect costs of base case and proposed technology
  - RS Means or other cost-estimating publications or software
  - Interviews with manufacturers, distributors or contractors
  - Interviews with stakeholders; building designers, Title 24 energy consultants, HERS Raters, subject matter experts
  - Design and other ‘soft’ costs are not part of the measure cost-effectiveness

Submeasure	Primary Cost Source
Fenestration thermal properties	RS Means and published product costs
Fenestration area metric	No applicable costs – reclassification only
QII	Interviews with building designers, HERS Raters, insulation contractors, and framers
Reduced thermal bridging	Interviews with building designers, contractors
Wall assembly U-factor	RS Means and published product costs

Preliminary Energy Savings Estimates

Preliminary Energy Savings Estimate				
Annual per Unit Electricity Savings* (kWh/sf-yr)	Annual per Unit Natural Gas Savings* (Therms/sf-yr)	First Year Statewide Electricity Savings (GWh/yr)	First Year Statewide Natural Gas Savings (Million Therms/yr)	Confidence Level (high, medium, low)
0.1	0.07	9.88	2.86	low

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process – Fenestration Properties

1. Design Phase

- Requires an integrative design process
  - Thermal properties must be specified early
  - Based on performance energy model needs
  - Placed on plans, communicated to procurement

2. Permit Application Phase

- New fenestration-classifications in performance modeling or prescriptive checklists
- Performance modeling may reveal need for more efficient windows as an available offset

Compliance Verification Process – Fenestration Properties

3. Construction phase

- Same as current construction process
- Need to retain and make available documentation for eventual inspection
  - Window stickers, specification sheets

4. Inspection Phase

- Will require awareness of code rules by construction/fenestration type

Compliance Verification Process – Window Area Limits

1. Design Phase

- Requires an integrative design process
  - Preliminary performance energy modeling
  - Significant performance modeling impact if area-limits are exceeded

2. Permit Application Phase

- Reclassification to window-to-floor area will invoke a change to existing forms
- Updated performance modeling required if design changes occur

Compliance Verification Process – Window Area Limits

3. Construction phase

- Same as current construction process

4. Inspection Phase

- Same as current inspection process

Compliance Verification Process - QII

1. Design Phase

- Requires an integrative design process
  - Consider inspection access and timing options when determining design
  - Communication with trades regarding quality expectations

2. Permit Application Phase

- Newly trigger installation forms, inspection forms, and registry requirements for high-rise buildings

Compliance Verification Process - QII

3. Construction phase

- Requires careful planning and oversight during construction
  - Cost of failure and mitigation
  - Just-in-time training of trades
  - Timing of access
- Inspections need to be concurrent with construction

4. Inspection Phase

- Third-party inspections need to be concurrent with construction for
  - Timing of inspections
  - Physical and visual access to air-sealing and insulation layers
  - Just-in-time training of trades

Compliance Verification Process – Thermal Bridging

1. Design Phase

- Requires an integrative design process
  - Construction details must be specified early
  - Based on performance energy model needs
  - Placed on plans, communicated to trades
- Designers need coordination with trades/specialists

2. Permit Application Phase

- New performance modeling or prescriptive compliance forms and methods required

Compliance Verification Process - Thermal Bridging

3. Construction phase

- Requires careful planning and oversight during construction
  - Cost of failure and mitigation
- Inspections may be concurrent with construction
  - Visual access

4. Inspection Phase

- Inspections may be concurrent with construction
- Newly created third-party verification methods possible

Compliance Verification Process – Wall Assemblies

1. Design Phase

- Requires an integrative design process
  - Construction details must be specified early
  - Based on performance energy model needs
  - Placed on plans, communicated to trades

2. Permit Application Phase

- New wall-classifications relative to fire-code definitions in performance modeling or prescriptive checklists

Compliance Verification Process – Wall Assemblies

3. Construction phase

- Use of continuous insulation may be new to many trades
- Construction of thicker wall assemblies may be new, and may be more difficult

4. Inspection Phase

- Will require awareness of code rules by construction type

Market Actors

Market actors involved in implementing this measure include:

Building owners/architects/electrical, mechanical designers/plumbing designers/energy consultants/builders/installers/plans examiners/building inspectors/HERS Raters/manufacturers

- Statewide CASE Team conducting interviews and surveys with designers, energy consultants, HERS Raters
- Statewide CASE Team conducting interviews with manufacturers, distributors.

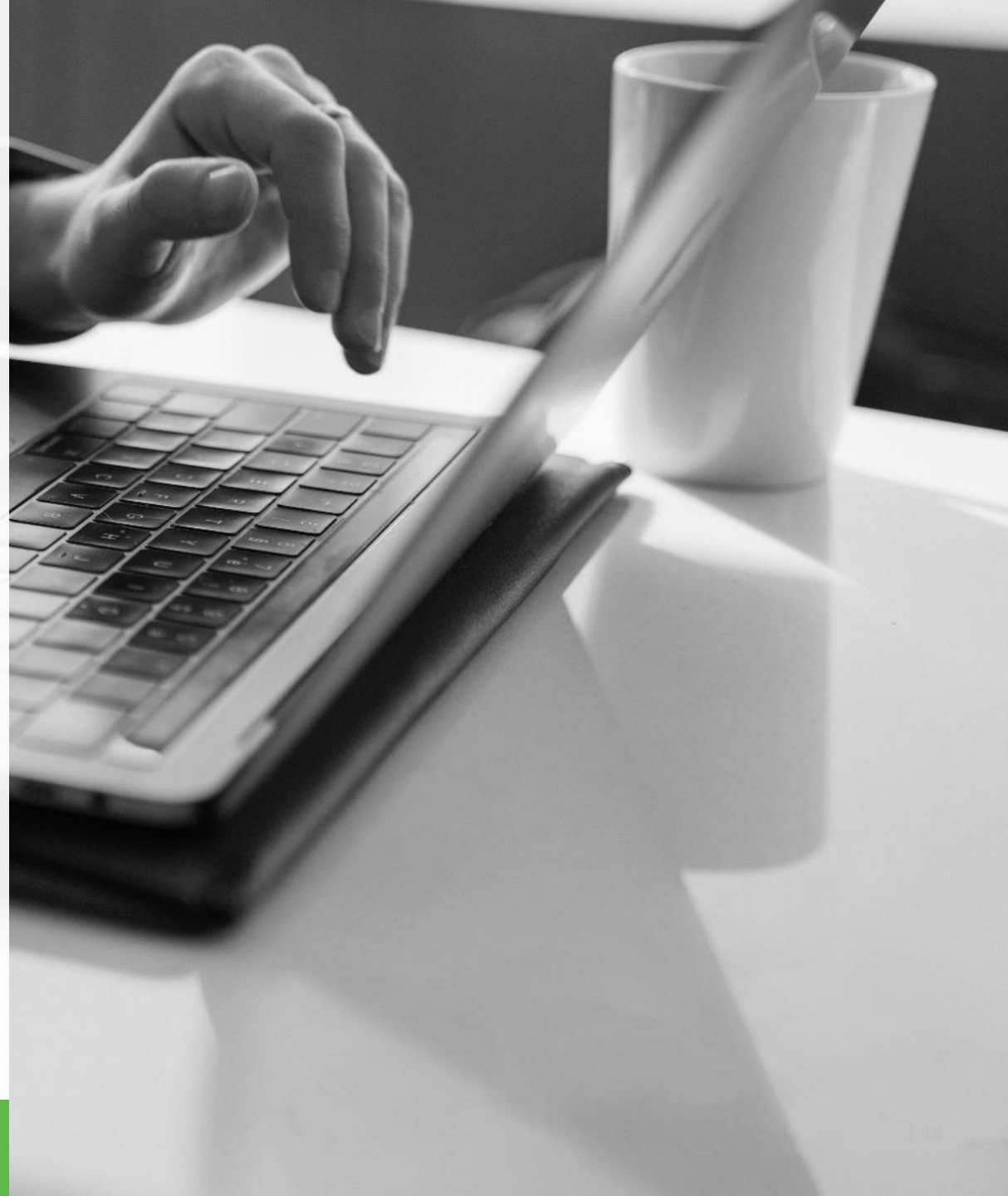
Poll

What method of wall-assembly classification seems most appropriate to define multifamily wall requirements in the energy code?

A. Fire-rating construction type – Type I, Type II, … Type V?
B. Construction material – Wood framed, metal framed, masonry, etc.
C. Maintain definition by # of stories; high-rise (4+) low-rise (3-)
D. Other (write in)
E. Don’t know

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language

- Newly created Component Package tables (akin to 150.1-B or 140.3-B)
  - Differentiating by construction type
  - New fenestration U-factor, SHGC, wall assembly U-factor, and window-area ratio limits
  - Table mock-up on the following slide

Draft Code Change Language – Component Package Mock-up

Multifamily				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation																			
Building Envelope Insulation	Walls	Above Grade	Construction Type X	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX
			Construction Type Y	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX
			Construction Type Z	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX	U 0.XXX
			Mass Wall Interior [4,5]	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.059 R 17
			Mass Wall Exterior [5]	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.077 R 13
	Fenestration	Construction Window Type X	Maximum U-factor	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX
			Maximum SHGC	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX
			Minimum VT	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX
		Construction Window Type Y	Maximum U-factor	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX
			Maximum SHGC	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX
			Minimum VT	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX	0.XX
		Maximum Total Area		YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%
		Maximum West Facing Area		YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%	YY%

Draft Code Change Language

- Updates to Reference Appendix JA4 – U-factor, C-factor, and Thermal Mass Data
  - Updated assembly U-factors to account for thermal bridging impact
  - New definitions and calculation methodologies to account for thermal bridge impacts
  - Updates to Section JA4.3.1 – Assembly wall U-factor default calculations by wall type

Draft Code Change Language

- Update Reference Appendix RA3.5.1 – Quality Insulation Installation Requirements and Protocols
  - Require QII on all multifamily building types (with likely Climate Zone 07 exemption)
  - Define QII requirements and protocols for high-rise construction types

RA3.5.1 Purpose and Scope

RA3.5 is a procedure for verifying the quality of insulation installation and air leakage control used in ~~lowrise~~ all residential buildings, including both high-rise and low-rise multifamily buildings. This procedure is to be followed by the insulation installer and a qualified Home Energy Rating System (HERS) rater must verify its conformance for meeting the requirements of Sections 150.1(c), [insert multifamily section number], and 110.7 of the Standards

Software Updates

- Current modeling capabilities
  - QII, window U-factor/SHGC, wall insulation and overall U-factor already modeled in CBECC-Res and CBECC-Com (and other compliance tools)
- Proposed modeling capabilities
  - QII modeling for high-rise multifamily needs to be added to CBECC-Com
  - Thermal bridging may require some changes to both inputs and calculations

Discussion and Next Steps

Feedback Requested

- We want to hear from you!
  - **Provide verbal feedback** now or over the chat
  - Send an **email** to info@title24stakeholders.com
    - **Email** the CASE Author(s)
    - **Email** the Statewide Utility Team
  - More information on pre-rulemaking for the 2022 California Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency
  - Submit a public comment to the California Energy Commission's docket
- Requesting input on this measure by **September 5, 2019**

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Thank you for your participation today

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Please complete the closing polls below

Upcoming Meetings

Meeting	Building Type	Date
Multifamily HVAC and Envelope	MF	Thursday, August 22, 2019
Lighting	MF, NR	Thursday, September 5, 2019
Grid Integration	MF, NR, SF	Tuesday, September 10, 2019
Covered Processes	NR	Thursday, September 19, 2019
Multifamily and Nonresidential Water Heating	MF, NR	Thursday, October 3, 2019
Single Family HVAC	SF	Thursday, October 10, 2019
Nonresidential HVAC	NR	Thursday, October 17, 2019
Nonresidential Envelope	NR	Thursday, October 24, 2019
Single Family Whole Building and Nonresidential Software Improvements	NR, SF	Tuesday, November 12, 2019