

Round
2

Welcome to the California Statewide Codes and Standards
Enhancement (CASE) Team's Stakeholder Meeting on
Single Family Whole Building Proposals


We will begin shortly.

In the meantime, please fill out the polls below.



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.



Join Audio Conference

How would you like to join the meeting's audio conference?

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Above: audio conference settings pop-up box

2022 TITLE 24 CODE CYCLE, PART 6

Second Utility-Sponsored Stakeholder Meeting

Single Family Whole Building

March 5, 2020

Meeting Guidelines

Part 1 of 3 - Muting

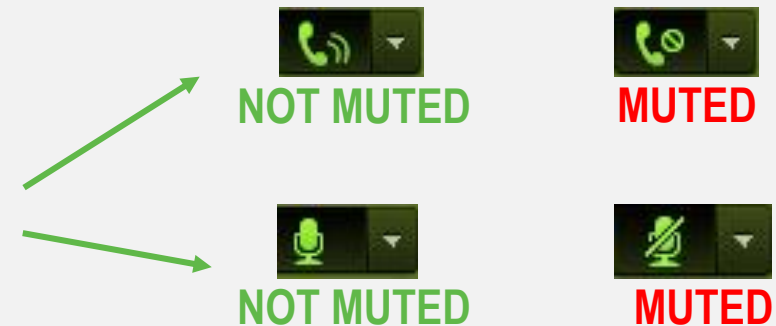
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- Please keep yourself **MUTED**.
- Wait for instructions and/or permission to unmute yourself during designated Q&A periods.

Two Options to Mute:

- 1 **Manually** mute your device, or;
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Meeting Guidelines

Part 2 of 3 - Participation

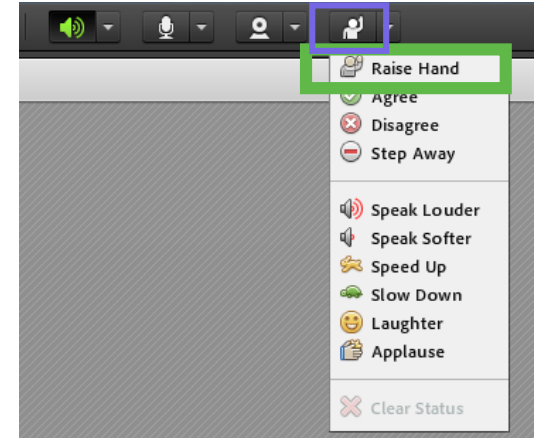
Participation Guidelines:

- **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.

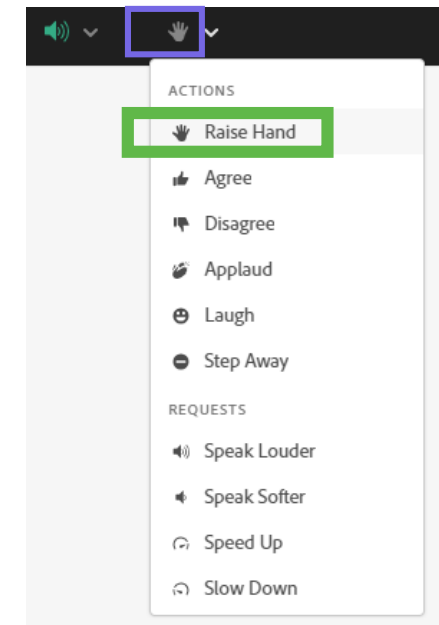
- **Other Meeting Feedback**

- 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 Guidelines

Part 3 of 3 – Discussion Ground Rules

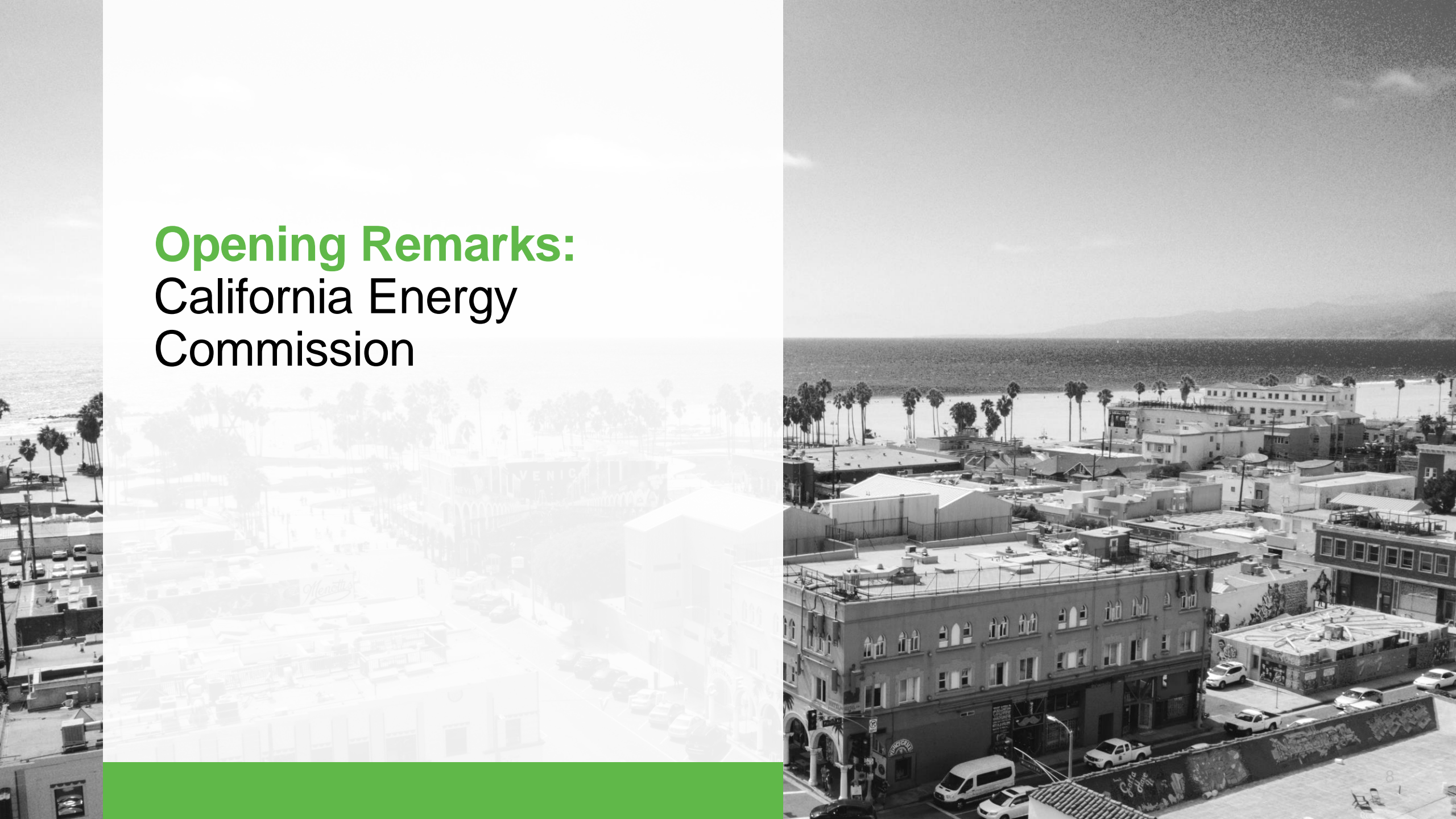
- **We want to hear your thoughts.**
 - Supporting and opposing viewpoints are welcome.
- **When making comments, please:**
 1. Unmute yourself;
 2. Clearly state your name and affiliation prior to speaking; and
 3. Place yourself back on mute when done speaking.
- **Calls are recorded** for note development, recordings will not be publicized.
- Notes and presentation material will be posted on Title24Stakeholders.com/events.



Agenda

1	Meeting Guidelines	<i>8:30 am</i>
2	Opening Remarks from the California Energy Commission	<i>8:35 am</i>
3	Overview & Welcome from the Statewide Utility Team	<i>8:40 am</i>
4	Presentation I: Energy Savings and Process Improvements for Additions and Alterations	<i>8:45 am</i>
6	Closing	<i>10:15 am</i>

Opening Remarks: 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 percent below 1990 levels by January 1, 2030

2022 Updated Standards Schedule



Estimated Date	ACTIVITY OR MILESTONE
November 2018 – November 2019	Updated Weather Data Files
November 2018 – December 2019	Metric Development
November 2018 - July 2019	Measures Identified and Approved
April 24, 2019	Present the Efficiency Measure Proposal Template for public to submit measures
October 17, 2019	Compliance Metrics and Climate Data Workshop
August 2019 – November 2019	First Round of Utility-Sponsored Stakeholder Workshops
January 2020	Research Version of CBECC Available with new weather data files and updated metric
March 2020 – April 2020	Second Round of Utility-Sponsored Stakeholder Workshops
March 10, 2020	Staff Workshop on the proposed changes for the ATTCP program
March 26, 2020	Staff Workshop on the EDR1
March 2020 – May 2020	All Initial CASE/PUBLIC Reports Submitted to Commission
July 2020 – August 2020	All Final CASE/PUBLIC Reports Submitted to the Commission
August 2020 – October 2020	Commission-Sponsored Staff Workshops
September 2020 – November 2020	Express Terms Developed (including New Multifamily Section)
February 2021	45-Day Language posted and sent to list serve, Start of 45-Day review/comment period
March 2021	Lead Commissioner Hearing
July 2021	Adoption of 2022 Standards at Business Meeting
September 2021	Final Statement of Reasons Drafted and Approved
July 2021	Adoption of CALGreen (energy provisions) - Business Meeting
December 2021	Approval of the Manuals
October 2021	Final Rulemaking Package delivered to CBSC
December 2021	CBSC Approval Hearing
January 2021	Software, Compliance Manuals, Electronic Documents Available to Industry
January 1, 2023	Effective Date

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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 support the California Energy Commission in developing proposed changes to the Energy Code (Title 24, Part 6) to achieve significant statewide energy use reductions through the development of code change proposals for the 2022 cycle 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



Stay Informed

Receive email notifications about upcoming meetings, notes and presentations from past meetings, and announcements about the California Energy Commission's rulemaking process.

Sign Up

Second Round Utility-Sponsored Stakeholder Meetings

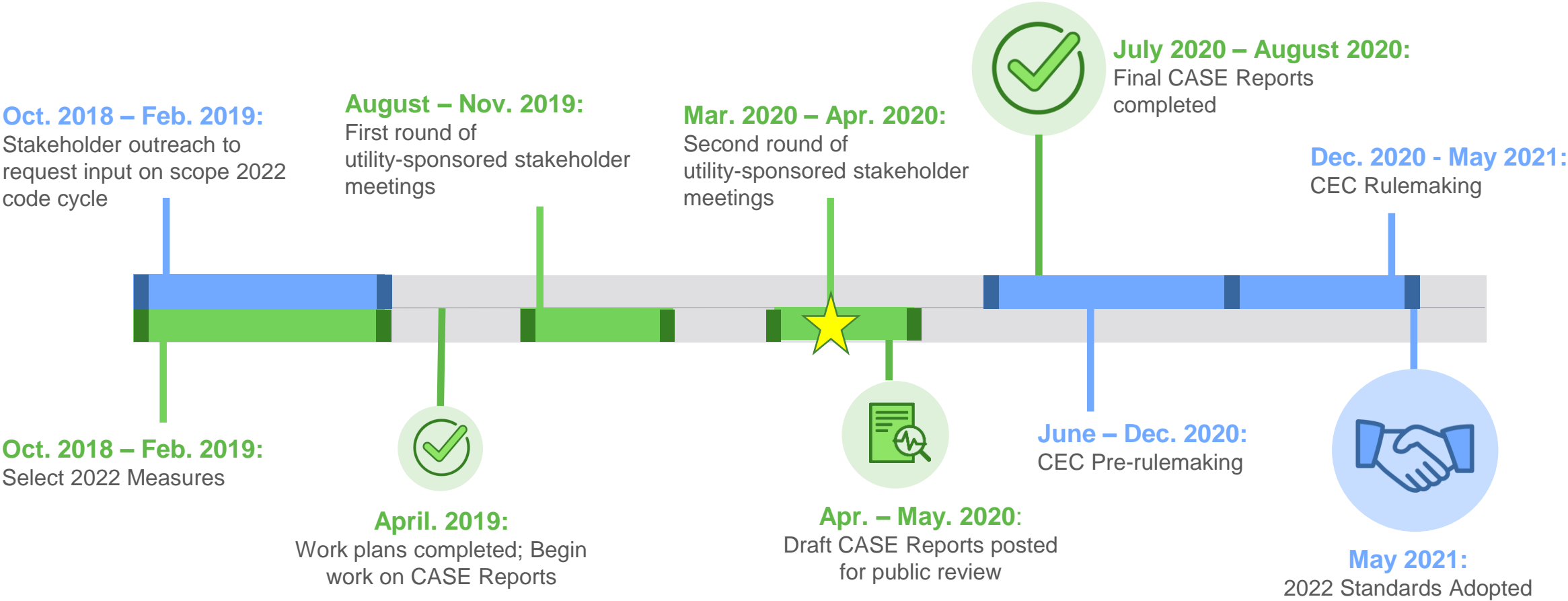
Meeting Topic	Building Type	Date
<i>Lighting</i>	NR/MF	Tuesday, March 3, 2020
Single Family Whole Building	SF	Thursday, March 5, 2020
Nonresidential and Single Family HVAC Part 1: Data Centers, Boilers, Air Distribution, Variable Capacity	NR/SF	Thursday, March 12, 2020
Water Heating and Multifamily All Electric Package	MF	Tuesday, March 17, 2020
Single Family Grid Integration	SF	Thursday, March 19, 2020
Multifamily HVAC and Envelope - to be rescheduled	MF	Thursday, March 26, 2020
Covered Processes Part 1: Refrigeration System Opportunities	NR	Thursday, April 2, 2020
Nonresidential HVAC and Envelope Part 2: Reduced Infiltration, HVAC Controls (Air Efficiency, DOAS)	NR	Tuesday, April 14, 2020
Covered Processes Part 2: Controlled Environmental Horticulture	NR	Thursday, April 16, 2020
Nonresidential Envelope Part 1: High Performance Envelope	NR	Thursday, April 23, 2020

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

2022 Code Cycle – Key Milestones

CEC Milestone

Utility Team Milestone



Comply With Me

Learn how to comply with California's building
and appliance energy efficiency standards

www.EnergyCodeAce.com

offers **No-Cost**

Tools ♠ Training ♠ Resources
to help you decode Title 24, Part 6 and Title 20



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.

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

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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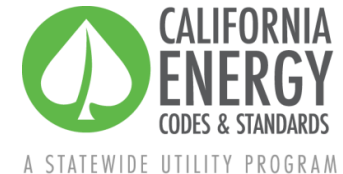
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Meeting Guidelines Reminder

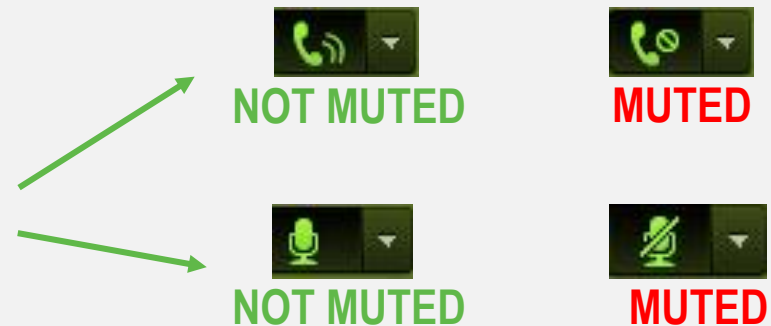
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Meeting Guidelines Reminder

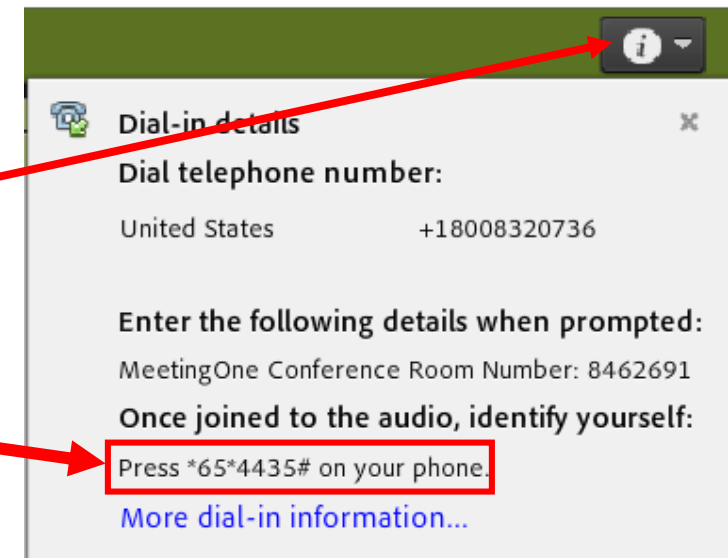
Pairing Guidelines:

If you dialed in to join the audio, please **pair your line**.

- Please keep yourself **MUTED**.
- Navigate to the (i) button in the top right of your screen.
- Click the pull-down menu and ***identify your line by entering your unique user ID on your phone.***

Steps to Pair Line:

- 1 **Select (i) button** pull-down on the top right of Adobe Connect window;
- 2 Identify your line using your unique code.



2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Energy Savings and Process Improvements for Additions and Alterations

Codes and Standards Enhancement (CASE) Proposal
Single Family | Energy Savings and Process Improvements for
Additions and Alterations

Alea German & Bill Dakin, *Frontier Energy*
March 5, 2020

Agenda

1 Today's Objectives

2 Proposal Background

Submeasure Presentations:

Roof Replacements

Attic Insulation

3

Electric Equipment Replacement

Duct Measures

Compliance Options

4 Questions and Next Steps

Today's Objectives

The focus of today's meeting includes:

1. **Review** Energy and Cost Calculations (*all measures*)
2. **Review** Market Analysis (duct leakage)
3. **Discuss** Technical Feasibility (*attic insulation*)
4. **Consider** Compliance and Enforcement (*attic insulation, duct leakage*)
5. **Review** Code Language (*roof alterations, attic insulation, compliance options*)



Proposal Background

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated	Changes from Round 1?
A: Prescriptive Changes: <i>Roof Replacements: Cool Roofs & Low-Slope Roof Insulation</i>	Prescriptive	Yes	100.1, 150.2(b)1I	CF1R-ALT-05-E, CF2R-ALT-05-E, CF2R-ENV-04	Yes
A: Prescriptive Changes: <i>Attic Insulation & Air Sealing</i>	Prescriptive	Yes	110.8(d)1, 150.2(a)1Bi, 150.2(b)1A	CF1R-ALT-05-E, CF2R-ENV-02	Yes
A: Prescriptive Changes: <i>Electric Equipment Replacements</i>	Prescriptive	Yes	150.2(b)1C, 150.2(b)1G, 150.2(b)1Hiid	CF1R-ALT-02-E, CF1R-ALT-05-E	Minor
A: Prescriptive Changes: <i>Duct Measures</i>	Prescriptive	Yes	150.2(b)1D 150.2(b)1Diib	CF1R-ALT-02-E, CF1R-MCH-01-H	Yes
B: Alteration Compliance Options	Performance Options	Yes	n/a	n/a	Yes

Code Change Proposal: Additional Resources

First-Utility Sponsored Meeting

The Statewide CASE Team held its first utility-sponsored stakeholder meeting for this topic on **November 12, 2019.**



Resources on

Presentation slides and **Submeasure summary** documents available that cover the following:

- ✓ Measure Background
- ✓ Market Overview & Analysis
- ✓ Technical Feasibility
- ✓ Compliance & Enforcement
- ✓ Draft Code Language

Also available in the **resources tab** in today's presentation.

Methodology for Energy Impacts Analysis

- Energy savings using CBECC and existing home prototypes
 - Statewide savings calculated based on estimates of building stock impacted for each submeasure
 - RASS¹, CalCERTS², & other resources

Tools Used	CBECC-Res 2022.0.1 Research Version
Building Prototypes Used	Single Family Low-rise Multifamily
Climate Zones Modeled	All 16 Climate Zones

Assumptions for Energy Impacts Analysis

- 30-year period of evaluation

SINGLE FAMILY EXISTING CONDITIONS	
Alteration Measures	Addition Measures
<ul style="list-style-type: none">• 1,665 ft² existing home, 3 bedrooms• 1990s vintage, mixed fuel<ul style="list-style-type: none">• R-13 walls, R-19 attic/roof• Dual pane metal windows• ~5 year old HVAC equipment<ul style="list-style-type: none">• 13 SEER, 80 AFUE, 15% duct leakage	<ul style="list-style-type: none">• 225 ft² addition• Addition per 2019 prescriptive standards



Submeasure A: Prescriptive Changes

Submeasure A1: Roof replacements

Submeasure A2: Attic insulation

Submeasure A3: Electric equipment

Submeasure A4: Duct measures

Submeasure B: Compliance options

Code Change Proposal Summary

- Prescriptive requirements for single family roof replacements
 - Expand cool roof requirements to additional climate zones
 - Add R-14 above roof deck insulation requirement for low-slope roofs

Climate Zones	Steep-Slope Reflectance	
	Existing	Proposed
1-3, 5-7, 16	NR	NR
4, 8, 9	NR	0.20
10-15	0.20	0.20

Climate Zones	Low-Slope Reflectance		Low-Slope Insulation	
	Existing	Proposed	Existing	Proposed
3, 5	NR	NR	NR	NR
1, 2	NR	NR	NR	R-14
6, 7	NR	0.63	NR	NR
4, 8-12, 14	NR	0.63	NR	R-14
13, 15	0.63	0.63	NR	R-14

- Major changes from Round 1 stakeholder meeting
 - Remove attic insulation requirement tied to steep-slope roof replacements
 - Revise exceptions for cool roof requirements

A low-slope roof has a ratio of rise to run of <2:12 while a steep-slope roof has a ratio of rise to run ≥2:12.

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts
- Cost Impacts
 - Incremental costs
 - Maintenance costs
 - Energy cost savings
- Cost-effectiveness



Definition of Baseline and Proposed Conditions



Baseline Conditions

- No cool roof
- 2 conditions:
 - R-11 & R-19 attic insulation for steep-slope
 - R-11 & R-19 rafter insulation for low-slope



Proposed Conditions

- Cool roof (minimum aged solar reflectance / thermal emittance)
 - Steep-slope = 0.20 / 0.75
 - Low-slope = 0.63 / 0.75
- Low-slope insulation
 - R-14 continuous above deck

2023 Construction Forecast: Existing Buildings

Steep Slope Cool Roof Alterations

Building Type	Total Statewide Existing Stock in 2023 (homes/dwelling units)	Percent of Homes Impacted by Proposal	Statewide Homes Impacted by Proposal in 2023
Single Family	8,828,191	1.58%	139,799
Low-Rise Multifamily	3,620,491	1.16%	41,919
Total	12,448,682	1.46%	181,718

- Statewide building stock estimates provided by the Energy Commission
- 2009 RASS data to estimate steep-slope vs. low-slope roofs¹
- 7 percent of roofs are replaced annually²

Are you aware of a better source of data on residential roof replacement rates in California?

2023 Construction Forecast: Existing Buildings

Low Slope Cool Roof Alterations

Building Type	Total Statewide Existing Stock in 2023 (homes/dwelling units)	Percent of Homes Impacted by Proposal	Statewide Homes Impacted by Proposal in 2023
Single Family	8,828,191	0.91%	79,991
Low-Rise Multifamily	3,620,491	3.10%	112,184
Total	12,448,682	1.54%	192,174

- Statewide building stock estimates provided by the Energy Commission
- 2009 RASS data to estimate steep-slope vs. low-slope roofs¹
- 7 percent of roofs are replaced annually²

Are you aware of a better source of data on residential roof replacement rates in California?

2023 Construction Forecast: Existing Buildings

Low Slope Roof Insulation

Building Type	Total Statewide Existing Stock in 2023 (homes/dwelling units)	Percent of Homes Impacted by Proposal	Statewide Homes Impacted by Proposal in 2023
Single Family	8,828,191	0.83%	73,156
Low-Rise Multifamily	3,620,491	2.76%	99,810
Total	12,448,682	1.39%	172,966

- Statewide building stock estimates provided by the Energy Commission
- 2009 RASS data to estimate steep-slope vs. low-slope roofs¹
- 7 percent of roofs are replaced annually²

Are you aware of a better source of data on residential roof replacement rates in California?

Energy Savings Results: Single Family Steep-Slope Cool Roofs

First Year Energy Savings

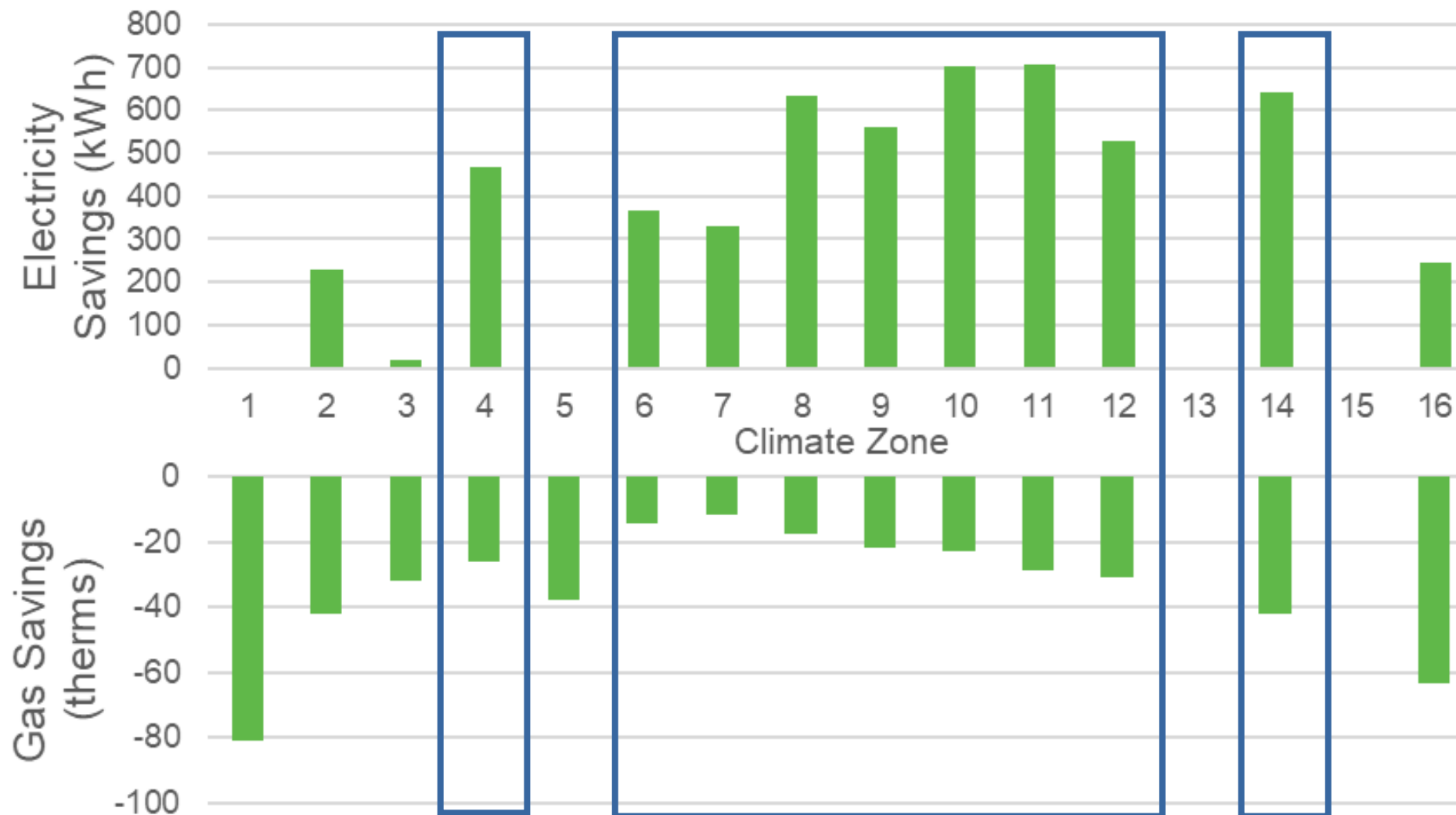
Range of
55 - 68 kWh/yr



Blue box
indicates CZs
where measure
is proposed

Energy Savings Results: Single Family Low-Slope Cool Roofs

First Year Energy Savings

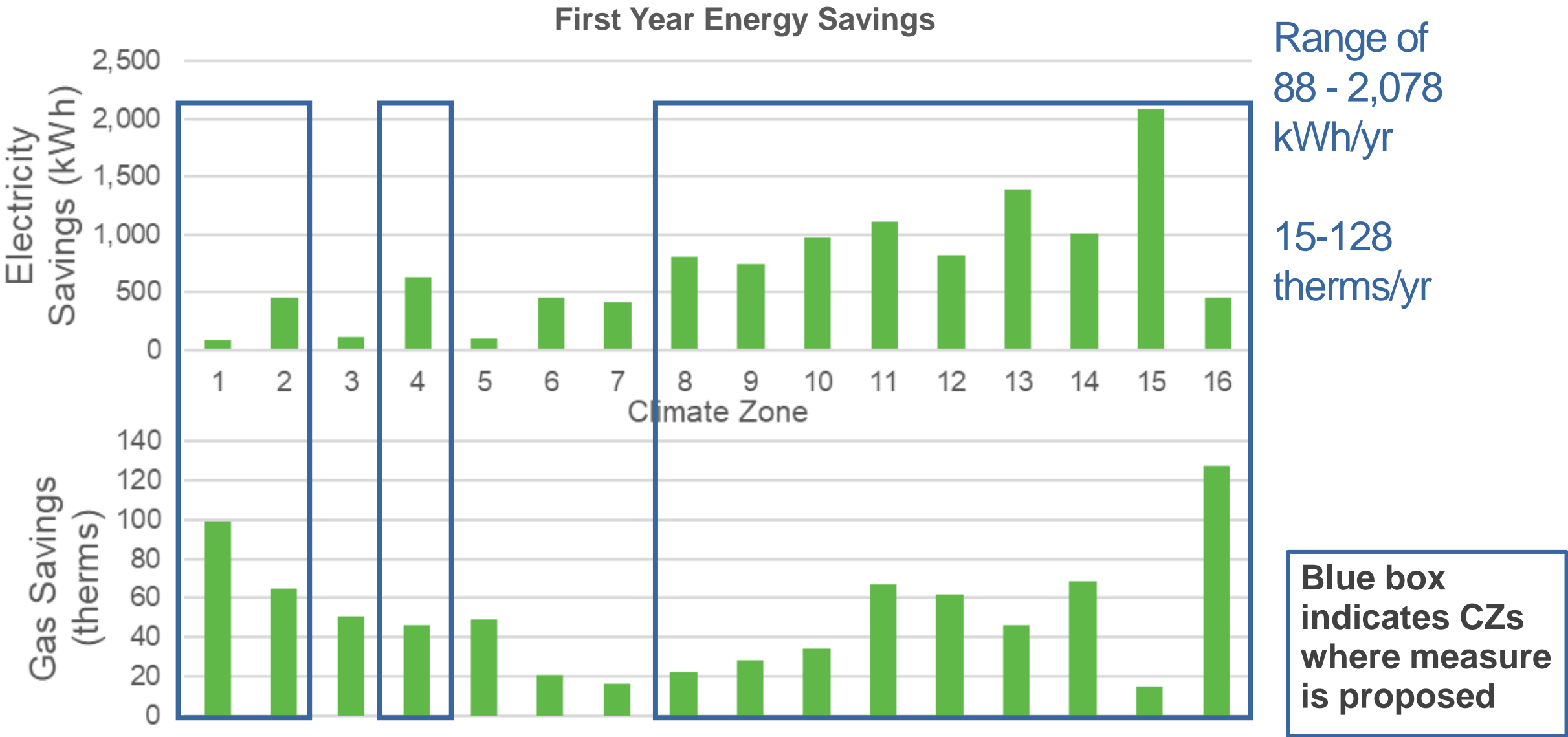


Range of
330 - 706
kWh/yr

Blue box
indicates CZs
where measure
is proposed

Energy Savings Results: Single Family

Low-Slope Roof Insulation (vs existing roof with R-11 cavity insulation)



Incremental Cost Information

- **Costs** of base case and proposed technology were **collected through**:
 - Previous project work: CASE and Reach Code reports¹
 - Interviews with manufacturers and contractors
 - Online product research
 - Review of product cost on Lowes & Home Depot websites

¹ 2013 CASE Report: Residential Roof Envelope Measures; 2019 Retrofit Reach Code Report; 2016 TRC Reach Code Report; TRC Palo Alto Report

Incremental Per Unit Cost

Over 30 Year Period of Analysis

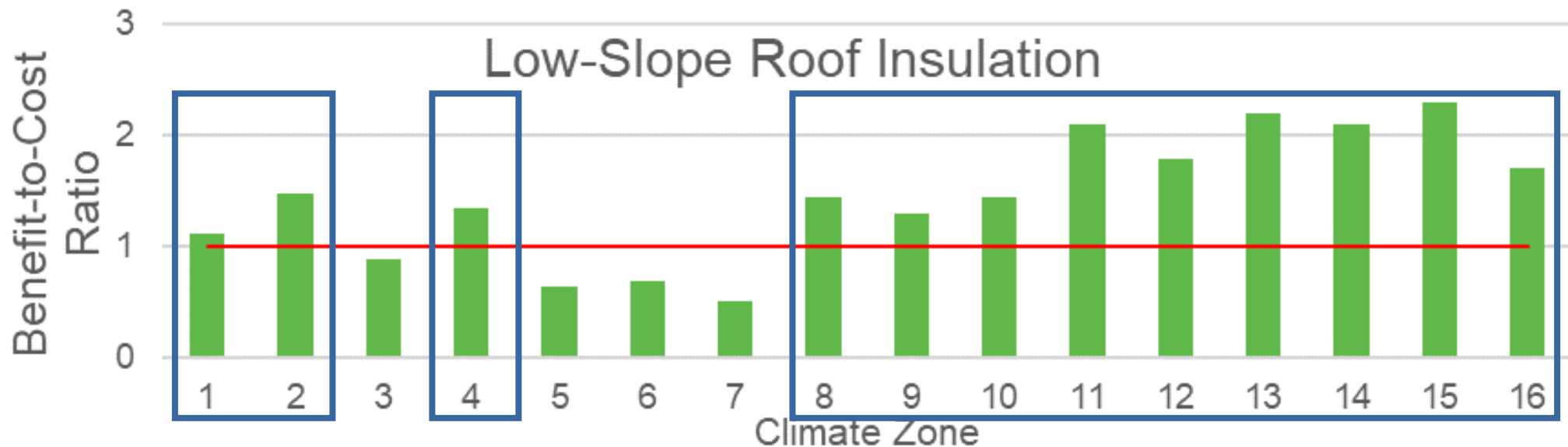
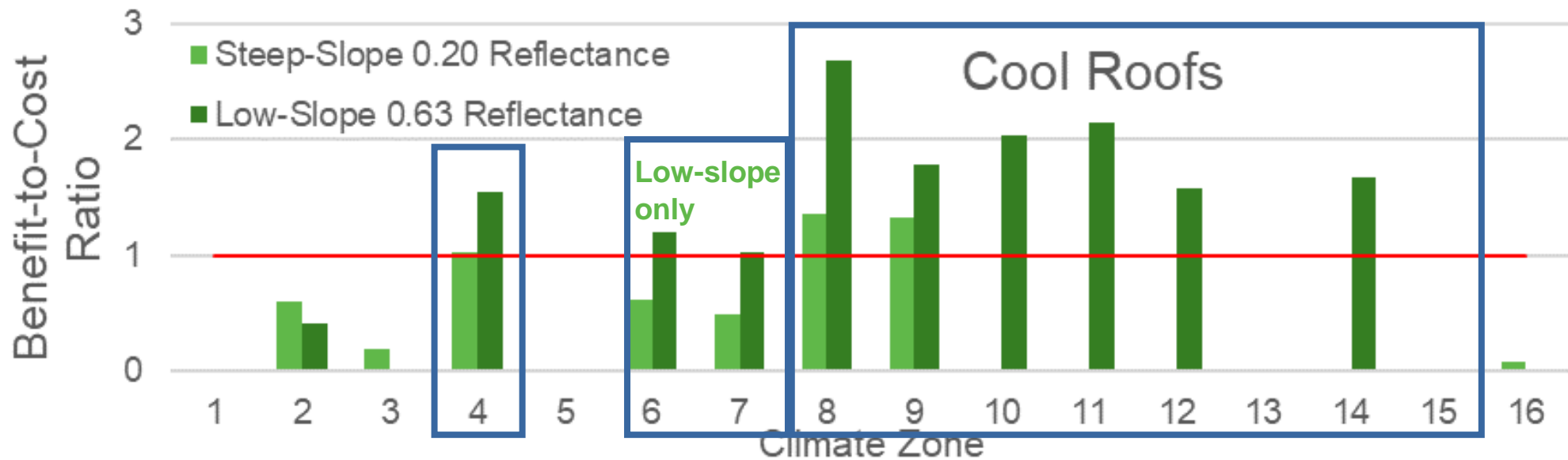
Incremental Cost – Cool Roof		
	Steep-slope cool roof / 0.20 solar reflect.	Low-slope cool roof / 0.63 solar reflect. (built-up roof)
Material	\$0.19 / ft ² roof	\$0.53 / ft ² roof
Labor	\$0	\$0
Present Value of Replacement Cost	\$0.07 / ft ² roof (20-yr lifetime)	\$0.34 / ft ² roof (15-yr lifetime)
Total	\$0.26 / ft² roof	\$0.86 / ft² roof

Incremental Cost	
Low-slope Roof Insulation – R-14	
Material	\$2.12 / ft ² roof
Labor	\$1.29 / ft ² roof
Replacement Cost	\$0
Total	\$3.41 / ft² roof

**Do you find
these costs to
be reasonable?**

Cost Effectiveness Results by Climate Zone

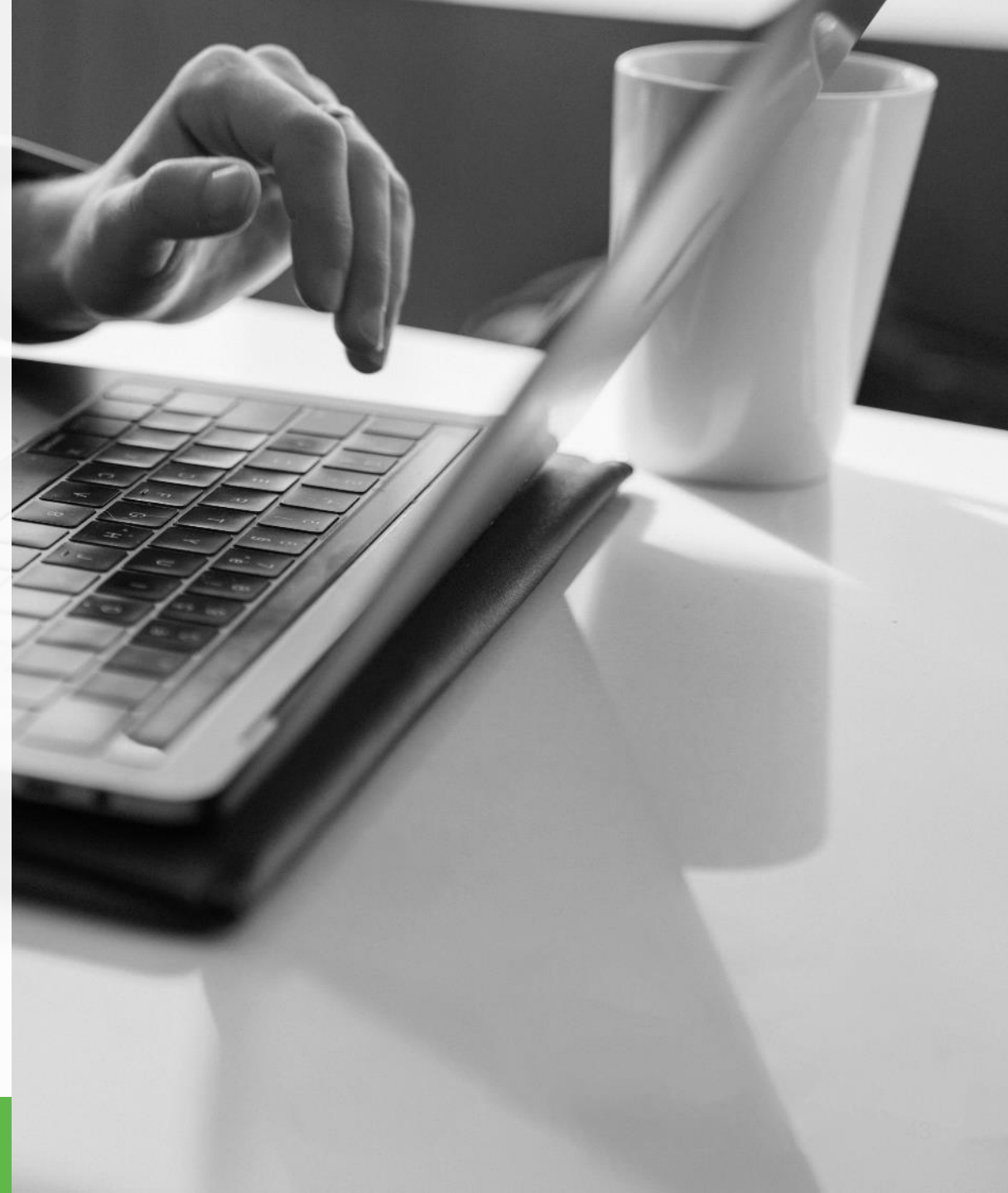
Red line shows cost effectiveness threshold



Blue box indicates CZs where measure is proposed

Proposed Code Changes

- Draft Code Change Language



Draft Code Change Language – Steep Slope Cool Roof Exceptions

- **Updated** draft code language for this submeasure is available in the **resources tab**.

Proposed exceptions to **150.2(b)1ii** steep-slope cool roof requirements

- Buildings with at least R-38 ceiling or roof insulation
- Buildings with a radiant barrier in the attic (not installed directly over spaced sheathing)
- Buildings with R-2 or greater insulation above the roof deck
- Buildings that have no ducts in the attic in Climate Zones 4, 9, 10, 12, and 14

Following exceptions removed

- Air-space of 1.0 inch between the top of the roof deck to the bottom of the roofing product
- The installed roofing product with a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product.
- Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9.

Draft Code Change Language – Low-Slope Roof Insulation Exceptions

- **Updated** draft code language for this submeasure is available in the **resources tab**.

Proposed exceptions to **150.2(b)1Iii** low-slope cool roof requirements

- Existing roofs with a U-factor ≤ 0.058 or R-10 continuous
- Current exceptions to insulation requirements for non-residential and high-rise residential buildings, exceptions b-d to **141.0(b)2Biii**
 - Insulation may be reduced if rooftop mechanical equipment will not be lifted as part of the roof replacement and 8" base flashing height cannot be met with existing curbs.
 - Insulation may be reduced if replaced roofing abuts penthouse and parapet walls in certain scenarios and 8" base flashing height cannot be met.
 - Allowance for tapered insulation.

Poll

For projects that apply for one of the exceptions to the insulation requirements for low-slope roof replacements, how should compliance be verified?

- A. Installer indicates exception applies on Certificate of Compliance/Installation
- B. Additional documentation provided by installer, such as photographs
- C. Physical verification by building inspector
- D. Physical verification by HERS Rater
- E. Don't know



Submeasure A: Prescriptive Changes

Submeasure A1: Roof replacements

Submeasure A2: Attic insulation

Submeasure A3: Electric equipment

Submeasure A4: Duct measures

Submeasure B: Compliance options

Code Change Proposal Summary

- Prescriptive requirement for altered ceilings

Climate Zones	Existing	Proposed
1, 3, 5-7	R-19	R-19
2, 4, 8-16	R-19	R-49 + air sealing

- Applies when *Entirely New or Complete Replacement Duct System* installed in attic
- Major changes from Round 1 stakeholder meeting
 - Attic insulation triggered by new duct system in attic
 - Attic air sealing included at time of attic insulation
 - Additional climates added

Not covered today

- *Attic insulation for additions $\leq 700\text{ft}^2$ - Align with new construction: Tables 150.1-A and B Option B for ceiling insulation*

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts
- Cost Impacts
 - Incremental costs
 - Maintenance costs
 - Energy cost savings
- Cost-effectiveness



Definition of Baseline and Proposed Conditions



Baseline Conditions

Altered Ceilings

- 2 conditions: R-11 & R-19 attic insulation
- 10 ACH₅₀



Proposed Conditions

Altered Ceilings

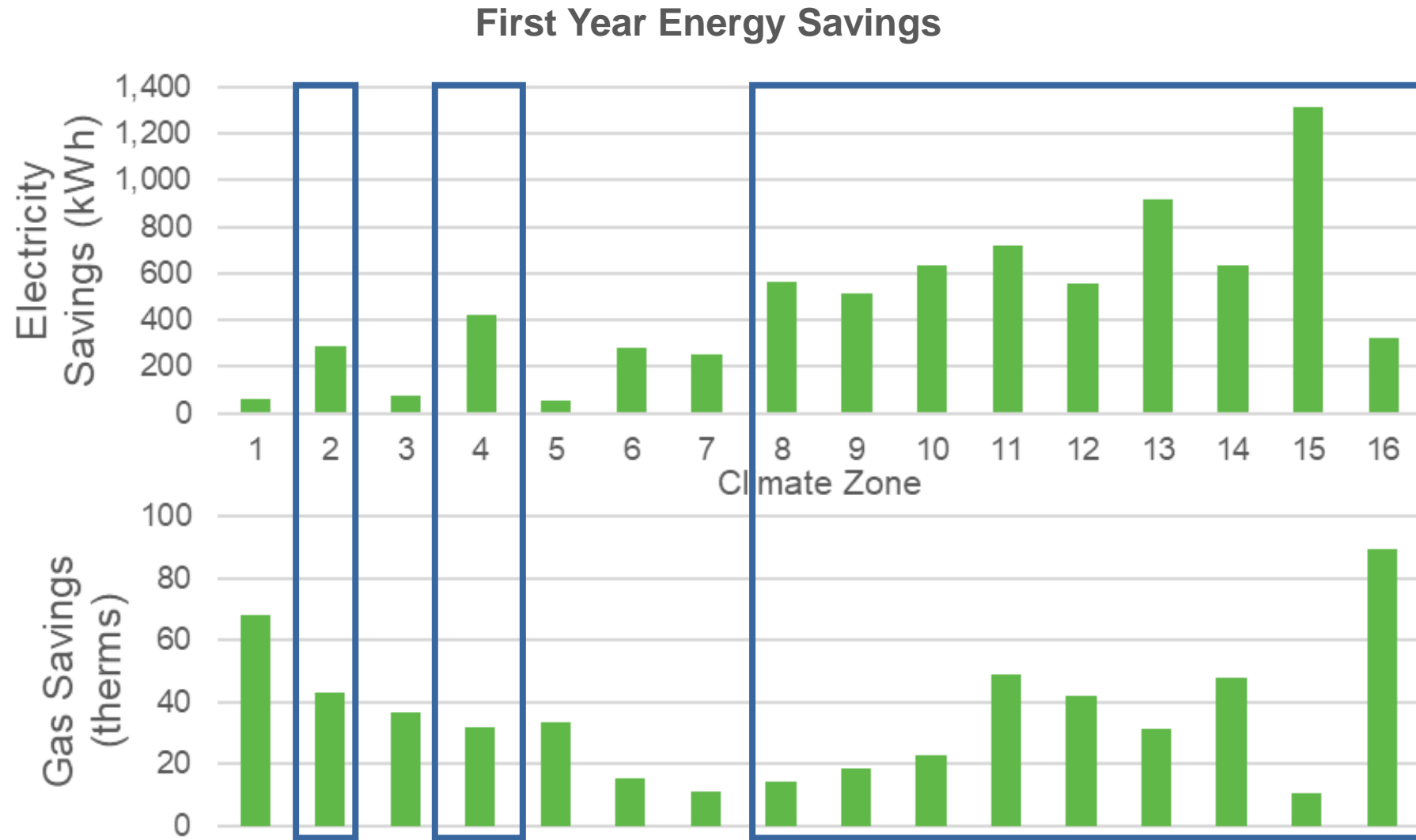
- R-49 attic insulation
- 8.6 ACH₅₀

2023 Construction Forecast: Existing Buildings Attic Insulation

Building Type	Total Statewide Existing Stock in 2023 (homes/dwelling units)	Percent of Homes Impacted by Proposal	Statewide Homes Impacted by Proposal in 2023
Single Family	8,828,191	0.16%	14,143
Low-Rise Multifamily	3,620,491	0.004%	145
Total	12,448,682	0.11%	14,287

- Statewide building stock estimates provided by the Energy Commission
- CalCERTS data for projects with altered ceilings & complete duct replacements

Energy Savings Results: Single Family (R-11 attic insulation baseline)



Range of
56 -1,318
kWh/yr

10 – 89
Therms/yr

Blue box
indicates CZs
where measure
is proposed

Incremental Cost Information

- Costs of base case and proposed technology were collected through:
 - Previous project work, contractor interviews, online product research

Incremental Per Unit Cost

Over 30 Year Period of Analysis

	Altered ceiling / R-49 insulation, air sealing	Source
Attic insulation	\$1.71 / ft ² ceiling	Contractor costs from prior year project, cross referenced with Home Depot material costs
Air sealing	\$0.72 / ft ² ceiling	Contractor costs from prior year project
Replace recessed cans	\$0.26 / ft ² ceiling	\$30/fixture for material from Home Depot. \$75/hr labor, replace 4 cans/hour. 7 cans per prototype home
Total	\$2.69 / ft² ceiling	

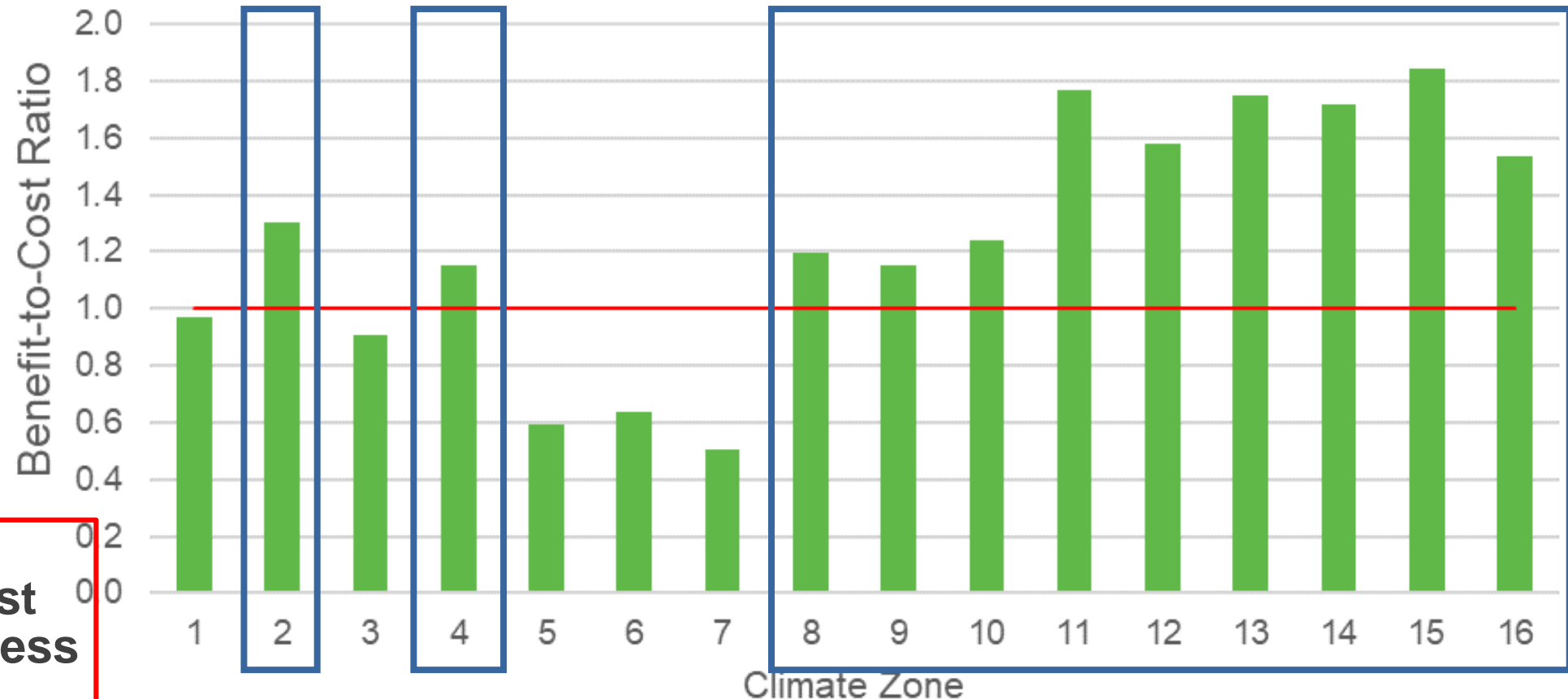
Do you find these costs to be reasonable?

Recessed can costs based on new IC-AT can & trim kit. Lower costs for fire-rated cover approach.

Cost Effectiveness Results by Climate Zone

- Cost effectiveness impacted by existing condition
- Exception with $\geq R-19$ attic insulation

Blue box indicates CZs where measure is proposed



Red line shows cost effectiveness threshold

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions



Technical Considerations

- Opportunity to address air sealing when adding insulating
 - Requires removal of existing insulation
 - Focus on big offenders
 - Non IC-AT rated recessed cans
 - Venting, plumbing, electrical penetrations
 - Soffits, dropped ceilings, or chases with no air barrier
- Change to standard practices at time of new ducts
 - Not typical work scope for HVAC – often requires additional contractor

What other challenges can you identify?



Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection



Compliance and Enforcement – Attic Insulation

- Additional requirement when entirely new duct system is installed
- May impact compliance with code
- How to verify air sealing?
 - Inspector can visually verify sealing before insulation is installed
 - Blower door before and after quantifies impact but adds cost

Poll

If attic air sealing is required, how best should air sealing be verified by inspector?

- A. Visual inspection before insulation installed in attic
- B. Pre- and post- blower door test by contractor
- C. Pre- and post- blower door test by HERS Rater
- D. Rely on contractor to self-certify on CF2R
- E. Don't know

Poll

Do you think the ***attic insulation*** requirement will result in more duct replacement projects to be completed without a permit?

- A. Yes, do not support the proposed code change
- B. Yes, but still support the proposed code change
- C. No
- D. Don't know

Poll

Do you think the ***air sealing*** requirement will result in more duct replacement projects to be completed without a permit?

- A. Yes, do not support the proposed code change
- B. Yes, but still support the proposed code change
- C. No
- D. Don't know

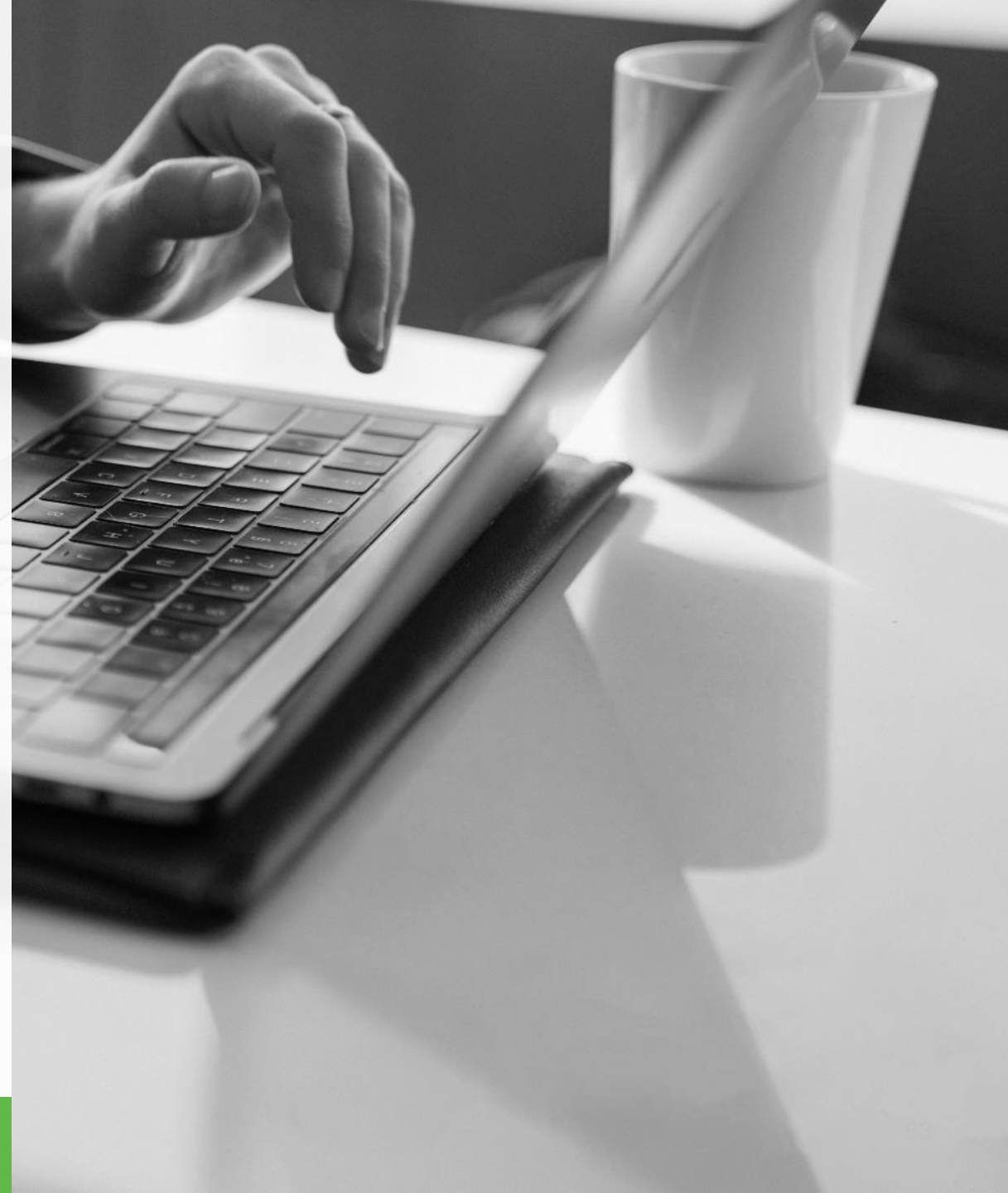
Poll

Would you support an alternative path for the attic air sealing requirements of this measure when high efficiency HVAC equipment is specified?

- A. Yes
- B. No
- C. Don't know

Proposed Code Changes

- Draft Code Change Language



Draft Code Change Language

- **Updated** draft code language for this submeasure is available in the **resources tab**.

Section 150.2(b)1A. **Ceiling Insulation.** Vented attics in Climate Zones 2, 4, and 8 through 16 shall meet the following:

- Insulated to achieve a weighted U-factor of 0.020 or R-49 ceiling insulation
- Air seal all accessible areas of the ceiling plane between the attic and the conditioned space in accordance with Section 110.7
- Recessed downlight luminaires in the ceiling are covered with insulation to the same depth as the rest of the attic (replace non IC-rated fixtures or fit with fire-rated cover)
- Attic ventilation shall comply with CBC requirements

Draft Code Change Language – Exceptions

1. Exception from air sealing & recessed can requirements
 1. Buildings with at least R-19 existing insulation
2. Exception from all requirements
 1. Buildings with at least R-38 existing insulation
 2. Buildings without attic access to the attic area
 3. Buildings where the alteration that would directly cause the disturbance of asbestos
 4. Buildings with knob and tube wiring located in the vented attic
 5. Where the accessible space in attic is not large enough to accommodate required R-value

Do you agree with these exceptions?

Additional exceptions?



Submeasure A: Prescriptive Changes

Submeasure A1: Roof replacements

Submeasure A2: Attic insulation

Submeasure A3: Electric equipment

Submeasure A4: Duct measures

Submeasure B: Compliance options

Code Change Proposal Summary

- HVAC Replacements:
 - Prohibit electric resistance replacement heating when the heating system is part of a new or replacement ducted cooling system
- Water Heater Replacements:
 - Prohibit electric resistance replacement water heaters:
 - Except when the existing electric resistance water heater is located within conditioned space or a space that cannot accommodate a heat pump water heater
- Major changes from Round 1 stakeholder meeting
 - Water heating - clarify exceptions

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts
- Cost Impacts
 - Incremental costs
 - Maintenance costs
 - Energy cost savings
- Cost-effectiveness



Definition of Baseline and Proposed Conditions



Baseline Conditions

Space Heating

- New electric ducted furnace + A/C (14 SEER)
- New ductwork, 5% leakage

Water Heating

- New storage electric resistance water heater in garage (0.92 UEF)



Proposed Conditions

Space Heating

- New ducted heat pump (14 SEER, 8.2 HSPF)
- New ductwork, 5% leakage

Water Heating

- New heat pump water heater in garage (2.0 UEF)

2023 Construction Forecast: Existing Buildings

Electric Space Heating

Building Type	Total Statewide Existing Stock in 2023 (homes/dwelling units)	Percent of Homes Impacted by Proposal	Statewide Homes Impacted by Proposal in 2023
Single Family	8,828,191	0.04%	3,461
Low-Rise Multifamily	3,620,491	0.11%	3,922
Total	12,448,682	0.06%	7,383

- Statewide building stock estimates provided by the Energy Commission
- 2009 RASS data to estimate homes with central forced air electric furnace and ducted air conditioning¹
- 10 percent annual changeout rate for HVAC systems²

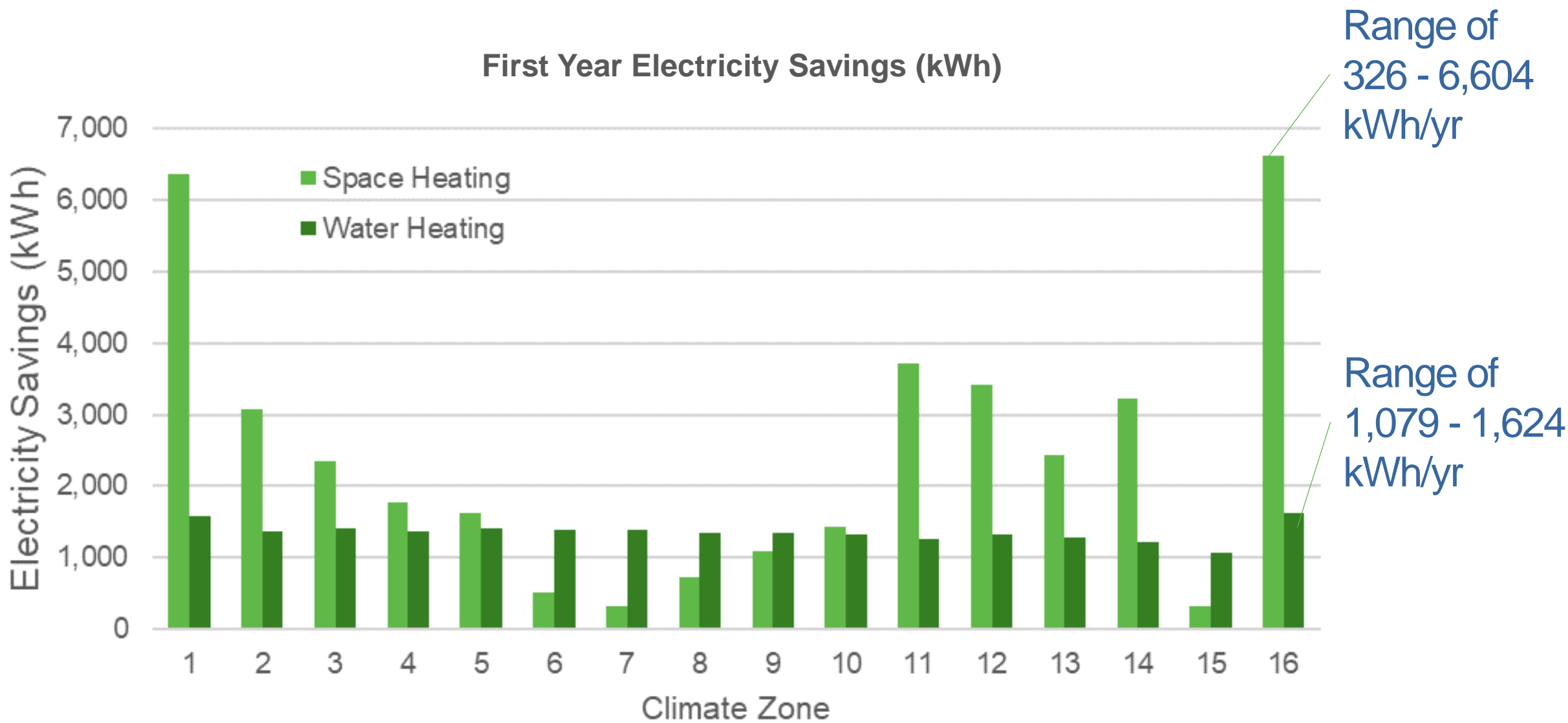
2023 Construction Forecast: Existing Buildings

Electric Water Heating

Building Type	Total Statewide Existing Stock in 2023 (homes/dwelling units)	Percent of Homes Impacted by Proposal	Statewide Homes Impacted by Proposal in 2023
Single Family	8,828,191	0.25%	21,932
Low-Rise Multifamily	3,620,491	0.45%	16,199
Total	12,448,682	0.31%	38,132

- Statewide building stock estimates provided by the Energy Commission
- 2009 RASS data to estimate homes with electric water heaters¹
- 4 percent annual changeout rate for DHW systems¹

Energy Savings Results: Single Family



Incremental Cost Information – Space Heating

- Heat pump costs were collected through:
 - Online product research (HVAC Direct)
 - 20 year lifetime for furnace & A/C, 15 year lifetime for heat pump¹
 - Incremental costs assume material costs only (assumes no incremental labor)

Incremental Per Unit Cost *Over 30 Year Period of Analysis*

	Heat pump vs electric resistance furnace & A/C
Material	\$408
Labor	\$0
Present Value of Replacement Cost	\$1,733
Total	\$2,141

Are these costs reasonable?

Incremental Cost Information – Water Heating

- Heat pump water heater costs were collected through:
 - Interviews with contractors, 1 project quote & online product research
 - 13 year lifetime for both water heaters¹
 - Material & labor costs included

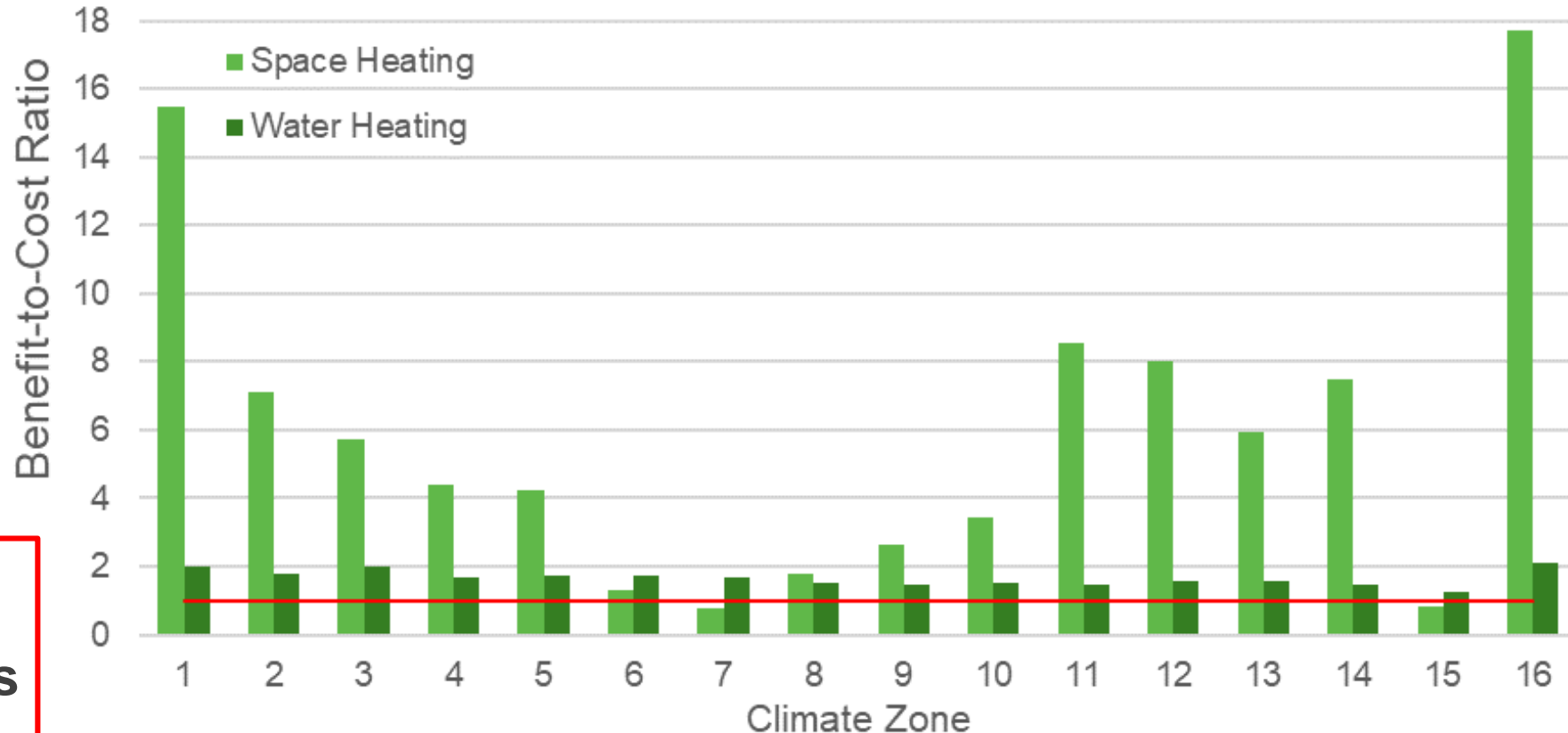
Incremental Per Unit Cost *Over 30 Year Period of Analysis*

	Heat pump water heater vs electric resistance storage
Material	\$920
Labor	\$1,080
Present Value of Replacement Cost	\$1,719
Total	\$3,719

Are these costs reasonable?

Cost Effectiveness Results

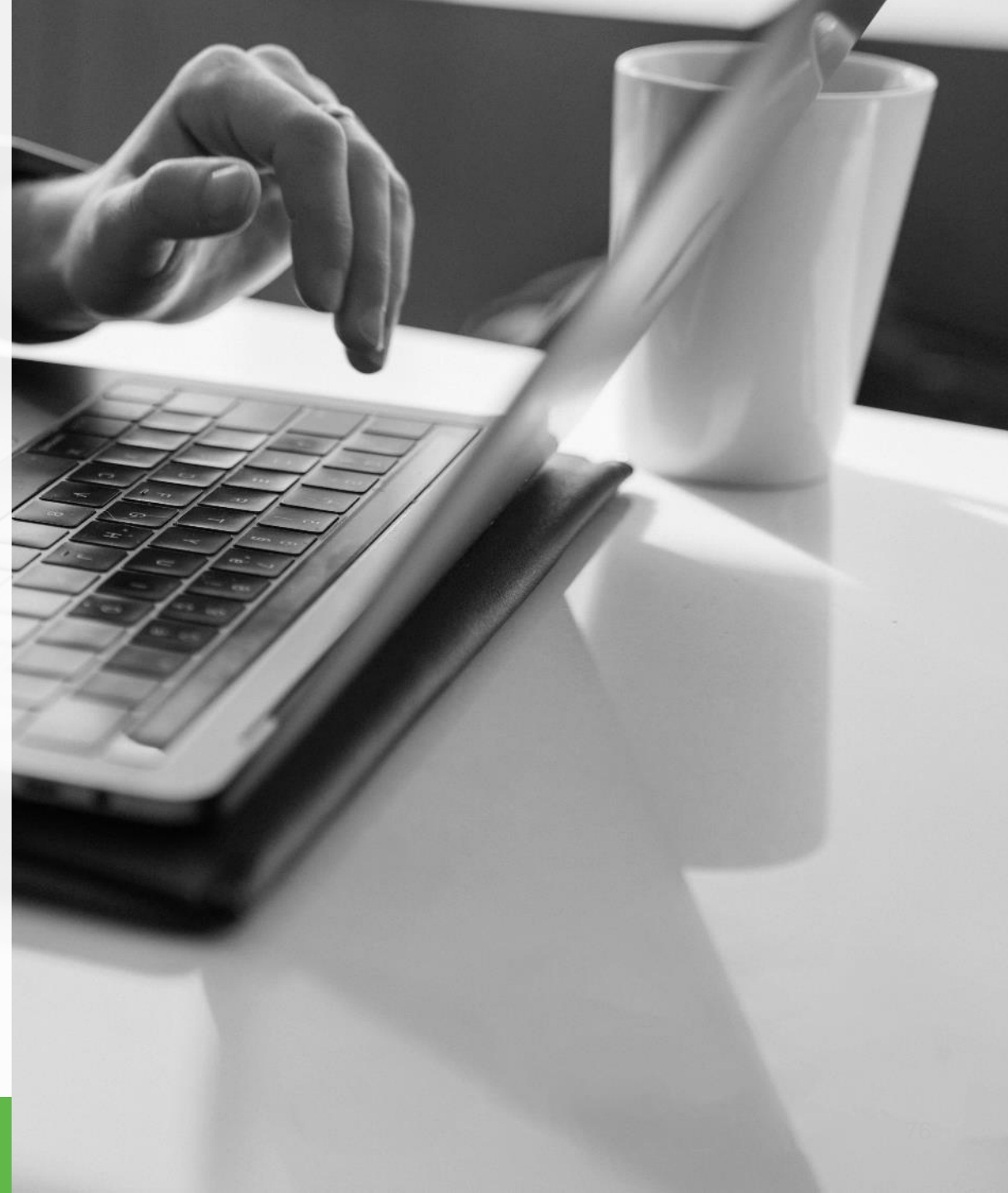
- Water heating **cost effective** in all climate zones
- Space heating **cost effective** in all but two climates: CZ7 & CZ15



Red line
shows cost
effectiveness
threshold

Proposed Code Changes

- Draft Code Change Language



Draft Code Change Language – Electric Equipment Replacement

- **Updated** draft code language for this submeasure is available in the **resources tab**.



Submeasure A: Prescriptive Changes

Submeasure A1: Roof replacement

Submeasure A2: Attic insulation

Submeasure A3: Electric equipment

Submeasure A4: Duct measures

Submeasure B: Compliance options

Code Change Proposal Summary

- Duct Leakage Requirements:
 - Reduce duct leakage target from 15% to 10%
 - Revise RA3.1.4.2 to require use of measured instead of nominal airflow when available for calculating allowable duct leakage
- Changes from Round 1 Stakeholder meeting
 - **Add duct leakage target reduction**
 - **Revision to RA3.1.4.2**

Not covered today

- Insulation requirements for new ducts in alterations - align with new construction: Tables 150.1-A and B Option B for duct insulation
- Duct leakage - Eliminate ≥ 40 foot duct length threshold for additions/alterations

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts
- Cost Impacts
 - Incremental costs
 - Maintenance costs
 - Energy cost savings
- Cost-effectiveness



Definition of Baseline and Proposed Conditions



Baseline Conditions

Duct Leakage

- 15% system airflow

Duct Insulation

- R-4.2 duct insulation



Proposed Conditions

Duct Leakage

- 10% system airflow

Duct Insulation

- R-4.2 duct insulation

2023 Construction Forecast: Existing Buildings

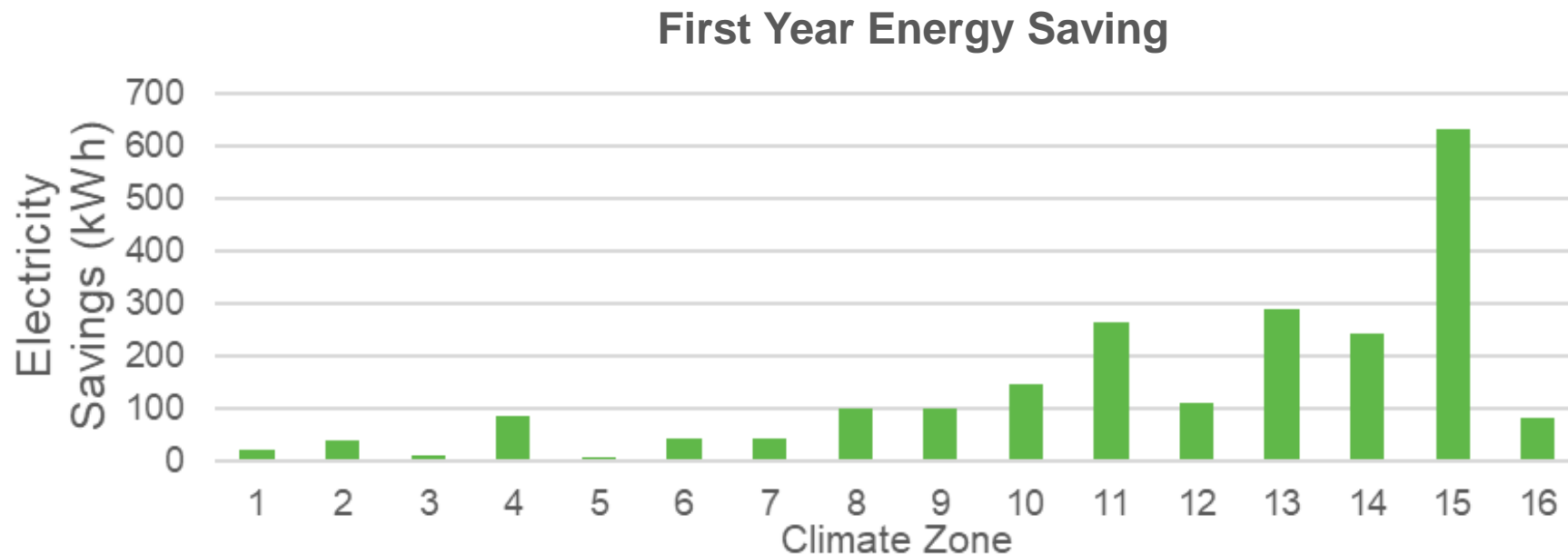
Duct Sealing

Building Type	Total Statewide Existing Stock in 2023 (homes/dwelling units)	Percent of Homes Impacted by Proposal	Statewide Homes Impacted by Proposal in 2023
Single Family	8,828,191	0.36%	31,497
Low-Rise Multifamily	3,620,491	0.02%	562
Total	12,448,682	0.26%	32,059

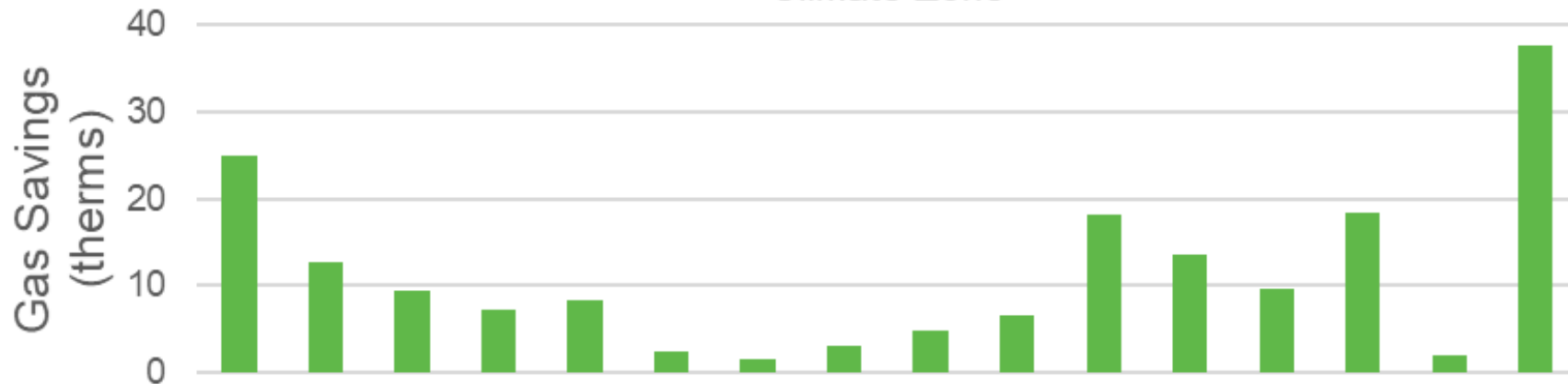
- Statewide building stock estimates provided by the Energy Commission
- *HERS Registry data* to estimate altered duct systems with 10-15% leakage¹

Energy Savings Results: Single Family

Altered ducts 10% vs 15% leakage



Range of
8 - 631 kWh/yr



Range of
1 - 38 Therms/yr

Incremental Cost Information

- Costs assume:
 - 2 hours of incremental labor for additional sealing
 - \$120/hour labor rate

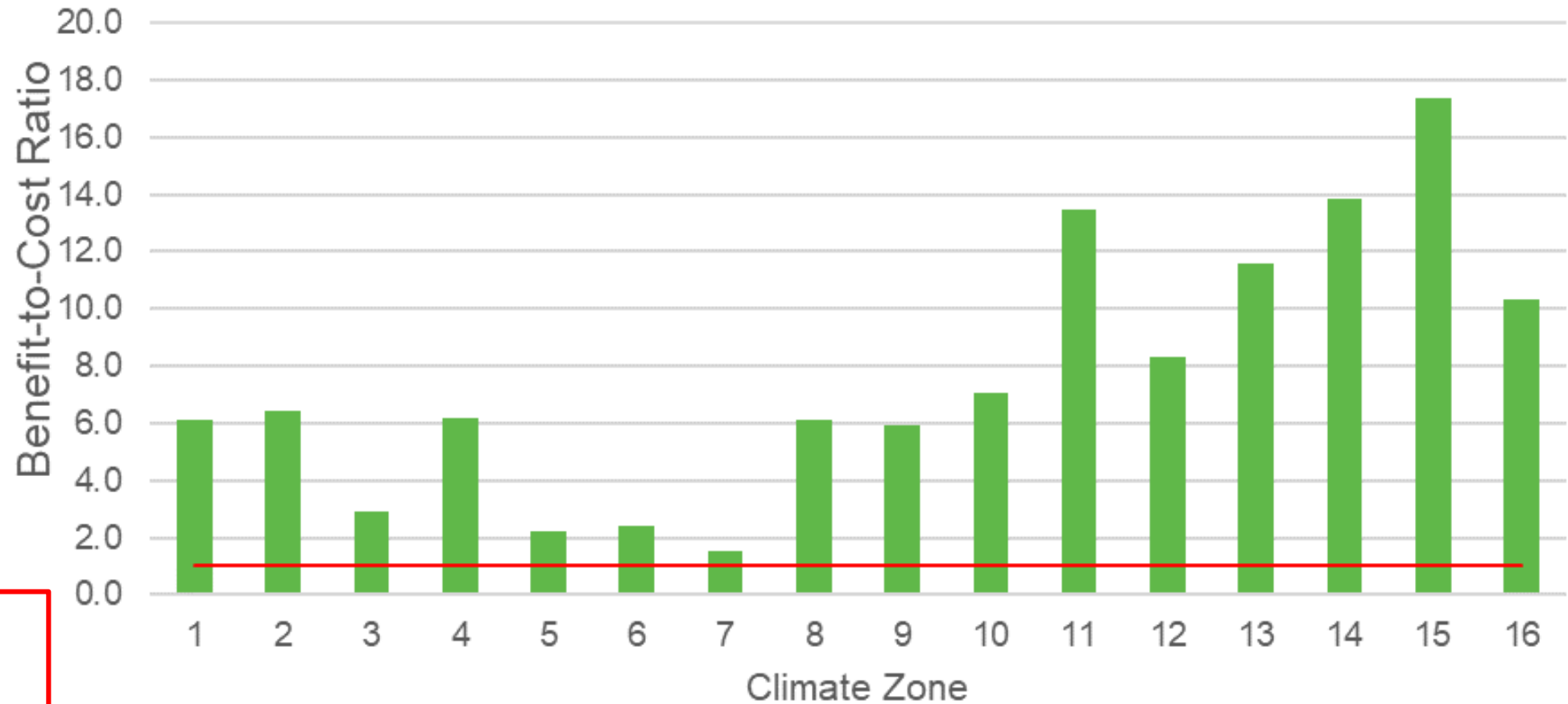
Incremental Per Unit Cost *Over 30 Year Period of Analysis*

	10% vs 15% leakage
Labor	\$240
Material	\$20
Total	\$260

Are these costs reasonable?

Cost Effectiveness Results

- Cost effective in all climate zones



**Red line
shows cost
effectiveness
threshold**



Market Overview

- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

Market Overview

- Single family ALT-02 projects with altered ducts in CalCERTS
 - 40% tested at $\leq 10\%$
 - 54% tested at $\leq 12\%$
- Single family ALT-02 projects with altered ducts and measured airflow in CalCERTS
 - 80% tested at < 400 cfm/ton
 - 63% tested at < 350 cfm/ton

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions



Technical Considerations

- Of existing projects >10%, how many can easily reduce leakage?
- 2-story homes more challenging
- Off-ramp with smoke test will remain

Are you aware of any data that could help inform how feasible achieving $\leq 10\%$ is for projects that test at 10-15% currently?



Poll

What is the most appropriate target to maximize savings from duct sealing altered duct systems?

- A. Leave at 15%
- B. 13%
- C. 12%
- D. 10%
- E. <10%
- F. Don't know

Poll

If you work on projects with altered ducts that conduct a smoke test what is the typical outcome?

- A. Smoke test usually shows that all accessible leaks have already been addressed
- B. Smoke test usually demonstrates where additional sealing can be done, and total leakage is reduced to <15%
- C. Smoke test usually demonstrates where additional sealing can be done, and total leakage is reduced to <10%
- D. Don't know

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection



Compliance and Enforcement

- Does not add new requirement
- Increases stringency
 - How will this impact compliance with code?

How do you think this will impact compliance?



Submeasure A: Prescriptive Changes

Submeasure A1: Roof alterations

Submeasure A2: Attic insulation

Submeasure A3: Electric equipment

Submeasure A4: Duct measures

Submeasure B: Compliance options

Code Change Proposal Summary

Submeasure	Description
1. Revised Blower Door & Infiltration Credit	<ul style="list-style-type: none">• Revise CBECC-Res default from 5 to 10 ACH50 to better represent existing building stock• Allow full credit for reduction of infiltration based on pre- and post- retrofit blower door values
2. Fireplace Removal Credit	<ul style="list-style-type: none">• Meet prescriptive requirements for sealing and insulation
3. Quality Insulation Installation (QII) credit for altered assemblies	<ul style="list-style-type: none">• QII compliance credit for altered wall, ceiling and floor assemblies• Can apply to any altered assembly and does not need to apply to an entire building

Fireplace Remove Credit Proposal Details

Masonry fireplace removal credit

Proposed ACM Changes	
Baseline	10 ACH50
Proposed	8.8 ACH50 (12% reduction*)

- 12% reduction based on prior studies looking at contribution of fireplace leakage to total house leakage
- Project can alternatively conduct pre- and post-retrofit blower door test

Is the proposed reduction in infiltration reasonable?

QII Credit for Altered Assemblies Proposal Details

Aspects of QII that cannot be addressed in altered assemblies:

- Seal subfloor to create continuous airtight air barrier
- Bottom plates sealed to the floor
- Rim joist gaps and openings fully sealed
- Inaccessible penetrations at the top plate in attics
- Insulation around structural framing such as structural bracing, tie-downs, steel framing
- Insulation in hard to access wall stud cavities
- Insulated window and door headers

Assume 80% of the assembly derating can be addressed

Are there other areas that we missed?

QII Credit for Altered Assemblies Proposal Details

Proposed ACM Changes			
Component	Baseline – No QII	Alteration – QII	Addition/New Construction – QII
Walls, Floors, Attic Roofs, Cathedral Ceilings	Multiply the cavity insulation R-value/inch by 0.7.	Multiply the cavity insulation R-value/inch by 0.94.	No adjustment to R-value
Ceilings Below Attic	Multiply the blown and batt insulation R-value/inch by $0.96 - 0.00347 \cdot R$.	Multiply the blown and batt insulation R-value/inch by $0.992 - 0.00069 \cdot R$.	No adjustment to R-value
Ceilings Below Attic	Add a heat flow from the conditioned zone to the attic of 0.015 times the area of the ceiling below attic times (the conditioned zone temperature - attic temperature) whenever the attic is colder than the conditioned space.	Add a heat flow from the conditioned zone to the attic of 0.003 times the area of the ceiling below attic times (the conditioned zone temperature - attic temperature) whenever the attic is colder than the conditioned space.	No heat flow added

Are you aware of data to better inform the proposed ACM changes?

Questions and Next Steps



Thank You

Questions?

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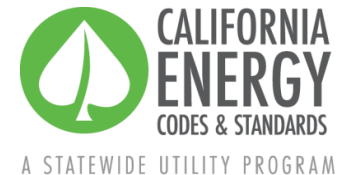
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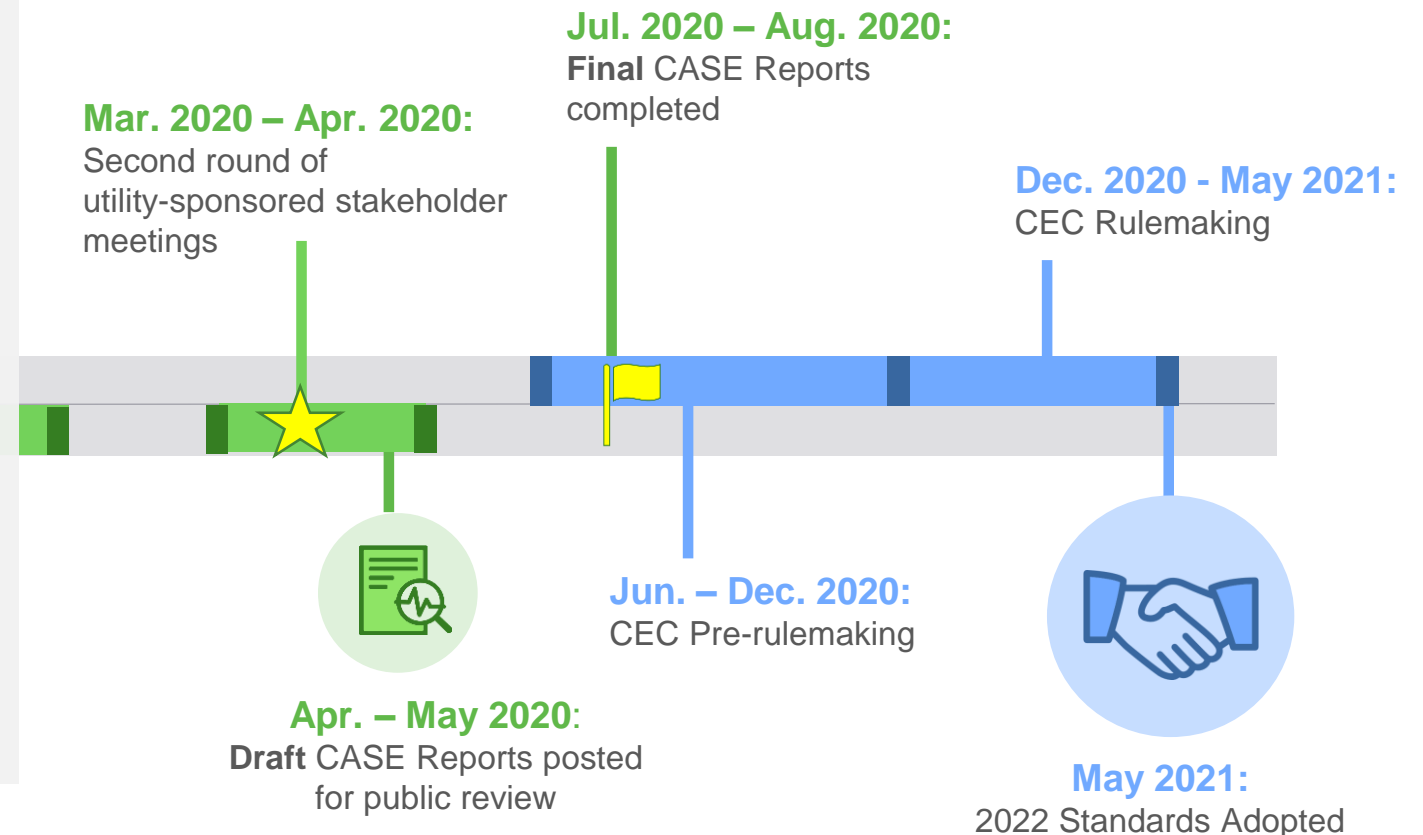
We want to hear from you!

- + Stakeholder meeting feedback informs utility-sponsored CASE Reports.
- + Draft CASE Reports for today's topics will be published in **April 2020**.

*Comments will be considered as they are received. Stakeholders are invited to submit feedback on [today's presentation](#), and the [Draft CASE Report](#) to help shape the **Final** CASE Report submitted to the Energy Commission.*



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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>

Upcoming Meetings

Meeting Topic	Building Type	Date
Nonresidential and Single Family HVAC Part 1: Data Centers, Boilers, Air Distribution, Variable Capacity	NR/SF	Thursday, March 12, 2020
Water Heating and Multifamily All Electric Package	MF	Tuesday, March 17, 2020
Single Family Grid Integration	SF	Thursday, March 19, 2020
Multifamily HVAC and Envelope - <i>to be rescheduled</i>	MF	Thursday, March 26, 2020
Covered Processes Part 1: Refrigeration System Opportunities	NR	Thursday, April 2, 2020
Nonresidential HVAC and Envelope Part 2: Reduced Infiltration, HVAC Controls (Air Efficiency, DOAS)	NR	Tuesday, April 14, 2020
Covered Processes Part 2: Controlled Environmental Horticulture	NR	Thursday, April 16, 2020
Nonresidential Envelope Part 1: High Performance Envelope	NR	Thursday, April 23, 2020

Thank you for your participation today

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Please complete the closing polls below

