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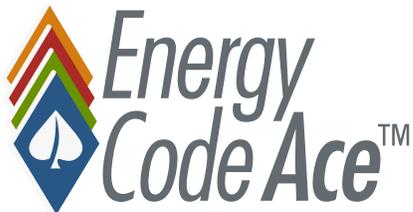
CODE BREAKER

Solar, Battery
& Zero Net Carbon Design

Solving the Energy Code Puzzle One Piece at a Time

Participant Workbook

November 2023



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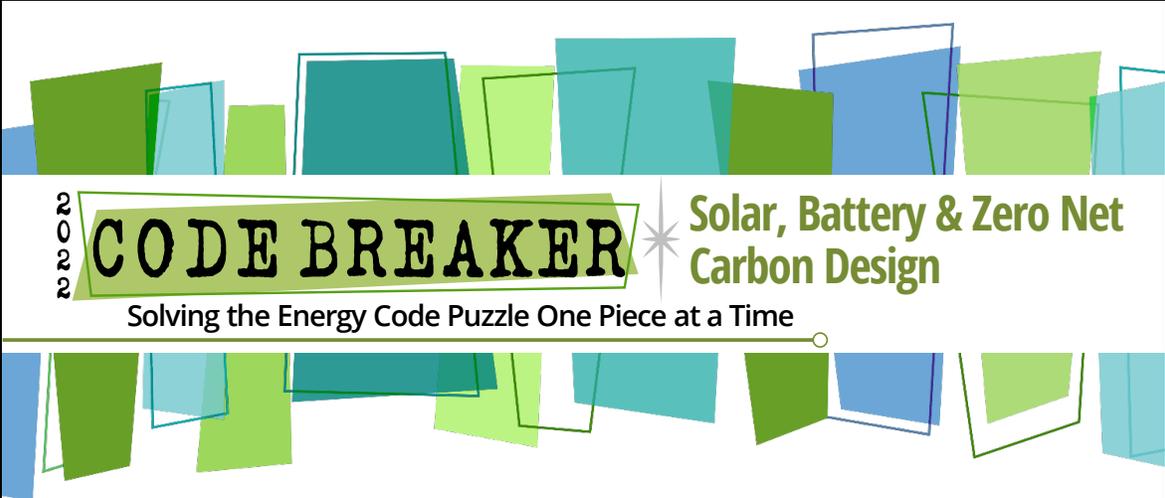
ABOUT THE STATEWIDE CODES AND STANDARDS PROGRAM

The Statewide Codes and Standards Program (C&S Program) is jointly managed by PG&E, SDG&E, and SCE. The C&S Program saves energy on behalf of ratepayers by directly influencing standards and code-setting bodies to strengthen energy efficiency regulations, by improving compliance with existing codes and standards, and working with local governments to develop ordinances that exceed statewide minimum requirements.

This class is one of many free courses, tools, and resources that the C&S Program offers. Please visit <http://energycodeace.com/> or contact info@energycodeace.com to find out more about all program offerings.



Welcome



2022 **CODE BREAKER** * **Solar, Battery & Zero Net Carbon Design**
Solving the Energy Code Puzzle One Piece at a Time

Gina Griffiths Rodda
Energy Code Ace Instructor
Gabel Energy

Continuing Education Information	
AIA Provider ID: 40410982	AIA Course Number: 22 CB SB ZNCD
ICC Provider ID: 1534	ICC Course Number: 36420

Code Breaker: Solar, Battery & Zero Net Carbon Design — 2022 Energy Code

Learning Units: 1.0 AIA LU | HSW

Energy Code Ace
Provider Number: 404109083

AIA
Continuing
Education
Provider

Course Description

The 2022 Energy Code adds Solar and Battery requirements for most new Nonresidential and High-rise Multifamily buildings. New single family homes were first required to add Solar systems in the 2019 Energy Code, as well. This course covers the Solar and Battery requirements for all affected occupancies, as well as why renewable energy systems like Solar and Battery help California meet its climate goals. The role of these systems in Zero Net Carbon design will also be covered.

Course Objectives

- Recognize when solar photovoltaic and battery systems are required in single-family homes
- Recognize when solar photovoltaic and battery systems are required in Nonresidential buildings and Multifamily buildings
- Explain how solar and battery systems improve grid harmony of buildings and onsite consumption of solar energy
- Understand how alternative design options for single-family homes and nonresidential buildings can achieve ZNCD using efficiency measures, solar, and battery systems
- Identify online resources for more guidance on these topics

AIA
Continuing
Education
Provider

Credit(s) earned on completion of this course will be reported to **AIA CES** for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with **AIA CES** for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Documenting Continuing Education Units (CEUs)

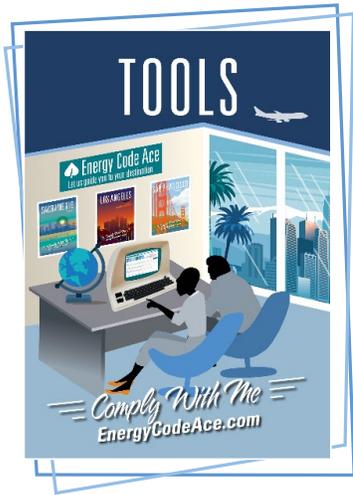
- ✦ Attendees who meet the completion criteria receive “standard” certificates of completion:
 - ✦ Typically sent within two weeks of course delivery
 - ✦ Certificate includes:
 - ◆ Course IDs (AIA & ICC)
 - ◆ Energy Code Ace Provider info (AIA & ICC)
- ✦ You may use this certificate to “self-certify” with a number of organizations in addition to AIA & ICC
 - ✦ If you entered your AIA member number when you registered, we will submit your course-completion information to AIA for you
- ✦ If you want a **certificate specific to ZNCD**, contact us at online.training@energycodeace.com
Please include the following, which is called for in the ZNCD certificate:
 - ✦ Your CA Architect license number
 - ✦ The date when your license expires
 - ✦ The course title and delivery date





Your one-stop shop for no-cost tools, training and resources to help you comply with California's Title 24, Part 6 building energy code and Title 20 appliance standards.

We're powered by the California Statewide Codes & Standards Program and vetted by the California Energy Commission.



A suite of interactive tools to help you understand the compliance process, required forms, installation techniques and energy efficiency regulations applicable to building projects and appliances in California

Our Tools include:

- + Energy Code Product Finder
- + Forms Ace
- + Image Ace
- + Navigator Ace
- + Nonres. Indoor Lighting Wheel
- + Q&Ace
- + Reference Ace
- + Timeline Ace
- + Virtual Compliance Assistant

Ace*Tools™

Ace*Resources™

A portfolio of on-demand and live online and in-person training alternatives on California's Energy Code and Title 20 regulations, tailored to a variety of industry professionals and addressing key measures

Our Training includes a variety of formats:

- ✦ In-person instructor-led
- ✦ Online instructor-led
- ✦ Online self-study
- ✦ Recorded webinars
- ✦ YouTube — live streaming & videos

Ace*Tools™

Ace*Training™

An array of downloadable materials providing practical and concise guidance on how and when to comply with California's building and appliance energy efficiency standards

Our Resources include:

- ✦ Application Guides
- ✦ Checklists
- ✦ Fact Sheets
- ✦ Submit a Question
- ✦ Trigger Sheets
- ✦ Useful Links



Energy Code Basics

2022 Code Breaker: Solar & Battery & ZNCD

1. Energy Code Basics

- 2. Why Renewables are Required
- 3. Single Family & Multifamily ≤3 Stories Requirements
- 4. Nonresidential & Multifamily ≥4 Stories Solar Requirement
- 5. Nonresidential & Multifamily ≥4 Stories Battery Requirement
- 6. Next Steps

2022 Energy Code Schedule

- ✦ Energy Code Language Adoption
- ✦ Date of Implementation

Building Type Reorganization

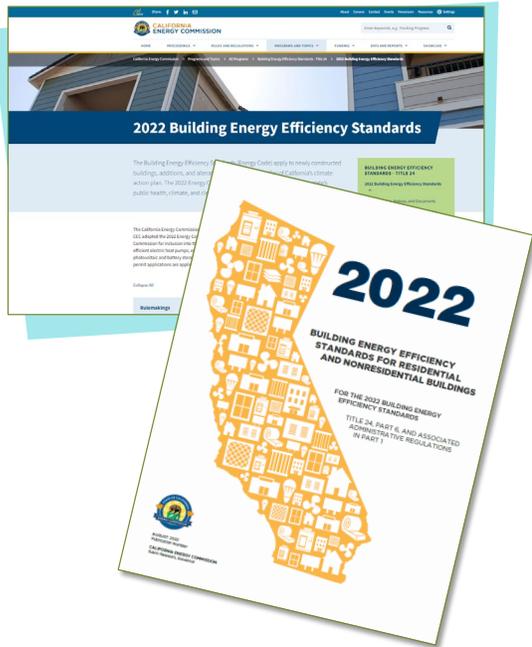
- ✦ Single-family vs Multifamily
- ✦ New Performance Metrics

Structure of the Energy Code

- ✦ Mandatory, Prescriptive and Performance



2022 Energy Code



Implementation Date

January 1, 2023

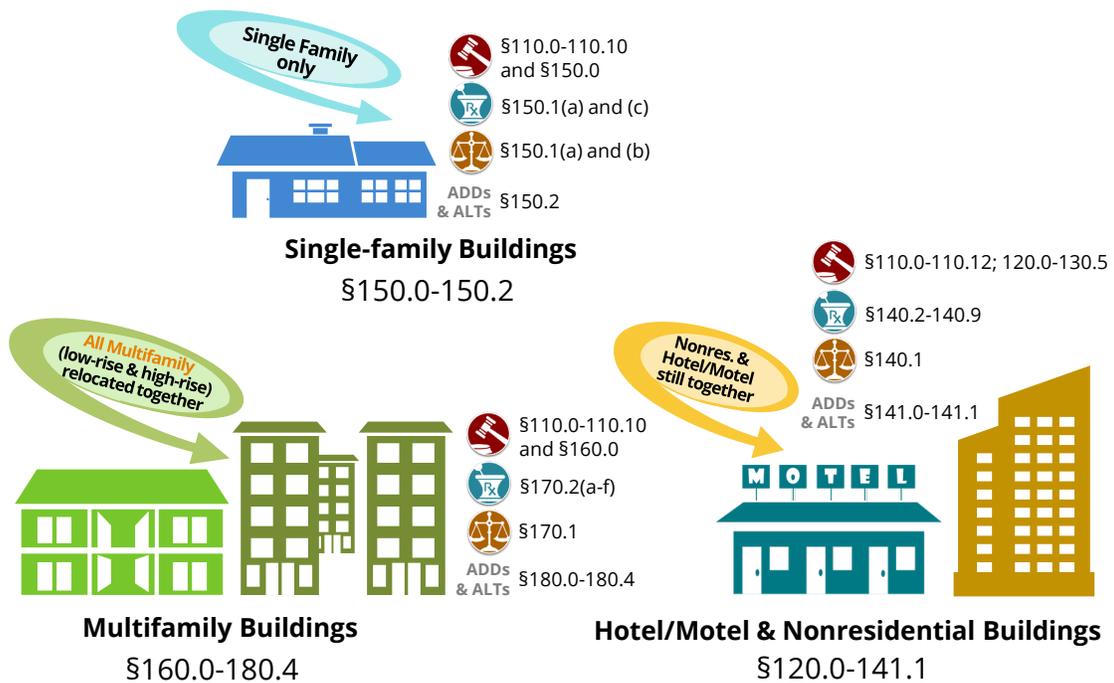
Any projects that apply for a permit on or after this date will be subject to the 2022 Energy Code requirements

Information and documents available on the CA Energy Commission website at:

<https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency>



Building Type Reorganization – 2022 Energy Code



Course Conventions

Mandatory



✦ Always required regardless of compliance approach used

Prescriptive



✦ Required when using the Prescriptive compliance approach

Performance



✦ Optional feature accounted for when doing Performance-based computer modeling

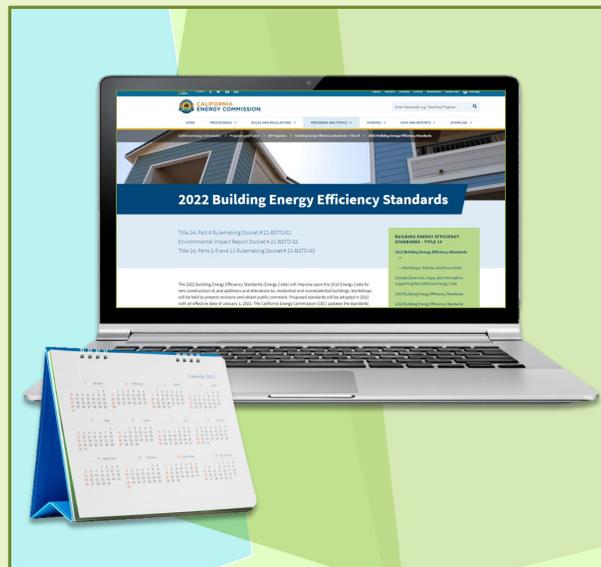


Check Your Understanding #1

What do you think?

On what date did enforcement of the 2022 Energy Code begin?

- a) January 1, 2022
- b) January 1, 2023
- c) Immediately after the California Energy Commission officially adopts the language



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Why Renewables

2022 Code Breaker: Solar & Battery & ZNCD

1. Energy Code Basics

2. Why Renewables

3. Single Family & Multifamily ≤ 3 Stories Requirements

4. Nonresidential & Multifamily ≥ 4 Stories Solar Requirement

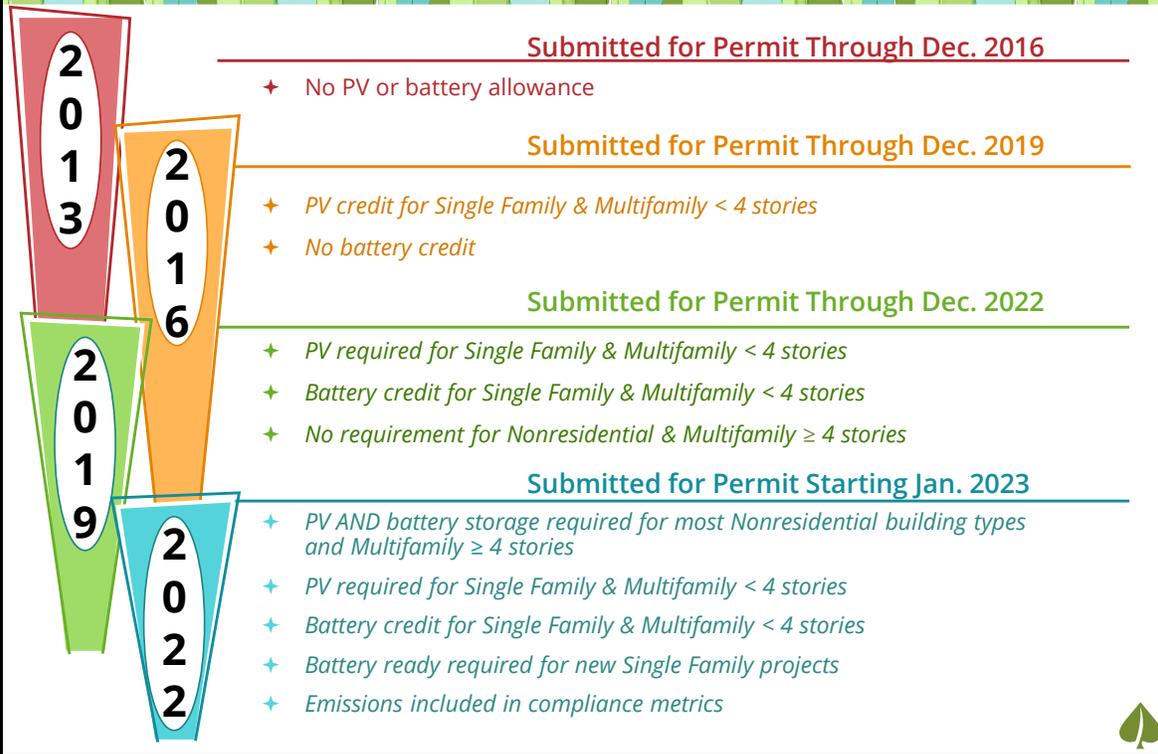
5. Nonresidential & Multifamily ≥ 4 Stories Battery Requirement

6. Next Steps

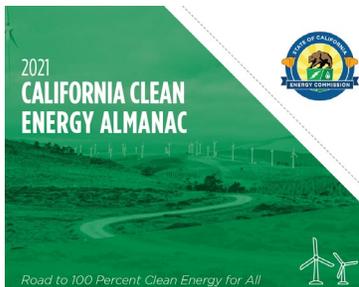
Why Does the Energy Code Require Renewable Solar & Battery Systems in New Buildings?

- ✦ California's climate goals
- ✦ The grid transition to clean forms of energy supply
- ✦ Energy affordability

Timeline: Energy Code & Solar & Battery



Why Energy Code Requires Renewables



Source: <https://www.energy.ca.gov/data-reports/energy-almanac>

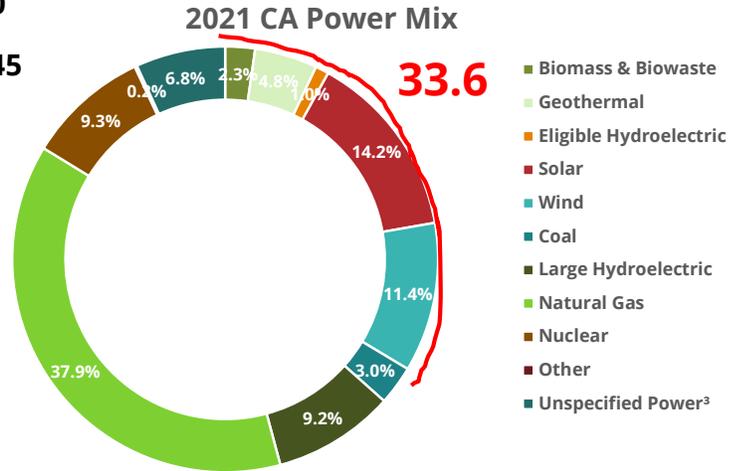
- ✦ California legislature has committed us to:
 - ✧ 40% reduced GHG emissions by 2030
 - ✧ 40% reduced GHG emissions in buildings by 2030
 - ✧ 100% renewable electric grid by 2045
- ✦ Onsite renewable energy production reduces greenhouse gas emissions and can provide for Zero Net Carbon buildings.
- ✦ Onsite PV on rooftops have advantages over utility scale PV (less distribution losses, improved resiliency when paired with batteries)
- ✦ Solar plus storage has Grid harmony, self-consumption, and resiliency benefits

California's Clean Energy Transition

- ✦ Currently 33.6% renewables in 2021
 - ✧ not counting Nuclear or Large Hydroelectric

✦ **60% target by 2030**

✦ **100% target by 2045**

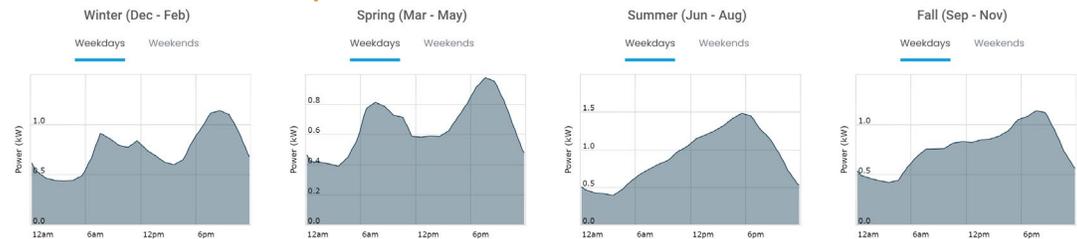


Source: <https://www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure/power-content-label>

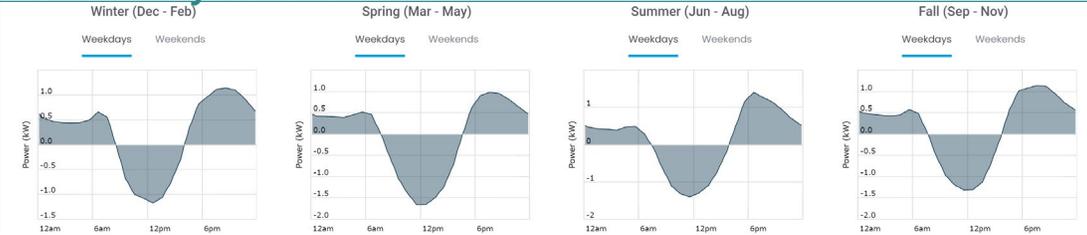


Projected annual utility cost for 2-story home in Climate Zone 10 (2022 Energy Code)

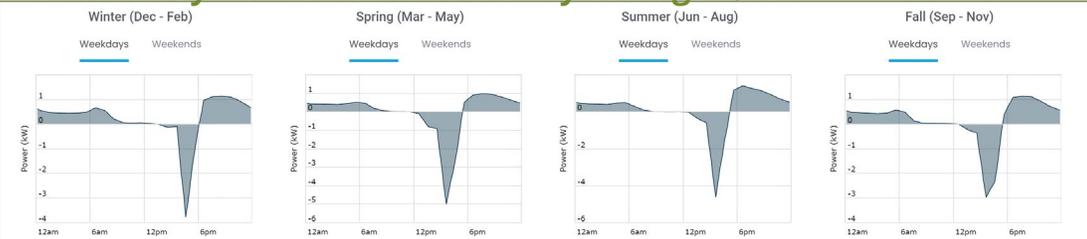
No renewables: \$ 2,357



3.5 kW PV System: \$621



3.5 kW PV System & 10 kWh Battery Storage: \$401



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Single Family & Multifamily ≤ 3 Stories

2022 Code Breaker: Solar & Battery & ZNCD

1. Energy Code Basics
2. Why Renewables are Required
- 3. Single Family & Multifamily ≤ 3 Stories**
4. Nonresidential & Multifamily ≥ 4 Stories Solar Requirement
5. Nonresidential & Multifamily ≥ 4 Stories Battery Requirement
6. Next Steps

Solar Photovoltaic (PV) Requirement for Single Family & ≤ 3 Story Multifamily Buildings

- ✦ Solar Access Roof Area (SARA)
- ✦ Solar PV System Size
- ✦ Solar PV Exceptions
- ✦ Battery Credit
- ✦ Battery Ready

Single-family & Multifamily ≤3 Stories: PV & Battery Storage Factsheet

2022 Energy Code



Single-family and Low-rise Multifamily Solar and Battery Systems



What Are Residential Solar and Battery System Requirements?

The 2022 California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) include requirements for photovoltaic (PV) systems, solar readiness and energy storage systems (ESS).

The information in this fact sheet applies to newly constructed low-rise residential buildings. The Energy Code defines New Construction as a building that has never been used or occupied for any purpose. Low-rise residential buildings are single-family residences of any number of stories or multifamily buildings with 3 or fewer habitable stories. For definitions and examples of the occupancies and buildings included, see Table 1.

PV system requirements apply to newly constructed single-family buildings and to newly constructed multifamily buildings with 3 or fewer habitable stories.

Solar readiness requirements apply when PV systems are not installed in newly constructed single-family homes in subdivisions with 10 or more residences and newly constructed multifamily buildings with 3 or fewer habitable stories.

ESS readiness requirements apply only to newly constructed single-family buildings with one or 2 dwelling units. The ESS readiness requirements are not applicable to townhome buildings with 3 or more dwelling units. Full installation of the ESS with a battery is not required for single-family buildings. However, there is an **optional Performance Approach credit** available for projects that install one.

For information on solar and battery system requirements that apply to nonresidential buildings and multifamily buildings with 4 or more habitable stories, see the [Energy Code Ace Nonresidential and High-rise Multifamily Solar and Battery Systems Fact Sheet](#) at [bit.ly/ECA-building-fact-sheets](#)

For basic information about PV systems, see the 2022 [Title 24, Part 6 Essentials On Demand](#) — Single-family Standards & Technology: Solar Systems at [www.energycodeace.com/training](#).

Importance of Compliance

Solar electricity from residential PV systems in combination with battery storage is part of meeting California climate goals. California is aiming to reduce its greenhouse gas (GHG) emissions while creating an energy system that is resilient to climate risks, spurring innovation and a low-carbon transition nationally and internationally. California met its 2020 target four years early in 2016, and emissions have continued to drop since then. California's next climate targets are to reduce emissions by 40% below 1990 levels by 2030 and by 80% below 1990 levels by 2050.

Residential PV systems are an increasing part of California's electrical grid. However, the existing power grid does not have enough central storage capacity to store all the residentially-generated solar electricity for use later in the day.

Residential battery storage systems help to keep the electricity levels in the grid stable and balanced by backing up mid-day solar electricity for use during peak use periods on the site where it was generated, rather than moving residentially-generated electricity to the grid at mid-day and then taking electricity from the larger grid at peak use periods.

For more, read the [Designing Single-family Homes to Run on Clean Energy Fact Sheet](#) at [bit.ly/building-fact-sheets](#).

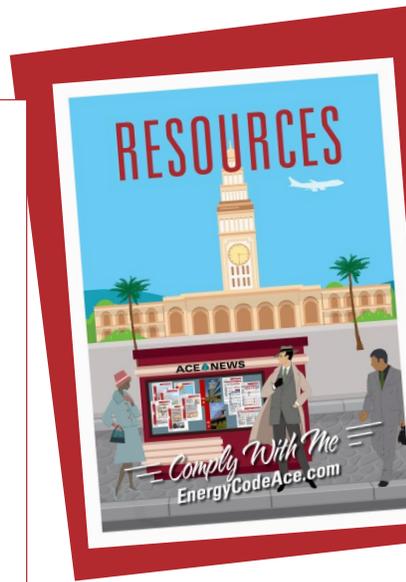
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2022 Title 24, Part 6 - Single-family and Low-rise Multifamily Solar and Battery Systems

Page 1 of 12
2022-06-16



Single-family & Multifamily ≤3 Stories: PV & Battery Storage Factsheet

§150.1(c)14/170.2(g)



Task	Question	When Exempt
Determine if the minimally required PV kW per the Energy Code allows an exception .	Using Equation 150.1-C or 170.2-C , is the required PV kW ≥ 1.8 kW? This step must be completed when using either Prescriptive or Performance Approach.	No PV system is required to be installed, but the project will be required to meet applicable solar readiness requirements of \$110.10 for single family subdivisions of ≥ 10 homes and for any number of multifamily buildings ≤ 3 stories. It is important to provide solar assessment report that supports any exception.

Table 150.1-C

Climate Zone	A - CFA	B - Dwelling Units
1	0.793	1.27
2	0.621	1.22
3	0.628	1.12
4	0.586	1.21
5	0.585	1.06
6	0.594	1.23
7	0.572	1.15
8	0.586	1.37
9	0.613	1.36
10	0.627	1.41
11	0.836	1.44
12	0.613	1.40
13	0.894	1.51
14	0.741	1.26
15	1.56	1.47
16	0.59	1.22

DC Rating = (CFA x A) / 1000 + B

- ★ CFA = Conditioned floor area
- ★ A = CFA adjustment factor from [Table 150.1-C](#)
- ★ B = Dwelling unit adjustment factor from [Table 150.1-C](#)

*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.



Single-family & Multifamily ≤3 Stories: PV & Battery Storage Factsheet

§150.1(c)14/170.2(g)



Task	Question	When Exempt
<p>Determine if the shading exception is applicable. Roof slope will dictate additional exceptions and/or requirements.</p>	<p>How much of the roof(s)/structure(s) has ≥70% annual solar access (using a CEC approved solar shading assessment tool) when removing all areas that are obstructed or occupied roof, or required to remain clear because of other Building Code requirements? * This represents the Solar Access Roof Area (SARA) of the project.</p> <p>↓ ≥ 80 ft² available? < 80 ft² available? →</p>	<p>No PV system is required to be installed, but the project will be required to meet applicable solar readiness requirements of §110.10 for single family subdivisions of ≥ 10 homes and for any number of multifamily buildings ≤ 3 stories. It is important to provide solar assessment report that supports any exception.</p> <p><i>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</i></p>
<p>SARA includes:</p> <ul style="list-style-type: none"> ✦ The area of a building's roof space capable of structurally supporting a PV system AND ✦ The area of all roof space on covered parking areas, carports and all other newly constructed structures on the site that are compatible with supporting a PV system per CA Building Code §1511.2 <p>Exceptions:</p> <ul style="list-style-type: none"> ✦ Any roof area that has < 70% annual solar access ✦ Occupied roof areas as specified by CA Building Code §503.1.4 ✦ Roof area that is otherwise not available due to compliance with other building code requirements if confirmed by the Executive Director 		



Single-family & Multifamily ≤3 Stories: PV & Battery Storage Factsheet

§150.1(c)14/170.2(g)



Task	Question	When Exempt
<p>Determine if the SARA PV capacity exception is applicable.</p>	<p>Using the SARA determined above, and designing a PV kW system for that area, is the designed PV kW ≥ 1.8 kW?</p> <p>↓ Yes No →</p>	<p>No PV system is required to be installed, but the project will be required to meet applicable solar readiness requirements of §110.10 for single family subdivisions of ≥ 10 homes and for any number of multifamily buildings ≤ 3 stories. It is important to provide solar assessment report that supports any exception.</p> <p><i>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</i></p>
<p>Figure 2. Solar Access Roof Area</p> 		



Single-family & Multifamily ≤3 Stories: PV & Battery Storage Factsheet

§150.1(c)14/170.2(g)



Task	Question	When Exempt
<p>Determine if the snow load exception is applicable.</p>	<p>If the project location is in a snow load area, has the location of the project been approved by the authority having jurisdiction as being able to meet ASCE Snow Load Standard 7-16?</p> <p style="text-align: center;"> ↓ Yes → No Choose an Approach </p>	<p>No PV system is required to be installed, but the project will be required to meet applicable solar readiness requirements of \$110.10 for single family subdivisions of ≥ 10 homes and for any number of multifamily buildings ≤ 3 stories. It is important to provide solar assessment report that supports any exception.</p> <p>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</p>



Single-family & Multifamily ≤3 Stories: PV & Battery Storage Factsheet

§150.1(c)14/170.2(g)



Task	Question	When Exempt						
<p>Determine the minimally required PV kW per the Energy Code using any of the three approaches.</p>	<p><i>The general requirements for photovoltaics are the lesser of the Prescriptive or Performance calculations and what the Solar Access Roof Area (SARA) will allow.</i></p> <table border="1"> <thead> <tr> <th>Prescriptive Approach</th> <th>Performance Approach</th> <th>SARA Approach</th> </tr> </thead> <tbody> <tr> <td>Use Equation 150.1-C or 170.2-C, including option to reduce PV kW when using battery storage.</td> <td>Use CEC-approved compliance software, including option to reduce PV kW when using battery storage.</td> <td>Calculate viable SARA square footage and design a PV kW system for that area.</td> </tr> </tbody> </table>	Prescriptive Approach	Performance Approach	SARA Approach	Use Equation 150.1-C or 170.2-C , including option to reduce PV kW when using battery storage.	Use CEC-approved compliance software, including option to reduce PV kW when using battery storage.	Calculate viable SARA square footage and design a PV kW system for that area.	<p>No PV system is required to be installed, but the project will be required to meet applicable solar readiness requirements of \$110.10 for single family subdivisions of ≥ 10 homes and for any number of multifamily buildings ≤ 3 stories. It is important to provide solar assessment report that supports any exception.</p> <p>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</p>
Prescriptive Approach	Performance Approach	SARA Approach						
Use Equation 150.1-C or 170.2-C , including option to reduce PV kW when using battery storage.	Use CEC-approved compliance software, including option to reduce PV kW when using battery storage.	Calculate viable SARA square footage and design a PV kW system for that area.						



Single-family & Multifamily ≤3 Stories: PV & Battery Storage Factsheet

§150.1(c)14/170.2(g)



Task:	Question:	When Exempt:
 <ul style="list-style-type: none"> ✦ Allows a common shared system to offset solar and/or battery requirements <ul style="list-style-type: none"> ◇ Must be operational before final permit signed off on building ◇ Must provide equivalent or better performance than what is specified for building ◇ Must provide benefit to the building for 20 years minimum ◇ Cannot transfer benefit to another building ◇ Located on a distribution system of the participating buildings ◇ No larger than 20 MW 	<p>Does the load-serving entity have a community solar program that will be utilized for the project?</p> <p>Yes: Minimum required PV kW of Prescriptive or Performance Approaches must be provided by a community solar program.</p> <p>No: Minimum required PV kW of Prescriptive, Performance or SARA Approaches must be installed on-site.</p>	<p>No PV system is required to be installed, but the project will be required to meet applicable solar readiness requirements of §110.10 for single family subdivisions of ≥ 10 homes and for any number of multifamily buildings ≤ 3 Stories. It is important to provide solar assessment report that supports any exception.</p> <p><i>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the Energy Commission for not installing PV.</i></p>
<p>Determine if a community solar program is to be utilized.</p>		



Additional PV Exceptions

§150.1(c)14, §170.2(f)

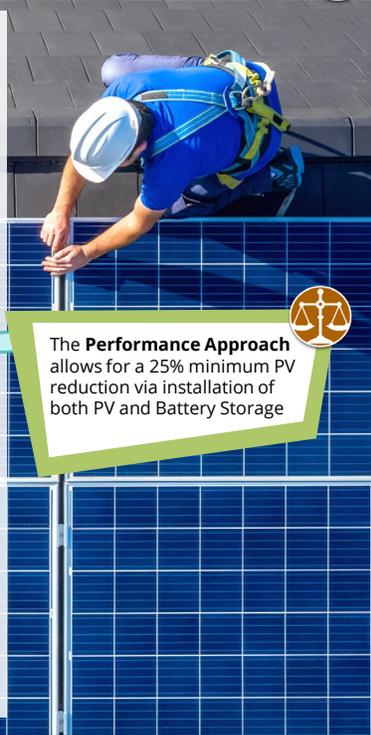


No PV system is required if:

- ✦ The building is approved by the local planning department **prior to January 1, 2020** with mandatory conditions for approval

Required minimum PV system may be reduced by 25% if:

- ✦ Installed in conjunction with a **battery storage system**
 - ◇ Battery storage system shall meet Joint Appendix JA12 qualification requirements and have a minimum **usable capacity of 7.5 kWh**



The **Performance Approach** allows for a 25% minimum PV reduction via installation of both PV and Battery Storage



New Single-Family Homes Must Be Battery Ready

\$150.0(s)



This requirement does not apply to new townhomes or multifamily buildings ≤ 3 stories

Basic Vision of Energy Code: All new single-family homes to be wired to allow the easy installation of a future whole-house battery supply system.

Readiness Requirements

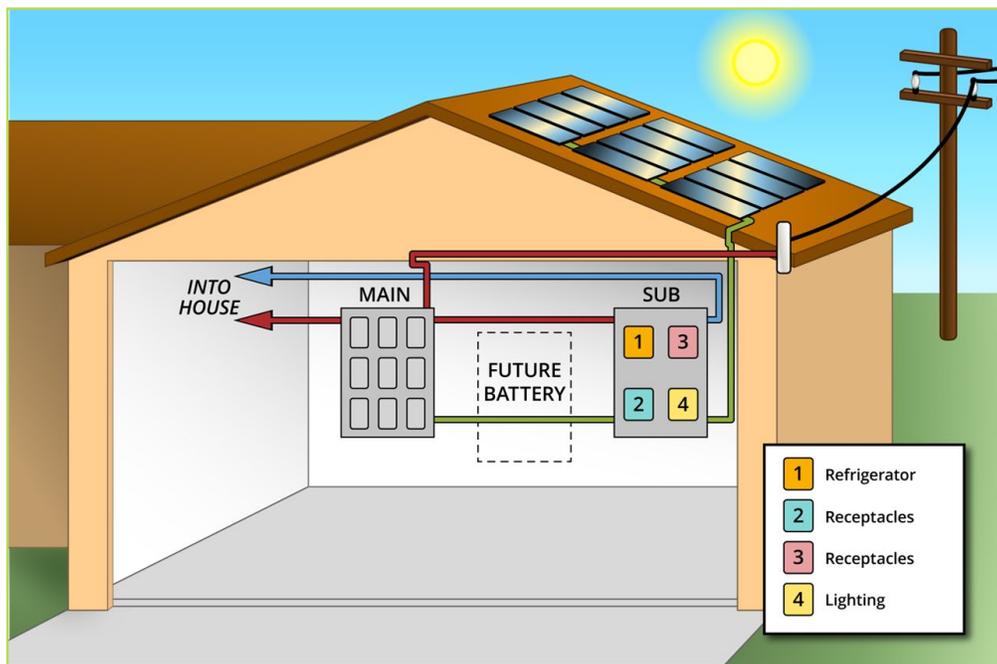
For battery readiness, an ESS must have the following:

- ✦ Main panel board minimum busbar rating of 225 amps
- ✦ Four or more branch circuits in a subpanel designed for a future ESS feeding:
 - ◇ Refrigerator
 - ◇ One lighting circuit near the primary egress
 - ◇ A sleeping room receptacle outlet
 - ◇ A fourth location, wherever desired
- ✦ Space reserved for future installation of a system isolation equipment or a transfer switch within 3 ft of the main panelboard
- ✦ Raceways between the panelboard and the system isolation equipment or transfer switch location to connect a backup power source
- ✦ At least one of the following:
 - ◇ Interconnection equipment with a minimum backed up capacity of 60 amps
 - ◇ A dedicated raceway from the main service to a subpanel that supplies the branch circuits

Choose either of two methods



Battery Ready Graphic





What do you think... Are any of these ZNCD?

- ✦ Single-family new construction
- ✦ 1-story house
- ✦ 1,751 sf conditioned floor area
- ✦ Climate Zone 12 (Cooling Dominated)



The 2022 energy code does not require Zero Net Carbon buildings, but it is an important step in that direction.

Which of the following supports Zero Net Carbon?

Feature	A - Typical Mixed Fuel	B - All-electric Prescriptive Std	C - All-electric Upgraded
Envelope	<ul style="list-style-type: none"> ✦ 2x6 R-21 walls; ✦ R-38 attic 	<ul style="list-style-type: none"> ✦ HPW 2x6 R-21+R-5; ✦ HPA R-38+R-19 	<ul style="list-style-type: none"> ✦ HPW 2x6 R-21+R-5; ✦ HPA R-38+R-19
HVAC	<ul style="list-style-type: none"> ✦ Standard gas furnace & A/C unit, ducts in attic 	<ul style="list-style-type: none"> ✦ Ducted code-minimum heat pump, ducts in attic 	<ul style="list-style-type: none"> ✦ Variable Capacity Heat Pump
Water Heating	<ul style="list-style-type: none"> ✦ Standard gas tankless water heater, .81 uef 	<ul style="list-style-type: none"> ✦ Heat Pump Water Heater, 50 gallon in garage 	<ul style="list-style-type: none"> ✦ Heat Pump Water Heater, 50 gallon in garage
Battery	<ul style="list-style-type: none"> ✦ None 	<ul style="list-style-type: none"> ✦ None 	<ul style="list-style-type: none"> ✦ 20 kWh, TOU control mode
PV panels	<ul style="list-style-type: none"> ✦ 2.9 kW (prescriptive standard) 	<ul style="list-style-type: none"> ✦ 2.9 kW (prescriptive standard) 	<ul style="list-style-type: none"> ✦ 5.4 kW
Carbon Generated	2.29 mt/yr	1.07 mt/yr	-0.04 mt/yr
	not very close	closer...	Zero Net Carbon!



Check Your Understanding #2

What do you think?

Below what threshold does 2022 Energy Code NOT require a PV system?

- 500 ft²
- 2.0 kW
- 1.8 kW





Check Your Understanding #3

What do you think?

When does the 2022 Energy Code mandate the installation of battery systems in new single family homes?

- a) Never
- b) Starting January 1, 2023
- c) Only if the main panel is 225 amps or greater



Check Your Understanding #4

What do you think?

The compliance modeling software can be used to design for lower Carbon emissions and Zero Net Carbon. If you were building a new home in CZ12 and had modeled Carbon emissions of 2.29 mt/yr for a typical mixed fuel design, **what upgrades would you choose from the list as part of a Zero Net Carbon package?**

- a) Battery only
- b) All of these features
- c) Additional PV panels

	Total CO2 Potential: (excl. Solar & Flexibility) (metric tons/yr)	CO2 Saved by Solar Electricity:		CO2 Generated:	
		Self Consumed (metric tons/yr)	Exported to Grid (metric tons/yr)	Total (metric tons/yr)	Excluding Exports (metric tons/yr)
Standard Design	1.75	0.10	0.04	1.60	1.65
Proposed Design	2.44	0.10	0.05	2.29	2.34

Feature	Upgrade	Carbon Emissions Savings (mt/yr)
Envelope	High-performance walls and attic	0.20
HVAC	Ducted code-minimum heat pump	0.46
Water Heating	Heat Pump Water Heater 50 gallon	0.53
Battery	7.5 kWh in Time of Use control mode	0.34
PV panels	Additional 1.5 kW (~5 panels)	0.01



Nonresidential & Multifamily ≥ 4 Stories: Solar Requirements

2022 Code Breaker: Solar & Battery & ZNCD

1. Energy Code Basics
2. Why Renewables are Required
3. Single Family & Multifamily ≤ 3 Stories Requirements

4. Nonresidential & Multifamily ≥ 4 Stories Solar

5. Nonresidential & Multifamily ≥ 4 Stories Battery Requirement
6. Next Steps

Solar Requirements for Nonresidential & Multifamily Buildings ≥ 4 Stories

- ✦ Solar Access Roof Area (SARA)
- ✦ Solar PV System Size
- ✦ Exceptions

Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

2022 Energy Code
Ace Resources Table 24, Part 6 **Fact Sheet**

Nonresidential and High-rise Multifamily Solar and Battery Systems

What Are Solar and Battery Systems Requirements?

The 2022 California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) include requirements for photovoltaic (PV) systems, battery storage systems and solar readiness for multifamily buildings with 4 or more habitable stories, nonresidential buildings, hotels, motels and mixed-use buildings.

PV and battery systems requirements apply to newly constructed:

- Multifamily buildings with 4 or more habitable stories
- Nonresidential buildings
- Hotels and motels
- Mixed-use buildings when 80% of the floor area is one or more of the following:
 - ◊ Multifamily Building
 - ◊ Medical Office Building or Clinic
 - ◊ Grocery
 - ◊ Auditorium
 - ◊ Office
 - ◊ Convention Center
 - ◊ Financial Institutions
 - ◊ Hotel or Motel
 - ◊ Unleased Tenant Space
 - ◊ Library
 - ◊ Retail
 - ◊ Restaurant
 - ◊ School
 - ◊ Theater
 - ◊ Warehouse

Solar readiness requirements apply when a PV system is not included in the design. Some of the newly constructed buildings of the types listed above and Additions to them that increase the total roof area by ≥ 2,000 ft² are required to be solar ready.

For information on solar and battery system requirements that apply to single-family buildings and multifamily buildings with 3 or fewer habitable stories, see the *Energy Code Ace Single-Family and Low-rise Multifamily Solar and Battery Systems Fact Sheet* at <http://t1.eca-building-fact-sheets>

Importance of Compliance

Solar electricity from nonresidential and residential PV systems in combination with battery storage is part of meeting California climate goals. California is aiming to reduce its greenhouse gas (GHG) emissions while creating an energy system that is resilient to climate risks, spurring innovation and a low-carbon transition nationally and internationally.

California met its 2020 target four years early in 2016, and emissions have continued to drop since then. California's next climate targets are to reduce emissions by 40% below 1990 levels by 2030 and by 80% below 1990 levels by 2050.

PV systems are an increasing part of California's electrical grid. However, the existing power grid does not have enough central storage capacity to store all of the onsite-generated solar electricity for use later in the day.

Battery storage systems help to keep the electricity levels in the grid stable and balanced by backing up onsite-generated solar electricity for use during peak use periods on the site where it was generated, rather than moving onsite-generated electricity to the grid and then taking electricity from the larger grid at peak use periods.

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EnergyCodeAce
 2022 Title 24, Part 6 – Nonresidential and High-rise Multifamily Solar and Battery Systems
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Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

Task	Question	When Exempt																																			
Determine if the scope of the project is subject to PV requirements of the Energy Code.	Is this a new conditioned project and a type specified in Table 140.10-A or Table 170.2-U , or is it a mixed-occupancy building where one or more of the building types in Table 3 constitute at least 80% of the floor area of the building? Yes ↓ / No →	<p>No PV system is required to be installed, but the project is required to meet applicable solar readiness requirements of §110.10.</p> <p>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</p>																																			
<p>Photovoltaic System Size: New Nonresidential Buildings, Hotels and Motels, Mixed-use Buildings and Multifamily Buildings ≥ 4 Habitable Stories</p> <p>Equation 140.10-A / Equation 170.2-D</p> <p>DC Rating = (CFA x A) / 1000</p> <p>DC Rating (or kW_{pv}) kW_{dc} size of the PV system CFA Conditioned floor area A CFA Adjustment factor from 140.10-A or 170.2-U</p> <p>Table 140.10-A / Table 170.2-U</p> <table border="1"> <thead> <tr> <th rowspan="2">Building Type</th> <th colspan="3">Minimum PV Capacity (W/ft² CFA)</th> </tr> <tr> <th>CZ 1, 3, 5, 16</th> <th>CZ 2, 4, 6-14</th> <th>CZ 15</th> </tr> </thead> <tbody> <tr> <td>Grocery</td> <td>2.62</td> <td>2.91</td> <td>3.53</td> </tr> <tr> <td>High-rise Multifamily</td> <td>1.82</td> <td>2.21</td> <td>2.77</td> </tr> <tr> <td>Office, Financial Institutions, Unleased Tenant Space</td> <td>2.59</td> <td>3.13</td> <td>3.80</td> </tr> <tr> <td>Retail</td> <td>2.62</td> <td>2.91</td> <td>3.53</td> </tr> <tr> <td>School</td> <td>1.27</td> <td>1.63</td> <td>2.46</td> </tr> <tr> <td>Warehouse</td> <td>0.39</td> <td>0.44</td> <td>0.58</td> </tr> <tr> <td>Auditorium, Convention Center, Hotel, Motel, Library, Medical Office Building or Clinic, Restaurant, Theater</td> <td>0.39</td> <td>0.44</td> <td>0.58</td> </tr> </tbody> </table> <p>Table 3. Photovoltaic System Size for Nonresidential Buildings, Hotels, Motels, Multifamily Buildings < 3 Habitable Stories and Mixed-use Buildings</p> <p><i>CFA = conditioned floor area; CZ = Climate Zone.</i></p>			Building Type	Minimum PV Capacity (W/ft ² CFA)			CZ 1, 3, 5, 16	CZ 2, 4, 6-14	CZ 15	Grocery	2.62	2.91	3.53	High-rise Multifamily	1.82	2.21	2.77	Office, Financial Institutions, Unleased Tenant Space	2.59	3.13	3.80	Retail	2.62	2.91	3.53	School	1.27	1.63	2.46	Warehouse	0.39	0.44	0.58	Auditorium, Convention Center, Hotel, Motel, Library, Medical Office Building or Clinic, Restaurant, Theater	0.39	0.44	0.58
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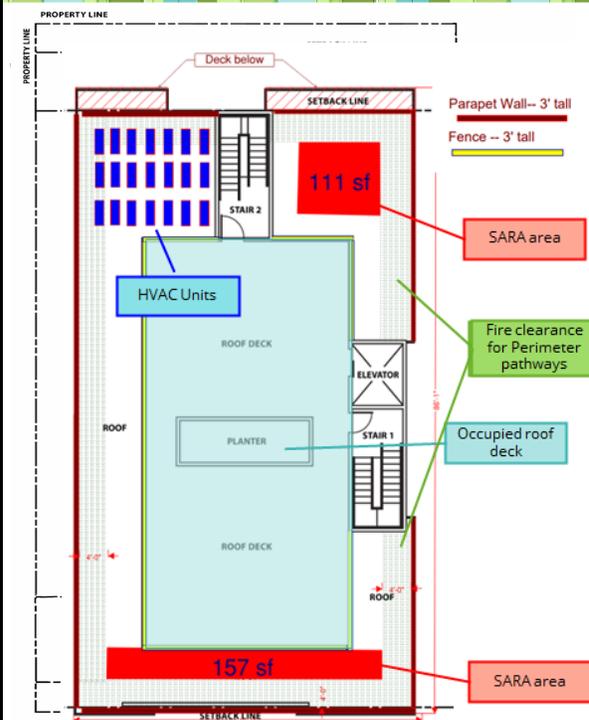
Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

Task	Question	When Exempt
<p>Determine if the VNEM or snow load exceptions are applicable. The load-serving entity would be the utility providing electricity to the site.</p>	<p>If the project location is in a snow load area, has the location of the project been approved by the authority having jurisdiction as being able to meet ASCE Snow Load Standard 7-16? Is the project in a multi-tenant building in an area where the load-serving entity provides virtual net metering (VNEM)?</p> <p style="text-align: center;"> ↓ Yes → No </p>	<p>No PV system is required to be installed, but the project is required to meet applicable solar readiness requirements of §110.10.</p>
<p>Virtual Net Energy Metering (VNM or VNEM): A tariff arrangement that enables a multi-meter property owner to allocate the property's solar system's energy credits to tenants, and the generated electricity feeds directly back onto the grid instead of directly to any tenant meter</p>		<p>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</p>

Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

Task	Question	When Exempt
<p>Determine if the viable solar area (SARA) supported by the roof(s) and structure(s) capable of supporting PV associated with the project meets the minimum threshold.</p>	<p>How much of the roof(s) or structure(s) has a solar access roof area (SARA) with ≥ 70% annual solar access (using a CEC-approved solar shading assessment tool) when removing all areas that are obstructed or occupied roof, or required to remain clear because of other building code requirements?*</p> <p style="text-align: center;"> ↓ ≥ 80 ft² available? → < 80 ft² available? </p> <p>Is the total of all available SARA with ≥ 70% annual solar access ≥ 3% of the project's conditioned floor area?</p> <p style="text-align: center;"> ↓ Yes → No </p> <p style="text-align: center; color: green;">Choose an Approach</p>	<p>No PV system is required to be installed, but the project is required to meet applicable solar readiness requirements of §110.10.</p>
		<p>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</p>

Documenting SARA Example



- ◆ Roof conditions have big impact
- ◆ Unobstructed early roof design meant 36 kW PV in the center of the roof (103 panels)
- ◆ Final roof design reduced SARA to 268 sf and PV to 3.8 kW (11 panels)



Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

Task	Question	When Exempt
<p>An office building located in Climate Zone 3 with a CFA of 100,000 ft² and SARA of 15,000 ft²</p> <p>DC Rating based on Equation 140.10-A:</p> $\text{DC Rating} = (\text{CFA} \times A) / 1000$ $\text{DC Rating} = (100,000 \text{ ft}^2 \times 2.59 \text{ W/ft}^2) / 1,000$ <p>DC Rating = 259 kW</p>	<p>DC Rating based on Performance Approach:</p> <p>DC Rating = 250 kW</p> <p>DC Rating based on SARA:</p> $\text{DC Rating} = \text{Total SARA} \times 14 \text{ W/ft}^2$ $\text{DC Rating} = 15,000 \text{ ft}^2 \times 14 \text{ W/ft}^2$ <p>DC Rating = 210,000 W</p> <p>DC Rating = 210 kW</p>	<p>No PV system is required to be installed, but the project is required to meet applicable solar readiness requirements of §110.10.</p>
<p>Determine the minimum required PV kW per the Energy Code using any of the three approaches.</p> <p><i>Note: For buildings with more than one applicable building type, calculate each building type PV kW applicable to each space, then add together to determine the total minimum required PV kW.</i></p>	<p>Prescriptive Approach</p> <p>Use Equation 140.10-A or 170.2-D to calculate the kW of PV required. Is the required PV kW ≥ 4 kW?</p> <p>Yes ↓</p> <p>Performance Approach</p> <p>Using the CEC-approved compliance software, is the required PV kW ≥ 4 kW?</p> <p>Yes ↓</p> <p>SARA Approach</p> <p>Multiply roof square footage ≥ 80 ft² with ≥ 70% annual solar access x 14 Watts. Is the required PV kW ≥ 4 kW?</p> <p>Yes ↓ No →</p> <p>The smaller of the Prescriptive or Performance PV size and the SARA PV size is the minimum required PV kW for the project.</p>	<p>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</p>
<p>Required PV System Size:</p> <p>Smallest of the three results: 210 kW</p>		



Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

Task	Question	When Exempt
 <p> ✦ Allows a common shared system to offset solar and/or battery requirements <ul style="list-style-type: none"> ✦ Must be operational before final permit signed off on building ✦ Must provide equivalent or better performance than what is specified for building ✦ Must provide benefit to the building for 20 years minimum ✦ Cannot transfer benefit to another building ✦ Located on a distribution system of the participating buildings ✦ No larger than 20 MW </p>	<p>Does the load-serving entity have a community solar program that will be utilized for the project?</p> <p>Yes: Minimum required PV kW of Prescriptive or Performance Approaches must be provided by a community solar program.</p> <p>No: Minimum required PV kW of Prescriptive, Performance or SARA Approaches must be installed on site.</p>	<p>No PV system is required to be installed, but the project is required to meet applicable solar readiness requirements of §110.10.</p> <p>*If a local ordinance or local code requires the roof area be used for anything other than PV, the project must seek approval from the CEC for not installing PV.</p>
<p>Determine if a community solar program is to be utilized.</p>		



Check Your Understanding #5

What do you think?

1. Below what threshold does 2022 Energy Code NOT require a PV system for new nonresidential office buildings?
 - a) 5,000 ft² conditioned floor area
 - b) 100 ft² SARA
 - c) 4.0 kW PV
 - d) 90% annual solar access



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Nonresidential & Multifamily ≥ 4 Stories: Battery Requirements

2022 Code Breaker: Solar & Battery & ZNCD

1. Energy Code Basics
2. Why Renewables are Required
3. Single Family & Multifamily ≤ 3 Stories Requirements
4. Nonresidential & Multifamily ≥ 4 Stories Solar Requirement

5. Nonresidential & Multifamily ≥ 4 Stories Battery

6. Next Steps

Battery Requirements for Nonresidential & Multifamily Buildings ≥ 4 Stories

- ✦ Battery System Size
- ✦ Exceptions

Battery Storage



- ✦ Batteries store renewable energy produced by onsite PV to promote “self-consumption” of renewable energy onsite later in the day during peak grid periods

Buildings with PV and battery have lower GHG emissions than buildings with PV alone

This is called ‘grid harmonization.’

- ✦ Additional demand response controls on battery system can be used to respond to critical peak periods on the grid by exporting electricity back to the grid



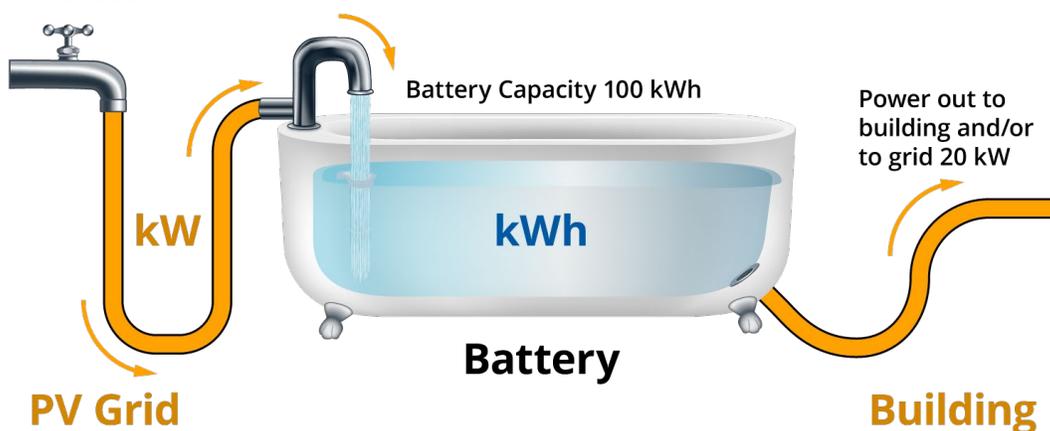
Key Battery Performance Values

Think of a bathtub as an analogy for a battery storage system.

The flow of water into and out of the “tub” corresponds to the instantaneous **Power Capacity measured in kW.**

The quantity of water that the “tub” can hold is the **Energy Capacity measured in kWh.**

PV/Grid 20 kW



Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

Task	Question	When Exempt
Determine if the scope of the project is subject to the battery storage requirements of the Energy Code.	Is the project required to have a PV system? (See the PV System Sizing flowchart on page 9.) ↓ Yes No →	No battery storage system is required to be installed. *Tenant spaces ≤ 5,000 ft² are not included in the battery storage assessment. This exception does not apply to ≥ 4 story multifamily buildings.
	Is the project type and location anything other than an office, school or warehouse in Climate Zone 1? ↓ Yes No →	
	Is the project either a single-tenant building with conditioned floor area > 5,000 ft², or is the project a multi-tenant building in which one or more of the tenant spaces are > 5,000 ft²? ↓ Yes No →	
	Is the required PV system size ≥ 15% of the size determined by PV Prescriptive Approach Equation 140.10-A or Equation 170.2-D ? ↓ Yes, Choose an Approach No →	



Nonresidential & Multifamily ≥4 Stories: PV & Battery Storage Factsheet

Task	Question	When Exempt
Determine the minimally required battery energy and power capacity per the Energy Code using either of the two approaches.	<p>Prescriptive Approach A battery storage system is required to be installed with the battery energy capacity determined using Equation 140.10-B or 170.2-E and the battery power capacity determined using Equation 140.10-C or 170.2-F.</p> <p>Performance Approach A battery storage system is required to be installed with the battery energy capacity and the battery power capacity as shown on the NRCC-PRF-E.</p> <p>When using the required PV kW to calculate required battery storage (Prescriptive, Performance or SARA method), is the required battery storage size ≥ 10 kWh? ↓ Yes Provide the minimum required battery storage capacity documented via the Prescriptive or Performance Approach. No →</p> <p>If the project is a mixed-use building and uses the SARA Approach for minimum required PV kW, please see Blueprint #141. www.energy.ca.gov/publications/2023/blueprint-newsletter-january-march-2023-issue-141.</p>	No battery storage system is required to be installed. *Tenant spaces ≤ 5,000 ft² are not included in the battery storage assessment. This exception does not apply to ≥ 4 story multifamily buildings.

The office building located in Climate Zone 3 with a CFA of 100,000 ft² and SARA of 15,000 ft²
PV Size = 210 kW
Round Trip Battery Efficiency = 95%
Energy Capacity Factor B = 1.68
Power Capacity Factor C = 0.42

Minimum rated energy capacity is:
kWh = kW_{PVdc} × B / D^{0.5}
kWh = 210 × 1.68 / 0.95^{0.5}
kWh = 362 kWh

Minimum rated power capacity is:
kW = kW_{PVdc} × C
kW = 210 × 0.42
kW = 88 kW

Battery Capacity Factors		
Building Types	Factor B Energy Capacity	Factor C Power Capacity
Office, Financial Institutions, Unleased Tenant Space	1.68	0.42

Performance Approach



CEC APPROVED

✦ PV & Battery are prescriptive requirements and using the performance approach:

- ✧ Can reduce the size of PV system through added efficiency
- ✧ Can reduce the size of PV system by adding battery and vice-versa
- ✧ Can reduce the size of battery through added efficiency
- ✧ More ability to downsize battery than PV

✦ Modeling can also inform design of PV/battery:

- ✧ For utility cost savings
- ✧ For Zero Net Carbon and other goals
- ✧ For Grid Harmony metrics
- ✧ For above-code program goals



Check Your Understanding #6

What do you think?

When does the 2022 Energy Code mandate the installation of battery storage systems for new school buildings?

- Battery storage will never be required for new nonresidential buildings
- When the permit application is submitted as of January 1, 2023
- When PV is required and conditioned floor area $>5,000$ ft²
- When PV is required and required battery storage is ≥ 10 kWh



Next Steps

2022 Code Breaker: Solar & Battery & ZNCD

- 1. Energy Code Basics
- 2. Why Renewables are Required
- 3. Single Family & Multifamily ≤ 3 Stories Requirements
- 4. Nonresidential & Multifamily ≥ 4 Stories Solar Requirement
- 5. Nonresidential & Multifamily ≥ 4 Stories Battery Requirement

6. Next Steps

Key Points & Next Steps

- ✦ Take the **Single Family & ≤ 3 Story Multifamily Solar & Battery Class!**
- ✦ Take the **Nonresidential & Multifamily ≥ 4 Stories Solar & Battery Class!**
 - ◇ Other Training
 - ◇ Resources
 - ◇ Tools
- ✦ Local Incentives and Rebates

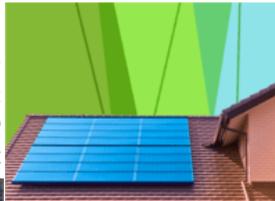
Key Points

- ✦ PV & Battery are vital to the state reaching its Climate goals
 - ◇ California currently stands at 33.6% renewable energy, with requirements to reach 60% by 2030 and 100% by 2045
- ✦ The 2022 energy code extended PV as a prescriptive requirement for new Nonresidential and Multifamily buildings ≥ 4 Stories in addition to the previous PV requirements for single-family and Multifamily buildings ≤ 3 Stories
- ✦ The 2022 code also made battery storage a prescriptive requirement for new Nonresidential and Multifamily buildings ≥ 4 Stories
 - ◇ Including new battery ready requirements for new Single-Family and Duplex buildings

Virtual Classes

2022 Title 24, Part 6 Essentials — Single-family Standards: Solar & Battery Storage

Online Live Event



2022 Title 24, Part 6 Essentials — Nonresidential & Multifamily Standards: Solar & Battery Storage

Online Live Event

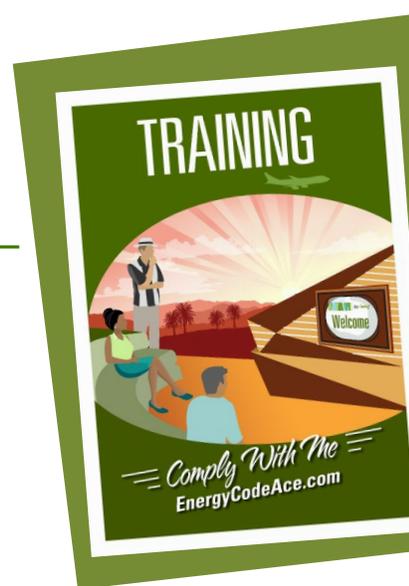
2022 Title 24, Part 6 Essentials — Single-family Standards for Architects & Designers

Online Live Event



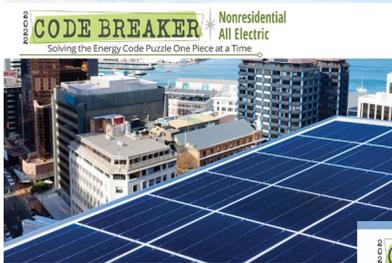
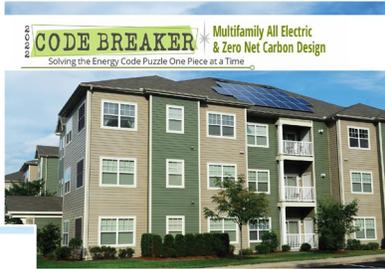
2022 Title 24, Part 6 Essentials — Nonresidential Standards for Architects & Designers

Online Live Event



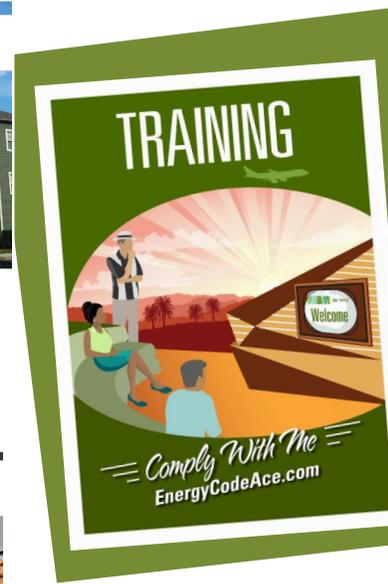
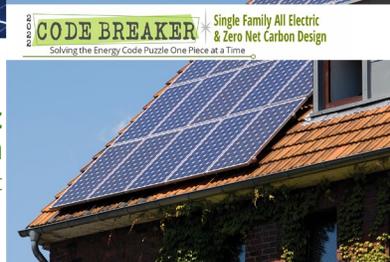
Additional Code Breaker Sessions

2022 Multifamily All Electric & Zero Net Carbon Design
Online Live Event



2022 Nonresidential All Electric
Online Live Event

2022 Single Family All Electric & Zero Net Carbon Design
Online Live Event



PV Quick Reference

2022 Energy Code
Ace Resources **Fact Sheet** Title 24, Part 6
Nonresidential and High-rise Multifamily Solar and Battery Systems

What Are Solar and Battery Systems Requirements?
The 2022 California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) include requirements for photovoltaic (PV) systems, battery storage systems and solar readiness for multifamily buildings with 4 or more habitable stories, nonresidential buildings, hotels, motels and mixed-use buildings.

PV and battery systems requirements apply to newly constructed:

- Multifamily buildings with 4 or more habitable stories
- Nonresidential buildings
- Hotels and motels
- Mixed-use buildings when:
 - Multifamily Building
 - 4 Habitable Stories
 - Grocery
 - Office
 - Financial Institutions
 - Unleased Tenant Space
 - Retail
 - School
 - Warehouse

Importance of Compliance
Solar electricity from nonresidential and residential PV systems in combination with battery storage is part of meeting California climate goals. California is aiming to reduce its greenhouse gas (GHG) emissions while creating an energy system that is resilient to climate risks, spurring innovation and a low-carbon transition nationally and internationally.

California met its 2020 target four years early in 2016, and emissions have continued to drop since then. California's next climate targets are to reduce emissions by 40% below 1990 levels by 2030 and by 80% below 1990 levels by 2050.

PV systems are an increasing part of California's electrical grid. However, the existing power grid does

2022 Energy Code
Ace Resources **Fact Sheet** Title 24, Part 6
Single-family and Low-rise Multifamily Solar and Battery Systems

What Are Residential Solar and Battery System Requirements?
The 2022 California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) include requirements for photovoltaic (PV) systems, solar readiness and energy storage systems (ESS).

The information in this fact sheet applies to newly constructed low-rise residential buildings. The Energy Code defines New Construction as a building that has never been used or occupied for any purpose. Low-rise residential buildings are single-family residences of any number of stories or multifamily buildings with 3 or fewer habitable stories. For definitions and examples of the occupancies and buildings included, see [Table 1](#).

PV system requirements apply to newly constructed single-family buildings and to newly constructed multifamily buildings with 3 or fewer habitable stories.

Solar readiness requirements apply when PV systems are not installed in newly constructed single-family homes in subdivisions with 10 or more residences and newly constructed multifamily buildings with 3 or fewer habitable stories.

ESS readiness requirements apply only to newly constructed single-family buildings with one or two dwelling units. The ESS readiness requirements are not applicable to two-story buildings with 3 or more dwelling units. Full installation of the ESS with a battery is not required for single-family buildings. However, there is an optional Performance Approach credit available for projects that install one.

For information on solar and battery system requirements that apply to nonresidential buildings and multifamily buildings with 4 or more habitable stories, see the Energy Code Ace Nonresidential and High-rise Multifamily Solar and Battery Systems Fact Sheet at [bit.ly/ACE-NonRes-Solar-Battery-Systems-Fact-Sheet](#).

For basic information about PV systems, see the 2022 Title 24, Part 6 Essentials On Demand — Single-Family Standards & Technology: Solar Systems at [bit.ly/ACE-Training-2022-01-solar-systems](#).

Importance of Compliance
Solar electricity from residential PV systems in combination with battery storage is part of meeting California's climate goals. California is aiming to reduce its greenhouse gas (GHG) emissions while creating an energy system that is resilient to climate risks, spurring innovation and a low-carbon transition nationally and internationally. California met its 2020 target four years early in 2016, and emissions have continued to drop since then. California's next climate targets are to reduce emissions by 40% below 1990 levels by 2030 and by 80% below 1990 levels by 2050.

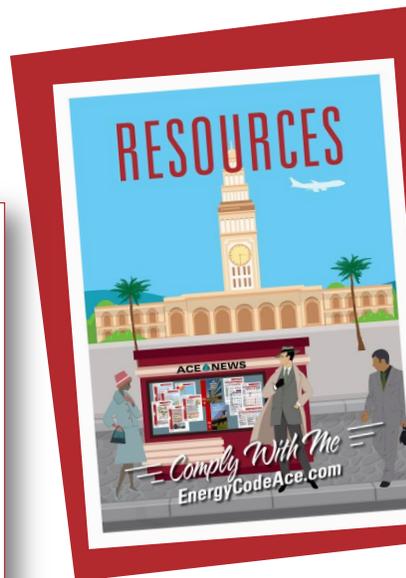
Residential PV systems are an increasing part of California's electrical grid. However, the existing power grid does not have enough central storage capacity to store all of the residentially-generated solar electricity for use later in the day.

Residential battery storage systems help to keep the electricity levels in the grid stable and balanced by backing up mid-day solar electricity for use during peak use periods on the site where it was generated, rather than moving residentially-generated electricity to the grid at mid-day and then taking electricity from the larger grid at peak use periods.

For more, read the [Designing Single-Family Homes to Run on Clean Energy Fact Sheet at bit.ly/Designing-SF-Homes-With-Clean-Energy-Fact-Sheet](#).

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