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

Single Family Whole Building and Nonresidential Software Improvements.

We'll get started shortly.

In the meantime, please fill out the polls below.

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

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LA DWP Los Angeles Department of Water & Power

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

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2022 TITLE 24 CODE CYCLE, PART 6

First Utility-Sponsored Stakeholder Meeting

Single Family Whole Building and Nonresidential Software Improvements

Statewide CASE Team
November 12, 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 QandA periods.

Phone users – please mute your phone line.

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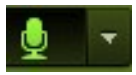


NOT MUTED

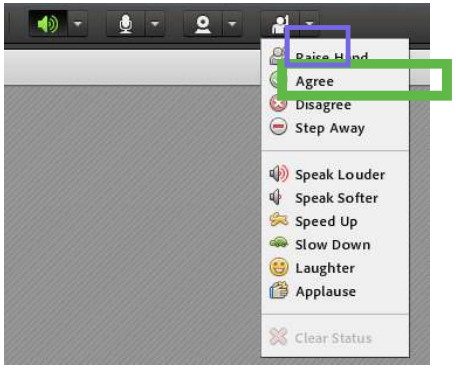
MUTED

Meeting Guidelines

Participation Guidelines

- **Questions and 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.*

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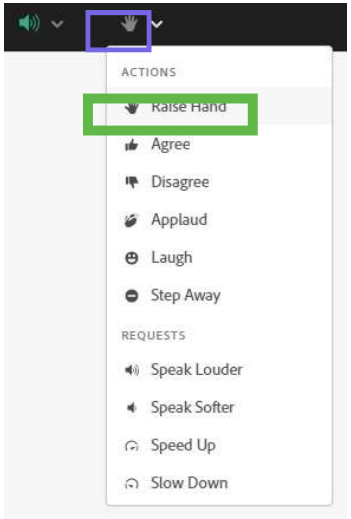

Meeting Ground Rules

- **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 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 and Welcome** from the Statewide Utility Team	*8:40 am*
4	**Presentation I:** Single Family Passive House Prescriptive Pathway	*8:45 am*
5	**Presentation II:** Single Family Energy Savings and Process Improvements for Alterations and Additions	*9:30 am*
6	***5 MINUTE BREAK***	*11:00 am*
7	**Presentation III:** Nonresidential Grid Integration	*11:05 am*
8	**Presentation IV:** Nonresidential Elevator Compliance	*12:05 pm*
9	**Closing**	*12:25 pm*

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 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
October 17, 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

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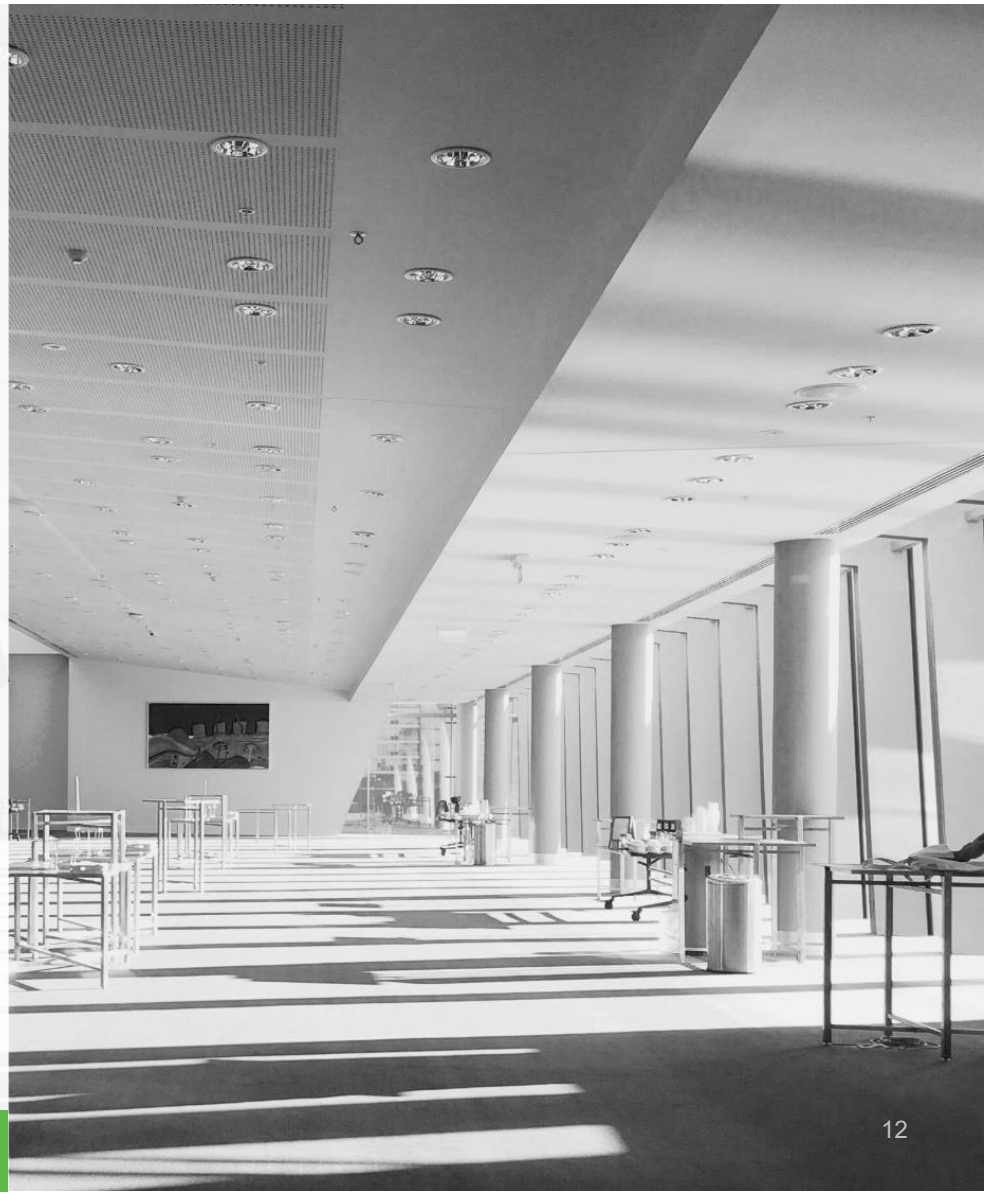
More information on pre-rulemaking for the 2022 Energy Code at:
https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Title 24, Part 6 Overview

Kelly Cunningham
Codes and Standards
Pacific Gas and 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

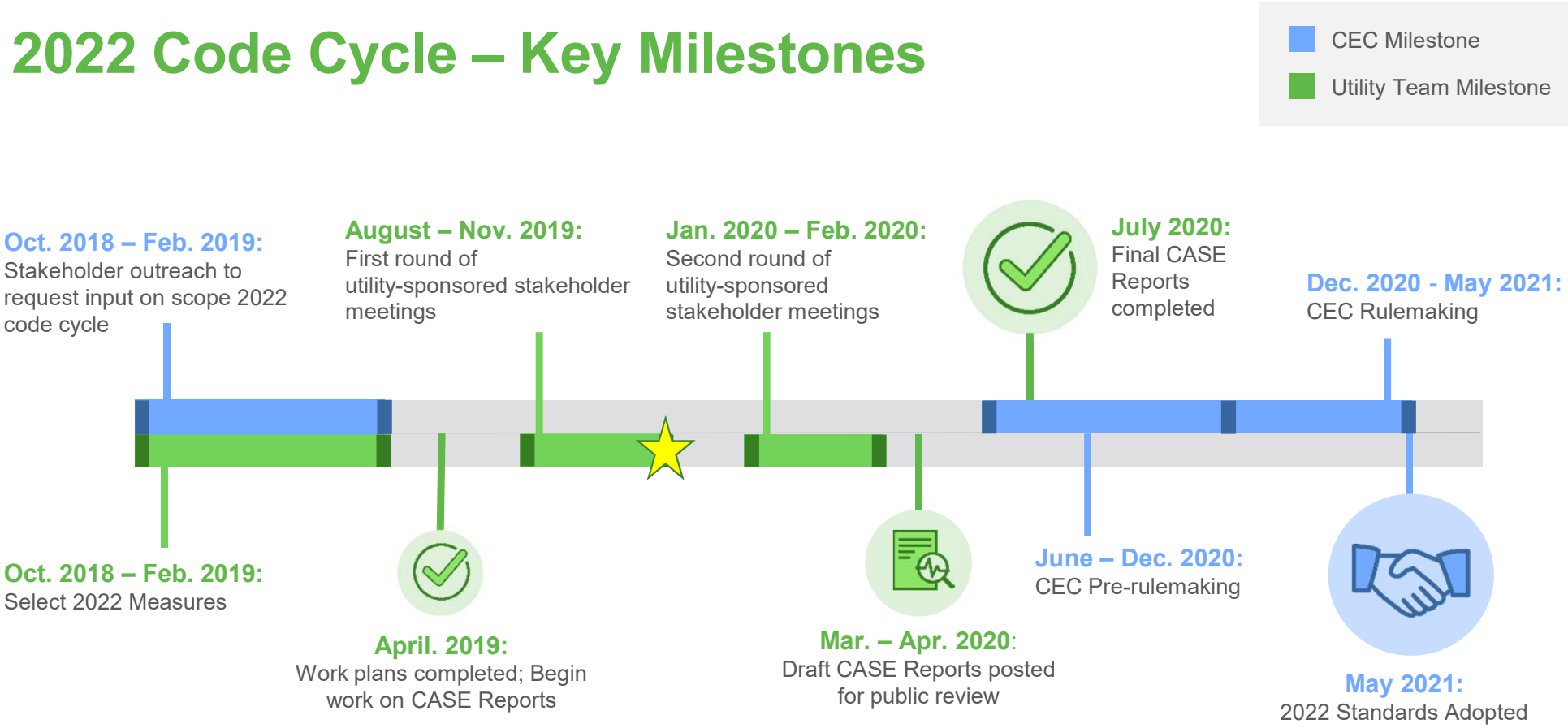
- All meetings can be attended **remotely**
- Check Title24Stakeholders.com/events for information about meetings and topic updates
- Sign up to receive email notifications

First Round Utility-Sponsored Stakeholder Meetings

Meeting Topic	Building Type	Date
Multifamily HVAC and Envelope	MF, NR	Thursday August 22, 2019
Outdoor Lighting and Daylighting	MF, NR	Thursday September 5, 2019
Indoor Lighting	NR	Thursday September 12, 2019
Covered Processes Part 1: Controlled Environment Horticulture	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 Part 1: Data Centers, Boilers, and Controls	NR	Tuesday, October 15, 2019
Nonresidential Envelope Part 1	*NR*	*Thursday, October 24, 2019*
Nonresidential HVAC and Envelope Part 2: Air Distribution, and Controls	*NR*	*Tuesday, November 5, 2019*
Covered Processes Part 2: Compressed Air, Steam Traps, and Refrigeration	*NR*	*Thursday, November 7, 2019*
Single Family Whole Building	**SF**	**Tuesday, November 12, 2019**
Nonresidential Software Improvements	**NR**	**Tuesday, November 12, 2019**

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

2022 Code Cycle – Key Milestones



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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.

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
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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Single Family Passive House Prescriptive Pathway

Codes and Standards Enhancement (CASE) Proposal

Residential | Whole Building

Bill Dakin, *Frontier Energy*

November 12, 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

Code Change Proposal – Summary

Building Types	System Type	Type of Change	Software Updates Required	Section of Code Updated
Low-rise residential	Whole building	Alternative to Primary Prescriptive Path	No	150.1(a)3

- Provide a compliance pathway for Passive House (PH) certified projects
- Would apply to both single family and low-rise multifamily
- Determine if buildings built to the PH Standard could potentially satisfy requirements under the 2022 California Energy Code
- Current PH projects must also complete a performance compliance run using CBECC-Res

Context and History

- **Why are we proposing this measure?**
  - The guiding principles behind the Passive House Standard and Certification embrace the ongoing goals and intent of Title 24, Part 6
  - Passive House emphasizes high quality construction and minimizing space heating and cooling loads
  - Focus on building envelope, eliminating thermal bridging, and air sealing
    - Employs high-performance windows (double or triple-paned windows depending on climate and building type) and doors
    - Solar gain is managed to exploit the sun's energy for heating purposes in the heating season and to minimize overheating during the cooling season
    - Balanced heat- and moisture-recovery ventilation
  - Past Passive House projects have exceeded Title 24 code by large margins

Context and History

TWO PASSIVE HOUSE PROGRAMS

Category	Passive House Institute (PHI)	Passive House Institute US (PHIUS)
Origins	Darmsdadt, Germany	US, 2002
Modeling Software	Passive House Planning Package (PHPP)	WUFI Passive
Energy Targets	Fixed 4.75 kBtu/ft^2-yr	Varies by climate and bldg. type
Quality Assurance / Testing	Blower door testing, Ventilation system commissioning	Additional testing requirements (aligned w/ DOE and EnergyStar programs)

- Same goals and principles
- Modeling tools based on the same algorithms.

2019 Code Requirements

- 2019 Requirements in Title 24, Part 6
  - All Passive House projects must use the performance method to comply with code. Typically exceed code with large compliance margins. Added time and cost to project.
- Existing Model Codes

Jurisdiction	
City of Vancouver	• Removes regulatory barriers. Pathway to rezoning • Allowed exceptions for building height and setbacks • Certification not required. Must meet certification criteria as shown in PHPP tool
New York State	• NYSERDA developed stretch code • PHI or PHIUS performance equivalency • Mandatory and prescriptive sections of NY state code still required
Massachusetts	• PHI or PHIUS performance equivalent to performance (Energy Rating Index) approach in IECC • Mandatory measures in IECC (section) still required • Verification of compliance by certified Passive House consultant
Washington DC	• Commercial buildings only

2019 Code Requirements (continued)

- Other regulatory considerations
  - Tested according to ASHRAE Standard 140 to reference software under thirty-eight test cases
  - Increasing California code stringency is moving T24 closer to Passive House performance
  - Need to ensure no loopholes exist that result in Passive House projects that do not meet Title 24
- Design / verification considerations
  - There are two Passive House certification programs: (PHI, PHIUS).
    - Similar goals but different programs, targets and tools
  - PHI has less third-party verification requirements. Would require some HERS testing for mandatory and prescriptive measures
  - Upload project to HERS Registry
    - Hand input data
    - Passive House tool to provide XML output for Registry upload

Proposed Code Change Overview

- Draft code language is available in the **resources tab**
- Provide an exception to prescriptive / performance compliance path for low-rise residential buildings
- Additional mandatory and prescriptive requirements, including:
  - All mandatory sections under 110.0 through 110.10 and 150.0
  - Alignment with ventilation requirements
  - Photovoltaic Requirements
  - Quality Insulation Installation (QII)
  - Other HERS verification and testing required by code

Market Overview

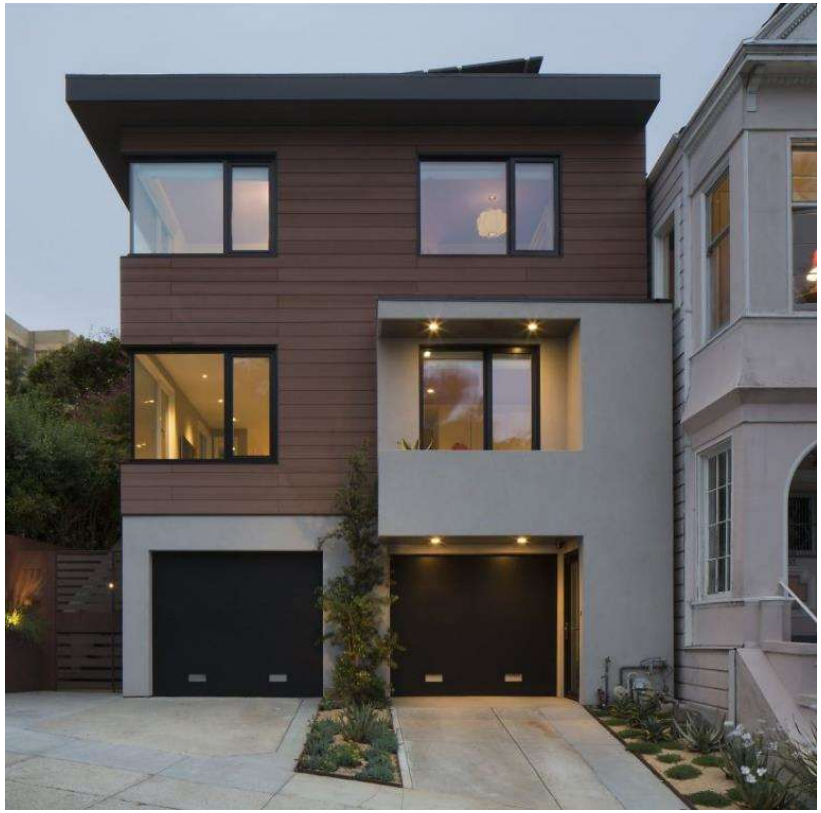
- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

Market Overview and Analysis

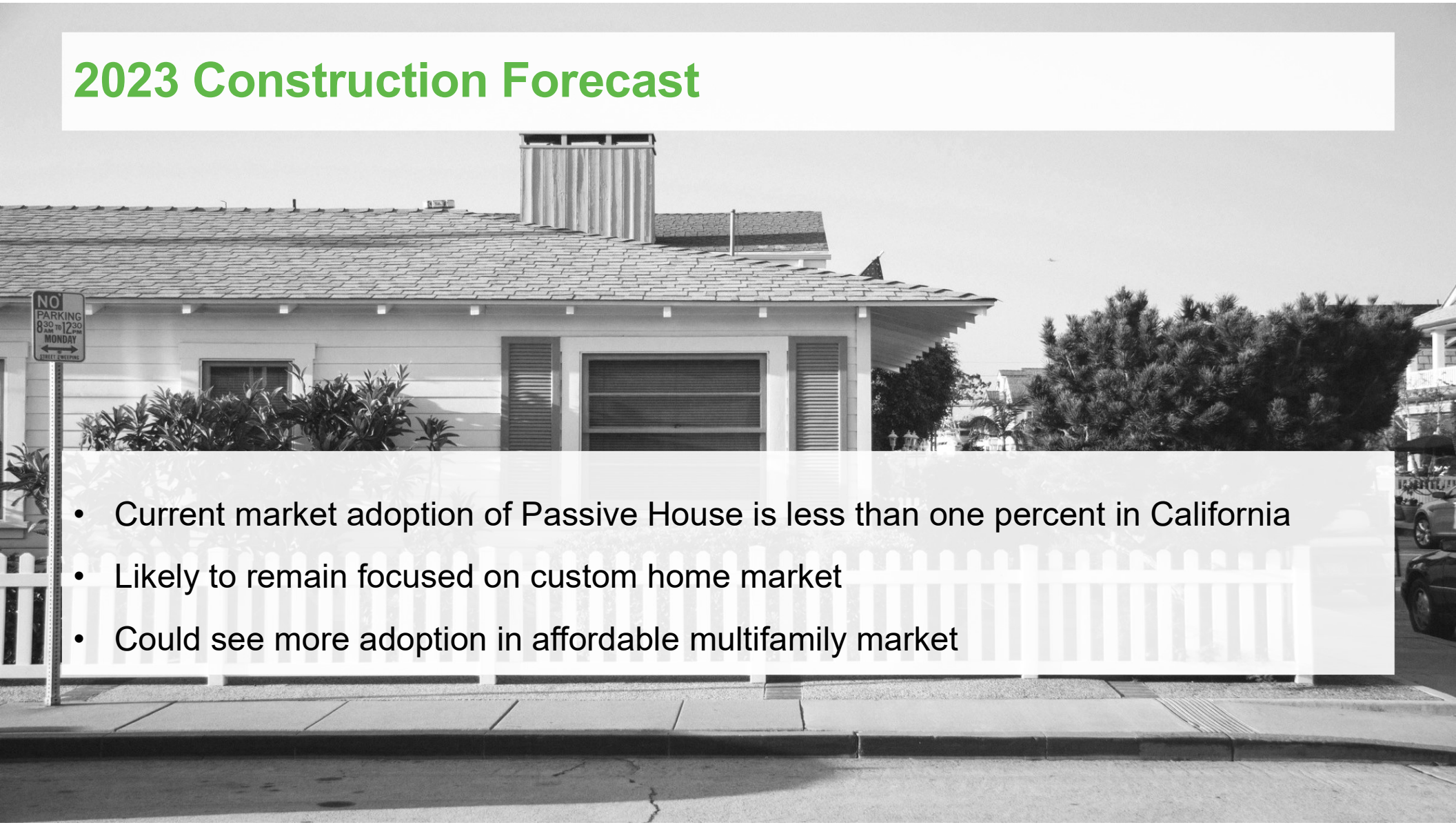
- Current Market
  - Emerging market: Less than five Passive House projects built per year in California
  - ~65 Passive House projects in California
  - 24 projects certified in California since 2010
  - Self-motivated builders/designers, dedicated to optimizing building performance
  - No utility incentive programs in state to date

Market Overview and Analysis

- Market Trends
  - Continues to be a niche market. Early adopters consisting of self-motivated builders/designers
  - Push towards meeting state's climate goals could increase interest Passive House practices
- Market Barriers
  - High cost for certification. Providing a compliance path could allow for further recognition and understanding of PH concepts
  - Steep learning curve to meet air tightness targets
    - Increased adoption / market awareness could result in improved construction quality



2023 Construction Forecast



- Current market adoption of Passive House is less than one percent in California
- Likely to remain focused on custom home market
- Could see more adoption in affordable multifamily market

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations

- No change proposed for Title 24 Standard Design practices
- Identify equivalency of Passive House requirements with mandatory and prescriptive requirements under 2019 Title 24, Part 6
- Identify what additional requirements are needed to show equivalency with Title 24 code
- Identify aspects of Passive House design that are not captured or credited in Title 24

Technical Barriers and Potential Solutions

- Requires additional inspections, testing, and paperwork for compliance
- Building inspectors not familiar w/ Passive House
  - Training for all building inspectors is not practical
  - PHPP could generate XML file and CF1R, or checklist for plans inspectors
- PHPP data differs from Title 24
  - Passive House Planning Package (PHPP) output does not provide the same information as CF1R forms (e.g., Window NFRC specifications)
    - PHPP looks at window glazing and frame separately
    - Requires that NFRC data be provided in output
- Two Passive House programs (PHI, PHIUS), means two different tools that could create confusion for equivalency
  - Both programs be considered equivalent and allowed

Technical Barriers and Potential Solutions

- Passive House credits some design strategies not allowed for compliance
  - Site shading and operable window shading devices
  - California version of compliance software could lockout some of these features
- Ventilation requirements for Passive House do not always align with ASHRAE 62.2 and code
- Full Passive House certification occurs after occupancy
  - Could result in projects being permitted and then never getting certification
  - Require third-party (HERS) testing and inspections before certificate of occupancy
  - Require certified Passive House consultant to sign off on design and installation

Do you agree with this summary? Are there other issues we should consider with providing a compliance path for Passive House?

Poll

Is Passive House **certification** required if the building design meets Passive House criteria and third-party testing and inspections are still required?

A. Yes
B. No
C. Do not know

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts Methodology

Methodology Energy Impacts Analysis

- Identify performance of buildings meeting Passive House criteria relative to 2019 code compliant building
- Evaluation using both 2019 CBECC-Res and PHI PHPP
  - PHPPv9.7 used to evaluate Passive House performance
- Evaluate using 2,100 and 2,700 square feet prototype homes in all 16 climate zones
- All-electric and mixed fuel baselines
- Evaluate 2019 prescriptive Standard Design in PHPP
  - Add mandatory Passive House measures
  - Additional measures needed to meet Passive House targets
- Run resultant package in CBECC-Res to compare w/ Standard Design
- Identify areas where Passive House design could result in non-compliant building

Definition of Baseline and Proposed Conditions

Baseline Conditions

- Minimally compliant with 2019 Code (Standard Design)

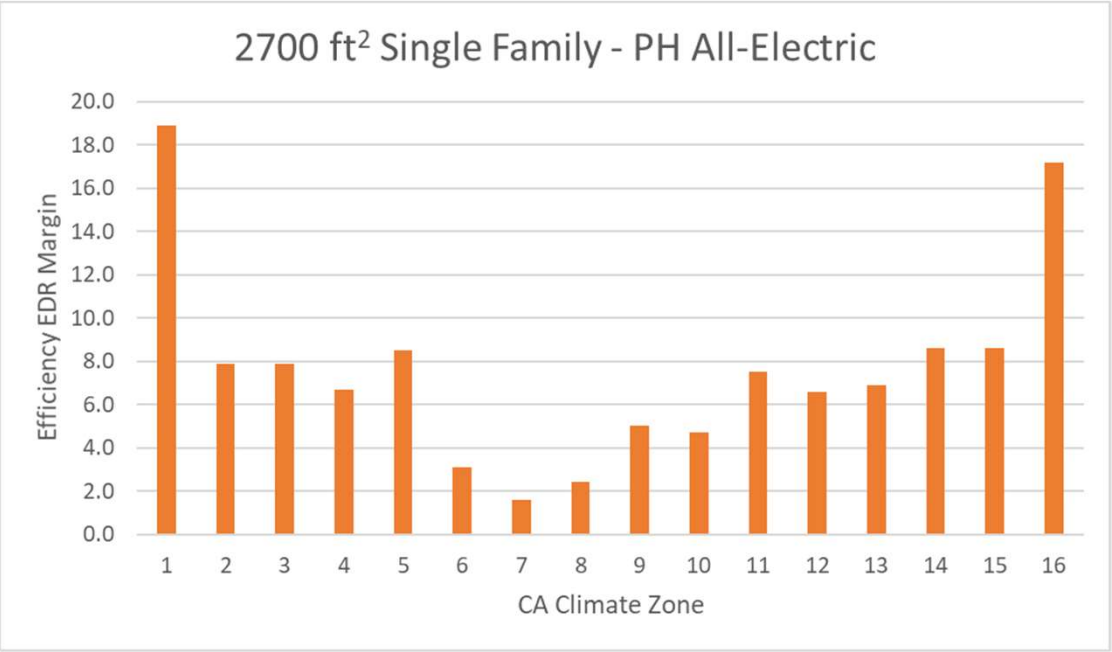
Proposed Conditions

- Minimally compliant with Passive House targets: 4.75 kBtu/ft^2-yr heating and cooling
- Ducts in conditioned space (Attic/Duct Option C)
- Air sealing: 0.6 air changes per hour (ACH50)
- Balanced whole house ventilation. HRV 70 percent effectiveness. No HRV is Climate zones 6 and 7
- NEEA heat pump water heater for all-electric case
- No ventilation cooling

- **Initial results based on all-electric 2700 prototype**

Initial Data and Findings

- Evaluation of all-electric 2700 square foot prototype
- Efficiency EDR Margin



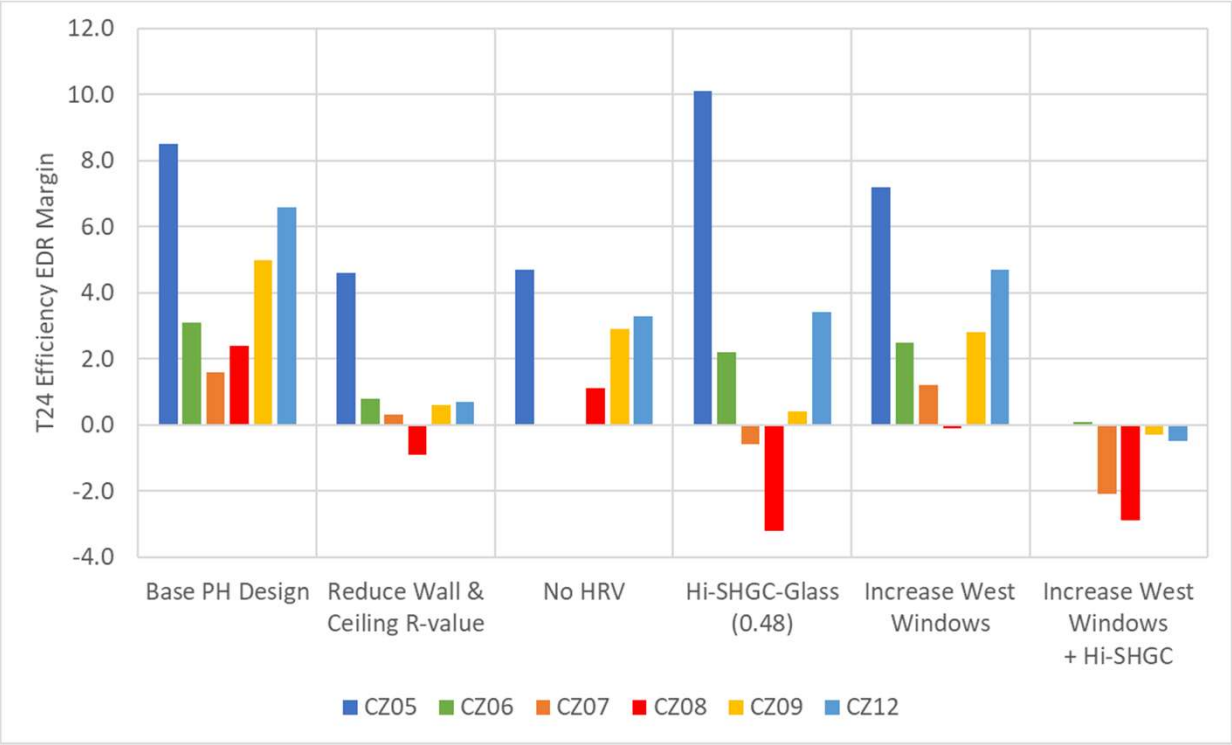
- Standard design w/ Passive House measures exceed 2019 code in all climate zones
- Additional measures required in Climate Zone 1, 15, 16 to meet Passive House targets
- Smaller Title 24 compliance margins in mild climates
- Potential for non-compliance Climate Zones 5 – 9?

Initial Data and Findings

- Title 24: Performance relative to standard design that is climate dependent
  - Cooling energy is driving factor in many cases due to TDV
- PHPP: Performance compared to fixed performance targets (4.75 kBtu/ft^2-yr heating and cooling)
  - Heating performance targets are driving design in most California climates
- Additional modeling in Climate Zones 5 through 9 to identify if adjusting building design while still meeting the PHPP criteria can result in non-compliant results in CBECC-Res
  - What are impacts of non-uniform glazing areas?

Initial Data and Findings

2019 Title 24 Performance of changes to building design



- All cases still meet PHPP criteria
- Increasing window SHGC results in Title 24 non-compliance in Climate zones 7 and 8
- Increasing west-facing glass also results in Title 24 non-compliance in Climate Zone 8
  - West glass at 50 percent of wall area
- Impact can be minimized by limiting window SHGC in affected climates

Initial Conclusions

- Easier to meet PHPP criteria in mild climates
  - Mild climates also have lower compliance margins
  - Climate Zone 8 has the largest discrepancy
- How to avoid non-compliance with Title 24
  - Require additional prescriptive requirements
    - SHGC limits in all climates with prescriptive requirement
    - Wall U-factors in Climate Zone 8
  - Restrict compliance path to certain climate zones
- Evaluation of impacts of shading and overhangs

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process

1. Design Phase

- Coordinate design with other team members on the requirements and inspections needed for PH certification
- Complete PH performance package and perform required calculations to confirm PH compliance

2. Permit Application Phase

- Complete compliance documents for permit application
- Plans Examiners to review that the building specifications needed for PH certification are called out on the drawings
- Required third party inspections / testing included in submittal

Compliance Verification Process

3. Construction phase

- Ensure that all PH elements are installed as specified
- Ensure that all installed equipment meets PH criteria
- Coordinate with PH certifier and HERS Rater that all testing and inspections are scheduled and completed

4. Inspection Phase

- Verify that all required inspections (HERS and PH) listed on plans have been completed and signed off by appropriate PH certifier / HERS Rater
- Ensure that continuous air barrier requirement is met and that air leakage targets are met

Market Actors

Market actors involved in implementing this measure include:

- Architects, Designers, Building Owners
- Builders, Contractors
- Passive House Consultants
- HERS Raters, Passive House Certifiers
- Plans Examiners/Building Inspectors
- Manufacturers of Passive House products (windows, HRV/ERV, HVAC equipment)

- Stakeholder outreach targeting energy and PH consultants, designers, builders, and building officials

HERS Registry

How to ensure projects added to HERS Registry

- Currently all projects are entered via performance method project upload
- Prescriptive projects required to enter manually online
- Options Include:
  - Require PH program tools develop XML for registry upload
  - Require PH projects manually enter online
  - Require PH projects complete CBECC-Res run
  - Develop PH path in CBECC-Res

Poll

What is the best way to handle upload to the HERS registry?

A. Manual prescriptive CF1R form upload
B. PH modeling tools export XML for registry upload
C. Require CBECC-Res or EnergyPro model as is currently required
D. Other, please explain in chat box

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates

Draft Code Change Language

- Please take a minute to review the draft code language available in the **resources tab**
- Propose added language to 150.1(a)3
- Provide an exception to prescriptive / performance compliance path for low-rise residential buildings
- Mandatory and prescriptive requirements to maintain equivalency
- Additional prescriptive requirements to avoid non-compliance

Draft Code Change Language

- Additional mandatory and prescriptive requirements. Proposed requirements include:

Mandatory Sections	
110.0 through 110.10 and 150.0	Includes duct leakage, fan watt draw, system airflow, and ventilation airflow testing
Prescriptive Sections	
Section 150.1(c)1E	Field verification of Quality Insulation Installation (QII)
Section 150.1(c)6 and Section 150.1(c)7	Space Heating and Cooling Systems, including refrigerant charge
Section 150.1(c)8	Domestic Water-Heating Systems
Section 150.1(c)9B	Space Conditioning Distribution Systems, Ducts and air handlers located in conditioned space
Section 150.1(c)14	Photovoltaic Requirements
Additional Prescriptive Sections	
Section 150.1(c)1Aiii	Roof and ceiling insulation. Meet the minimum ceiling insulation R-value requirements in Option C
Section 150.1(c)1B	Minimum wall insulation R-value per Table 150.1A
Section 150.1(c)3A	Fenestration U-factor and SHGC requirements SHGC requirements can be met with exterior shading per Section 150.1(c)4

Poll

Are you in favor of having a Passive House path to compliance and if it was available would you use it?

A. Yes, I am in favor of this proposal, and I would use it
B. Yes, but I would probably not use it
C. No, I am not in favor of this proposal
D. No opinion

Poll

Which additional prescriptive measures do you think should be required of Passive House projects?

A. None. Demonstrating that Passive House performance level is met is sufficient
B. Prescriptive window SHGC requirements, per Table 150.1 in **ALL** climate zones
C. Prescriptive opaque assembly requirements, per Table 150.1 in **SOME** climate zones
D. B and C
E. Restrict Passive House prescriptive path compliance to certain climate zones and avoid additional prescriptive measures

Poll

Which additional HERS inspections/tests do you see as needed for verification? Check all that apply.

A. Mandatory HERS tests only: duct leakage, system airflow, fan watt draw, and whole house ventilation airflow
B. Duct leakage to outside
C. Quality Insulation Installation (QII)
D. Refrigerant charge verification
E. None of the above

Software Updates

- No software updates required for CBECC-Res
- Updates would be needed for Passive House software tools to generate CF1R form and XML

Discussion and Next Steps

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the chat
- 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

Comments on this measure are due by December 5, please send to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide)

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS
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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Residential Energy Savings and Process Improvements for Additions and Alterations

Codes and Standards Enhancement (CASE) Proposal

Residential | Whole Building

Alea German, *Frontier Energy*

November 12, 2019

CALIFORNIA ENERGY CODES & STANDARDS

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Agenda

1	Background and Overview	*5 min*
2	Roof Alterations, Cool Roofs, and Insulation	*35 min*
3	Electric Equipment Replacements	*25 min*
4	Duct Measures	*10 min*
5	Compliance and Enforcement	*5 min*
6	Proposed Code Changes	*5 min*
7	Discussion and Next Steps	*5 min*

Background

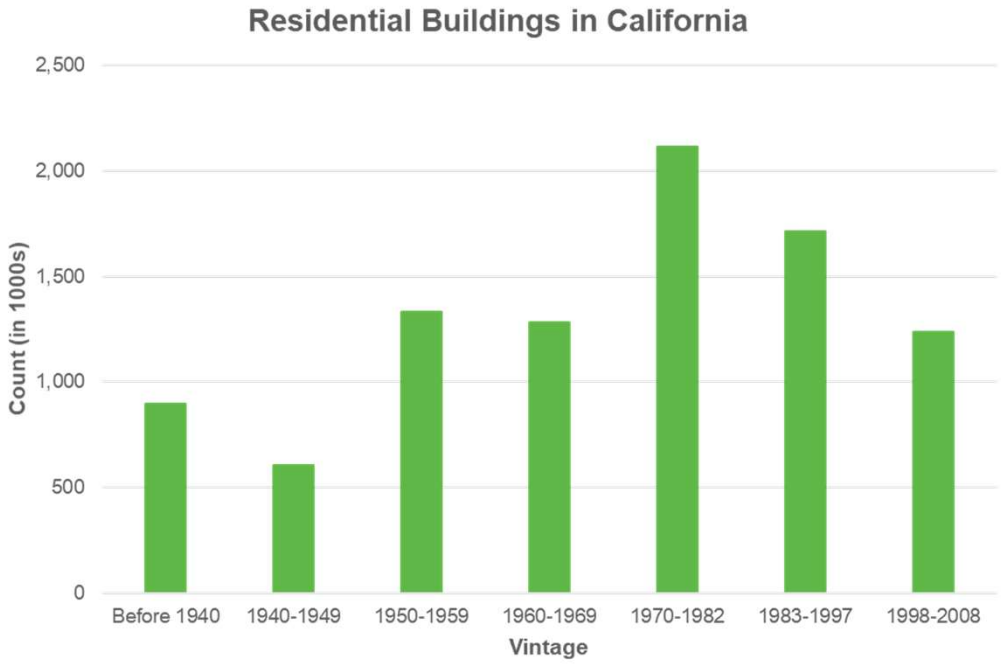
- Context and History
- 2019 Code Requirements
- Code Change Proposal

Code Change Proposal – Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Forms Updated
A: Prescriptive Changes: *Roof Alterations, Cool Roofs and Insulation*	Prescriptive	Yes	150.2(b)1I, 150.2(b)1, and 150.2(a)1Bi 110.8(d)1	Yes
A: Prescriptive Changes: *Electric Equipment Replacements*	Prescriptive	Yes	150.2(b)1G and 150.2(b)1Hiiid	Yes
A: Prescriptive Changes: *Duct Measures*	Prescriptive	Yes	150.2(b)1D	Yes
B: Clarifying Standards Language	Language only	No	n/a	n/a
C: Performance Calculation Improvements	Performance Options	Yes	n/a	n/a

Context and History

- **Why are we proposing these measures?**
  - New construction has been the focus of recent Title 24 updates
  - AB3232: reduce GHG emissions from the building stock by 40 percent below 1990 levels by 2030
  - Significant savings opportunity
  - Harmonize code where appropriate
    - Alterations and additions with new construction



Source: 2009 Residential Appliance Saturation Survey: https://ww2.energy.ca.gov/appliances/rass/previous_rass.html

Methodology for Energy Impacts Analysis Applies to all Measures

- Conducting CBECC-Res simulations in all 16 climate zones
- Analyze single family prototypes.
  - Work with TRC to consider which measures apply to multifamily, conduct additional analysis

EXISTING CONDITIONS

Alteration Measures

- 1,665 square foot existing home, three bedrooms
- 1990s vintage, mixed fuel
  - R-13 walls, R-19 attic/roof
  - Dual-pane metal windows
  - ~5 year old HVAC equipment
    - 13 SEER, 80 AFUE, 15 percent duct leakage

Addition Measures

- 1,440 square foot existing home with 225 square foot addition, three bedrooms
- Addition per 2019 prescriptive standards
- Existing building is 1990s vintage, mixed fuel
  - Same as for alteration measures

Submeasure A: Prescriptive Changes

Submeasure A.1: Roof alterations, cool roofs and insulation

Submeasure A.2: Electric equipment replacements

Submeasure A.3: Duct measures

Submeasure B: Clarifying Standards Language

Submeasure C: ACM

Current Code Requirements – Cool Roof

- Existing Requirements in Title 24, Part 6 Section 150.2(b)1I
  - Steep slope exceptions
    - Air space; Profile rise
    - Sealed ducts; no ducts in attic
    - Radiant barrier
    - R-38 ceiling insulation
    - R-2 above roof deck insulation
  - Low slope exceptions
    - No ducts in attic
    - Solar reflectance tradeoff with roof deck insulation

Aged solar reflectance / Thermal emittance

	Steep Slope	Low Slope
CZs 1-9, 16	NR	NR
CZs 10-12, 14	0.20/0.75	NR
CZs 13, 15	0.20/0.75	0.63/0.75

NR = No Requirement

Proposed Code Change Overview – Cool Roof

- Expand cool roof requirements to cover Climate Zones 8-15
  - Add Climate Zones 8-9 for steep slope
  - Add Climate Zones 8-12, 14 for low slope
- Revisit exceptions

Aged solar reflectance / Thermal emittance

	Steep Slope *Existing*	Steep Slope *Proposed*	Low Slope *Existing*	Low Slope *Proposed*
CZs 1-7, 16	NR	NR	NR	NR
CZs 8-9	NR →	0.20/0.75	NR →	0.63/0.75
CZs 10-12, 14	0.20/0.75	0.20/0.75	NR →	0.63/0.75
CZs 13, 15	0.20/0.75	0.20/0.75	0.63/0.75	0.63/0.75

NR = No Requirement

Poll

Do you install/specify cool roofs on re-roofing projects you work on?

A. Yes, I install prescriptive cool roofs on steep slope roofs
B. Yes, I install prescriptive cool roofs on low slope roofs
C. Yes, I install prescriptive cool roofs on steep and low slope roofs
D. No, I take one of the exceptions
E. No, I don’t work in climate zones where it’s required
F. I don’t work on existing roofs

Poll

If you have used one of the exceptions, which ones? (check all that apply)

A. 1-inch air space between roof deck and roofing product
B. Roofing product with minimum profile ratio of rise
C. Sealed ducts
D. Radiant barrier
E. R-38 ceiling insulation
F. R-2 above roof deck insulation
G. No ducts in attic (steep slope)
H. No ducts in attic (low slope)
I. Trade off with roof deck insulation (low slope)

Current Code Requirements – Insulation at Re-Roof

- No Existing Requirements in Title 24, Part 6 in 150.2 (low-rise residential)

Insulation R-Value

	Steep Slope	Low Slope
All Climate Zones	NR	NR

NR = No Requirement

- Existing Model Code Requirements
  - 2018 IECC R503.1.1 *"Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing."*
    - Confusing language, written as an exception, but required by some jurisdictions

Proposed Code Change Overview – Insulation at Re-Roof

- Insulation requirement or U-factor equivalency in Climate Zones 2, 4, 8-16
- Potential alternatives to R-49
  - Above roof deck (~R-4)
  - Higher solar reflectance cool roof with radiant barrier
  - Even higher solar reflectance cool roof
- Potential alternative to R-14
  - Tradeoffs between solar reflectance and insulation

Insulation R-value

	Steep Slope Existing	Steep Slope Proposed	Low Slope Existing	Low Slope Proposed
CZs 1, 3, 5-7	NR	NR	NR	NR
CZs 2, 4, 8-16	NR →	R-49 attic	NR →	R-14 continuous

NR = No Requirement

- Exceptions
  - Attics with R-38, limited clearance/access, safety considerations
  - Low slope roofs with mechanical equipment that must be moved

Poll

How should the steep slope insulation requirements apply to rafter roof assemblies?

A. Rafter roofs should be exempt
B. The same requirement for low slope roofs should apply to steep slope rafter roofs (R-14 above roof deck insulation)
C. Require above roof deck insulation, but less than R-14
D. Only require insulation if the roof deck is to be removed and the cavity can be insulated
E. Something else (please explain)
F. Don’t know

Poll

What exceptions should be allowed for the low slope re-roof insulation requirements? (check all that apply)

A. Existing roofs that meet a maximum U-factor (value to be determined)
B. Curb height at mechanical equipment is reduced so much to violate building codes or void manufacturer warranties
C. Base flashing height for parapet or penthouse walls is reduced to less than 8-inches
D. Base flashing height for parapet or penthouse walls is reduced to less than 4-inches
E. Other exceptions (please explain)

Attic Insulation, Alterations
Existing vs Proposed Code Change Overview

- Existing Requirements in Title 24, Part 6
  - Section 150.2(b)1, meet 150.0 mandatory minimum requirements
    - Weighted U-factor less than or equal to 0.054, or R-19 insulation
- Proposed Requirement
  - Require R-49 for vented attics
    - Exception for existing attics with R-38, limited clearance/access, safety considerations

	Existing	Proposed
CZs 1, 3, 5-7	R-19	R-19
CZs 2, 4, 8-16	R-19 →	R-49

Attic Insulation, Additions less than or equal to 700 square feet Existing vs Proposed Code Change Overview

- Existing Requirements in Title 24, Part 6
  - Section 150.2(a)1Bi: R38 in CZs 1, 11-16 or R-30 in CZs 2-10
  - Aligns with Table 150.1-A/B Option C, but doesn't require ducts in conditioned space
- Proposed Requirement
  - Align with Table 150.1-A/B Option B for ceiling insulation (no roof deck insulation)

	Existing	Proposed
CZs 3,5-7	R-30	No change
CZs 2,4,8-10	R-30 →	R-38
CZs 1,11-16	R-38	No change

Market Overview

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

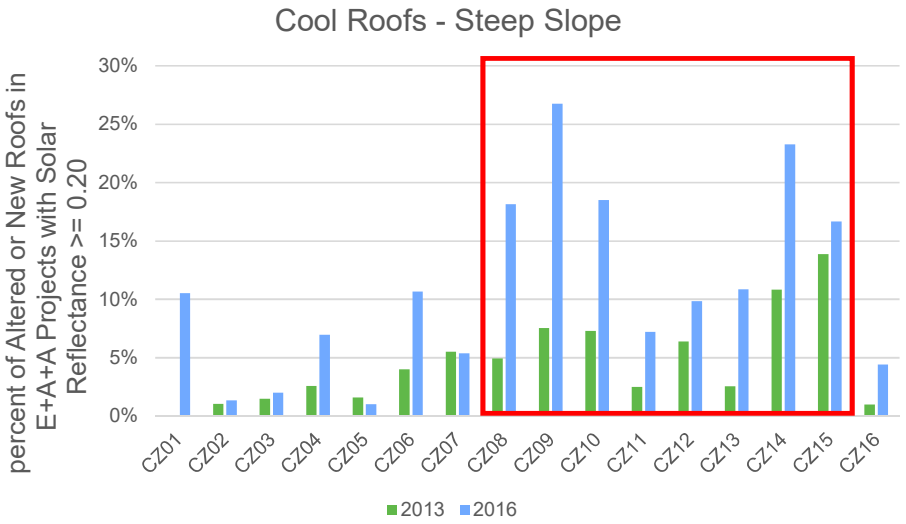
Market Overview and Analysis

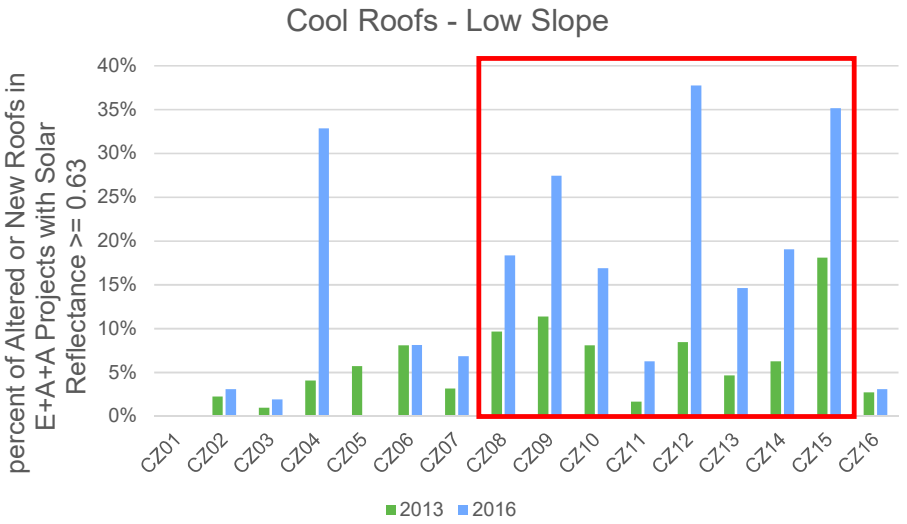
- Current Market
  - ~12 million existing homes in CA
    - 7 percent of single family homes get a new roof each year
  - 65 percent of single family homes have insulated attics (2009 RASS)
    - 70 percent of those homes have R-19 or less insulation (~3.5 million homes)
  - Single family new or altered roofs in CalCERTS under 2013/2016 code (E+A+A)
    - 78 percent are steep slope, 22 percent low-slope
    - 67 percent of homes with new or altered ceilings in alterations/additions R-30 or less. ~1 percent with R-19

2009 Residential Appliance Saturation Survey: https://ww2.energy.ca.gov/appliances/rass/previous_rass.html

Market Trends and Barriers, Cool Roofs

- Existing Model Code Requirements - Reach Codes
  - Los Angeles County (CZs 6/8/9): 0.20/0.75 for steep slope and 0.63/0.75 for low slope
  - Brisbane and San Mateo (CZ 3): Low-slope requirement 0.70/0.85





CalCERTS data query

Market Trends and Barriers, Insulation

- Market Trends
  - Some roofing contractors offering attic insulation services
  - Historically, many incentive programs for insulating existing homes, but there are fewer today
  - Interest in retrofit reach codes: City of Carlsbad has adopted one
- Market Barriers
  - C39 license likely doesn't allow for attic insulation services
    - May require engaging a subcontractor
  - Unpermitted re-roofs
    - Education to industry

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

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations

- Technical Considerations
  - Insulation requirement at re-roof is a change to standard design and construction practice
  - Insulating attics
    - Potential space limitations with R-49 insulation
    - Ensure adequate attic ventilation
    - Properly address non IC rated recessed can lights, blocking for attic vents
- Technical Barriers and Potential Solutions
  - Challenging details when adding thickness to roofs
    - Driven by existing conditions
    - Propose reasonable exceptions

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

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts Methodology
- Cost Impacts Methodology
  - Incremental costs
  - Energy cost savings

Definition of Baseline and Proposed Conditions
Cool Roof

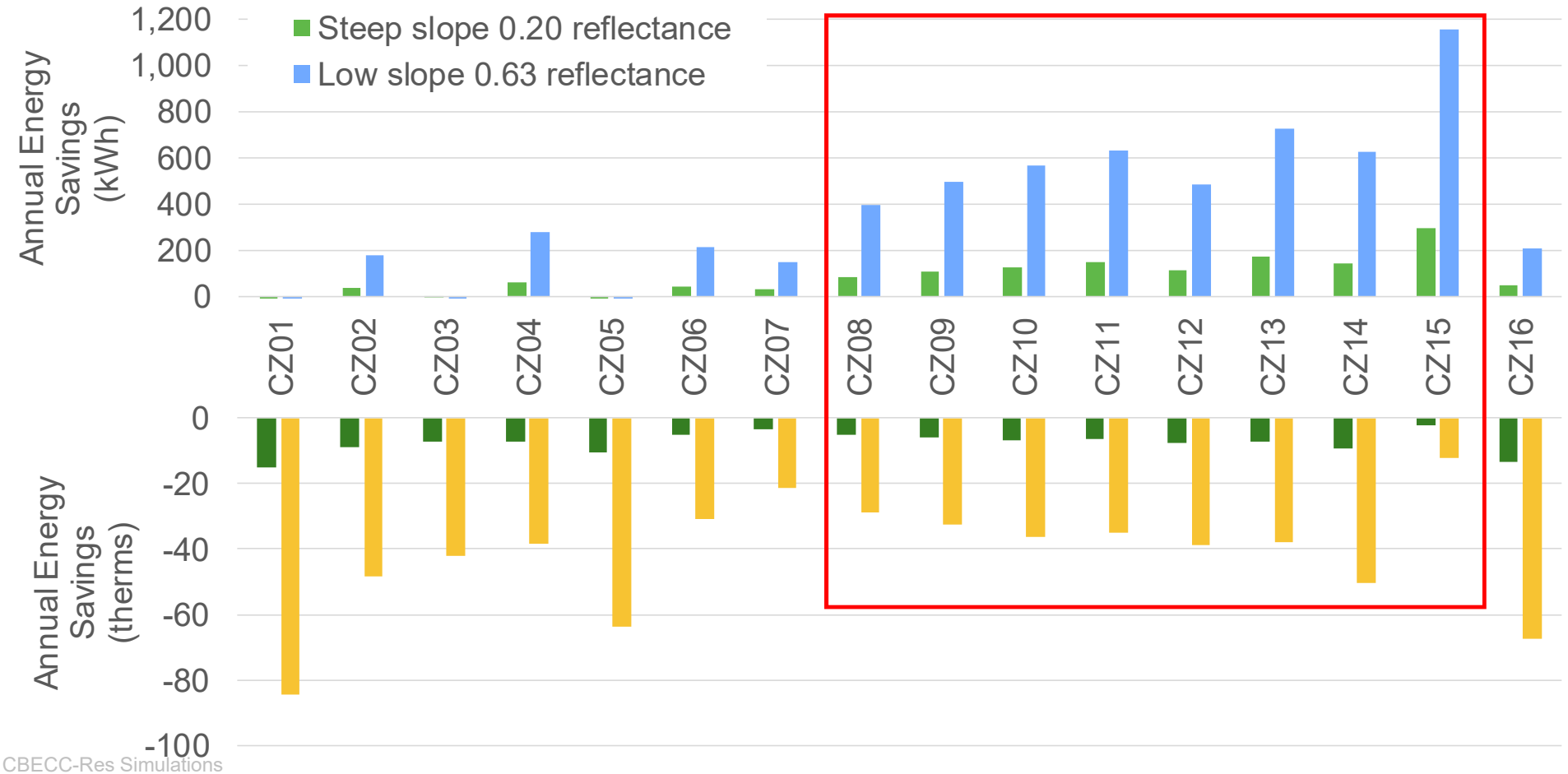
Baseline Conditions

- No cool roof

Proposed Conditions

- Steep slope roofs:
  - 0.20/0.75 cool roof
- Low slope roofs:
  - 0.63/0.75 cool roof

Energy Savings for Cool Roof



Definition of Baseline and Proposed Conditions
Attic/Roof Insulation

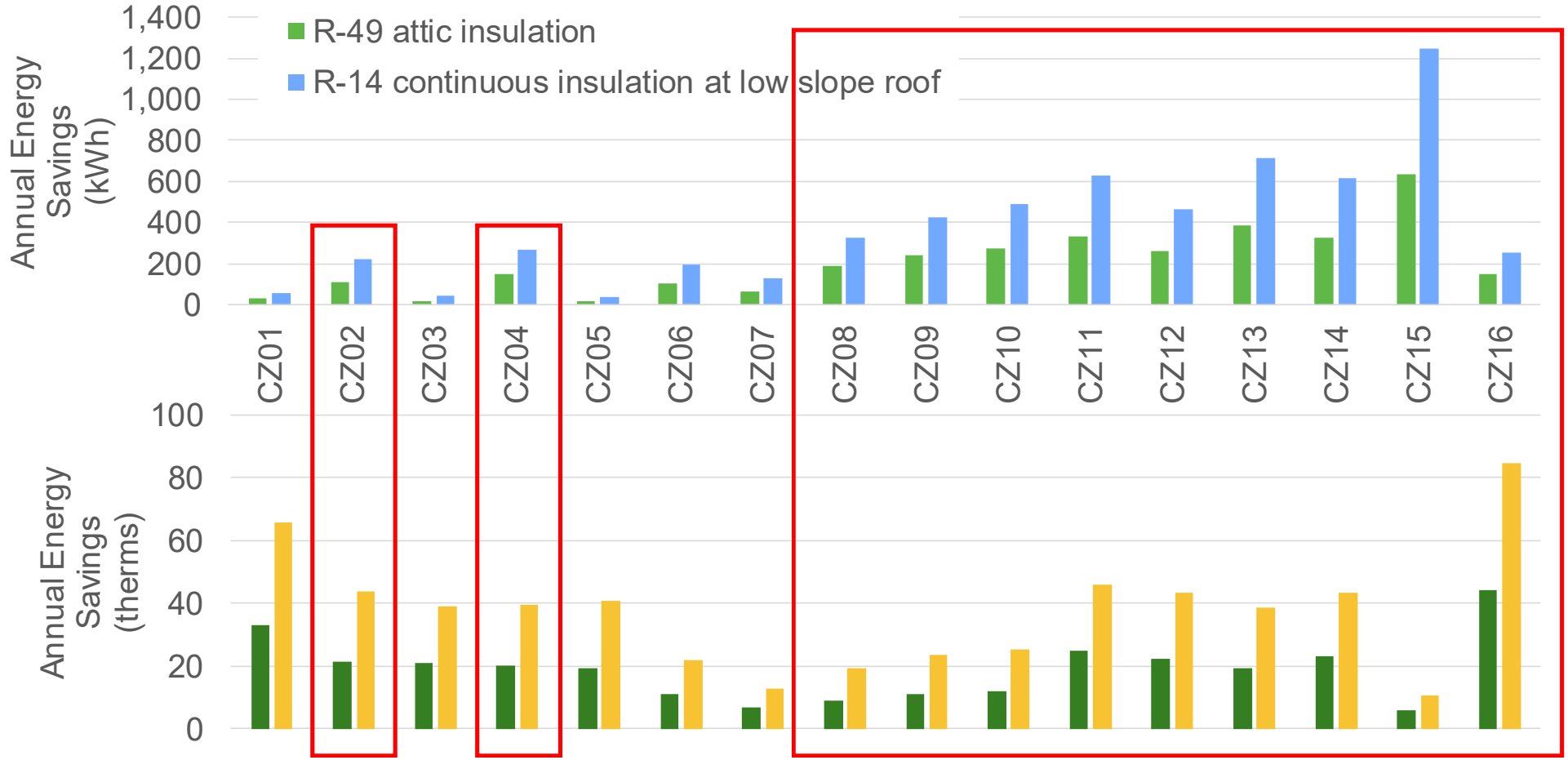
Baseline Conditions

- Steep slope: R-19 attic
- Low-slope: R-19 cavity

Proposed Conditions

- Steep slope: R-49 attic insulation
- Low-slope: R-14 continuous insulation

Energy Savings for Adding Attic/Roof Insulation



Incremental Cost Information **Preliminary*

- How we are collecting costs of base case and proposed technology
  - Interviews with manufacturers and contractors
  - Previous project work
  - Online product research
- Incremental costs were found to be:

	0.20 solar ref. steep slope roof	0.63 solar ref. low slope roof	R-49 attic insulation	R-14 continuous insulation	R-38 vs R-30 attic (additions)
Incremental First Cost	**$0-0.20/ sqft roof**	**$0-0.50/ sqft roof**	**$1.50/ sqft ceiling**	**$4.20/ sqft roof**	**$0.17/ sqft ceiling**

Do you find these costs to be reasonable?

Submeasure A: Prescriptive Changes

- Submeasure A.1: Roof alterations, cool roofs and insulation
- **Submeasure A.2: Electric equipment replacements**
- Submeasure A.3: Duct measures

Submeasure B: Clarifying Standards Language

Submeasure C: ACM

Current Code Requirements – HVAC Replacements

- Existing Requirements in Title 24, Part 6 Section 150.2(b)1G

G. Altered Space-Conditioning System. Replacement space-conditioning systems shall be limited to natural gas, liquefied petroleum gas, or the existing fuel type.

EXCEPTION to Section 150.2(b)1G: When the fuel type of the replaced heating system was natural gas or liquefied petroleum gas, the replacement space-conditioning system may be a heat pump

Proposed Code Change Overview – HVAC Replacements

- Draft code language is available in the **resources tab**

<u>Space Heating</u>

- Prohibit electric resistance replacement heating when the existing system is:
  - Central electric resistance furnace with air conditioning

Poll

What should trigger the upgrade to a heat pump system?

A. Any heating system component replacement
B. Any cooling system component replacement
C. Either a heating or cooling system component replacement
D. Both heating and cooling system component replacement
E. None of the above
F. Don’t know

Current Code Requirements – Water Heater Replacements

- Existing Requirements in Title 24, Part 6 Section 150.2(b)1Hiiid

iii. Water heating system. The water heating system shall meet one of the following:

a. A natural gas or propane water-heating system; or

b. For Climate Zones 1 through 15, a single heat pump water heater. The storage tank shall not be located outdoors and be placed on an incompressible, rigid insulated surface with a minimum thermal resistance of R-10. The water heater shall be installed with a communication interface that meets either the requirements of 110.12(a); or

c. For Climate Zones 1 through 15, a single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. The storage tank shall not be located outdoors; or

d. If no natural gas is connected to the existing water heater location, a consumer electric water heater.

Proposed Code Change Overview – Water Heater Replacements

- Draft code language is available in the **resources tab**

Water Heating

- Prohibit electric resistance replacement water heaters:
  - Except when the existing electric resistance water heater is located within conditioned space or in an exterior closet
- Considering electric water heaters in other locations (interior and exterior closets)
  - Challenges with limited space, condensate lines, ducting
- Alternative paths with solar thermal, equivalent PV, or grid interactive electric water heaters

Poll

Where should replacement electric resistance water heaters be prohibited?

A. Garage locations only
B. Garage and exterior closets
C. Garage and interior spaces
D. Any location with exceptions allowed for limited space conditions
E. None of the above
F. Don’t know

Poll

What alternative paths should be allowed for the heat pump water heater requirement? (check all that apply)

A. Solar thermal system
B. Direct DC PV water heating system
C. Grid connected PV system that meets a minimum capacity
D. Grid interactive two-way communicating electric water heater
E. None of the above
F. Don’t know

Market Overview

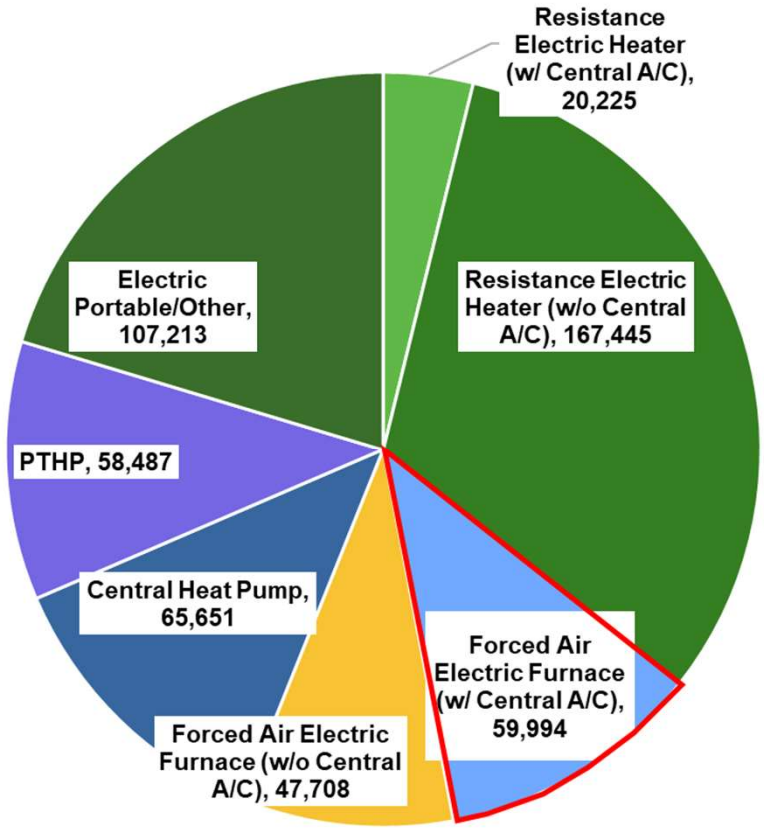
- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

Space Heating Heat Pumps Market Overview and Analysis

- Current Market

Space Heating System	Single Family	Townhouse, Duplex	Apt Condo 2-4 Units	Apt Condo 5+ Units
Electric	2.0 percent	5.9 percent	8.3 percent	17.2 percent
Forced Air Electric Furnace (w/ Central A/C)	0.3 percent	2.1 percent	0.3 percent	1.5 percent
Other Electric Resistance	1.1 percent	3.2 percent	6.5 percent	11.6 percent
Heat Pump	0.6 percent	0.7 percent	1.5 percent	4.2 percent
Natural Gas	89.0 percent	90.6 percent	81.1 percent	71.6 percent
Other	9.0 percent	3.5 percent	10.6 percent	11.1 percent

- Market Trends
  - Rebates for high-efficiency heat pumps
  - Increasing market share for heat pumps gaining in acceptance



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

2009 Residential Appliance Saturation Survey: https://ww2.energy.ca.gov/appliances/rass/previous_rass.html

Heat Pump Water Heaters
Market Overview and Analysis

- Current Market

DHW System	Single Family	Townhouse, Duplex	Apt Condo 2-4 Units	Apt Condo 5+ Units
Electric	6.8 percent	10.5 percent	18.6 percent	25.4 percent
Standard Tank	6.1 percent	9.6 percent	16.9 percent	22.6 percent
Tankless	0.3 percent	0.7 percent	0.7 percent	1.8 percent
HPWH	0.2 percent	0.3 percent	0.9 percent	0.8 percent
Point of Use Tankless	0.2 percent	0.0 percent	0.1 percent	0.2 percent
Natural Gas	88.1 percent	87.8 percent	79.5 percent	72.4 percent
Other	5.1 percent	1.7 percent	1.9 percent	2.2 percent

- Market Trends
  - Incentive programs encouraging heat pumps (SMUD, PGandE, SCE, SDGandE, City of Palo Alto)
  - Equivalency in 2019 code for all-electric homes may increase market share
- Market Barriers
  - Contractor experience with HPWHs

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

2009 Residential Appliance Saturation Survey: https://ww2.energy.ca.gov/appliances/rass/previous_rass.html

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations

- Technical Considerations
  - Condensate lines for heat pump water heaters
  - “To duct or not to duct” interior located water heaters
  - Cold climates
- Technical Barriers and Potential Solutions
  - Potential challenges with closet located water heaters
    - Potential space limitations
    - Propose exceptions and alternative paths

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

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts Methodology
- Cost Impacts Methodology
  - Incremental costs
  - Energy cost savings

Space Heating
Definition of Baseline and Proposed Conditions

Baseline Conditions

- **New electric ducted furnace**
- **New ducted air conditioning (14 SEER)**
- New ductwork, 5 percent leakage

Proposed Conditions

- **New ducted heat pump (14 SEER, 8.2 HSPF**
- New ductwork, 5 percent leakage

Water Heating
Definition of Baseline and Proposed Conditions

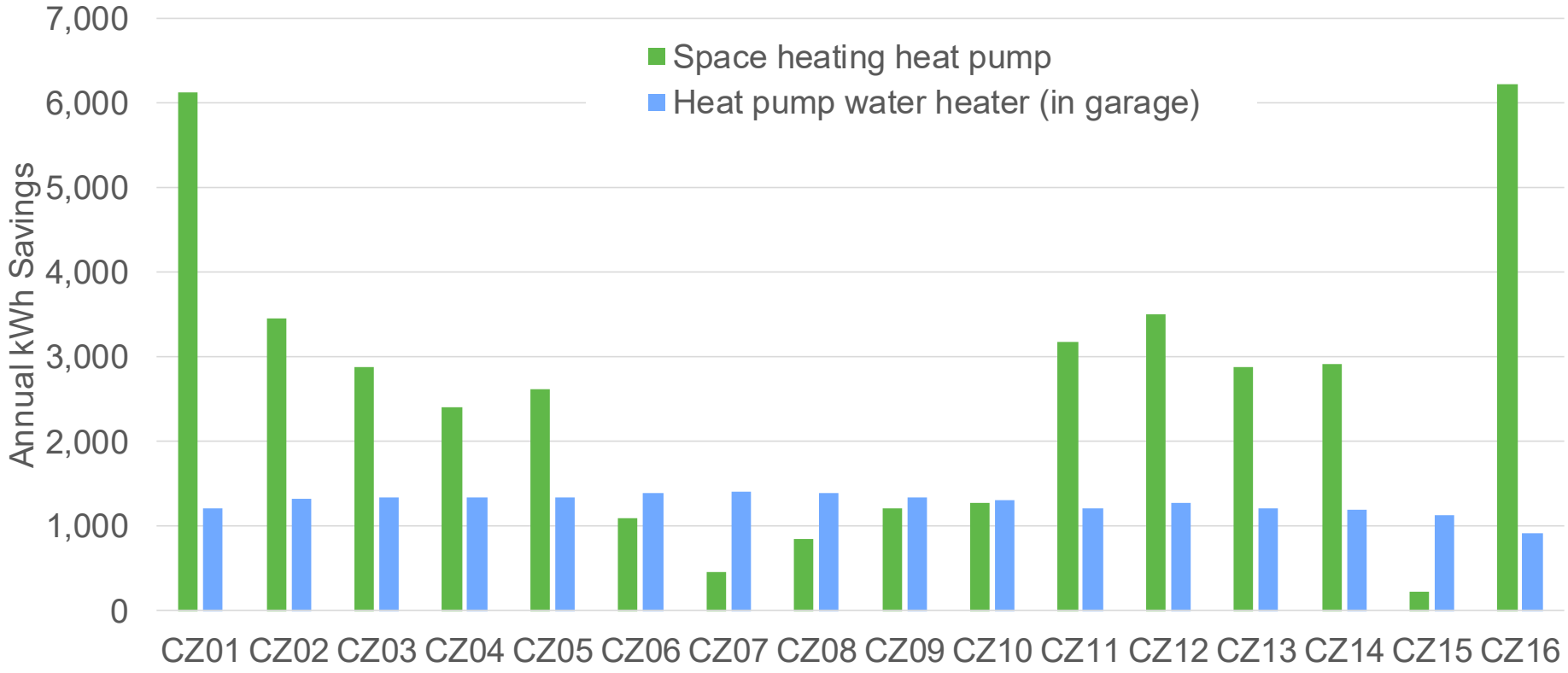
Baseline Conditions

- **New storage electric resistance water heater (0.92 UEF)**
  - Garage located

Proposed Conditions

- **New heat pump water heater (2.0 UEF)**
  - Garage located

Energy Savings for Heat Pump vs Electric Resistance Heating Appliances



Incremental Cost Information **Preliminary*

- How we collected costs of base case technology and proposed technology
  - Online product research
  - Interviews with contractors
- Incremental costs were found to be:
  - **~$500** for ducted heat pump system vs electric resistance furnace and A/C
    - Material only
  - **~$1,500** for heat pump water heater vs electric resistance storage water heater **in garage**
    - Material and labor

Do you find these costs to be reasonable?

- **How much additional cost for interior located water heaters?**

Submeasure A: Prescriptive Changes

- Submeasure A.1: Roof alterations, cool roofs and insulation
- Submeasure A.2: Electric equipment replacements
- **Submeasure A.3: Duct measures**

Submeasure B: Clarifying Standards Language

Submeasure C: ACM

New Ducts in an Alteration
Existing vs Proposed Code Change Overview

- Existing Requirements in Title 24, Part 6
  - Section 150.2(b)1Di: R-6 in Climate Zones 1-10, 12-13 or R-8 in Climate Zones 11, 14 -16
- Proposed Requirement
  - Align with Table 150.1-A/B Option B for duct insulation

	Existing	Proposed
CZs 3, 5-7	R-6	No change
CZs 1-2, 4, 8-10, 12-13	R-6	R-8
CZs 11, 14-16	R-8	No change

Altered Ducts – Duct Sealing
Existing vs Proposed Code Change Overview

- Existing Requirements in Title 24, Part 6
  - Section 150.2(b)1D: duct sealing triggered “when more than 40 feet of new or replacement space-conditioning system ducts are installed”
- Proposed Requirement
  - Reduce or eliminate the 40 foot limit

Poll

What should the 40 foot limit be reduced to?

A. No change (40 feet)
B. 30 feet
C. 20 feet
D. 10 feet
E. 0 feet (any length of added duct triggers duct testing)
F. Don’t know

Market Overview

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

Market Overview and Analysis

- Current Market
  - Single family data from CalCERTS under 2013/2016 code
    - **86 percent** of HVAC change-outs with new supply ducts in Climate Zones 1-2, 4, 8-10, 12-13 have **R-6 duct insulation**
    - **2 percent** of E+A+A projects called out an **extension of duct system less than or equal to 40 feet**

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

2009 Residential Appliance Saturation Survey: https://ww2.energy.ca.gov/appliances/rass/previous_rass.html
CalCERTS data query.

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations

- Minor changes in standard design practices
- Potential space limitations with R-8 ducts
- Challenges with sealing existing ducts in certain scenarios
  - Existing exceptions in the code handle this

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

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts Methodology
- Cost Impacts Methodology
  - Incremental costs
  - Energy cost savings

New Ducts in an Alteration
Definition of Baseline and Proposed Conditions

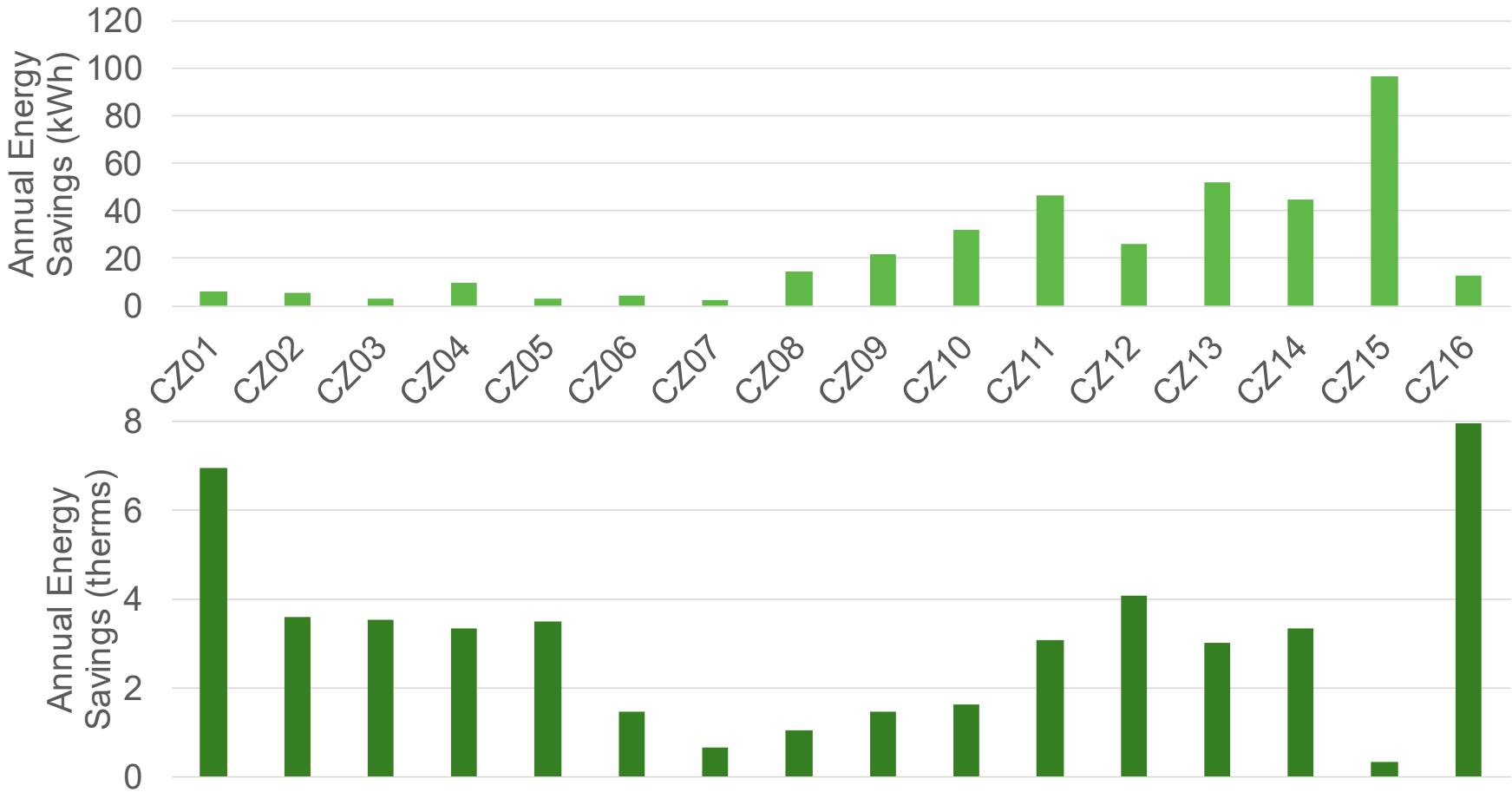
Baseline Conditions

- Entirely New HVAC System
- **R-6 duct insulation**

Proposed Conditions

- Entirely New HVAC System
- **R-8 duct insulation**

Energy Savings for R-8 vs R-6 New Ductwork in an Alteration



Duct Sealing in an Alteration
Definition of Baseline and Proposed Conditions

Baseline Conditions

- 25 percent duct leakage

Proposed Conditions

- 15 percent duct leakage

Energy Savings for Duct Sealing in an Alteration

Incremental Cost Information **Preliminary*

- How we are collecting costs of base case and proposed technology
  - Interviews with contractors
  - Online product research
  - Previous project work
- Incremental costs were found to be:

	R-8 vs R-6 ducts	Duct sealing
Incremental First Cost	**$0.70/ linear foot[1]**	**$500/ system[2]**

[1]Average for 6-12in duct
[2]4 hrs labor + $250 HERS test

Do you find these costs to be reasonable?

Submeasure A: Prescriptive Changes

- Submeasure A.1: Roof alterations, cool roofs and insulation
- Submeasure A.2: Electric equipment replacements
- Submeasure A.3: Duct measures

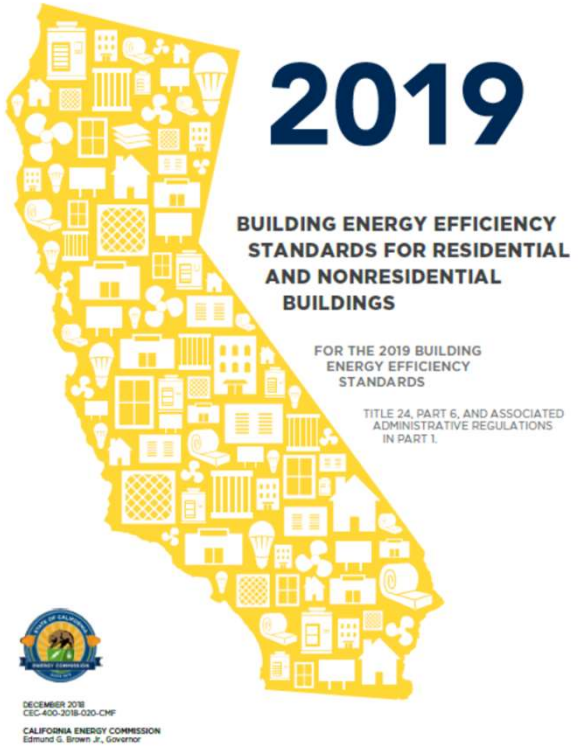
Submeasure B: Clarifying Standards Language

Submeasure C: ACM

Standards Language
Proposed Code Change Overview

- Suggest language changes to improve readability and add clarity
- To be provided outside of the CASE Report

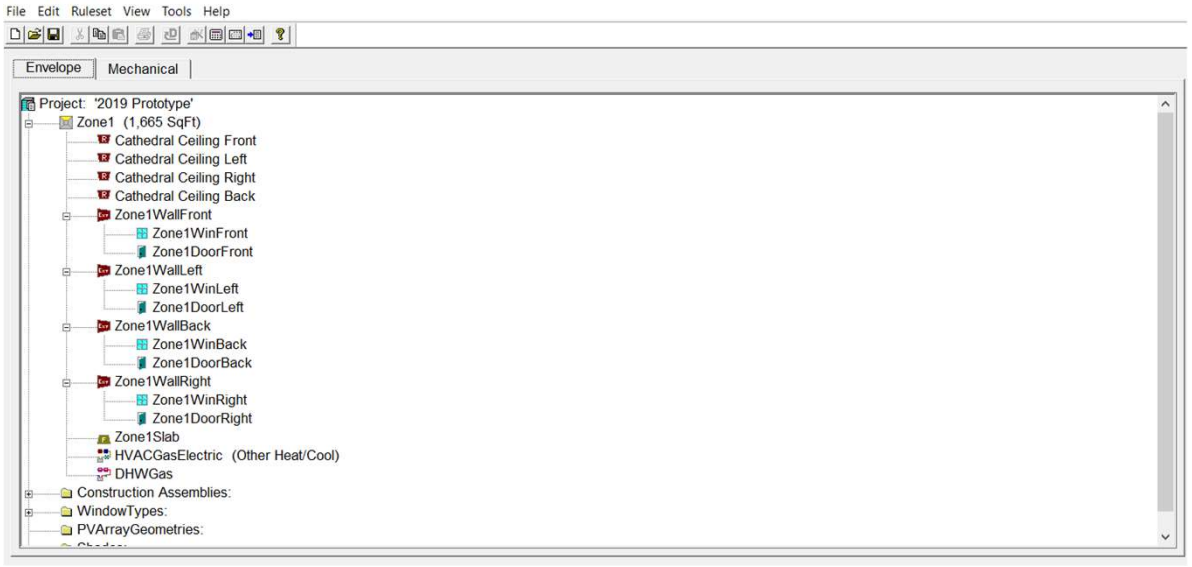
What are your suggestions?



Alternative Calculation Method Proposed Code Change Overview

- Recommend compliance options
  - QII for altered walls
  - Fireplace removal credit

Other suggestions?



Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process

1. Design Phase

- Designers/contractors specify design and products

2. Permit Application Phase

- Plans examiners to review that the building meets prescriptive standards or performance budget
- Permitting process distinct across jurisdictions and scopes of work, especially for re-roofs

Compliance Verification Process

3. Construction phase

- Contractor completes scope of work

4. Inspection Phase

- Building inspector field verifies work
- HERS rater verifies for measures that currently require HERS

Market Actors

Market actors involved in implementing this measure include:

- Contractors
  - Roofing
  - Mechanical
  - Plumbing
  - Insulating
  - Home Performance
- Trade Organizations / Industry Reps
- Architects/Designers
- Builders
- Energy Consultants
- HERS Raters
- Plans Examiners / Building Inspectors

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates

Draft Code Change Language

- Please take a minute to review the draft code language available in the **resources tab**

- Re-roofs – 150.2(b)1I
- Electric equipment replacements – 150.2(b)1G and 150.2(b)1Hiiid
- Attic insulation – 150.2(a)1Bi and 150.2(b)1
- Duct insulation and duct leakage – 150.2(b)1D

Software Updates

- Submeasure A – Prescriptive measures
  - Various changes to CBECC-Res E+A+A
  - No new modeling capabilities required
- Submeasure B – Clarifying Standards language
  - N/A
- Submeasure C – Performance calculation updates
  - New compliance options

Discussion and Next Steps

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the chat
- 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

Comments on this measure are due by December 5, please send to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

5 Minute Break

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Nonresidential Grid Integration

Codes and Standards Enhancement (CASE) Proposal

Nonresidential | Software Improvements

Jessica Peters, David Jagger, Christine Riker, Kitty Wang,
Energy Solutions
November 12, 2019

CALIFORNIA ENERGY CODES & STANDARDS
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Agenda

1	Background	*5 min*
2	Heat Pump Water Heaters	*10 min*
3	Thermal Energy Storage Systems	*10 min*
4	DC-DC Circuitry	*10 min*
5	HVAC Considerations	*5 min*
6	Discussion and Next Steps	*15 min*

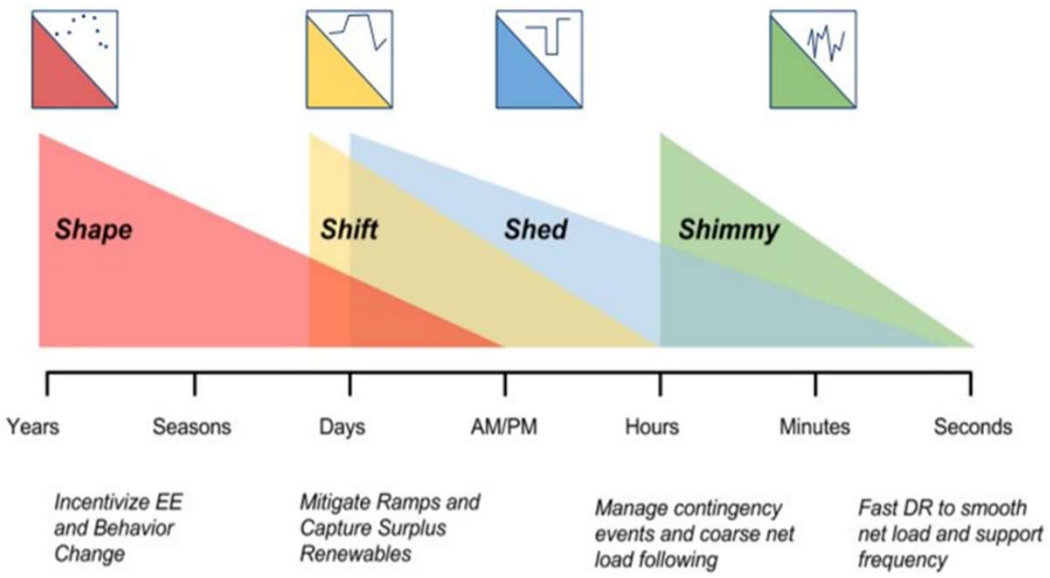
Demand Management

Goal: Adjust code requirements so facilities with demand management controls are more likely to use their controls to participate in demand management programs

Why are demand management programs important?

Flexible loads and controls can be used for day-to-day load management and peak demand reduction enable:

- Grid resiliency and reliability
- Increased renewable energy adoption
- Time-of-use rates, demand charges, and demand management programs to manage grid congestion
- Reduced need for inefficient/ high emissions peak generation plants



Demand Management in Nonresidential Buildings

The commercial and industrial sectors accounts for the majority of California's energy consumption*

- Commercial and Industrial: 41.8 percent
- Residential: 18.7 percent
- Transportation: 40.3 percent

Key nonresidential considerations:

- Larger energy use represents more potential for flexible demand
- A range of operating hours and operation flexibility well suited for current and future demand peaks and valleys
- Load shape and technology variation allow nonresidential buildings to take advantage of different demand management products (shift, shimmy, etc.)

*According to the Energy Information Administration in 2017

Nonresidential Software Considerations

CBECC-Com only includes specific end-uses in the compliance total

- Space Heating
- Space cooling
- Indoor Fans
- Heat Rejection
- Pumps and Misc.
- Domestic Hot Water
- Indoor Lighting

No flexibility score or consideration for Batteries/ PV in compliance – opportunities for demand flexibility must be identified in the end uses considered in compliance.

With the demand peak shifting to later in the day demand management strategies are most beneficial to a few key building types:

- Retail, restaurant, hospitality, (not office)

Photovoltaics and Batteries

- We recognize that photovoltaics and battery storage systems are a key element of grid integration efforts
- These technologies are currently under review by the Energy Commission and will not be discussed in this meeting

Code Change Proposal – Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Forms Updated
HPWH	Compliance Option	Yes	Potentially JA13	Yes
Thermal Energy Storage Systems Review	Compliance Option	Yes	NA7.5.14	Yes
DC-DC Circuitry	Compliance Option	Yes		Yes
HVAC Pre-Cooling	Compliance Option	Yes	Potentially JA5	Yes

- Designers will **not be required** to pursue these options
- Buildings will **receive credit through the performance approach** if they choose to pursue
- Reviewing existing materials to improve **Demand Flexibility Capabilities**

Submeasure A: Heat Pump Water Heaters With Grid Connectivity

Submeasure B: Thermal energy Storage Systems

Submeasure C: DC-DC Circuitry

Submeasure D: HVAC Pre-Cooling

Background

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

Context and History (HPWH)

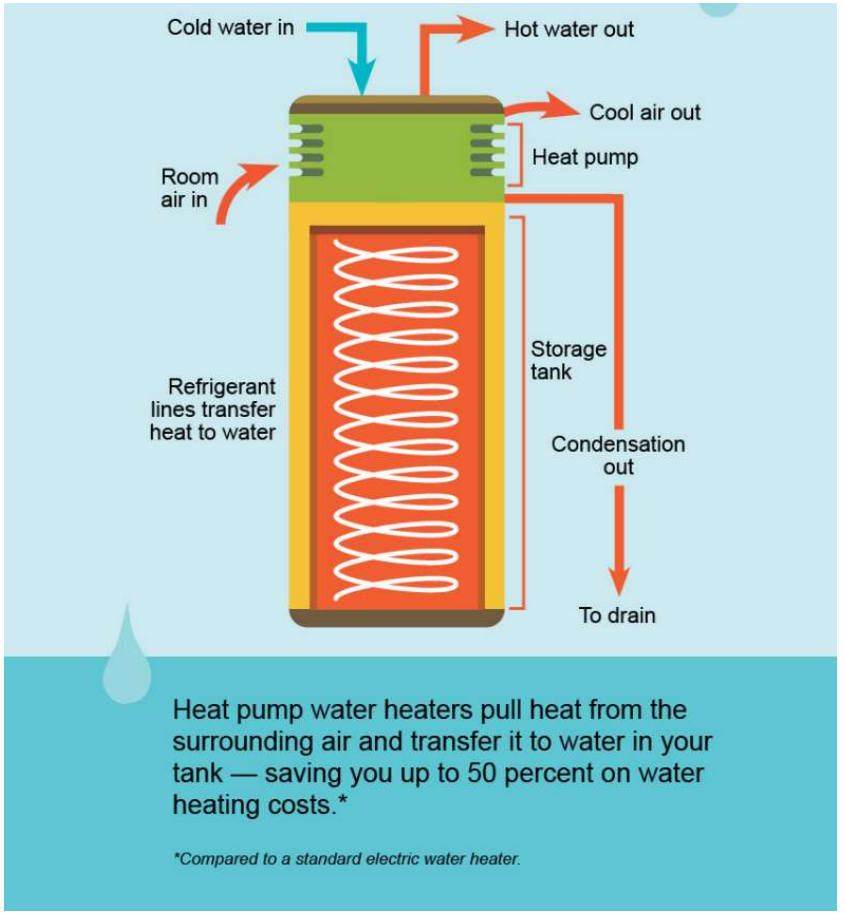
- **Why are we proposing this measure?**
  - Heat Pump Waters Heaters (HPWH) are an emerging market that can provide both increased efficiency and demand flexibility
  - Gaining traction in the residential market - need to expand to NR buildings who can benefit
  - Provides an opportunity to intelligently manage water heading load

How it Works (HPWH)

Heat pump water heaters use electricity to move heat from one place to another instead of generating heat directly.

Load Shifting

- Possible to use the thermal storage component of Water heater as a battery to use energy when demand is low, and store for peak period use
- Potentially significant grid harmonization for specific buildings types and later peaks
  - Prevent full recharge of water heaters after 9-5 Office use so as not to conflict with new 4-9 peak
  - Pre-heat water for restaurants peak use of 4-9 hours



https://www.netzeromontpelier.org/blog/hphw

Current Code Requirements (HPWH)

- Existing Requirements in Title 24, Part 6
  - Currently only included in the prescriptive approach in single family residences
  - Electric heat pump water heater is an option in the nonresidential performance approach – but no scheduling capability for charging/ discharging
    - EnergyPlus can include a Set Point Temp Schedule

- Existing Model Code Requirements
  - New in 2019: Appendix JA13 – currently a draft, only considers residential use

Proposed Code Change Overview (HPWH)

- Description of change
  - Incorporate setpoint temperature scheduling for CBECC-Com
  - Review and revise JA13 to include consideration for nonresidential buildings
  - Create recommendations for modelling assumptions and control algorithms for CBECC-Com based on 2022 TDV values
  - Provide guidance for Alternative Calculation method updates

Market Overview

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

Poll

Have you ever worked on a project where a Heat Pump Water Heater was installed in a commercial property?

A. Yes
B. No
C. No, but I am aware of commercial properties with Heat Pump Water Heaters

Market Overview and Analysis (HPWH)

- Current Market
  - Very small commercial market in US currently, but gaining traction overseas (China, Europe)
  - AO Smith just began selling HPWH last year
- Market Trends
  - Currently growing in the residential sector
- Market Barriers
  - Very few products on the market
  - Unfamiliarity with technology
- **Do you agree with this description? What else should we know?**

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations (HPWH)

- Technical Considerations
  - Consideration for potential efficiency tradeoffs when storing charge
  - Understanding typical size and operation of units in a very small market
  - Key differences in residential and nonresidential load profiles
- Technical Barriers and Potential Solutions
  - Units themselves are typically efficient compared to traditional water heating system so likely won't be a significant tradeoff
  - Test load profiles in simulations

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

Proposed Methodology

- Review 2019 CBECC-Res HPWH modelling assumptions and algorithms
- Evaluate existing models for impacts on TDV compliance score
  - Consider evaluation via EnergyPlus
  - Look at key nonresidential prototypes such as: Restaurant, Hotel, Retail, Office in all climate zones

https://bigladdersoftware.com/epx/docs/8-0/input-output-reference/page-025.html#waterheaterheatpump

Submeasure A: Heat Pump Water Heaters With Grid Connectivity

Submeasure B: Thermal energy Storage Systems

Submeasure C: DC-DC Circuitry

Submeasure D: HVAC Pre-Cooling

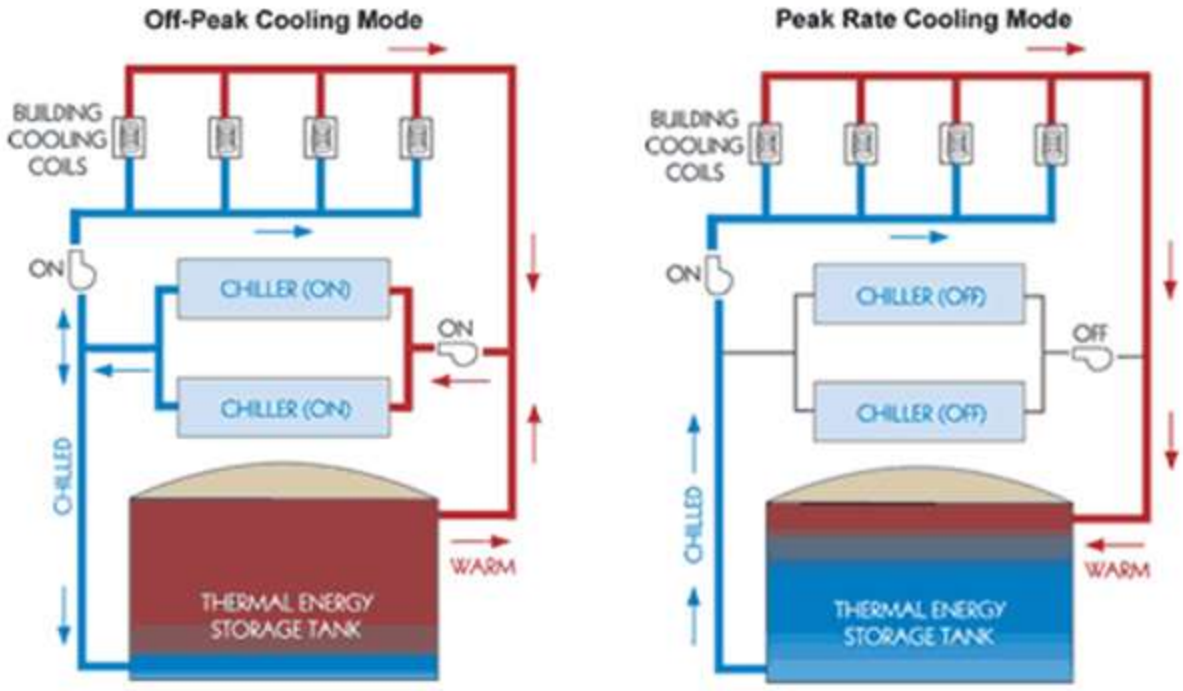
Context and History (TES)

- **Why are we proposing this measure?**
  - Thermal Storage can act as a battery for load management in cooling systems
  - Market for Thermal Energy Storage (TES) systems expected to grow from USD 3.33 billion in 2016 to USD 6.20 billion by 2023
  - TES systems are most effective in large buildings, most applicable to nonresidential buildings

https://www.marketsandmarkets.com/Market-Reports/thermal-energy-storage-market-61500371.html

How it Works (TES)

TES systems are typically installed with a chiller to allow for a system to charge up when energy prices are low then supplement cooling demand during peak times with stored thermal energy from chilled water, ice, or other mediums



https://www.dntanks.com/what-we-do/thermal-energy-storage/how-tes-works/

Current Code Requirements (TES)

- Existing Requirements in Title 24, Part 6
  - Building Standards:
    - Exception 3 to Section 140.4(i)exception to chiller minimum efficiency when Chiller is used to charge TES where charging temp is less than 40 degrees
    - Exception 2 to Section 140.4(j) exception to limitation on Air-Cooled Chillers (less than or equal to 300 tons) when chiller is used to charge TES with design temp of less that 40 degrees
  - Reference Appendices: NA7.5.14 Verification test
  - Compliance option in CBECC-Com for chilled water TES Systems

Proposed Software Change Overview

- Existing Software Capabilities
  - CBECC-Com can model a chilled water thermal energy storage system when installed with a chiller
  - CBECC-Com can create a customized thermal energy storage charging/ discharging schedule
  - EnergyPlus can model chilled water and ice TES systems
- Potential updates
  - Update CBECC-Com to include more system types (ice storage)
  - Add phase change material systems (eutectic salts)
  - Pre-defined schedule options for optimized TOU schedule to ease user input

Discussion Questions (TES)

- CBECC-Com 2019 improved functionality for TES systems, are there still pain points?
- When designing a TES system – is the main consideration using it as a supplement to a smaller system or energy time of use?
- Are time of use electric rates considered when scheduling TES systems?
- How common are TES systems and what type do you see most (chilled water, ice, PCM)?
- What factors would cause you to recommend a TES System in a building?

Market Overview

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

Poll

Have you ever worked on a project where a TES system was installed in a commercial property?

A. Yes (see second poll)
B. No
C. No, but I am aware of commercial properties with TES Systems

Poll

If Yes, What kind of system was installed?

Market Overview and Analysis (TES)

- Current Market
  - A few key manufacturers
  - Popular in concentrating solar power (CSP)
- Market Trends
  - Increasing in popularity as intermittently available Renewables become more prevalent
- Market Barriers
  - Designer, engineer, contractor, and building owner knowledge gap.

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

Proposed Methodology

- Collect Stakeholder feedback on need for more system types
- Review current CBECC-Com TES modelling assumptions
- Conduct research on Ice storage modelling techniques (EnergyPlus) to incorporate into CBECC-Com
- Pending 2022 TDV, test charge/ discharging schedules for optimized use to create pre-sets for users

Submeasure A: Heat Pump Water Heaters With Grid Connectivity

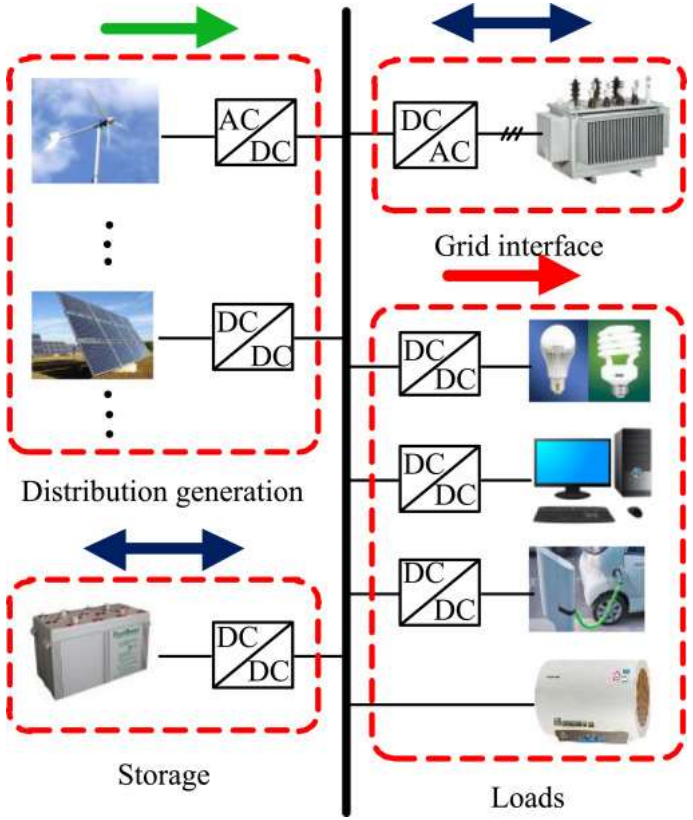
Submeasure B: Thermal energy Storage Systems

Submeasure C: DC-DC Circuitry

Submeasure D: HVAC Pre-Cooling

Context and History (DC-DC)

- Why are we proposing this measure?
  - Identified as an emerging technology that has potential to reduce energy use when PV and Battery storage is also installed on site
- How it Works
  - DC circuitry between the DC outputs of Photovoltaics and batteries and DC end uses such as LED lighting can eliminate energy lost through the inverting process



https://www.sciencedirect.com/science/article/abs/pii/S1364032117314788

Current Code Requirements (DC-DC)

- Existing Requirements in Title 24, Part 6
  - No current code language

- Existing Resources
  - Emerge Alliance standards
  - DLC QPL
  - ANSI C137.3 PoE standards for energy standards
  - IEEE 802.3bt
  - No modeling capabilities in EnergyPlus

Poll

Have you ever worked on a project where a DC to DC Distribution System or PoE was installed in a commercial property?

A. Yes
B. No
C. No, but I am aware of commercial properties with DC to DC Distribution Systems or PoE

Considerations

Complexity and variety of system designs	Complexity and variety of system architectures makes simplified modeling difficult.
	Not many parameters that always correlate to specific outcomes.
Gap in existing standards	Existing Standards aren't prescriptive in terms of power loss and don't specify end points. Lots of gray area for what happens between the building main panel to the lighting chip.
Conversion efficiency considerations for load factor	Specifically in lighting applications, a good lighting design should be running at 60 percent power or less so users can apply dimming. Efficiency conversion is a large variable when considering the load factor. How does running at 20 percent effect conversion efficiency?
Lack of testing standards	Little data on efficiency gains and no applicable testing standard that adequately fits needs for testing (not quite a solar inverter, not quite a cell phone charger). Difficult to verify savings without a testing standard.
CBECC-Com does not consider electrical wiring	The only way to model multiple points of inversion/rectification in CBECC-Com is by reducing the inverter efficiency.
	Indoor lighting is expressed only as Watts per square foot

Discussion Questions

- What percentage of a systems power consumption would you expect to be saved by a DC-DC Distribution system?
- Would you expect to receive significant credit in compliance software for installing this measure?
  - If so, in what building end use (e.g., Lighting, Cooling, Misc.)?
- When designing a PV and battery storage system – do you always invert at ONE point (i.e., PV and Battery on the same DC circuit)?
  - How many power conversion steps does a system typically have?
- Are you aware of any simulations for DC systems?

Market Overview

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

Market Overview and Analysis (DC-DC)

- Current Market
  - Not currently common in the US market
  - Case studies in the US and abroad
- Market Trends
  - Potential for significant growth with more Distributed energy resources and need for communication/ controls capability (PoE is great for this)
- Market Barriers
  - Little standardization
  - Unfamiliarity with technology from designers and installers
- **Do you agree with this description? What else should we know?**

Submeasure A: Heat Pump Water Heaters With Grid Connectivity

Submeasure B: Thermal energy Storage Systems

Submeasure C: DC-DC Circuitry

Submeasure D: HVAC Pre-Cooling

Other Potential Consideration

- Pre-Cooling for nonresidential HVAC systems
- Review of Load Management capacities in HVAC system modelling

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts Methodology
- Cost Impacts Methodology
  - Incremental costs
  - Energy cost savings

Assumptions for Energy Impacts Analysis

- Key assumptions
  - 2022 TDV assumptions
  - Period of evaluation: 15 years for nonresidential
  - CBECC-Com Building Prototypes
  - Customizable operating schedules

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
- Manufacturers
- Energy Modelers

Energy Modelers – Please provide feedback. We want to hear pain points.

What are we missing? Do you feel you have opportunities to utilize TDV in your designs?

Discussion and Next Steps

Poll

Which update would you most like to see in CBECC-Com 2022

A. Heat Pump Water Heaters
B. Thermal Energy Storage Systems
C. DC-DC Circuitry
D. HVAC Pre Cooling/Load Management Capabilities
E. Other

Poll

If you Chose other or have another area you would like us to look at, please specify.

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Thank You

Questions?

Jessica Peters, *Energy Solutions*
jpeters@energy-solution.com

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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Elevator CASE Measure

Codes and Standards Enhancement (CASE) Proposal

Nonresidential | Software

Eric Martin, *Energy Solutions*

November 12, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

1	NR Plug Load Modeling Update	*1 min*
2	Background	*5 min*
3	Compliance and Enforcement	*5 min*
4	Proposed Code Changes	*5 min*
5	Discussion and Next Steps	*5 min*

NR Plug Load Modeling Update

- Measure will be deferred until the 2025 code cycle due to a lack of adequate data
- Looking for sources that contain both equipment power densities (Watts per square foot) and load profiles by space or building type, which meet the following criteria:
  - Recent (2016 or later)
  - California-specific
  - Based on measured data
- CBECS 2018 will be published in late 2020 but is not California-specific and does not include load profiles

Background

- Context and History
- Code Change Proposal

Code Change Proposal – Summary

Measure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Forms Updated
Elevator CASE Measure	Compliance Credit	Yes	ACM Reference Manual	NRCA (Potentially NRCC)
Elevator CASE Measure	Mandatory Requirement	Yes	Section 120.6	TBD

- No energy savings or incremental measure cost
- Uncertain whether this measure will be a mandatory or compliance option for the performance approach
- In the process of collecting information to decide

Current Code Requirements

Code	Requirements
Title 24, Part 6	• Light power density • Ventilation fans • Auto shut-off • Elevator lighting and ventilation control acceptance (not including healthcare facilities)
ASHRAE	• Luminous efficacy • Ventilation power • Standby mode • Design documents for energy efficiency classes

Energy Efficient Hardware: Regenerative Drives

- Recycles energy (motor acts as a generator)
- Reduces elevator energy consumption by **up to 75 percent**
- Heat generation can be reduced up to 50 percent depending on size of equipment
- Can be retrofitted to existing elevator systems
- Elevators typically represent 2–5 percent of annual building energy, but can account for up to 50 percent of energy during busy periods[1]

1. "Advancing Elevator Energy Efficiency." 2015. http://www.aceee.org/sites/default/files/publications/researchreports/a1501.pdf

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process

1. Design Phase

- Complete compliance document
- Choosing a regenerative drive reduces modeled energy use and improves compliance margin

2. Permit Application Phase

- Authority having jurisdiction reviews compliance document

Compliance Verification Process

3. Construction Phase

- Likely no change

4. Inspection Phase

- Acceptance Test Technician?

Is there an easy way to verify that an elevator has regenerative drive?

Market Actors

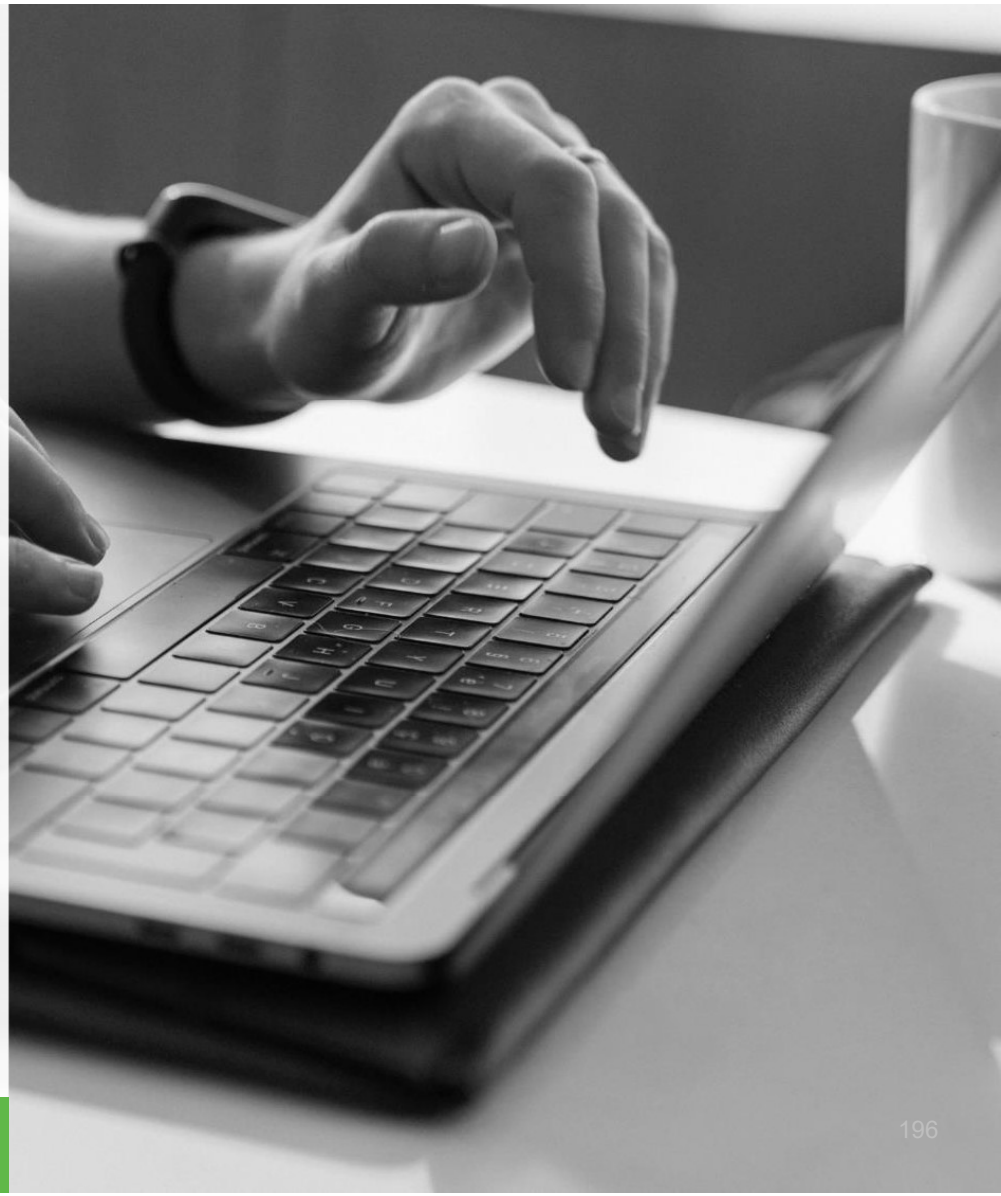
Market actors involved in implementing this measure include:

- Elevator Contractors
- Design Engineers
- Energy Modelers
- Acceptance Test Technicians

If you are one of these market actors and want to provide information on how this will impact your role, please leave your information in the chat.

Proposed Code Changes

- Proposed Software Updates



Software Updates – CBECC-Com

Current Modeling Capabilities

- Select quantity of elevators per space
- Software assumes 10 kW per elevator and assigns a default operation schedule
  - Option to specify a custom operation profile

Proposed Modeling Capabilities

- Select the elevator drive type (e.g., geared, hydraulic, or regenerative drive)
- Different power draw associated with each drive type
- Scale power draw based on number of stories served

Discussion and Next Steps

Compliance Credits – General

Compliance credit criteria:

- Must improve efficiency **beyond what Title 24 requires**
- Must be **easily verifiable** through on-site inspection
  - Easiest to verify if the loads are installed with the building and if there are a small number per building so that each one can be verified

Are there any other compliance credits for more efficient nonresidential equipment loads that we should consider?

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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Nonresidential Software Updates

Codes and Standards Enhancement (CASE) Proposal

Nonresidential

Eric Martin, *Energy Solutions*

November 12, 2019

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Nonresidential CASE Proposals – Summary of Software Revisions

#	CASE Initiative Name	Submeasure	Type of Software Change	Summary of Software Change
1	High Performance Envelope	Cool Roofs	Minor Update	Update existing Solar reflectance and emittance values for both new and exiting buildings. Do we have a vintage building that we can use.
2	High Performance Envelope	Thermal Bridging (on hold)	Minor Update	Implement phi, chi or derating factor for selected or all assemblies
3	High Performance Envelope	Roof Alteration	Minor Update	Update insulation values
4	High Performance Envelope	High Performance Windows	Minor Update	Update U, SGHC, VT values
5	High Performance Envelope	Opaque envelope	Minor Update	Wall, Roof, Slab, Door - Update insulation R / Assembly U-values
6	Nonresidential Plug Load Modeling	Elevator Compliance Credit	Minor Update	May introduce a compliance credit for specific elevator types
7	Nonresidential Indoor Lighting	Networked Lighting Controls	Minor Update	Insert PAF for networked lighting controls
8	Nonresidential Indoor Lighting	Mutli-zone Occupancy Sensing in Open Plan Offices	Minor Update	Allow for multiple occupancy sense points
9	Nonresidential Daylighting	Daylighting Dimming to OFF	Minor Update	Update so luminaires can be dimmed down to off
10	Nonresidential Daylighting	Mandatory Controls in the Secondary Daylit Zone	Minor Update	Update so daylighting controls are required in the secondary sidelit daylit zone
11	Nonresidential Air Distribution	Improved Fan Efficiency Metric	Minor Update	Add fan energy index inputs
12	Nonresidential Air Distribution	Expand Duct Leakage Testing	Minor Update	Add duct leakage rates and return air plenum to Standard Design and add field for specifying proposed leakage
13	Drainwater Heat Recovery	Nonresidential Drain Water Heat Recovery	New Feature	Add user input fields for u-factor, surface area, and DHW draw schedule
14	High Efficiency Boilers and Service Water Heating	Service Water Heating System Efficiency	Minor Update	Update minimum efficiency to 90% for water heaters serving large offices
15	High Efficiency Boilers and Service Water Heating	High Efficiency Boiler Systems and Oxygen Trim Control	Minor Update	Update minimum efficiency to 90% for boilers serving large offices

Nonresidential CASE Proposals – Summary of Software Revisions (continued)

#	CASE Initiative Name	Submeasure	Type of Software Change	Summary of Software Change
16	Nonresidential HVAC Controls	VAV Minimum Airflow	Minor Update	Change primary airflow rate in the deadband to zone outdoor airflow rate.
17	Nonresidential HVAC Controls	Air Efficiency - Airside Economizer	Minor Update	Update air economizer cutoff cooling capacity from 54,000 Btu/h to 36,000 But/h
18	Nonresidential HVAC Controls	Air Efficiency - Expand Economizer Integration	Minor Update	• Lower packaged unit compressor turndown to 25% for 240,000 Btu/h cooling capacity and less • Lower packaged unit compressor turndown to 10% for 240,000 Btu/h cooling capacity and larger
19	Nonresidential Air Distribution	High Performance Ducts/Updates to Fan Power Limits	Major Update	Revise fan power limits by adopting AMCA 208.
20	Nonresidential Grid Integration	Compliance Options that Enable Load shifting – Heat Pump Water Heaters	Major Update	Add Set Point Temperature Scheduling component to existing Electric HPWH modeling
21	Nonresidential Grid Integration	Compliance Options that Enable Load shifting – Thermal Energy Storage	Major Update	Add system types such as ice and phase change materials and review user scheduling input
22	Nonresidential HVAC Controls	Dedicated Outside Air System	Minor Update	Implement mandatory requirements for DOAS systems
23	Reduce Infiltration	Reduce Door Air Infiltration	Minor Update	Change infiltration assumptions for doors
24	Data Center Efficiency	Many submeasures	Major Update	Add newly regulated systems (e.g. uninterruptible power supplies) and ability to model data center heat recovery; plus minor updates to existing software inputs

Thank You

Questions?

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Thank you for your participation today

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Please complete the closing polls below

Stay Tuned for the Second Round of Utility-Sponsored Stakeholder Meetings in January/February 2020

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