

Round
2

Welcome to the California Statewide Codes and Standards
Enhancement (CASE) Team's Stakeholder Meeting on
Single Family Grid Integration 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.



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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 Grid Integration

Statewide CASE Team

March 19, 2020

Meeting Guidelines

Part 1 of 3 - Muting

Muting Guidelines:

Once you establish your audio connection please **MUTE** your microphone.

- 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;

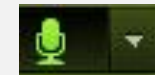
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MUTED



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Meeting Guidelines

Part 2 of 3 - Participation

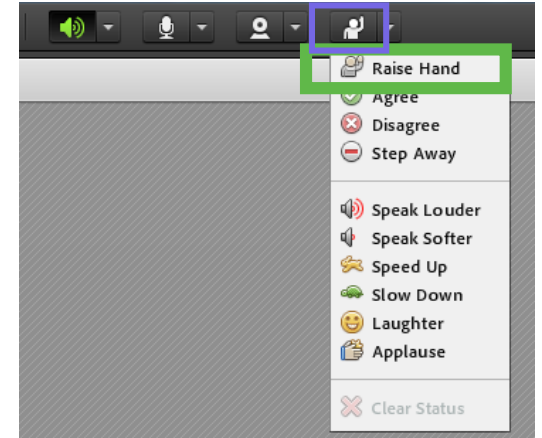
Participation Guidelines:

- **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.

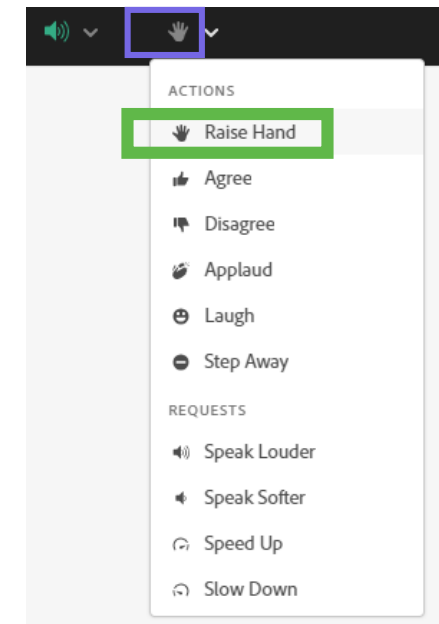
- **Other Meeting Feedback**

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



Above: feedback view for Adobe Connect [app users](#).

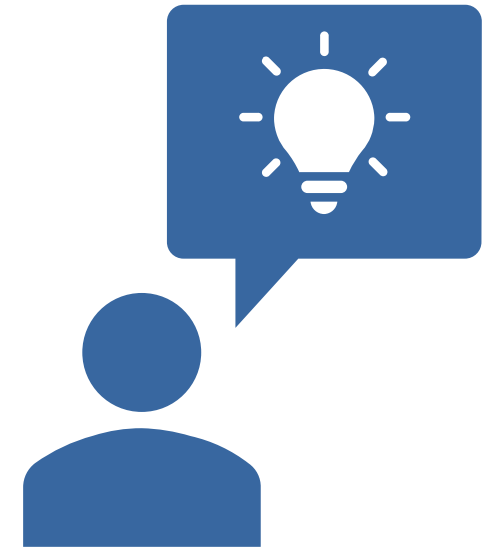
Below: feedback view for [HTML users](#).



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: Single Family Grid Integration <ul style="list-style-type: none">• Home Energy Management Systems and Smart Thermostats• Battery Storage Systems• HPWH Load-shifting• HVAC Load-shifting	<i>8:45 am</i>
6	Wrap Up & Closing	<i>11:15 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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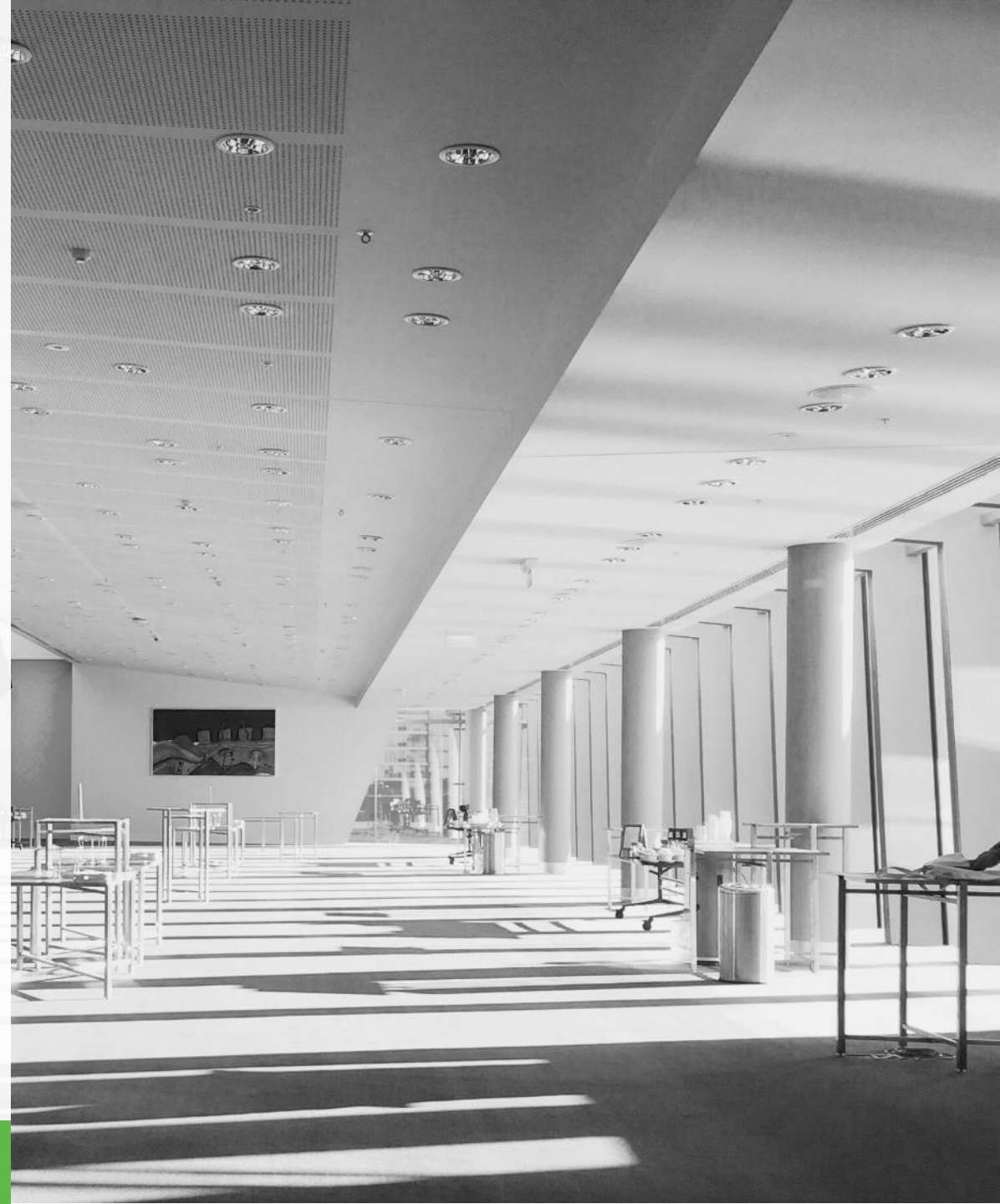


More information on pre-rulemaking for the 2022 Energy Code at:

<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.

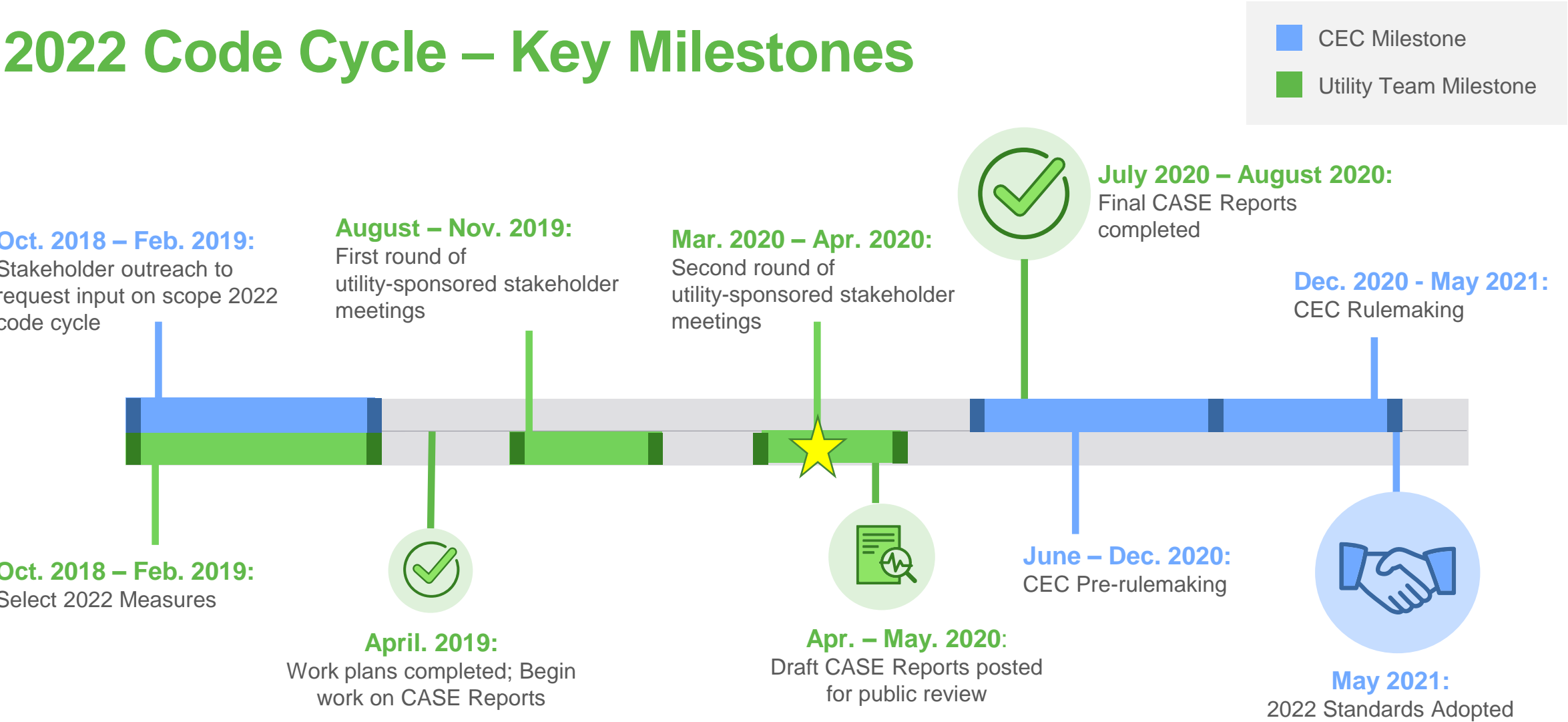
Sign Up

Second Round Utility-Sponsored Stakeholder Meetings

Meeting Topic	Building Type	Date
Lighting	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	MF	Wednesday, March 25, 2020 (NEW)
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



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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Meeting Guidelines Reminder

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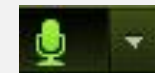
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Meeting Guidelines Reminder

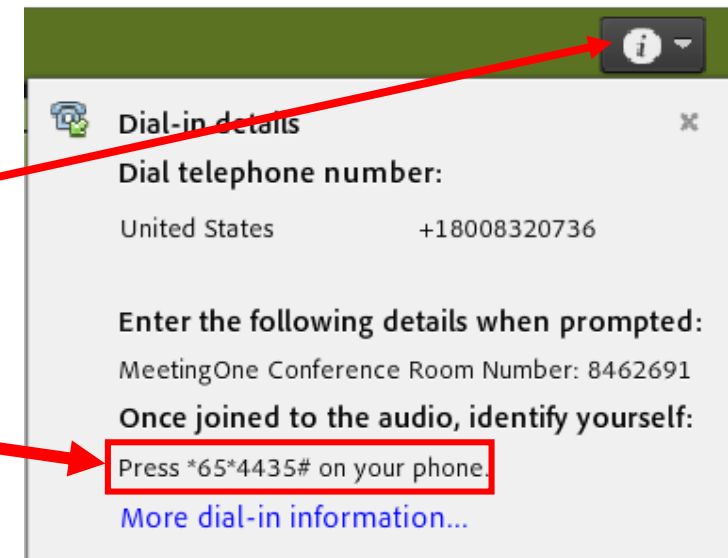
Pairing Guidelines:

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)

Single Family Grid Integration

Codes and Standards Enhancement (CASE) Proposal
Single Family Residential | Grid Integration

Bob Hendron, Marc Hoeschele, and Kristin Heinemeier, *Frontier Energy*

David Zhang, *Energy Solutions*

Ben Larson, *Larson Energy Research*

March 19, 2020

Agenda

1 Introduction/General Updates

2 *Home Energy Management Systems
and Smart Thermostats (brief update)*

3 *Battery Storage Systems*

4 *Heat Pump Water Heater Load Shifting*

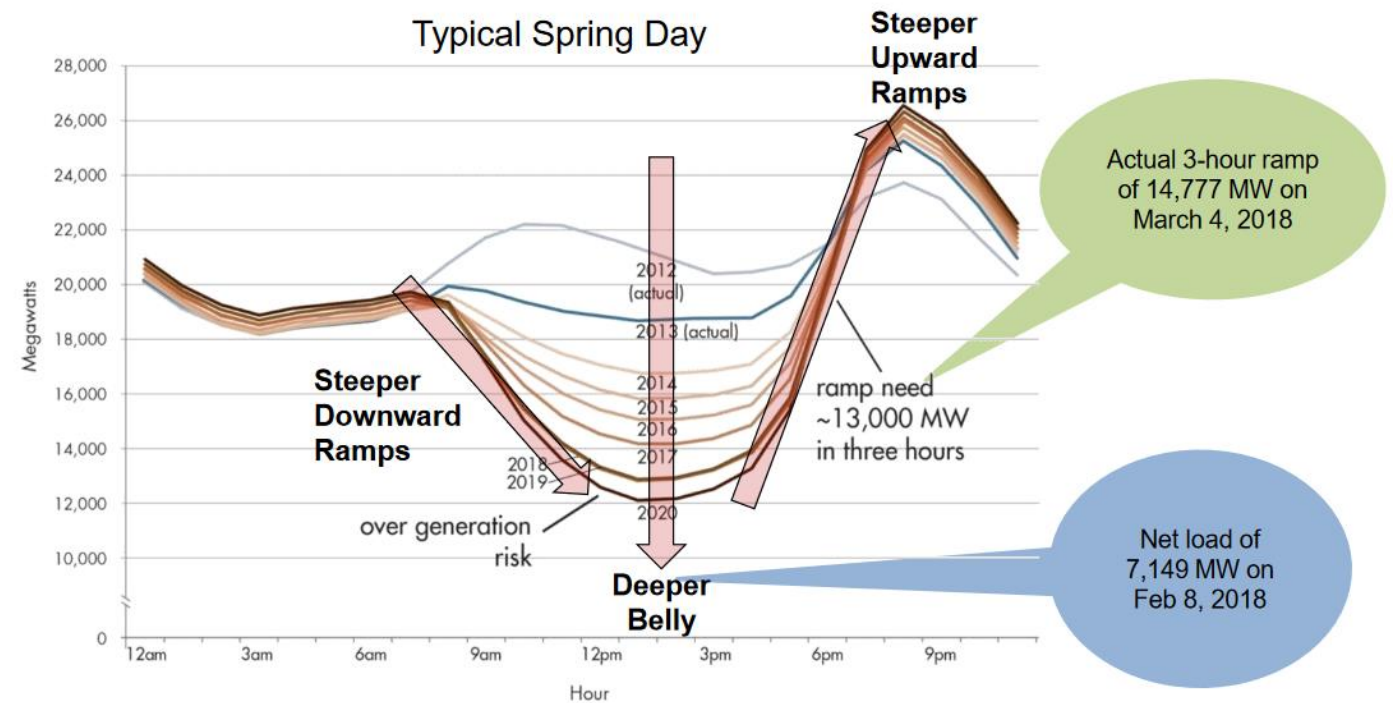
5 *HVAC Load Shifting*



Introduction

Context and History

- **Issue:** Maintaining grid stability continues to grow in importance as renewables increase, driven by state policies such as SB 32¹ and SB 100²
- **Goal:** Shift household electricity use from peak periods to off-peak periods that better align with PV production
- **Approach:** Technological advances allow for peak demand reduction through several means:
 - Energy storage
 - Turning off non-critical devices
 - Rescheduling of loads



Source: California Independent System Operator. 2019. Energy Storage and Distributed Energy Resources Phase 4 Stakeholder Workshop.
<http://www.caiso.com/Documents/Presentation-Energy-Storage-DistributedEnergyResourcesPhase4-Mar18-2019.pdf#search=duck%20curve>

¹ https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB32

² https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Battery Storage Systems	Compliance Option	Yes	Section 100.1(b); Residential Compliance Manual Chapter 7.5; Joint Appendix 12	Certificate of Installation CEC-CF2R-PVB-02-E
HPWH Load Shifting	Compliance Option	No	Section 100.1(b); Joint Appendix 13 (currently exists in draft form); Possible updates to Reference Appendices	Uncertain, pending Energy Commission activities
HVAC Load Shifting	Compliance Option	Yes	Section 150.1; Joint Appendix 5; Residential Appendix 3.4; Residential ACM Reference Manual	CF1R, CF2R, and CF3R forms, in the "Special Features" section
Home Energy Management	Compliance Option	No	Section 110.10; Section 100.1(b); Residential Compliance Manual -Sections 7.6, 7.8, and Appendix H; Joint Appendix JA5	CF2R-SRA-01-E

Description of Changes

- All submeasures either introduce new compliance options or clarify requirements
- Additional detail on code change language is provided
- Energy savings analysis is included

Code Change Proposal: Additional Resources

First-Utility Sponsored Meeting

The Statewide CASE Team held its first utility-sponsored stakeholder meeting for this topic on **September 10, 2019.**



Resources on [Title24stakeholders.com](https://www.title24stakeholders.com)

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.

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Home Energy Management and Smart Thermostats (*brief update*)

Codes and Standards Enhancement (CASE) Proposal

Single Family | Grid Integration

Bob Hendron and Kristin Heinemeier, *Frontier Energy*
March 19, 2020

Update on Home Energy Management System (HEMS) Submeasure

1. Based on stakeholder outreach, it is **premature to provide compliance credits** for home energy management, due to the variety of capabilities and evolving market.
2. Proposed code change defines **specific qualifying criteria** for the exception to the solar zone credit when a HEMS is installed in combination with a smart thermostat.
3. “Home automation” is **replaced with “home energy management”** throughout code.
4. Proposed change **requires compliance** with the ENERGY STAR Smart Home Energy Management System specification* **and compatibility** with other Title 24-compliant demand response technologies.
5. Additional direct **outreach to HEMS manufacturers** will be performed.

* ENERGY STAR Smart Home Energy Management Systems (SHEMS) Version 1.0.

https://www.energystar.gov/products/spec/smart_home_energy_management_systems_pd

Update on Smart Thermostats (“Advanced Energy Efficiency Thermostats” (AEET))

Provide minimal credit now, and set the stage for a more substantial credit in the next round.

Summary of changes:

1. Provide minimal credit for Installation of a Certified AEET:

- Exempt from Minimum Solar Zone Area if install AEET (or DRT or HEMS)
- Allow Winter Charge Weigh-In

2. Reorganize Joint Appendix 5 to include Technical Specifications for several areas of thermostat functionality:

- JA5.1: Thermostats for Demand Response (DRT) Change in nomenclature only - No changes made to specifications
- JA5.2: Thermostats for Pre-Cooling (PCT) Described in HVAC Load Shifting Submeasure discussion
- JA5.3: Thermostats for Energy Efficiency (EET)
 - JA5.3.2.1: Requirements for Programmable Thermostats
 - JA5.3.2.2: Requirements for Advanced Energy Efficiency Thermostats (AEET)

Certification Requirements for AEET

1. **Self-certify to Energy Commission as compliant with requirements for ENERGY STAR Connected Thermostat Products (v 1.0).**
2. **Submit to the Energy Commission all data that would be reported to EPA.**
3. **In addition:**
 1. Submit to the CEC:
 - The CT Field Savings Software Output File (per “Method to Demonstrate Field Savings Version 1.0”).
 - The Annual Percent Run Time Reduction for heating and/or cooling, for the relevant ENERGY STAR Climate Region.
 - Both the proposed methodology that was approved by the EPA, and the results of the study—if an alternative “A/B” study was used to establish savings.
 2. Have Annual Percent Run Time Reduction for the relevant ENERGY STAR Climate Region of at least 8 percent for heating and 10 percent for cooling.
 3. Have Standby Losses—as defined by ENERGY STAR—of ≤ 1.0 W.

Thank You

Questions?

Bob Hendron (HEMS)

Frontier Energy

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Kristin Heinemeier (Smart Thermostats)

Frontier Energy

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Submeasure A: Battery Storage Systems

Submeasure B: HPWH Load Shifting

Submeasure C: HVAC Load Shifting

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Battery Storage Systems

Codes and Standards Enhancement (CASE) Proposal

Single Family | Grid Integration

David Zhang, *Energy Solutions*

March 19, 2020

Agenda

- 1 Today's Objectives
- 2 Proposal Background
- 3 Cost and Energy Calculations
- 4 Market Analysis and Technical Feasibility
- 5 Questions and Next Steps



Proposal Background

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Battery Storage Systems	Compliance Option	Y	Section 100.1(b) Residential Compliance Manual Chapter 7.5 Joint Appendix 12 Residential ACM Manual Section 2.1.5, Appendix D	Certificate of Installation CEC-CF2R-PVB-02-E

Description of Changes

- Increase Round-Trip-Efficiency (RTE) requirements, update safety requirements, and improve verification and compliance procedures
- Increase AC-AC RTE from 80 Percent to 85 Percent
- Update TOU control strategy to year-round operation

Energy Impacts

- Assumptions & Methodology
- Energy Savings

Methodology for Energy Impacts Analysis

- Simulate prototype energy models in each climate zone with:
 - Standard Design PV
 - 5 kWh battery system (Basic control)
 - 2022 TDV Figures with 15 percent Retail Rate Adder

Tools Used	CBECC-Res and California Simulation Engine (CSE)
Building Prototypes Used	2100 & 2700 ft ² single-family residential prototype models
Climate Zones Modeled	All climate zones

Definition of Baseline and Proposed Conditions



Baseline Conditions

- Standard Design PV
- 5 kWh batter (Basic control)
- **80** percent RTE



Proposed Conditions

- Standard Design PV
- 5 kWh batter (Basic control)
- **85** percent RTE

Per Unit Energy Savings



- **1 – 5 percent** Electricity Savings depending on climate zone and building type
- **1 – 3 percent** TDV Savings depending on climate zone and building type

2023 Construction Forecast: New Construction

Building Type	Total Statewide New Construction Permitted in 2023 (# of buildings)	Percent of Statewide New Construction Impacted by Proposal	Statewide New Construction Impacted by Proposal in 2023 (# of buildings)
Single Family	119,045	8.7%	10,400

- Assuming 50/50 split between 2100 and 2700 ft² prototype models
- 13,000 single family homes currently have battery storage (2019)¹
- Battery storage is expected to grow 5x by 2024²
- Therefore, 52,000 new construction homes are projected to install battery storage by 2024 or 8.7 percent of all new construction homes
 - $5 \text{ times growth} \times 13,000 \text{ homes} - 13,000 \text{ existing storage homes} = 52,000 \text{ New Construction Single Family homes}$

1. https://www.californiadgstats.ca.gov/downloads/#_r21_ids

2. http://go.woodmac.com/l/131501/2019-12-02/2793m1/131501/98910/Completed_US_ESM_Q4_2019_Exec_Summary_Final.pdf

2023 Construction Forecast: Existing Buildings

Building Type	Total Statewide Existing Buildings (# of buildings)	Percent of Statewide Existing Buildings Impacted by Proposal	Statewide Existing Construction Impacted by Proposal in 2023 (# of buildings)
Single Family	8,828,191	0.147%	13,000

- Assuming 50/50 split between 2100 and 2700 ft² prototype models
- 13,000 single family homes currently have battery storage (2019)¹
- Existing building stock is estimated at 8,828,191 homes. Assuming similar rates of installation in existing buildings, we can assume this measure will apply to 0.147 percent of existing SF residential homes

1. https://www.californiadgstats.ca.gov/downloads/#_r21_ids



Market Overview

- Market Overview and Analysis - Revisited
- Market Trends
- Standalone Storage Market

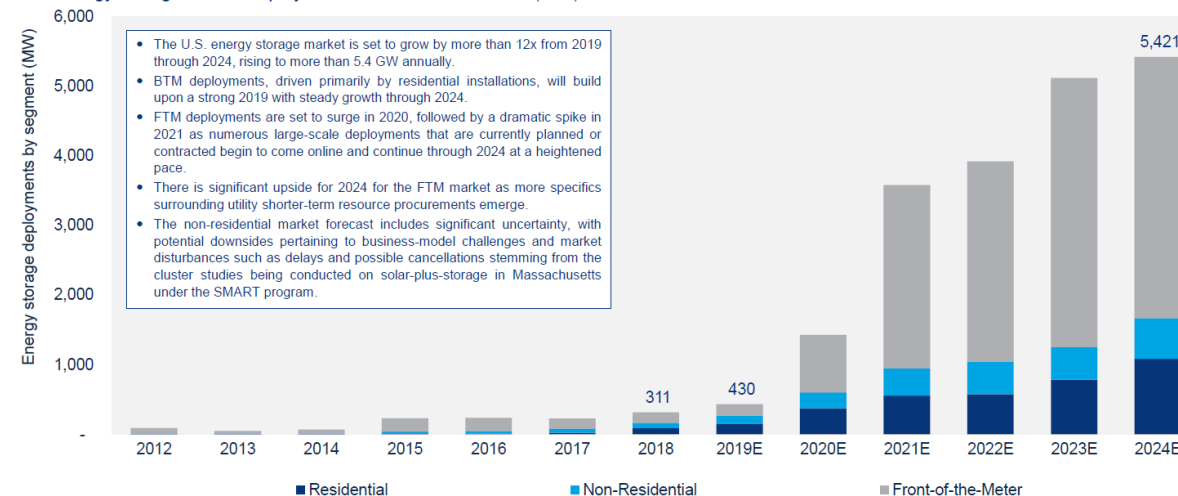
Market Overview and Analysis – Revisited from 2019

- Residential Energy Storage in the US still projected to exceed 1,000 MW by 2023¹
- Entire U.S. storage market has grown 93 percent year-over-year since 2013 (includes residential, non-residential and Front-of-the-Meter)
- Utility outages driving more residential installations to increase resiliency²

U.S. energy storage annual deployments will reach 5.4 GW by 2024

A shift in utility planning and procurement priorities will drive FTM deployments higher

U.S. energy storage annual deployment forecast, 2012-2024E (MW)



Source: Wood Mackenzie Power & Renewables

¹ GTM Research, U.S. Energy Storage Monitor: Q4 2019 Executive Summary, Dec 2019, http://go.woodmac.com//131501/2019-12-02/2793m1/131501/98910/Completed_US_ESM_Q4_2019_Exec_Summary_Final.pdf

² Greentech Media, US Storage Market Rebounds as Outage-Scarred California Promises Big 2020 Growth, Dec 2019, <https://www.greentechmedia.com/articles/read/us-storage-market-rebounds-in-q3-as-calif-power-outages-loom-large>

Market Trends

- Battery costs declined **15 percent** per year from 2012 to 2017 – totaling a 5-year 50 percent reduction¹
- Battery price declines slowed down in 2018 due to battery cell shortages²
- BloombergNEF's 2019 market study found that battery prices averaged \$156/kWh – projected to fall below \$100/kWh by 2023³
- Soft costs of battery installation still prevalent
- CPUC establishes equity resiliency budget within the Self Generating Incentive Program (SGIP) for “high fire threat districts.”⁴
- Up to \$1/watt-hour incentive can cover up to 98% of typical Tesla Powerwall installation

¹ McKinsey & Company, The New Rules of Competition in Energy Storage, June 2018, <https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/the-new-rules-of-competition-in-energy-storage>

² GTM Research, U.S. Energy Storage Monitor: Q3 2018 Executive Summary, Sep 2018, <https://dms.psc.sc.gov/Attachments/Matter/e0e54e2c-57c3-41df-9fa0-c165d0c6f437>

³ BloombergNEF, Battery Pack Prices Fall As Market Ramps Up with Market Average At \$156/kWh in 2019, Dec 2019, <https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/>

⁴ CPUC, Proposed Decision of Commissioner Reschtschaffen, R.12-11.005

Standalone Storage Market

- **Use cases include:**
 - Battery storage for community solar participation
 - Reliability benefits through backup power
 - Bill savings through TOU arbitrage
 - Homes where solar access is restricted
- **Out of all Residential Self-Generating Incentive Program (SGIP) Projects¹:**
 - 97 percent of Projects are Storage + Solar PV
 - 3 percent of Projects are Standalone Storage



Source: Renewable Energy World

¹California Distributed Generation Statistics, August 31, 2019, <https://www.californiadgstats.ca.gov/downloads/>

Poll

Should Title 24 include standalone batteries that are grid charged as a compliance option?

- A. Yes
- B. No
- C. Undecided (Feel free to comment in the chat)

Technical Considerations

- Battery Storage Readiness



Battery Storage Readiness

- **Goals are to:**
 - Make the battery storage system more plug and play
 - Significantly reduce the cost of installation
 - Provide basic considerations for battery storage systems without limiting flexibility in design
- **Potential considerations include:**
 - Designating a space near the electrical main panel for the battery storage system
 - Defining which appliances should be considered as critical loads

What additional considerations would make battery storage systems more plug and play?

Poll

Would battery storage readiness requirements be beneficial for builders and contractors?

- A. Yes
- B. No
- C. Undecided

Compliance and Enforcement

- Battery Control Strategy Verification



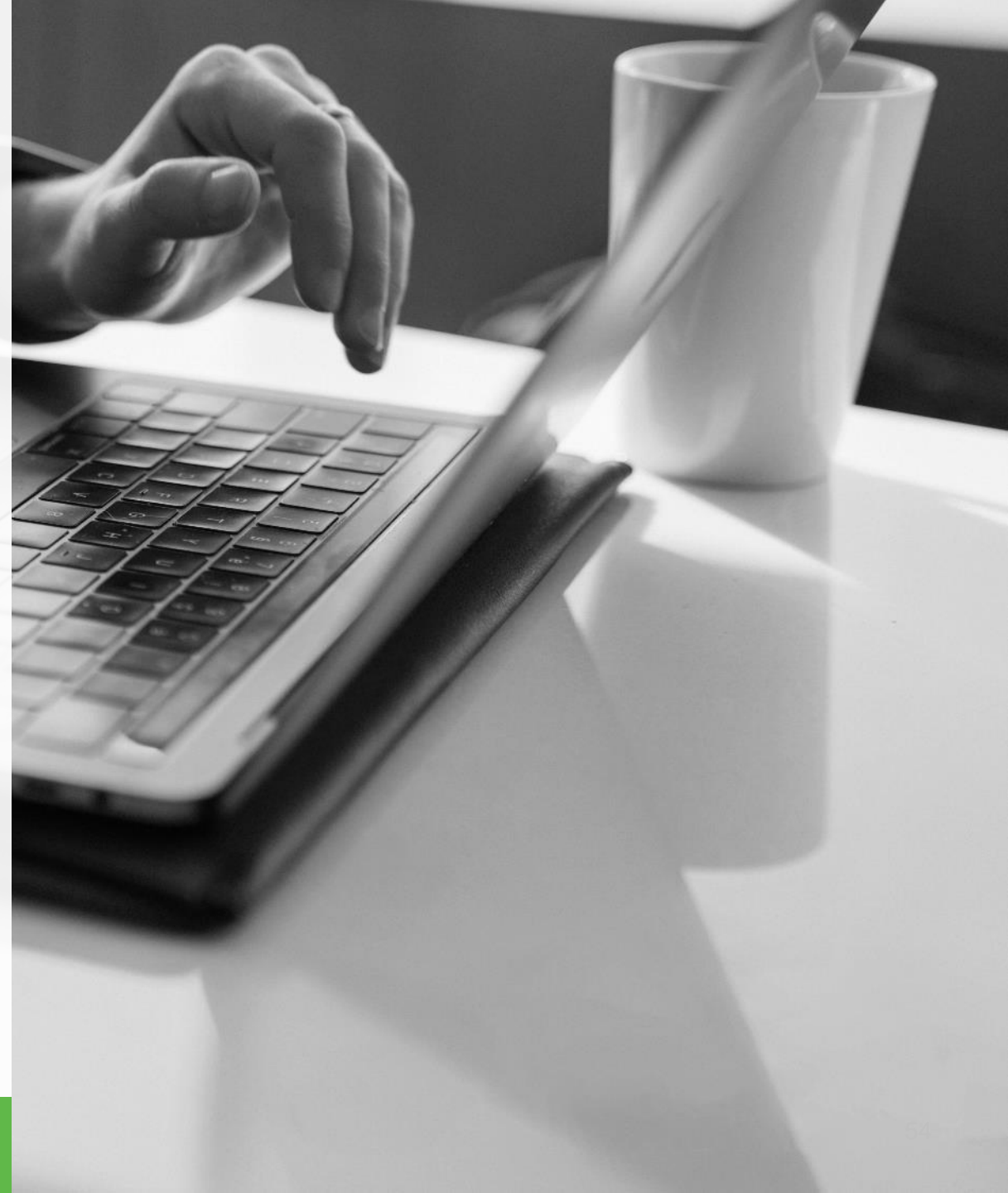
Battery Control Strategy Verification

- **Joint Appendix 12** requires that the Battery Storage System complies with an approved battery control strategy
- Battery control strategy can be listed in the battery user manual or in the battery settings. Other parameters are commonly found on the datasheet.
- Battery control strategy name may not exactly match the control name or control mode listed
- Therefore, additional guidance on the Certificate of Installation will support building inspectors with verification of the battery control strategy



Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language

- **Updated** draft code language for this submeasure is available in the **resources tab**.
- **Changes include:**
 - An updated and improved definition for "Battery Storage System"
 - Addition of UL9540A safety requirement
 - Increase in AC-AC RTE from 80 percent to 85 percent
 - Updated definition for TOU battery control strategy
 - Updated link to qualified JA12 products
 - Clarified battery storage design fields in compliance documents

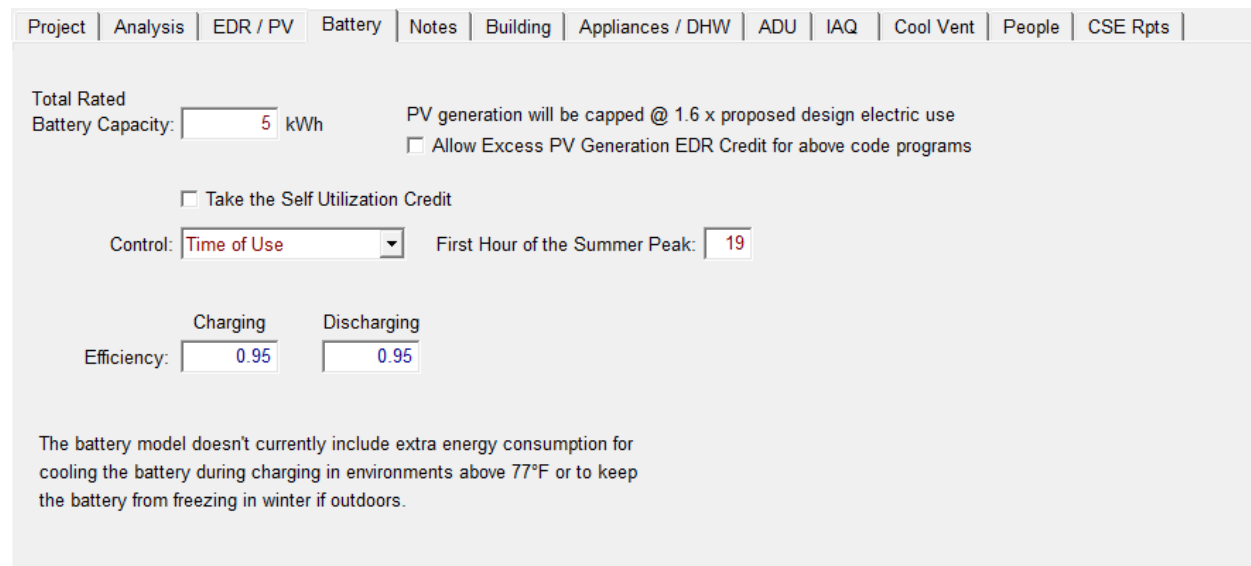
Battery Storage Control Strategy Analysis

- The Statewide Case Team analyzed existing and new battery control strategies across all Climate Zones and identified potential updates to existing battery control strategies
- **“Basic”** charges when there is excess PV and discharges to meet unmet load
- **“Time of Use”** selectively discharges at a specified default hour from June – September and reverts to “Basic” outside these months
 - Tou_yr: TOU control year-round (not limited to June through September)
 - Tou_+1: TOU control with start hour one hour after the default.
 - Tou_-1 TOU control with start hour one hour before the default
- **“Advanced DR”** discharges at maximum rate during highest TDV hours on peak days and reverts to “Basic” on non-peak days year round
 - Adr_tou: Advanced DR control June through September. TOU control all other months
 - Adr_basic: Advanced DR control June through September. Basic control all other months.

Abbreviated Strategy Name	Overall Rank
adv	1
adv_tou	2
tou_yr	3
tou_yr_-1	5
tou_yr_+1	6
tou	7
adv_basic	4
tou_+1	8
tou_-1	9
basic	10

Software Updates

- A new CBECC-Res user input, “Round Trip Efficiency”, is proposed as an alternative option to inputting both a charging and discharging efficiency.
- Update the TOU control strategy to operate year-round instead of just from June – Sep.
- Shift the default “First Hour of Summer Peak” from 7pm to 6pm for Climate Zones 8 and 9 and from 8pm to 7pm for Climate Zone 6.



The screenshot shows the 'Battery' tab in the CBECC-Res 2019 software interface. The form includes the following fields and options:

- Total Rated Battery Capacity:** A text input field containing the value '5' followed by 'kWh'.
- PV generation will be capped @ 1.6 x proposed design electric use** (checked).
- Allow Excess PV Generation EDR Credit for above code programs** (unchecked).
- Take the Self Utilization Credit** (unchecked).
- Control:** A dropdown menu currently set to 'Time of Use'.
- First Hour of the Summer Peak:** A text input field containing the value '19'.
- Charging Efficiency:** A text input field containing the value '0.95'.
- Discharging Efficiency:** A text input field containing the value '0.95'.

At the bottom of the form, a note states: "The battery model doesn't currently include extra energy consumption for cooling the battery during charging in environments above 77°F or to keep the battery from freezing in winter if outdoors."

CBECC-Res 2019

Thank You

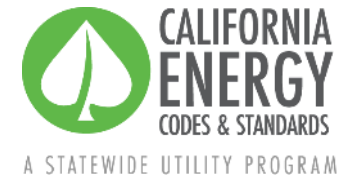
Questions?

David Zhang

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Submeasure A: Battery Storage Systems

Submeasure B: HPWH Load Shifting

Submeasure C: HVAC Load Shifting

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Load Shifting Heat Pump Water Heaters (LSHPWHs)

Codes and Standards Enhancement (CASE) Proposal
Single Family | Grid Integration

Marc Hoeschele, *Frontier Energy*
Ben Larson, *Larson Energy Research*
March 19, 2020

Agenda

- 1 Today's Objectives
- 2 Proposal Background
- 3 Market Overview
- 4 Current Status of LSHPWHs within Title 24, Part 6
- 5 Energy Calculations
- 6 Grid Connectivity
- 7 Proposed Code Changes
- 8 Questions and Next Steps

Today's Objectives

The focus of today's meeting includes:

1. **Summarize** Current Market Situation
2. **Review** Energy Impact Calculations
3. **Discuss** Grid Connectivity Proposal
4. **Review** Preliminary Code Language



Proposal Background



Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Load Shifting HPWHs	Compliance Option	No*	Update draft JA13 Appendix**	TBD
* Software modifications will be completed as part of Energy Commission effort currently underway				
** Refer to CEC Docket 19-BSTD-09 for proposed compliance option: JA13. Public comments through March 23, 2020.				

Description of Changes

- This code change will provide an expanded compliance credit for LSHPWHs configured to operate in the *Advanced Load Up* mode
- Requirement for CTA-2045 communications interface has been moved from Section 110 to Joint Appendix 13.

Market Overview

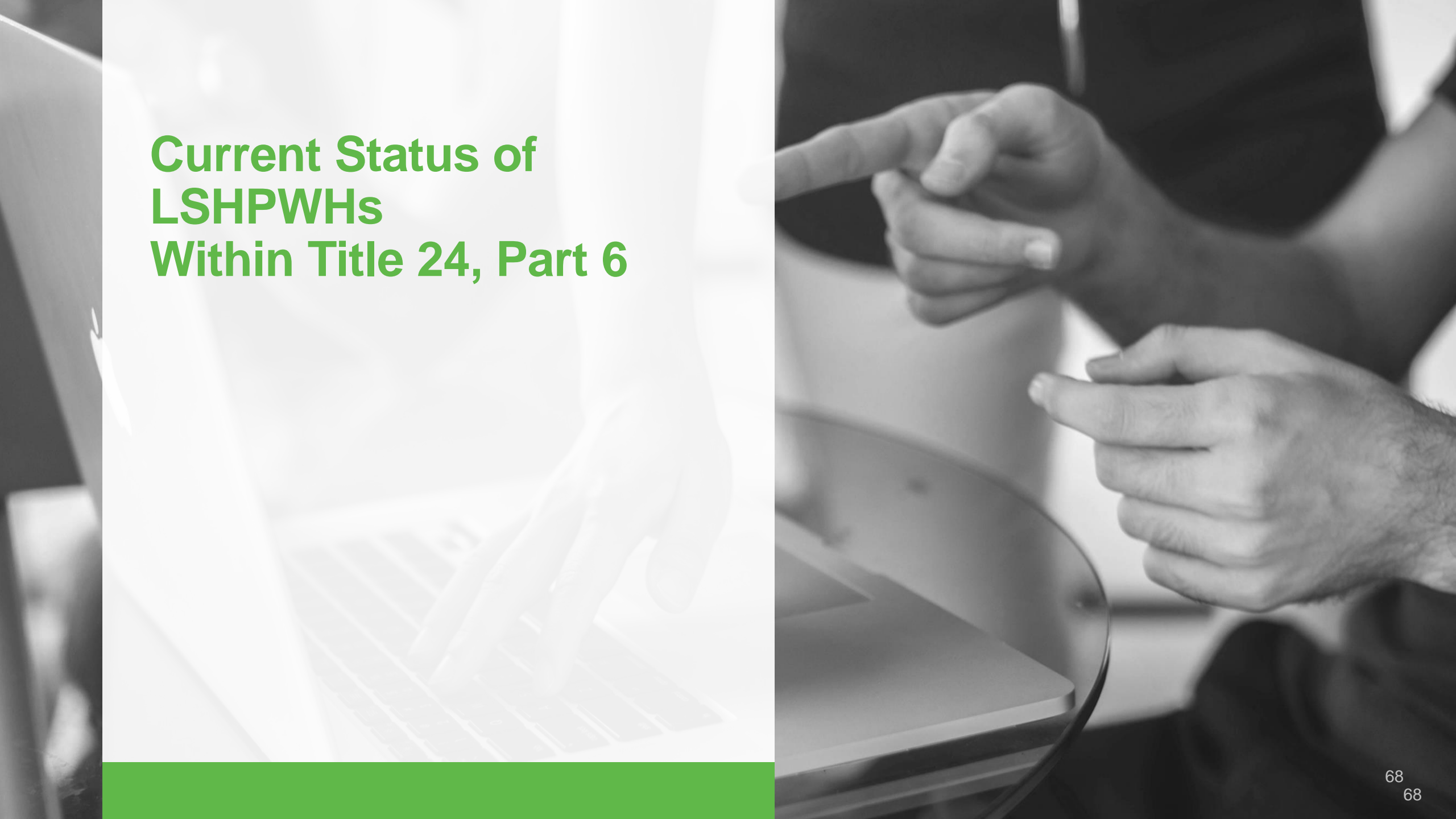
- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

Market Overview- LSHPWH Demonstrated Impacts

- Modeled LSHPWH Benefits ... [NRDC/Ecotope study](#)
- Lab impacts [Frontier Energy/ PG&E lab testing](#)
- and in the field....
 - Bonneville Power Administration [2018 CTA-2045 pilot field study](#)
 - PG&E and SMUD pilot studies underway (leading to future programs)
- PG&E starting WatterSaver program in 2020
 - [Five-year program](#) with goal of 2-5 MW load shift through residential HPWHs

Market Overview- Industry Trends

- Washington state legislation requiring CTA-2045 for all electric water heaters beginning 2021
- Manufacturers responding to market needs
 - SMUD HPWH Expo (January 2020)
 - All major manufacturers attended; highlighting new products
 - GE reentering market in 2020
 - CTA-2045 and WiFi connectivity were highlighted features of new product offerings



Current Status of LSHPWHs Within Title 24, Part 6

Docketed Joint Appendix 13 (February 21, 2020)

<https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-BSTD-09>

Qualification Requirements for HPWH Demand Management Systems

JA 13 Minimum requirements

- Basic Load-Up (water heater heats only to user set point)
- Time of Use Schedule pre-loaded on water heater (at time of install) with schedule updates possible via both local and remote methods
 - Implies some minimum connectivity to outside
- Mixing valve required
- Support various demand response commands

JA 13 Optional capabilities

- Advanced Load-Up (water heater exceeds user set point for added storage)



CBECC-Res Software Enhancement

- **CBECC-RES software team to integrate load shift capabilities**
 - Draft software version implementing JA13 expected in Q2 2020
 - LSHPWH credit then likely defined based on modeling outcomes
 - Expectation is that Energy Commission's near-term credit to be defined by Basic Load Up
- **Ecotope's HPWHsim is the simulation engine for CBECC-Res**
 - CASE Team used HPWHsim to provide current assessment of Advanced Load Up impacts
 - Will update impacts once load shift algorithm integrated in CBECC-Res

Energy Calculations

- Advanced Load Up
- Daily Operation to Address Renewables Curtailment



Methodology for Energy Impacts Analysis

- Preliminary estimates using HPWHsim tool and 2019 TDV
- Final CBECC-Res model and 2022 TDV and weather will have minor impact

Tools Used	Ecotope's HPWHsim tool
Building Prototypes Used	Hot water loads dependent on number of bedrooms
Climate Zones Modeled	All 16 climate zones

Definition of Baseline and Proposed Conditions



Baseline Conditions

HPWH model:

- Standard “hybrid” mode operation, as currently modeled in 2019 CBECC-Res with diverse set of hot water load profiles
- 50 gallon tank size
- HPWH product performance selected to be typical of current market



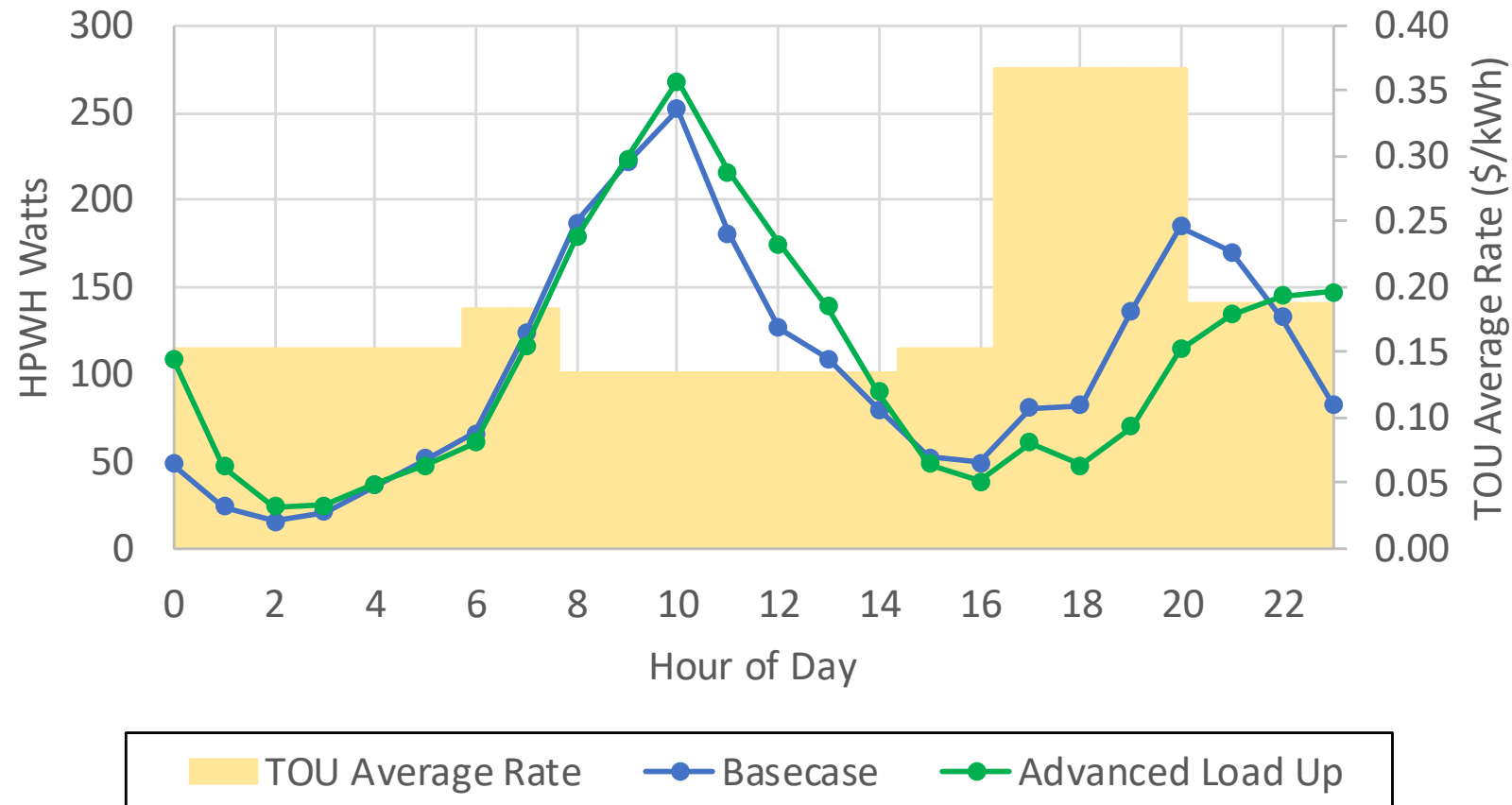
Proposed Conditions

Advanced Load Up model:

- Same 50 gallon tank size in “hybrid” mode
- Same compressor efficiency
- Controlled to store hotter water, above user set point during the middle of the day and coast through afternoon/evening electricity peak

Projected Annual Impacts (Advanced Load Up)

Annual Average - Across all climates (weighted) and household sizes (weighted)



Projected Annual kWh Impacts

Climate Zone	Base HPWH Usage (kWh/yr)	Basic Load Up LSHPWH Usage (kWh/yr)	Advanced Load Up LSHPWH Usage (kWh/yr)
1	1,290	1,305	1,319
2	1,069	1,082	1,094
3	1,053	1,065	1,077
4	979	991	1,002
5	1,087	1,097	1,107
6	863	874	884
7	827	839	851
8	803	813	823
9	814	824	833
10	817	828	837
11	941	956	969
12	985	997	1,008
13	879	893	907
14	992	1,007	1,020
15	550	566	580
16	1,830	1,848	1,864

On average, Basic kWh is 1.3 percent higher than Base; Advanced is 2.5 percent higher

Projected Annual TDV Impacts (2019 TDV)

Climate Zone	Base HPWH TDV (TDV kBtu/yr)	Basic Load Up LSHPWH TDV (TDV kBtu/yr)	Advanced Load Up LSHPWH TDV (TDV kBtu/yr)
1	35,256	34,252	33,127
2	27,908	27,131	26,259
3	29,032	27,867	26,494
4	25,628	24,827	23,912
5	29,273	28,064	26,635
6	21,728	21,063	20,307
7	21,271	20,671	19,998
8	19,691	19,299	18,872
9	19,514	19,143	18,728
10	19,575	19,116	18,602
11	23,851	23,451	23,015
12	25,232	24,553	23,792
13	23,031	22,408	21,689
14	23,659	23,477	23,288
15	13,246	13,202	13,153
16	57,078	54,085	50,377

On average, Basic TDV is 2.6 percent lower than Base; Advanced is 5.6 percent lower

Projected Annual Operating Costs (hypothetical 3:1 TOU rate)

Climate Zone	Base HPWH TDV Operating Cost (\$)	Basic Load Up LSHPWH Operating Cost (\$)	Advanced Load Up LSHPWH Operating Cost (\$)
1	\$238	\$224	\$206
2	\$197	\$183	\$164
3	\$197	\$182	\$161
4	\$181	\$167	\$148
5	\$203	\$188	\$166
6	\$161	\$148	\$129
7	\$156	\$143	\$124
8	\$150	\$137	\$118
9	\$151	\$138	\$119
10	\$151	\$138	\$120
11	\$171	\$159	\$143
12	\$180	\$167	\$149
13	\$160	\$148	\$133
14	\$179	\$167	\$152
15	\$100	\$92	\$81
16	\$340	\$319	\$292

On average,
Basic cost is
8.0 percent
lower than
Base;
Advanced is
19.1 percent
lower



Grid Connectivity

- Need for an Open Standard
- CTA-2045

Need for Open Communications / Connectivity Standard

- **An open standard should:**
 - Include both hardware and software specification
 - Be inclusive to allow flexibility for market innovation and multiple communication pathways
- A flexible and open standard will greatly lessen the risk of “stranded assets”
- CTA-2045 is that inclusive standard



What is CTA-2045?

- **CTA: Consumer Technology Association**
- **CTA-2045: Modular Communications Interface for Energy Management**
 - **An ANSI Standard**
- **Specifies:**
 - Hardware: port on the water heater
 - Software: low level (communications protocols) and high level (DR command set)
- **Allows for:**
 - Unlimited communication pathway modules to be connected to the device including WiFi, cellular, AMI, FM radio, etc.
 - Interaction with the grid and can carry other, higher level command sets like OpenADR
 - High level DR command set is a ready-to-use set of commands to implement load shifting

Technology Readiness

- All major HPWH manufacturers likely to offer CTA-2045 support by end of 2020
- CTA-2045 can reside side-by-side with any other ports/connections (like onboard WiFi) on the water heater
- Success in BPA 2018 Pacific Northwest pilot (~275 sites)



- **Potential Limitations:**
 - High-level command set and translations between the commands and the native water heater controls is still to be ironed out both by HPWH manufacturers and CTA-2045 standard
 - Some cost associated, but Washington state legislation is driving things in near term
 - Long term per unit costs are small (a few \$'s per unit)
 - Relies on industry to embrace the standard (or alongside their proprietary interfaces)

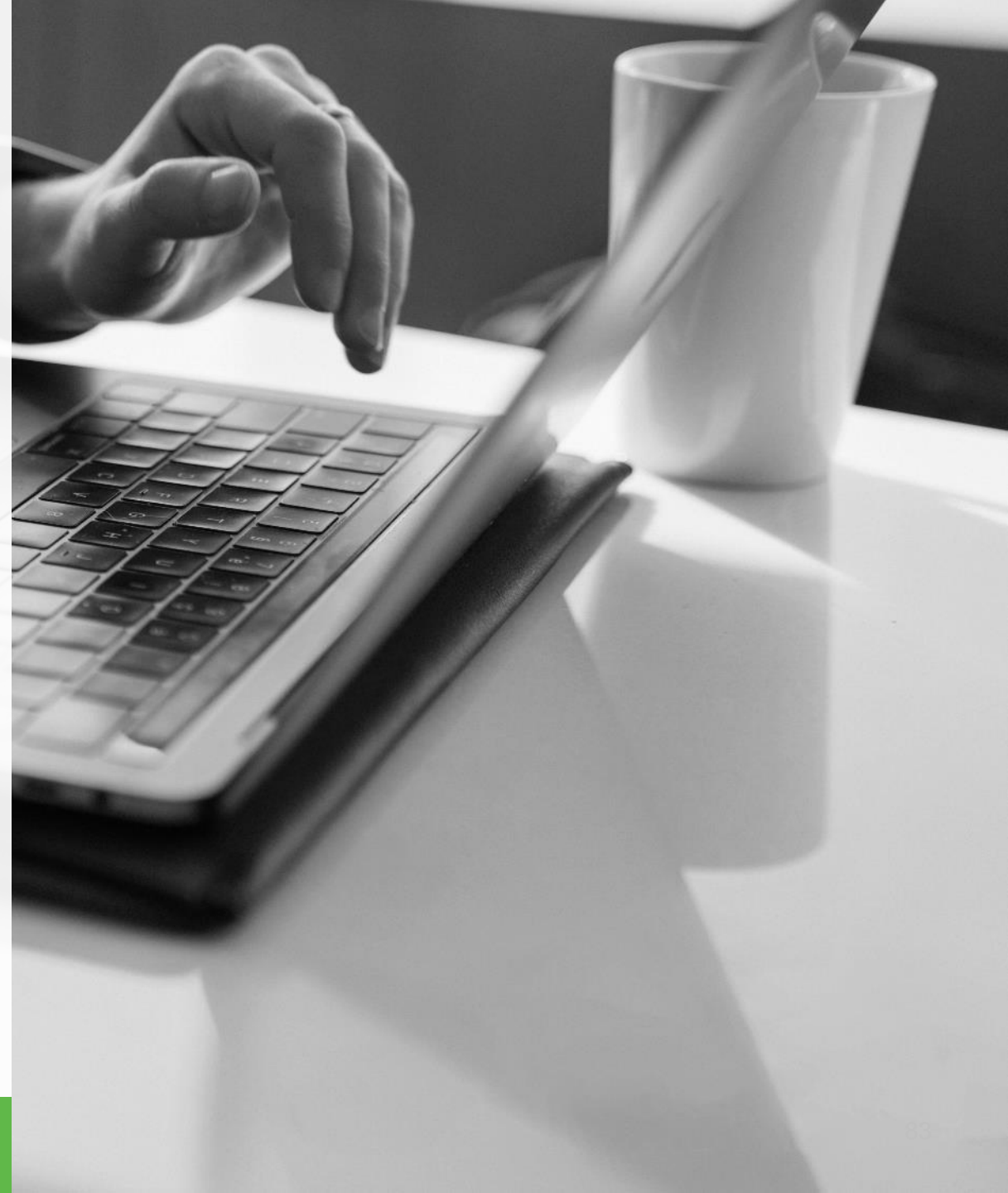
Poll

Do you have any concerns in proposing a modification to JA13 for 2022 that would require the CTA-2045 communications interface?

- A. None, especially since other communications standards may operate alongside, or in conjunction with, CTA-2045.
- B. Some concerns, but it still should be required since it will reinforce the signal to industry that CTA-2045 is the answer moving forward.
- C. Yes.

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates
- HERS verifications



Draft Code Language

- **Stakeholder Meeting 1 Proposal**

- Include CTA-2045 as a recognized alternative under 110.12(a)1

- **Stakeholder Meeting 2 Proposal**

- Modified the initial proposal to incorporate the following language into the “draft” JA13 for 2022:

JA13.3.2 Minimum Performance Requirements

(c) Grid Connectivity: the installed system shall have a modular demand response communications port compliant with the March 2018 version of the ANSI/CTA–2045-A communication interface standard.

Software Updates

- **None required.** The necessary Advanced Load Up capabilities will be added during the planned LSHPWH software development activity (Q2 2020 completion target).

HERS Verifications (Reference Appendices)

- Energy Commission proceeding, [Docket 19-BSTD-09](#), will presumably define some level of needed verification.
- **For 2022, Advanced Load Up credit should require the following verifications:**
 1. Installed HPWH is on CEC JA13 compliant HPWH list
 2. Installed HPWH demonstrates that it is in Advanced Load Up mode of operation
 3. Appropriate TOU rates have been uploaded to the HPWH

Poll

Should HERS verifications be required for verifying HPWH is in Advanced Load Up mode as well as that the proper TOU rate is active?

- A. Yes.
- B. Neither should be required.
- C. Advanced Load Up mode only.
- D. Proper TOU rate only.
- E. Other.

Thank You

Questions?

Marc Hoeschele

Frontier Energy

530-324-6007

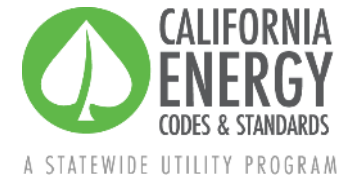
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Submeasure A: Battery Storage Systems

Submeasure B: HPWH Load Shifting

Submeasure C: HVAC Load Shifting

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

HVAC Load Shifting

Codes and Standards Enhancement (CASE) Proposal

Single Family | Grid Integration

Kristin Heinemeier, *Frontier Energy*

March 19, 2020

Agenda

1 Today's Objectives

2 Proposal Background

3 Software Changes

4 Compliance

5 Certified Thermostat Requirements

6 Cost and Energy Calculations

7 Questions and Next Steps

Today's Objectives

The focus of today's meeting includes:

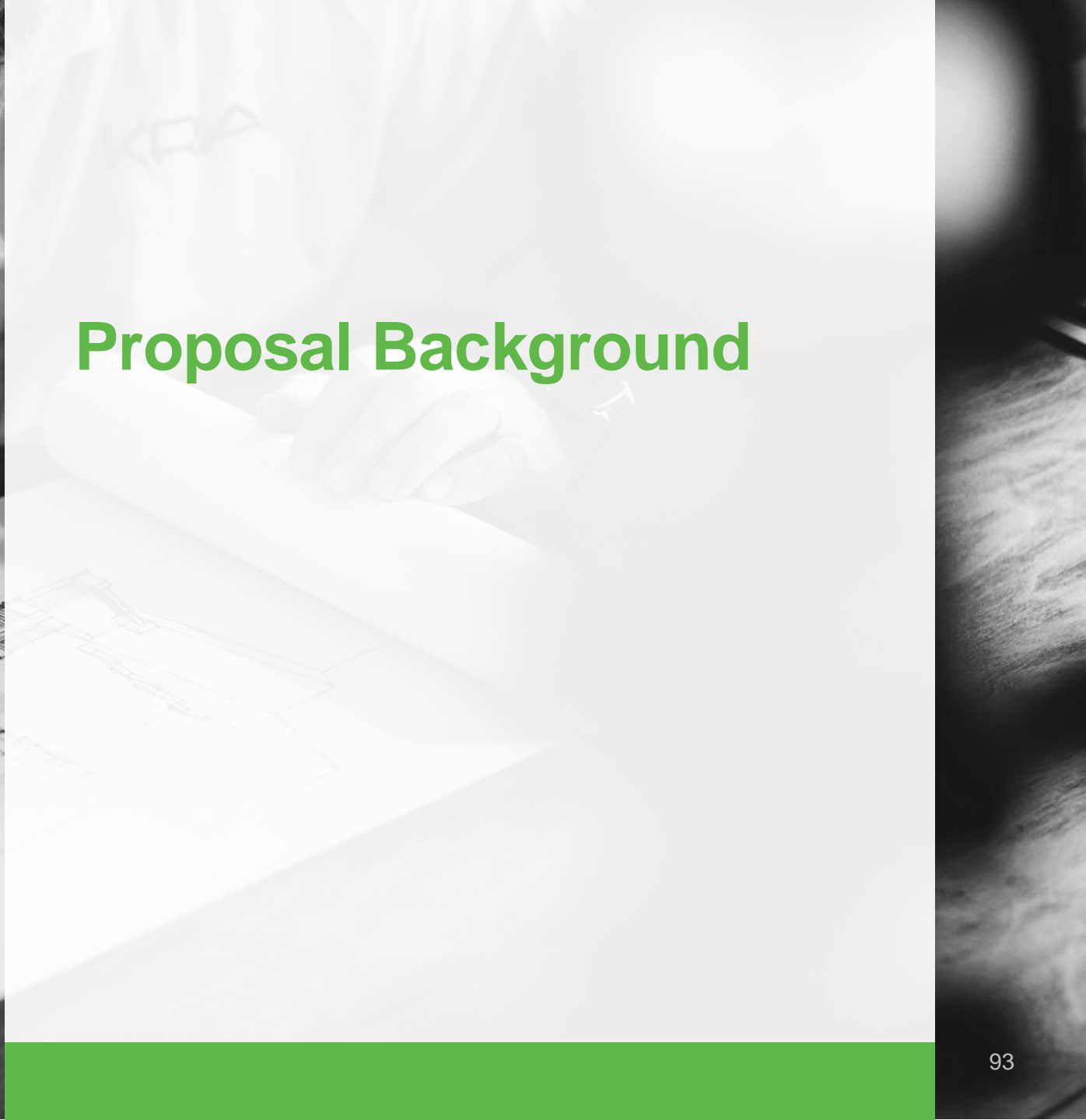
1. **Describe** Proposal Background, Including:

- a) Summary of Changes
- b) Software, Including Analysis to Determine Setpoint Assumptions
- c) Compliance Process
- d) Certified Thermostat Requirements

2. **Review** Energy and Cost Calculations



Proposal Background



Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
HVAC Load Shifting	Compliance Option: Applies only to Total EDR (not efficiency)	Modify defaults for existing pre-cooling calculation	<ul style="list-style-type: none"> New Requirements in Revised JA5.2 New RA 3.4.5 with HERS Verification Procedures New Section in ACM 	Modified CF1R; New CF2R, CF3R

Description of Changes

- Manufacturer Self-Certification per Specifications for Pre-Cooling Thermostat (PCT) Functionality
- HERS Verification of Critical Field-Adjusted Parameters
- Updated Assumptions in Software

Code Change Proposal Summary

	Current	2022 Proposal
Climate Zones Allowed	Any.	Climate Zones 9-15.
Software: Setpoint Assumptions	Setpoints based on forecast average OAT (SP=73°F when OAT _{max} =102°F, SP=77°F when OAT _{max} =86°F).	Optimal setpoints based on parametric modeling by Statewide CASE Team (SP=75°F, 4 hours of precooling).
Savings Derating	Derated by 70% due to occupant controllability.	TBD. PCT functionality may reduce this, but waiting for survey results.
Compliance	None.	HERS Verification, including verification of Critical Field-Adjusted Parameters (CFAPs).
Certified Thermostat Requirements	Requires OCST (now referred to as DRT), specs defined in JA5.1.	Can also use Pre-Cooling Thermostat (PCT), specs defined in JA5.2.

The background of the slide features a grayscale photograph of a person, likely a woman, focused on working on a laptop. The laptop screen displays a code editor with syntax-highlighted text, suggesting a software development or engineering context. The person's hands are visible on the keyboard. The overall image is slightly blurred, emphasizing the text overlay.

Software Changes:

- Savings Derating Factor (TBD)
- Assumptions for times and temperature setpoints.

Software: Setpoint Assumptions

When pre-cooling is selected, space temperature setpoint schedule is modified. Resulting savings derated by 70%. Credit to Total (not Efficiency) EDR.

Cooling Setpoint Temperature	Standard Setpoint (°F)	Proposed Setpoint (°F)
12pm-1am	78	78
1am-2am	78	78
2am-3am	78	78
3am-4am	78	78
4am-5am	78	78
5am-6am	78	78
6am-7am	78	78
7am-8am	83	83
8am-9am	83	83
9am-10am	83	83
10am-11am	83	83

Cooling Setpoint Temperature	Standard Setpoint (°F)	Proposed Setpoint (°F)
12pm-1pm	83	75
1pm-2pm	82	75
2pm-3pm	81	75
3pm-4pm	80	75
4pm-5pm	79	83
5pm-6pm	78	83
6pm-7pm	78	83
7pm-8pm	78	83
8pm-9pm	78	83
9pm-10pm	78	78
10pm-11pm	78	78

PRE-COOLING

NO COOLING

Parametric Analysis: SF 2100

- Results of Parametric Analysis for 2100 sqft Single-Family Prototype.
- Light shading** shows parameters that meet specific criteria (TDV Savings > 0, KWH Penalty ≤ 5%).
- Dark shading** shows Climate zones that meet criteria for all sets of parameters.
- The **first column** is the default for pre-cooling calculations in the software, and scenario that is modeled in the savings calculations.

(Savings not derated)

CZ	PC-TEMP = 75°F				PC-TEMP = 72°F			
	LO MASS		HI MASS		LO MASS		HI MASS	
	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS
	TDV PERCENT SAVINGS							
1	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	-1%	-1%	-1%	-1%
3	0%	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	-2%	-2%	-2%	-2%
5	0%	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	-1%	-1%	-5%	-6%	-6%	-6%
7	-1%	-1%	-1%	-1%	-5%	-6%	-3%	-4%
8	0%	0%	-2%	-2%	-4%	-5%	-5%	-7%
9	3%	3%	3%	2%	-1%	-2%	-2%	-3%
10	4%	4%	4%	3%	2%	1%	1%	0%
11	8%	9%	8%	9%	8%	8%	7%	8%
12	1%	1%	0%	0%	-2%	-2%	-3%	-3%
13	12%	13%	12%	12%	11%	11%	11%	10%
14	5%	6%	4%	5%	4%	4%	3%	3%
15	13%	19%	14%	19%	12%	17%	13%	17%
16	-1%	-1%	-1%	-1%	-2%	-2%	-2%	-2%
	KWH PERCENT PENALTY							
1	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	2%	2%	1%	1%
3	0%	0%	0%	0%	0%	1%	0%	0%
4	0%	1%	0%	0%	3%	3%	2%	3%
5	0%	0%	0%	0%	0%	0%	0%	0%
6	2%	2%	1%	2%	8%	9%	8%	9%
7	1%	1%	1%	1%	6%	8%	4%	6%
8	3%	3%	3%	3%	7%	10%	7%	9%
9	2%	3%	2%	3%	6%	8%	6%	9%
10	2%	3%	2%	3%	5%	7%	5%	7%
11	1%	1%	1%	2%	2%	4%	2%	4%
12	1%	1%	1%	2%	5%	6%	5%	6%
13	1%	1%	1%	2%	3%	5%	3%	5%
14	1%	2%	1%	2%	3%	5%	3%	5%
15	1%	2%	1%	2%	4%	6%	4%	6%
16	1%	1%	1%	1%	3%	3%	3%	3%

Parametric Analysis: SF 2700

- Results of Parametric Analysis for 2700 sqft Single-Family Prototype.
- Light shading** shows parameters that meet specific criteria (TDV Savings > 0, KWH Penalty ≤ 5%).
- Dark shading** shows Climate zones that meet criteria for all sets of parameters.
- The **first column** is the default for pre-cooling calculations in the software, and scenario that is modeled in the savings calculations.

(Savings not derated)

CZ	PC-TEMP = 75°F				PC-TEMP = 72°F			
	LO MASS		HI MASS		LO MASS		HI MASS	
	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS
	TDV PERCENT SAVINGS							
1	0%	0%	0%	0%	0%	0%	0%	0%
2	1%	1%	0%	0%	-1%	-1%	-2%	-2%
3	0%	0%	0%	0%	-1%	-1%	0%	0%
4	0%	0%	0%	0%	-2%	-2%	-2%	-2%
5	0%	0%	0%	0%	-1%	-1%	0%	0%
6	0%	0%	0%	0%	-4%	-5%	-4%	-5%
7	-1%	-2%	-1%	-1%	-5%	-6%	-5%	-6%
8	1%	1%	0%	0%	-2%	-4%	-3%	-5%
9	4%	4%	4%	4%	0%	-2%	-1%	-2%
10	5%	5%	4%	5%	2%	2%	2%	2%
11	9%	11%	9%	10%	8%	9%	8%	9%
12	3%	3%	2%	2%	1%	0%	-1%	-1%
13	14%	14%	13%	14%	13%	13%	12%	13%
14	7%	8%	6%	7%	6%	6%	5%	5%
15	14%	20%	14%	20%	13%	18%	13%	18%
16	0%	-1%	0%	-1%	-1%	-2%	-1%	-2%
	KWH PERCENT PENALTY							
1	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	3%	3%	2%	2%
3	0%	0%	0%	0%	1%	1%	1%	1%
4	1%	1%	1%	1%	3%	3%	3%	3%
5	0%	0%	0%	0%	1%	1%	1%	1%
6	2%	2%	2%	2%	8%	9%	7%	9%
7	2%	2%	1%	2%	6%	8%	6%	8%
8	3%	3%	3%	3%	7%	10%	7%	10%
9	2%	3%	2%	3%	7%	9%	7%	9%
10	2%	3%	2%	3%	5%	8%	5%	8%
11	1%	1%	1%	1%	2%	4%	2%	4%
12	1%	2%	1%	2%	5%	6%	5%	6%
13	0%	1%	1%	1%	2%	4%	2%	4%
14	1%	2%	1%	2%	2%	4%	2%	4%
15	1%	2%	1%	2%	3%	5%	3%	6%
16	1%	2%	1%	2%	3%	4%	3%	4%

Compliance and Enforcement



Proposed Compliance Process

Manufacturer:

- ☐ Submit Self-Certification to Energy Commission that design complies with JA5.2.
- ☐ Provide educational material to be left behind by the installer.

Energy Consultant:

- ☐ Include pre-cooling in compliance runs.
- ☐ Include in the table of requirements on the CF1R, indicating that HERS verification is required.

Proposed Compliance Process *(continued)*

Installer:

- ☐ Identify a suitable PCT from the list of certified models.
- ☐ Determine the optimal values of the CFAPs.
- ☐ Install the PCT according to manufacturer instructions.
- ☐ Program PCT by setting the CFAPs.
- ☐ Record the make and model number of the thermostat and the programmed values of the CFAPs on the CF2R.
- ☐ Leave behind materials.

Critical Field Adjusted Parameters

Designers encouraged to optimize the strategy for each home (based on its thermal mass, climate zone, and TOU rate periods).

Parameter	Parameter Name	Default	Allowed Ranges	Design Considerations
NC-START	No-Cooling Start Time	4:00 PM	Between 2:00 PM and 6:00 PM	Beginning of Utility's TOU Peak Period
NC-END	No-Cooling End Time	9:00 PM	No later than 11:00 PM	End of Utility's TOU Peak Period
PC-START	Pre-Cooling Start Time	12:00 PM	4 to 8 hours before NC-START	As late as possible while avoiding on-peak cooling
PC-TEMP	Pre-Cooling Temperature Setpoint	75°F	No less than 72°F and at least 8°F below NC-TEMP	As high as possible while avoiding on-peak cooling; subject to occupant comfort constraints
NC-TEMP	No-Cooling Temperature Setpoint	83°F	No less than 78°F and at least 8°F above PC-TEMP	As high as it takes to avoid on-peak cooling; subject to occupant comfort constraints

Proposed Compliance Process *(continued)*

HERS Rater:

- ☐ Verify that the make and model of the PCT are correct, as per the CF2R.
- ☐ Verify that the observed values of the CFAPs match the values on the CF2R and that they are within the allowable range.
- ☐ Verify that manufacturer's information has been left for the homeowner.
- ☐ Complete CF3R.

Building Inspector:

- ☐ Verify that the appropriate forms have been completed by the HERS Rater.



Certified Thermostat Requirements



Proposed Certified Thermostat Requirements

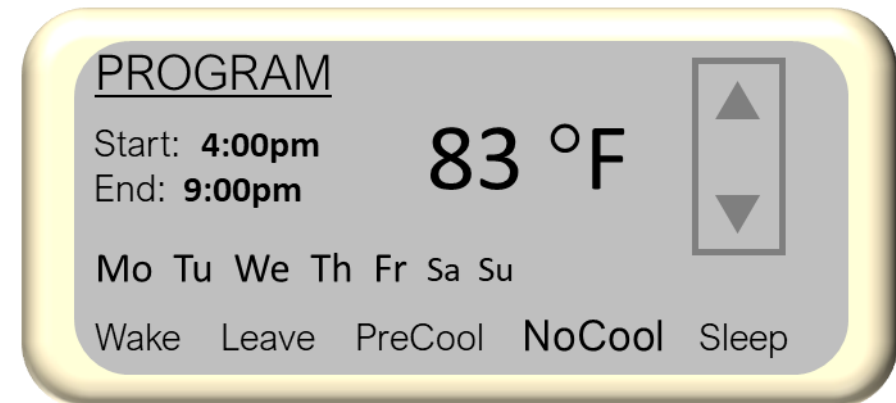
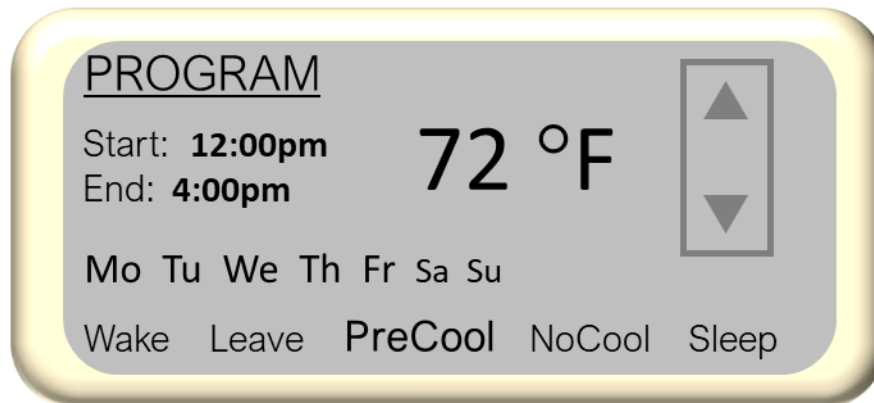
PCT Programming, either:

- Dedicated Pre-Cooling mode: With a simple gesture, initiate a pre-cooling schedule using the selected Pre-Cooling and No-Cooling times and setpoints.
- Pre-Existing Schedule Programming: For example, provide named schedules (similar to WAKE, LEAVE, RETURN, SLEEP) for PRE-COOL and NO-COOL, or Day Type (like HOLIDAY).

Critical Field-Adjusted Parameters:

- Provides the ability to set the parameters easily, in such a way that they can be readily confirmed by a HERS Rater.

Examples:

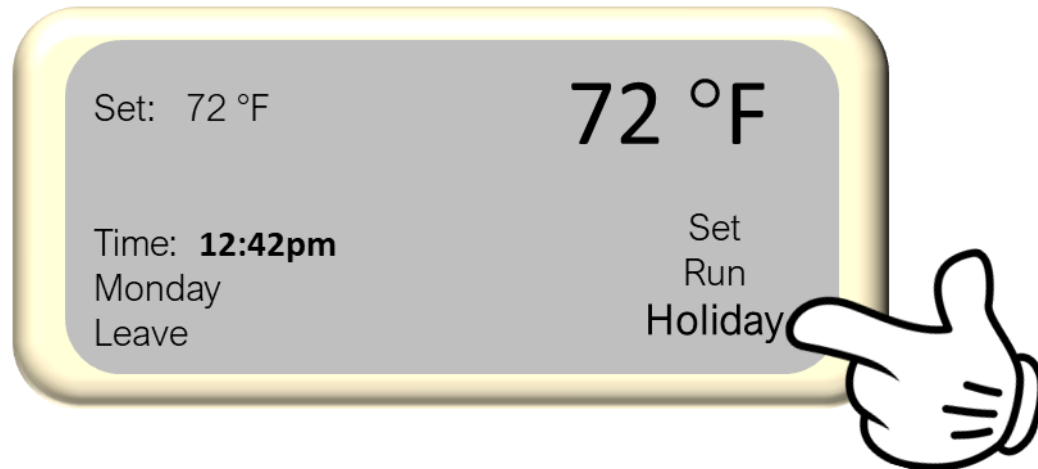


Proposed Certified Thermostat Requirements *(continued)*

Temporary Override:

- Shall be provided.
- Shall be simple to initiate, and it shall not be confused with a permanent override.
- Shall be limited to no more than 72 hours at a time.

Example:



Source: Statewide CASE Team

Proposed Certified Thermostat Requirements *(continued)*

Usability Considerations:

- Easy to program the pre-cooling schedule correctly.
- Difficult to inadvertently change the pre-cooling schedule or permanently override the pre-cooling strategy.
- Easy to temporarily override the Pre-Cooling and No-Cooling Mode, for a limited amount of time.
- A clear indication to the user that the Pre-Cooling or No-Cooling Mode is in effect.

Educational Materials:

- The manufacturer shall produce and supply educational material to be left behind by the installer.

Energy and Cost Impacts



First-Year Energy Impacts Per Home

SF2100 Prototype Building

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions* (kW)	Natural Gas Savings* (therms/yr)	TDV Energy Savings* (TDV kBtu/yr)
9	-154	0.333	-	1,831
10	-153	0.350	-	2,368
11	-70	0.454	-	6,844
12	-104	0.224	-	488
13	-70	0.538	-	10,407
14	-114	0.429	-	4,197
15	-95	0.616	-	13,138

SF2700 Prototype Building

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions* (kW)	Natural Gas Savings* (therms/yr)	TDV Energy Savings* (TDV kBtu/yr)
9	-200	0.479	-	2,790
10	-196	0.489	-	3,339
11	-63	0.575	-	8,923
12	-125	0.379	-	2,525
13	-51	0.625	-	13,647
14	-117	0.550	-	6,607
15	-92	0.747	-	16,274

**Assumes 70% Derating of Savings*

Annual Bill Analysis*

			SF 2100					SF 2700			
CZ	RATE		BASE	PROP	SAV	SAV%		BASE	PROP	SAV	SAV%
9	SCE – TOU-D1		\$727	\$709	\$18	2%		\$862	\$829	\$33	4%
10	SCE – TOU-D1		\$780	\$746	\$34	4%		\$921	\$866	\$55	6%
11	PG&E – TOU-B		\$1,094	\$1,045	\$49	4%		\$1,272	\$1,200	\$72	6%
12	PG&E – TOU-B		\$997	\$1,012	-\$15	-1%		\$1,139	\$1,148	-\$9	-1%
13	PG&E – TOU-B		\$1,021	\$963	\$58	6%		\$1,199	\$1,117	\$82	7%
14	SCE – TOU-D1		\$1,187	\$1,094	\$93	8%		\$1,414	\$1,282	\$132	9%
15	SCE – TOU-D1		\$1,037	\$755	\$282	27%		\$1,263	\$915	\$348	28%

*Assumes **NO**
Derating of
Savings

Moderate to sizeable bill savings in most climate zones allowed.

Thank You

Questions?

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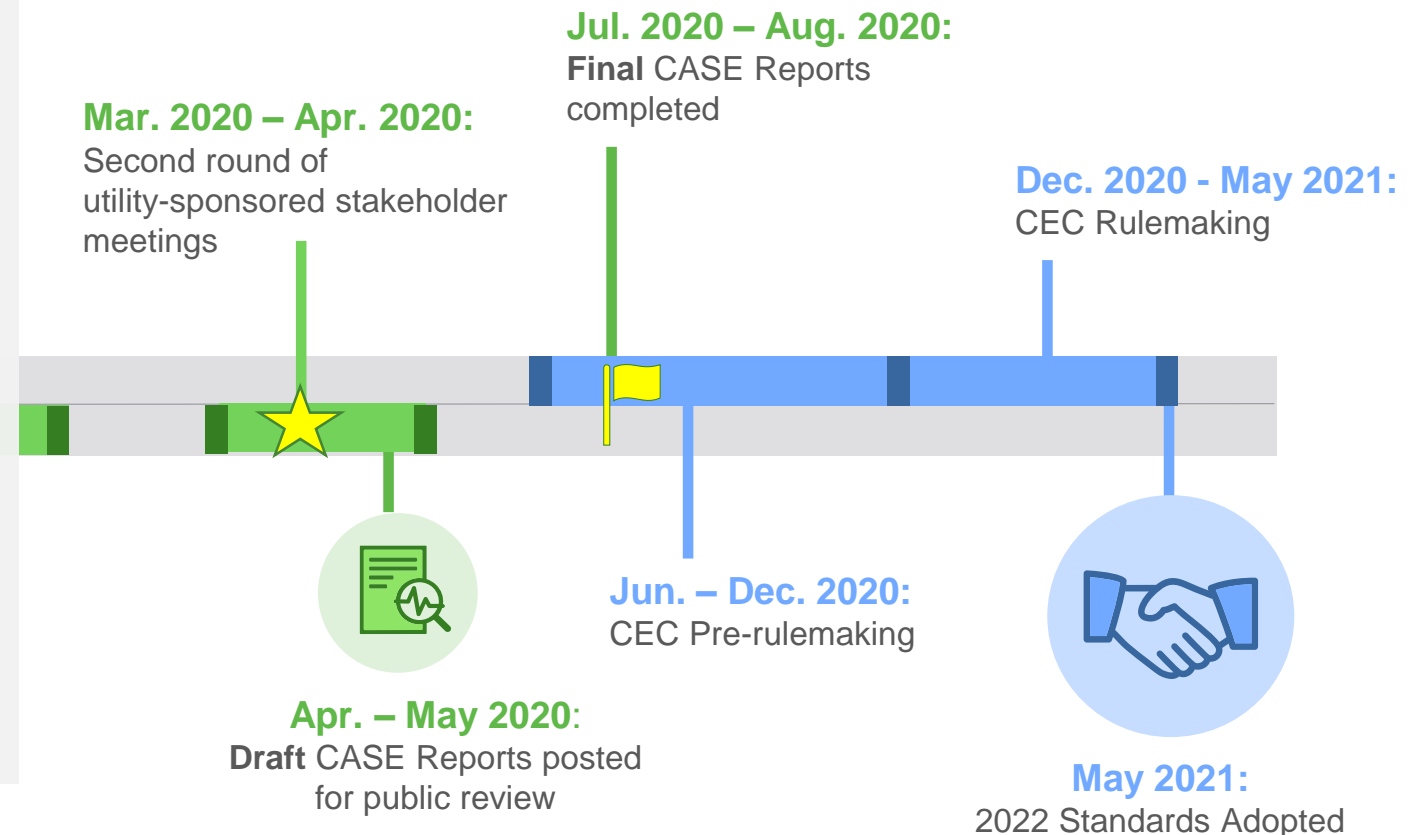
We want to hear from you!

- + 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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Upcoming Meetings

Meeting Topic	Building Type	Date
Lighting	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	MF	Wednesday, March 25, 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
NEW Multifamily Restructuring	MF	Thursday, May 7, 2020

Thank you for your participation today

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Please complete the closing polls below

