Proposal Summary

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2022 California Energy Code (Title 24, Part 6)

Single Family Grid Harmonization – Battery Storage Systems

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Introduction

The document summarizes proposed revisions to the California Energy Code (Title 24, Part 6) that will be discussed during Round 2 of the utility-sponsored stakeholder meetings on March 5, 2020. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. Please share comments by email to info@title24stakeholders.com.

Measure Description

Single Family Battery Storage Systems describe the battery storage system installed within single family residential homes. Primary functions of the battery storage system include:

1. Daily cycling for the purpose of load shifting
2. Maximized solar self-utilization
3. Grid integration

The battery storage system implements these functions by charging the battery from a solar photovoltaic (PV) system when there is limited electrical load at the building and discharging when building load exceeds generation. Additional controls strategies allow the battery system to adjust discharge time windows to better respond to peak demand periods when the cost of electricity is high.

Battery storage is available as a compliance credit in the performance compliance method. Battery storage is integrated in the latest version of 2019 CBECC-Res in accordance to Joint Appendix 12 (JA12) of the 2019 Title 24 Reference Appendices. JA12 defines compliance qualification requirements for battery systems installed in conjunction with on-site photovoltaic systems. Compliance qualifications include safety, performance, battery controls, interconnection, and enforcement requirements.

Draft Code Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2019 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions).

Standards

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

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BATTERY ~~SYSTEM, STATIONARY~~ **STORAGE** SYSTEM**.** A rechargeable energy storage system consisting of ~~electrochemical~~ a storage device~~batteries, battery chargers, controls,~~ and associated electrical equipment, including controls and inverters, designed to store and supply electrical power~~provide electrical power to a building~~. ~~The system is typically used to provide standby or emergency power, and uninterruptable power supply, load shedding, load sharing or similar capabilities.~~ Primary functions include self-utilization of solar PV, providing standby or emergency power, and load shedding / shifting.

Reference Appendices

Appendix JA12 – Qualification Requirements for Battery Storage System

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JA12.2.1 Safety Requirements

The battery storage system shall be tested in accordance with the applicable requirements given in UL1973, ~~and~~ UL9540, and UL9540A. Inverters used with battery storage systems shall be tested in accordance with the applicable requirements in UL1741 and UL1741 Supplement A.

JA12.2.2 Minimum Performance Requirements

The installed battery storage system should meet or exceed the following performance specification:

(a) Usable capacity of at least 5 kWh.

(b) Single Charge-discharge cycle AC to AC (round-trip) efficiency of at least ~~80~~ 85 percent.

(c) Energy capacity retention of 70 percent of nameplate capacity after 4,000 cycles covered by a warranty, or 70 percent of nameplate capacity under a 10-year warranty.

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JA12.3.2 Time-of-Use (TOU) Control

To qualify for the TOU Control, the battery storage system shall be installed in the default operation mode to allow charging from an on-site photovoltaic system. The battery storage system shall begin discharging as determined by seasonally specific grid load peaks, as determined by TDV ~~during the highest priced TOU hours of the day, which varies by time of the year and the local utility.~~ The operation schedule shall be preprogrammed from factory, updated remotely, or programmed during the installation/commissioning of the system. At a minimum, the system shall be capable of programming three separate seasonal TOU schedules, such as spring, summer, and winter.

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JA12.3 Interconnection and Net Energy Metering Requirements

The battery storage system and the associated components, including inverters, shall comply with all applicable requirements specified in Rule 21 and Net Energy Metering (NEM) rules as adopted by the California Public Utilities Commission (CPUC), in addition to all applicable local utility requirements.

JA12.4 Certificates and Enforcement Agency

The local enforcement agency shall verify that all Certificate of Installations are valid. The battery storage systems shall be verified as a model certified to the Energy Commission as qualified for credit as a battery storage system. In addition, the enforcement agency shall verify that the battery storage system is programmed and operational with one of the control strategies listed in JA12.2.3.1, JA12.2.3.2, JA12.2.3.3, or JA12.2.3.4. The programmed control strategy at system final inspection and commissioning shall be the strategy that was used in the Certificate of Compliance. To facilitate the verification of the battery round trip efficiency, the enforcement agency can perform a round trip efficiency test following the test procedure outlined in [Placeholder for round trip efficiency test procedure].

ACM Reference Manual

2.1.5 Photovoltaics Requirements

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2.1.5.4 *Battery Controls*

The three control options available are:

1. Basic (Default Control). A simple control strategy that provides a modest credit. The software assumes that the batteries are charged anytime PV generation (generation) is greater than the house load (load); conversely, the batteries are discharged when load exceeds generation. This control strategy does not allow the batteries to discharge into the grid.
2. Time of Use. To qualify for the TOU control, the battery storage system shall be installed in the default operation mode to allow charging from an on-site photovoltaic system. The battery storage system shall begin discharging as determined by seasonally specific grid load peaks, as determined by TDV~~during the highest priced TOU hours of the day, which varies by time of the year and the local utility.~~ At a minimum, the system shall be capable of programming three seasonal TOU schedules, such as spring, summer, and winter.
3. Advanced DR Control. To qualify for the advanced demand response control, the battery storage system shall be programmed by default as basic control or TOU control, as described above. The battery storage control shall meet the demand responsive control requirements specified in Section 110.12(a). The battery storage system shall have the capability to change the charging and discharging periods in response to signals from the local utility or a third-party aggregator. Upon receiving a demand response signal from a grid operator, this option allows discharging directly into the grid.

APPENDIX D – STATUS OF MODELING BATTERIES FOR CALIFORNIA RESIDENTIAL CODE COMPLIANCE

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Battery Representation in CSE

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And both a charge and discharge efficiency (fraction), which are user-defined:

η_charge

η_discharge

The user also has the option to input a round-trip efficiency (fraction) as an alternative to the charge and discharge efficiency. In this case, the charge and discharge efficiency would be equal to:

η_charge = sqrt(η_rte)

η_discharge = sqrt(η_rte)

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Time of Use Strategy

The TOU strategy attempts to preferentially discharge during high-value hours as determined by seasonally specific grid load peaks, as determined by TDV ~~during summer (June - September).~~ Charging rules are the same as the basic strategy. The discharge period is statically defined ~~(per climate zone)~~ by the first hour of the expected ~~evening~~ TDV peak~~.~~, which is a user-input within CBECC-Res called "First Hour of the Summer Peak". The default value for "First Hour of the Summer Peak" is 6pm for Climate Zones 8-9, 7pm for Climate Zones 2, 4, 6, 10-15, and 8pm for Climate Zones 1, 3, 5, and 7. The user has the option to change this value within CBECC-Res if desired.

Consider a summer day in which the evening peak is defined to start at 20:00 but during which simulation load exceeds PV production during the 19:00 hour. While a simulation utilizing the Basic strategy would discharge to neutralize the net load during the 19:00 hour, a simulation on the TOU strategy would reserve the battery until 20:00 before commencing discharge. Because the TDV at 20:00 is likely to be higher than the TDV at 19:00, this strategy of reserving the battery for higher-value hours results in a lower (better) annual TDV.

A second difference: During the peak window, the battery is permitted to discharge at full power, even exceeding the site's net load. This is in contrast to the Basic strategy, which is limited to the net load.

```
if this_hour < first_peak_hr:
    charge_request = -min(load_seen, 0)   // only charge
else:
    charge_request = -1000   //  maximum discharge
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~~Outsid of July-September the TOU strategy reverts to the Basic strategy.~~

Compliance Manuals

7.5 Battery Storage System

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The list of qualified JA12 product~~s list~~ can be found here:

~~http://www.energy.ca.gov/title24/equipment_cert/~~
https://www.gosolarcalifornia.org/equipment/battery-and-energy-storage-systems.php

7.5.1 Minimum Performance Requirements

JA12 specifies that the battery storage system must meet or exceed the following performance specifications:

a. Usable capacity of at least 5 kWh

b. Single Charge-discharge cycle AC to AC (round-trip) efficiency of at least ~~80~~85 percent

c. Energy capacity retention of 70 percent of nameplate capacity after 4,000 cycles covered by a warranty, or 70 percent of nameplate capacity under a 10-year warranty

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7.5.3 Control Strategies

Time-of-Use (TOU) Control: Designed to take advantage of TOU rates where they are available. This control strategy generally results in a greater Energy Design Rating (EDR) impact than the Basic Control. This control strategy does not allow discharging into the grid. To qualify for the TOU Control, the battery storage system shall be installed in the default operation mode to allow charging from an on-site photovoltaic system. The battery storage system shall begin discharging during the highest priced TOU hours of the day hours as determined by seasonally specific grid load peaks, as determined by TDV. The operation schedule shall be preprogrammed from factory, updated remotely, or programmed during the installation/commissioning of the system. At a minimum, the system shall be capable of programming three separate seasonal TOU schedules, such as spring, summer, and winter.

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7.5.4 Other Requirements

In addition to the requirements above, the battery storage system must also meet the following requirements in JA12:

Safety Requirements: The battery storage system shall be tested in accordance with the applicable requirements given in UL1973, ~~and~~ UL9540, and UL9540A. Inverters used with battery storage systems shall be tested in accordance with the applicable requirements in UL1741 and UL1741 Supplement A.

Interconnection and Net Energy Metering Requirements: The battery storage system and the associated components, including inverters, shall comply with all applicable requirements specified in Rule 21 and Net Energy Metering (NEM) rules as adopted by the California Public Utilities Commission (CPUC), in addition to all applicable local utility requirements.

Enforcement Agency: The local enforcement agency shall verify that all Certificate of Installations are valid. The battery storage systems shall be verified as a model certified to the Energy Commission as qualified for credit as a battery storage system. In addition, the enforcement agency shall verify that the battery storage system is programmed and operational with one of the control strategies listed in Section 7.5.2 above. The programmed control strategy at system final inspection and commissioning shall be the strategy that was used in the Certificate of Compliance. To facilitate the verification of the battery round trip efficiency, the enforcement agency can perform a round trip efficiency test following the test procedure outlined in [Placeholder for round trip efficiency test procedure].

Compliance Documents

Compliance document CEC-CF2R-PVB-02-E Battery Storage Systems Certificate of Installation will need to be revised. The revision is intended to facilitate the verification of battery control strategies by listing the allowable battery control strategies as specified in JA12.

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B. Design Battery Storage Systems Information				
01	02	03	04	05
Battery Capacity (kWh)	Battery Control Strategy	Charging Efficiency (%)	Discharging Efficiency (%)	Round Trip Efficiency (%)

C. Installed Battery Storage Systems Information						
01	02	03	04	05	06	07
Manufacturer	Model #	Battery Capacity (kWh)	Battery Control Strategy	Charging Efficiency (%)	Discharging Efficiency (%)	Round Trip Efficiency (%)
07 8	Battery Storage System Certified by CEC	□ **Yes** □ **No**				

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CF2R-PVB-02-E User Instructions

A. General Information
This table reports the general information that were specified on the registered CF1R compliance document for this project. For information only and requires no user input.

B. Design Battery Storage Systems Information
This table reports the battery storage system features that were specified on the registered CF1R compliance document for this project. For information only and requires no user input.

C. Installed Battery Storage Systems Information
01 Manufacturer – Enter the name of the manufacturer
02 Model # - Enter the model name or number of the battery storage system
03 Battery Capacity – Enter the rated usable battery capacity in kWh
04 Battery Control Strategy – Enter the control strategy of thefrom the options below that most closely resembles the control strategy for the installed battery storage system. The options are basic, TOU, and Advanced DR. The battery control strategy (or control mode) can be located in either the battery user manual or in the battery settings.

- Basic Control: Battery charges whenever there is excess PV. Battery discharges to meet house load when PV does not cover it. Battery only meets house loads and does not put power into grid.

- Time of Use Control: Battery charges whenever there is excess PV. During seasonally specific grid load peaks, start discharging at the beginning of the peak at maximum discharge rate until fully discharged. Battery will put power into grid after meeting house load if discharge rate allows it.
- Advanced DR Control: On a peak day, use all PV to charge the battery until it is full. Discharge at maximum rate during three highest TDV hours. Otherwise run with basic control. Battery will put power into grid after meeting house load if discharge rate allows it.

05 Charging Efficiency – Enter the rated AC charging efficiency in percent
06 Discharging Efficiency – Enter the rated AC discharging efficiency in percent
07 Round Trip Efficiency – Enter the rated AC-AC round trip efficiency in percent as an alternative to entering both the charging efficiency and discharging efficiency
0~~7~~8 Battery Storage System ~~C~~certified and listed be CEC – Check whether the battery storage system is certified and listed in the Energy Commission Website at https://www.gosolarcalifornia.org/equipment/battery-and-energy-storage-systems.php. Note that this is not a comprehensive list. However, all battery storage systems listed on this website have been confirmed to meet Title 24 requirements.