

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.













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2022 TITLE 24 CODE CYCLE, PART 6

## Second Utility-Sponsored Stakeholder Meeting Single Family Grid Integration

**Statewide CASE Team** 

March 19, 2020





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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.

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

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## **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. <u>Unmute</u> 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 <u>Title24Stakeholders.com/events</u>.

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## Agenda

1	Meeting Guidelines	8:30 am
2	<b>Opening Remarks</b> from the California Energy Commission	8:35 am
3	<b>Overview &amp; Welcome</b> from the Statewide Utility Team	8:40 am
4	<ul> <li>Presentation I: Single Family</li> <li>Grid Integration</li> <li>Home Energy Management Systems and Smart Thermostats</li> <li>Battery Storage Systems</li> <li>HPWH Load-shifting</li> <li>HVAC Load-shifting</li> </ul>	8:45 am
6	Wrap Up & Closing	11:15 am

#### **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

#### **2022 Standards Contact Info**

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

https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-

standards/2022-building-energy-efficiency

#### **Title 24, Part 6 Overview**

#### Kelly Cunningham Codes and Standards Pacific Gas & Electric



#### **Statewide Utility Codes and Standards Team**

Actively 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 <u>Title24Stakeholders.com/events</u> for information about meetings and topic updates



## Second Round Utility-Sponsored Stakeholder Meetings

MeetingTopic	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 <b>(NEW)</b>
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 <u>title24stakeholders.com/events/</u>





Comply With Me

Learn how to comply with California's building and appliance energy efficiency standards **www.EnergyCodeAce.com** offers No-Cost Tools I Training Resources to help you decode Title 24, Part 6 and Title 20

> Pacific Gas and Electric Compan



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.



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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o Wait for instructions and/or permission to unmute yourself during designated Q&A periods.

#### Two Options to Mute:



### **Meeting Guidelines Reminder**

#### **Pairing Guidelines:**

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- o Click the pull-down menu and *identify your line* by entering your unique user ID on your phone.



#### 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 32<sup>1</sup> and SB 100<sup>2</sup>
- Goal: Shift household electricity use from peak periods to off-peak periods that better align with PV production
   Typical Spring Day
   Steeper
- 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

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<sup>2</sup> 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

**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.

# 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 <u>relevant ENERGY STAR</u> <u>Climate Region.</u>
    - 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 <u>relevant ENERGY STAR Climate Region</u> 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 bhendron@frontierenergy.com

Kristin Heinemeier (Smart Thermostats) Frontier Energy kheinemeier@frontierenergy.com





#### 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

A STATEWIDE UTILITY PROGRAM

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 <sup>2</sup> 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



- 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 ft<sup>2</sup> prototype models
- 13,000 single family homes currently have battery storage (2019)<sup>1</sup>
- Battery storage is expected to grow 5x by 2024<sup>2</sup>
- Therefore, 52,000 new construction homes are projected to install battery storage by 2024 or 8.7 percent of all new construction homes
  - 5 times growth  $\times$  13,000 homes 13,000 existing storage homes = 52,000 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 ft<sup>2</sup> prototype models
- 13,000 single family homes currently have battery storage (2019)<sup>1</sup>
- 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



## **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 2023<sup>1</sup>  $\bullet$
- Entire U.S. storage market has grown 93 percent year-over-year since 2013 (includes  $\bullet$ residential, non-residential and Front-of-the-Meter)
- Utility outages driving more residential installations to increase resiliency<sup>2</sup>

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



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-g3-as-calif-power-outagesloom-large

## **Market Trends**

- Battery costs declined 15 percent per year from 2012 to 2017 totaling a 5-year 50 percent reduction<sup>1</sup>
  - Battery price declines slowed down in 2018 due to battery cell shortages<sup>2</sup>
- BloombergNEF's 2019 market study found that battery prices averaged \$156/kWhprojected to fall below \$100/kWh by 2023<sup>3</sup>
  - Soft costs of battery installation still prevalent
- CPUC establishes equity resiliency budget within the Self Generating Incentive Program (SGIP) for "high fire threat districts."<sup>4</sup>
  - Up to \$1/watt-hour incentive can cover up to 98% of typical Tesla Powerwall installation

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<sup>1</sup> 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

<sup>2</sup> 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

<sup>3</sup> BloombergNEF, Battery Pack Prices Fall As Market Ramps Up with Market Average At \$156/kWh in 2019, Dec 2019, <a href="https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/">https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/</a> 4 CPUC, Proposed Decision of Commisioner 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) Projects<sup>1</sup>:
  - 97 percent of Projects are Storage + Solar PV
  - 3 percent of Projects are Standalone Storage



Source: Renewable Energy World



# 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?



# 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_yr1	5
tou_yr_+1	6
tou	7
adv_basic	4
tou_+1	8
tou1	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.

Project Analysis EDR / PV Battery Notes Building Appliances / DHW ADU IAQ Cool Vent People CSE Rpts			
Total Rated       PV generation will be capped @ 1.6 x proposed design electric use         Battery Capacity:       5         kWh       Image: Capacity Comparison of Capacity Capacity Comp			
Take the Self Utilization Credit			
Control: Time of Use  First Hour of the Summer Peak: 19			
ChargingDischargingEfficiency:0.950.95			
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 Energy Solutions 510-482-4420 ext. 805 dzhang@energy-solution.com





### 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

#### 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 <u>CEC Docket 19-BSTD-09</u> 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 ... <u>NRDC/Ecotope study</u>
- 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 HPW Hs

## **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 HPW Hsim 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**



#### 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

#### Advanced Load Up model:

**Proposed Conditions** 

- 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	Base HPWH Usage	Basic Load Up	Advanced Load Up	
Zone	(kWh/yr)	LSHPWH Usage (kWh/yr)	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	On average,
5	1,087	1,097	1,107	Basic kWh is
6	863	874	884	1.3 percent
7	827	839	851	higher than
8	803	813	823	Base:
9	814	824	833	Advanced is
10	817	828	837	2.5 percent
11	941	956	969	higher
12	985	997	1,008	ingrici
13	879	893	907	
14	992	1,007	1,020	
15	550	566	580	
16	1,830	1,848	1,864	

## **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	On average,
5	29,273	28,064	26,635	Basic TDV is
6	21,728	21,063	20,307	2.6 percent
7	21,271	20,671	19,998	lower than
8	19,691	19,299	18,872	Base;
9	19,514	19,143	18,728	Advanced is
10	19,575	19,116	18,602	5.6 percent
11	23,851	23,451	23,015	lower
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	

#### **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	On average,
5	\$203	\$188	\$166	Basic cost is
6	\$161	\$148	\$129	8.0 percent
7	\$156	\$143	\$124	lower than
8	\$150	\$137	\$118	Base;
9	\$151	\$138	\$119	Advanced is
10	\$151	\$138	\$120	19.1 percent
11	\$171	\$159	\$143	lower
12	\$180	\$167	\$149	
13	\$160	\$148	\$133	
14	\$179	\$167	\$152	
15	\$100	\$92	\$81	
16	\$340	\$319	\$292	



## **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:
  - <u>Hardware</u>: port on the water heater
  - <u>Software</u>: 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)

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, <u>Docket 19-BSTD-09</u>, 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



#### 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?

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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> <li>New Requirements in Revised JA5.2</li> <li>New RA 3.4.5 with HERS Verification Procedures</li> <li>New Section in ACM</li> </ul>	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 OATmax=102°F, SP=77°F when OATmax=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.



#### **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)	Cooling Setpoint Temperature	Standard Setpoint (°F)	Proposed Setpoint (°F)		
12pm-1am	78	78	12pm-1pm	83	75		DDE
1am-2am	78	78	1pm-2pm	82	75		PRE-
2am-3am	78	78	2pm-3pm	81	75		COOLING
3am-4am	78	78	3pm-4pm	80	75		
4am-5am	78	78	4pm-5pm	79	83		
5am-6am	78	78	5pm-6pm	78	83	-	NO
6am-7am	78	78	6pm-7pm	78	83		COOLING
7am-8am	83	83	7pm-8pm	78	83		
8am-9am	83	83	8pm-9pm	78	83		
9am-10am	83	83	9pm-10pm	78	78		
10am-11am	83	83	10pm-11pm	78	78		

#### 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)

		PC-TEM	P = 75°F			PC-TEM	P = 72°F	
	LO N	ASS	HIM	IASS	LO M	ASS	HI M	ASS
CZ	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS
				TDV PERCE	NT 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 PERCE	NT 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)

[		PC-TEM	P = 75°F			PC-TEM	P = 72°F	
	LO N	IASS	HIN	IASS	LO MASS HI MASS			ASS
CZ	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS	4 HRS	6 HRS
				TDV PERCE	NT 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%
				<b>KWH PERCE</b>	NT 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:	PROGRAM Start: 12:00pm End: 4:00pm <b>72</b> °F	PROGRAM Start: 4:00pm End: 9:00pm 83 °F
	Mo Tu We Th Fr Sa Su	Mo Tu We Th Fr Sa Su
	Wake Leave PreCool NoCool Sleep	Wake Leave PreCool <b>NoCool</b> Sleep

## **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.



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 precooling 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

\*Assumes70% 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<u>NO</u> 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.
- <u>Draft</u> 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**

MeetingTopic	Building Type	Date
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

