



## 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-used 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 ≥ 4 Habitable Stories
  - ◇ Grocery
  - ◇ Office
  - ◇ Financial Institutions
  - ◇ Unleased Tenant Space
  - ◇ Retail
  - ◇ School
  - ◇ Warehouse
  - ◇ Medical Office Building or Clinic
  - ◇ Auditorium
  - ◇ Convention Center
  - ◇ Hotel or Motel
  - ◇ Library
  - ◇ Restaurant
  - ◇ Theater

**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  $\geq 2,000$  ft<sup>2</sup> 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 [bit.ly/ECA-building-fact-sheets](http://bit.ly/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 of all 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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## Occupancies and Buildings Covered in this Fact Sheet

Occupancy Group and Building Type California Building Code §§303-306, 309-310, 312		Building and Space Types Subject to PV and Battery Storage Requirements
<b>Multifamily Buildings with ≥ 4 Habitable Stories (High-rise)</b>		
<b>R-2</b>	<b>Residential Group R-2:</b> Buildings with 3 or more dwelling units for permanent residents	<b>High-Rise Multifamily:</b> A building, other than hotel or motel, of Occupancy Group R-2, R-3 or R-4 with 4 or more habitable stories Examples: Apartment buildings <i>Hotels, motels and timeshares are excluded.</i>
<b>R-3</b>	<b>Residential Group R-3:</b> Some multifamily congregate residences with primarily permanent residents	<b>High-Rise Multifamily:</b> A building, other than hotel or motel, of Occupancy Group R-2, R-3 or R-4 with 4 or more habitable stories Examples: Dormitories <i>Boarding houses or alcohol or drug abuse recovery homes with over 6 guests are excluded.</i>
<b>R-4</b>	<b>Residential Group R-4:</b> Supervised residential environments for more than 6 ambulatory clients and up to 16 total residents, excluding staff	<b>High-Rise Multifamily:</b> A building, other than hotel or motel, of Occupancy Group R-2, R-3 or R-4 with 4 or more habitable stories Examples: Assisted living facilities, halfway houses, drug treatment facilities
<b>Nonresidential Buildings on Multifamily Sites</b>		
<b>U</b>	<b>Miscellaneous:</b> Accessory buildings and structures and miscellaneous structures not classified in any specific occupancy	N/A
<b>Nonresidential Buildings</b>		
<b>A</b>	<b>Assembly:</b> Buildings or spaces where groups of people gather for civic, social or religious functions, recreation, food or drink consumption, entertainment, awaiting transportation, or television and movie production, among other uses	<b>Auditorium:</b> A room or area with a stage and fixed seats used for public meetings or gatherings <b>Convention Center (Assembly Building):</b> A building with meeting halls in which people gather for civic, social or recreational activities <b>Library:</b> A building with areas used to store literary materials and for reading reference such as books, periodicals, newspapers, pamphlets and prints <b>Tenant Lease Space:</b> A room or area in a building intended for lease for which a specific tenant is not identified at the time of building permit application <b>Theater (Performance Arts Theater):</b> A building used for showing performing arts that include plays, music or dance to audiences, also a building used for showing motion pictures to audiences

**(Continued)**



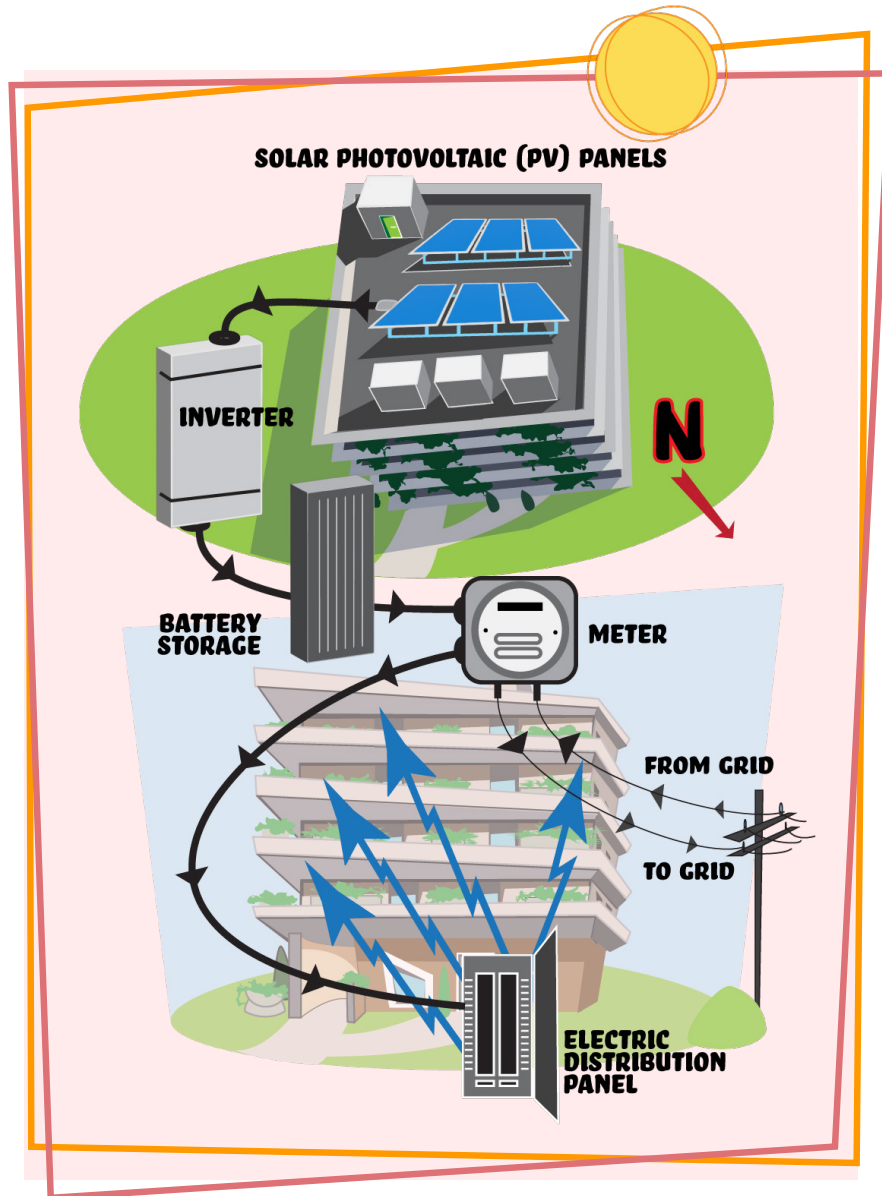
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<b>Occupancies and Buildings Covered in this Fact Sheet</b>	
<b>Occupancy Group and Building Type California Building Code §§303-306, 309-310, 312</b>	<b>Building and Space Types Subject to PV and Battery Storage Requirements</b>
<b>B</b>	<p><b>Business:</b> Buildings or spaces for office, professional or service-type transactions, including storage of records and accounts</p> <p><b>Financial Institution:</b> A building with areas used by an institution which collects funds from the public and places them in financial assets, such as deposits, loans and bonds</p> <p><b>Medical Office Building or Clinic Office:</b> A building of Occupancy Group B with areas in which business, clerical or professional activities are conducted</p> <p><b>Restaurant:</b> A building with areas in which food and drink are prepared and served to customers in return for money</p> <p><b>Tenant Lease Space:</b> A room or area in a building intended for lease for which a specific tenant is not identified at the time of building permit application</p>
<b>E</b>	<p><b>Education:</b> Buildings or spaces used for more than 6 persons at any one time for educational purposes through the 12th grade</p> <p><b>School:</b> A building used by an educational institution with a building floor area that can include classrooms or educational laboratories and may include an auditorium, gymnasium, kitchen, library, multipurpose room, cafeteria, student union or workroom</p> <p><i>Maintenance and storage buildings are not school buildings.</i></p>
<b>F</b>	<p><b>Factory:</b> Buildings or spaces used for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations that are not classified as a Group H hazardous or Group S storage occupancy</p> <p><b>Warehouse:</b> A manufacturing, commercial or industrial work area in which an art, craft, assembly or manufacturing operation is performed</p> <p><b>Tenant Lease Space:</b> A room or area in a building intended for lease for which a specific tenant is not identified at the time of building permit application</p>
<b>M</b>	<p><b>Mercantile:</b> Buildings or spaces used to display and sell merchandise to the public, plus supporting areas for stocks of goods, wares or merchandise</p> <p><b>Grocery:</b> A building with building floor areas used for the display and sale of food</p> <p><b>Retail Store:</b> A building with building floor areas used for the display and sale of merchandise except food</p> <p><b>Tenant Lease Space:</b> A room or area in a building intended for lease for which a specific tenant is not identified at the time of building permit application</p>
<b>R-1</b>	<p><b>Residential Group R-1:</b> Buildings with sleeping units for primarily transient occupants</p> <p><b>Hotel and Motel:</b> A building or buildings with 6 or more guest rooms for use, rental or hire as sleeping areas, including timeshares, boarding houses and alcohol or drug treatment facilities with 6 or more guests and all conditioned and supporting spaces in the same building envelope or on the same property</p>
<b>U</b>	<p><b>Miscellaneous:</b> Accessory buildings and structures and miscellaneous structures not classified in any specific occupancy</p> <p style="text-align: center;">N/A</p>

**Table 1.** Occupancies and Buildings Covered in this Fact Sheet



# System Components and Key Terms



## Key Terms

**Battery Energy Capacity:** The amount of energy that a battery can store, with the minimum rated energy capacity for battery storage systems when they are required for nonresidential and multifamily buildings set by [Equations 140.10-B](#) and [170.2-E](#)

**Battery Power Capacity:** How quickly energy can be stored in and pulled out of the battery, with the minimum rated power capacity for battery storage systems when they are required for nonresidential and multifamily buildings set by [Equations 140.10-C](#) and [170.2-F](#)

**Community-shared Solar Electric Generation System or Battery Storage System Offset:** Solar electric generation or other renewable electric generation technology and/or energy storage systems (batteries) that are installed at location outside of the project site and for compliance with the 2022 Energy Code, meet the qualifications of [§10-115](#) and be approved by the CEC

**Energy Storage System (ESS):** One or more devices, assembled together, that are capable of storing energy used for safely supplying electrical energy to selected loads at a future time (also known as a battery)

**Inverter:** Component in a photovoltaic (PV) system that converts direct current (DC) to alternating current (AC) and may have the capability to connect the system to the grid through the utility service

**Newly Constructed Building:** A building that has never been occupied for any purpose

**Photovoltaic (PV) System:** A system to generate electricity from solar energy that includes photovoltaic panels and may include an inverter and other interconnection equipment to the building's electrical system

**Solar Access Roof Area (SARA):** The area of the building's roof space that is capable of structurally supporting a photovoltaic (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 Title 24, Part 2, Section 1511.2 (For exceptions, see the [Photovoltaics Systems](#) section below in this fact sheet.)

**Solar Assessment:** Verification and documentation of the shading conditions for a photovoltaic (PV) system as specified in [Joint Reference Appendix JA11.4](#) and completed using a CEC-approved solar assessment tool listed at [bit.ly/CEC-Solar-Assessment-Tools](http://bit.ly/CEC-Solar-Assessment-Tools)

**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, with the generated electricity feeding directly back onto the grid instead of directly to any tenant meter

**Figure 1.** Photovoltaic System Components



# Photovoltaic Systems

## Photovoltaic System Sizing and Installation

§§140.10(a), 170.2(g)



### Prescriptive Requirement



### Performance Requirement

A solar electric generation system, or photovoltaic (PV) system, is the complete set of all components for converting sunlight into electricity through the photovoltaic process, including the array of panels, inverter(s) and the balance of system components required to enable the system to effectively deliver power to reduce a building's consumption of electricity from the utility grid.

## Commonly Applicable Project Scopes

In New Construction, a PV system is required in the buildings listed in Table 2.

Additions and Alterations to the buildings listed in Table 2 do not require new PV systems in the Energy Code.

For 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 [bit.ly/ECA-building-fact-sheets](http://bit.ly/ECA-building-fact-sheets).

PV System Requirements by Building Type	
New Construction	Building Type
Installation of a new PV system is required for:	<ul style="list-style-type: none"> <li>✦ Multifamily Building ≥ 4 Habitable Stories</li> <li>✦ Grocery</li> <li>✦ Office</li> <li>✦ Financial Institutions</li> <li>✦ Unleased Tenant Space</li> <li>✦ Retail</li> <li>✦ School</li> <li>✦ Warehouse</li> <li>✦ Auditorium</li> <li>✦ Convention Center</li> <li>✦ Hotel or Motel</li> <li>✦ Library</li> <li>✦ Medical Office Building or Clinic</li> <li>✦ Restaurant</li> <li>✦ Theater</li> </ul>
<ul style="list-style-type: none"> <li>✦ Newly constructed building types listed on the right</li> <li>✦ Newly constructed mixed occupancy buildings when 80% of the floor area (both conditioned and unconditioned) is one or more of the building types on the right</li> </ul>	<p><i>Adapted from Tables 140.10-A, 170.2-U.</i></p>

**Table 2.** PV System Requirements by Building Type



### WHAT'S NEW

For nonresidential buildings, hotels and motels, and multifamily buildings of 4 or more habitable stories, PV systems and battery storage systems are required Prescriptively for most building types.

Multifamily buildings have a new chapter of the Energy Code and Performance software (CBECC).



### Solar Assessment Tools

A list of CEC-approved solar assessment tools is available at [bit.ly/CEC-Solar-Assessment-Tools](http://bit.ly/CEC-Solar-Assessment-Tools).



## Solar Access Roof Area

The **solar access roof area (SARA)** defines how much of the roof area is both capable of supporting a PV system and has sufficient annual solar exposure to generate energy.

For nonresidential buildings, hotels and motels, and multifamily buildings of 4 or more habitable stories, the Energy Code description of SARA is provided below:

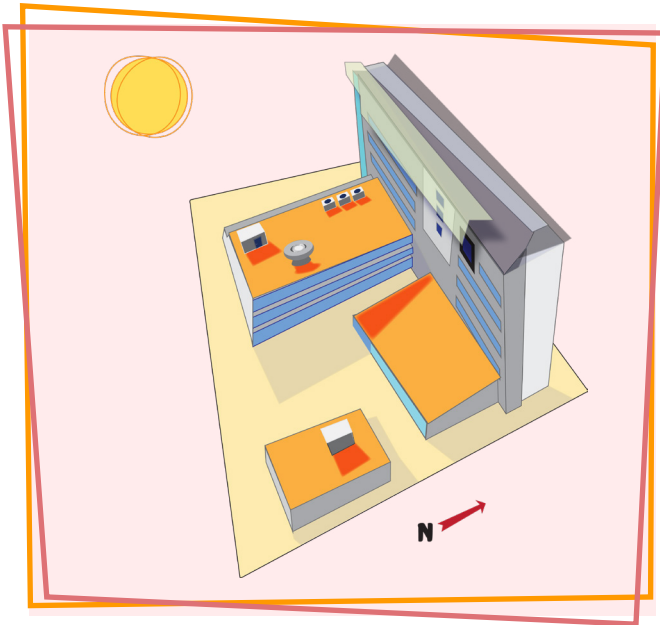
### SARA includes:\*

- ✦ The **area of the 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 Title 24, Part 2, §1511.2

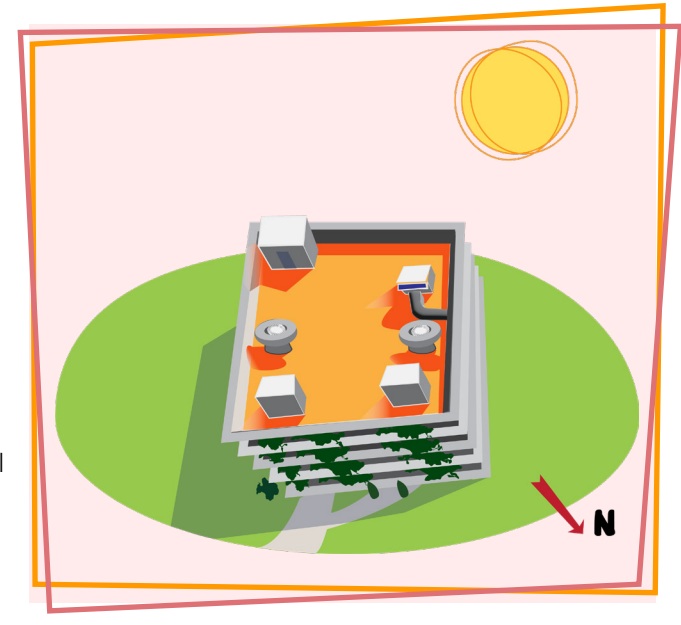
### SARA does not include:\*

- ✦ **Any roof area that has less than 70% annual solar access:** Annual solar access is determined by dividing the total annual solar insolation (accounting for shading obstructions) by the total annual solar insolation if the same areas were unshaded by those obstructions. For all roofs, all obstructions including those that are external to the building, and obstructions that are part of the building design and elevation features may be considered for the annual solar access calculations.
- ✦ Occupied roof areas as specified by *California Building Code* §503.1.4
- ✦ Roof area that is otherwise not available due to compliance with other building code requirements if confirmed by the CEC Executive Director

\*Language taken from the Energy Code [§§140.10\(a\)](#) and [170.2\(g\)](#).



**Figure 2.** SARA Rooftop Access on Nonresidential Building



**Figure 3.** SARA rooftop access on Multifamily Building ≥ 4 Stories





## PV System and Sizing Exceptions

The Energy Code has five exceptions for nonresidential buildings, hotels, motels, multifamily buildings with four or more habitable stories, and mixed-use buildings. These exceptions are listed below.

### Exceptions to [§§140.10\(a\)](#) and [170.2\(g\)](#)\*\*

1. No PV system is required where the total of all available SARA is less than 3% of the conditioned floor area.
2. No PV system is required where the required PV system size is less than 4 kW<sub>dc</sub>.
3. No PV system is required if the SARA contains less than 80 contiguous ft<sup>2</sup>.
4. For buildings with enforcement-authority-approved roof designs, the enforcement authority has determined that it is not possible for the PV system, including panels, modules and components and supports and attachments to the roof structure, to meet the requirements of the *American Society of Civil Engineers (ASCE), Standard 7-16, Chapter 7, Snow Loads*.
5. Multitenant buildings are excepted in areas where a load-serving entity does not provide either a virtual net metering (VNEM) or community solar program. Note that this exception does not apply to multifamily residential buildings.

\*\*Language taken from the Energy Code [§§140.10\(a\)](#) and [170.2\(g\)](#).

Photovoltaic System Size: New Nonresidential Buildings, Hotels and Motels, Mixed-use Buildings and Multifamily Buildings ≥ 4 Habitable Stories			
Equation 140.10-A / Equation 170.2-D			
<b>DC Rating = (CFA x A) / 1000</b>			
<b>DC Rating (or kW<sub>PV</sub>)</b> .....	kW <sub>dc</sub> size of the PV system		
<b>CFA</b> .....	Conditioned floor area		
<b>A</b> .....	CFA Adjustment factor from 140.10-A or 170.2-U		
Table 140.10-A / Table 170.2-U			
Building Type	Minimum PV Capacity (W/ft <sup>2</sup> CFA)		
	CZ 1, 3, 5, 16	CZ 2, 4, 6-14	CZ 15
<b>Grocery</b>	2.62	2.91	3.53
<b>High-rise Multifamily</b>	1.82	2.21	2.77
<b>Office, Financial Institutions, Unleased Tenant Space</b>	2.59	3.13	3.80
<b>Retail</b>	2.62	2.91	3.53
<b>School</b>	1.27	1.63	2.46
<b>Warehouse</b>	0.39	0.44	0.58
<b>Auditorium, Convention Center, Hotel, Motel, Library, Medical Office Building or Clinic, Restaurant, Theater</b>	0.39	0.44	0.58

*CFA = conditioned floor area; CZ = Climate Zone.*

**Table 3.** Photovoltaic System Size for Nonresidential Buildings, Hotels, Motels, Multifamily Buildings ≥ 4 Habitable Stories and Mixed-use Buildings



## Required Photovoltaic System Size

Projects in the applicable project scopes that do not qualify for an exception must have a PV system of a size determined using either the Prescriptive or Performance Approach.



### Prescriptive Requirement

Using the Prescriptive Approach, PV system size is determined using the equations and table values in Table 3:

- ✦ For newly constructed nonresidential buildings, use [Equation 140.10-A](#) and [Table 140.10-A](#).
- ✦ For newly constructed multifamily buildings with  $\geq 4$  habitable stories, use the lesser of
  - ◇ [Equation 170.2-D](#) and [Table 170.2-U](#)
  - or
  - ◇ The maximum PV system size that can be installed on the building's SARA multiplied by 14 W/ft<sup>2</sup>



### Performance Requirement

In the Performance Approach, the sizing for PV is calculated by the software based on inputs by the user into Performance Approach software available at [bit.ly/CEC-2022-Compliance-Software](http://bit.ly/CEC-2022-Compliance-Software).

For newly constructed multifamily and nonresidential buildings, the Standard Design PV system is designed to allow for self-utilization by the building of 80% of PV production over the course of the year.

For PV sizing calculations, the Performance Approach software assumes the California flexible installation (CFI) orientation at 170 degrees, standard efficiency for modules, inverter efficiency of 96%, fixed tracking, standard shading (excluding horizon), roof tilt of 22.61 degrees (5:12 pitch) and annual solar access of 98%.

## Photovoltaic System Qualification Requirements

If a PV system is required, it must meet the qualification requirements in [Joint Reference Appendix JA11](#).

Requirements include:

- ✦ System orientation
- ✦ Shading
- ✦ Solar access verification
- ✦ System monitoring
- ✦ Interconnection
- ✦ Certificates

The PV installer must certify on the CF2R-PVB-01-E, Certificate of Installation for Photovoltaic System, that all provisions of JA11 are met and provide a solar assessment report.





Task	Question	When Exempt								
Determine if the scope of the <b>project is subject to PV requirements</b> of the Energy Code.	Is this a new conditioned project and a type specified in <a href="#">Table 140.10-A</a> or <a href="#">Table 170.2-U</a> , or is it a mixed-occupancy building where one or more of the building types in <a href="#">Table 3</a> constitute at least 80% of the floor area of the building? Yes No	<p><b>No PV system is required to be installed, but the project is required to meet applicable solar readiness requirements of §110.10.</b></p> <p><b>*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.</b></p>								
Determine if the <b>VNEM or snow load exceptions</b> are applicable. The load-serving entity would be the utility providing electricity to the site.	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)? Yes No									
Determine if the <b>viable solar area (SARA)</b> supported by the roof(s) and structure(s) capable of supporting PV associated with the project meets the minimum threshold.	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?*									
	≥ 80 ft <sup>2</sup> available? < 80 ft <sup>2</sup> available? Is the total of all available SARA with ≥ 70% annual solar access ≥ 3% of the project's conditioned floor area? Yes Choose an Approach No									
Determine the <b>minimally required PV kW</b> per the Energy Code using any of the three approaches.	<table border="0"> <tr> <td style="text-align: center;"><b>Prescriptive Approach</b></td> <td style="text-align: center;"><b>Performance Approach</b></td> <td style="text-align: center;"><b>SARA Approach</b></td> </tr> <tr> <td>Use Equation <a href="#">140.10-A</a> or <a href="#">170.2-D</a> to calculate the kW of PV required. Is the required PV kW ≥ 4 kW?</td> <td>Using the CEC-approved compliance software, is the required PV kW ≥ 4 kW?</td> <td>Multiply roof square footage ≥ 80 ft<sup>2</sup> with ≥ 70% annual solar access x 14 Watts. Is the required PV kW ≥ 4 kW?</td> </tr> <tr> <td style="text-align: center;">Yes ↓</td> <td style="text-align: center;">Yes ↓</td> <td style="text-align: center;">Yes No →</td> </tr> </table> The smaller of the Prescriptive/Performance PV size and the SARA PV size is the minimum required PV kW for the project.		<b>Prescriptive Approach</b>	<b>Performance Approach</b>	<b>SARA Approach</b>	Use Equation <a href="#">140.10-A</a> or <a href="#">170.2-D</a> to calculate the kW of PV required. Is the required PV kW ≥ 4 kW?	Using the CEC-approved compliance software, is the required PV kW ≥ 4 kW?	Multiply roof square footage ≥ 80 ft <sup>2</sup> with ≥ 70% annual solar access x 14 Watts. Is the required PV kW ≥ 4 kW?	Yes ↓	Yes ↓
<b>Prescriptive Approach</b>	<b>Performance Approach</b>	<b>SARA Approach</b>								
Use Equation <a href="#">140.10-A</a> or <a href="#">170.2-D</a> to calculate the kW of PV required. Is the required PV kW ≥ 4 kW?	Using the CEC-approved compliance software, is the required PV kW ≥ 4 kW?	Multiply roof square footage ≥ 80 ft <sup>2</sup> with ≥ 70% annual solar access x 14 Watts. Is the required PV kW ≥ 4 kW?								
Yes ↓	Yes ↓	Yes No →								
Determine if a <b>community solar program</b> is to be utilized.	Does the load-serving entity have a community solar program that will be utilized for the project? <b>Yes:</b> Minimum required PV kW of Prescriptive or Performance Approaches must be provided by a community solar program. <b>No:</b> Minimum required PV kW of Prescriptive, Performance or SARA Approaches must be installed on site.									

## Determining Nonresidential and Multifamily ≥ 4 Stories PV System Sizing

In this flowchart, you will first evaluate the applicability of on-site PV on your projects, including multiple exceptions. The final step will be to perform the PV system sizing requirements after you have determined that exceptions do not apply to your project.

**If you would like to jump to the minimum required PV kW, skip to the minimally required PV kW step.**

### Example

**An office building located in Climate Zone 3 with a CFA of 100,000 ft<sup>2</sup> and SARA of 15,000 ft<sup>2</sup>**

**DC Rating based on Equation 140.10-A:**

$$\text{DC Rating} = (\text{CFA} \times A) / 1000$$

$$\text{DC Rating} = (100,000 \text{ ft}^2 \times 2.59 \text{ W/ft}^2) / 1,000$$

$$\text{DC Rating} = 259 \text{ kW}$$

**DC Rating based on Performance Approach:**

$$\text{DC Rating} = 250 \text{ kW}$$

**DC Rating based on SARA:**

$$\text{DC Rating} = \text{Total SARA} \times 14 \text{ W/ft}^2$$

$$\text{DC Rating} = 15,000 \text{ ft}^2 \times 14 \text{ W/ft}^2$$

$$\text{DC Rating} = 210,000 \text{ W}$$

$$\text{DC Rating} = 210 \text{ kW}$$

**Required PV System Size:**

Smallest of the three results: 210 kW

## Solar Readiness

### §110.10



#### Mandatory Requirements

Nonresidential buildings, hotels, motels, multifamily buildings with 4 or more habitable stories and mixed-use buildings that do not have a PV system installed may be required to be ready for installation of solar systems for electrical power. Solar readiness provisions are made in the building design and plans by reserving space for equipment and planning electrical connections.

### Commonly Applicable Project Scopes

The solar-ready requirements apply to these buildings that do not have a PV system installed:

- ✦ Hotels, motels and multifamily buildings with 4 to 10 habitable stories
- ✦ Nonresidential buildings with 3 habitable stories or fewer, other than I-2 and I-2.1 buildings

### Non-applicable Projects and Exceptions

Exceptions to the solar zone requirements are described in [§110.10\(b\)](#).

### Requirements

Solar readiness includes several provisions that are described below. For details on when buildings must make these provisions, see Table 4.

- ✦ A **solar zone** is a location where solar panels can be installed at a future date. The solar zone must be located on the roof or overhang of the building or on the roof or overhang of another structure located within 250 ft of the building or on covered parking installed with the building project and must have a total area no less than 15% of the total roof area of the building excluding any skylight area. The solar zone requirement applies to the entire building, including mixed occupancy. Exceptions to the solar zone requirements are listed in [§110.10\(b\)1B](#).
- ✦ **Interconnection pathways** include a location for an inverter and metering equipment, electrical conduits, and for single-family buildings and buildings with central water-heating systems plumbing routes noted on construction documents.
- ✦ **Documentation** of solar-ready provisions must be provided to the occupant.

**Solar Readiness Provisions §110.10**

Solar Readiness Requirements	Nonresidential Buildings		Multifamily Buildings, Hotels and Motels	
	≤ 3 Habitable Stories*	≥ 4 Habitable Stories*	4-10 Habitable Stories	≤ 3 or ≥ 11 Habitable Stories
<b>Solar Zone</b> <a href="#">§110.10(b)</a>	<b>Yes</b> Exceptions apply	No	<b>Yes</b> Exceptions apply	No
<b>Interconnection Pathways</b> <a href="#">§110.10(c)</a>	<b>Yes</b>	No	<b>Yes</b>	No
<b>Documentation</b> <a href="#">§110.10(d)</a>	<b>Yes</b>	No	<b>Yes</b>	No

*\*Nonresidential buildings of occupancy types I-2 and I-2.1 are not included.*

**Table 4.** Solar Readiness Provisions Required for Nonresidential Buildings, Hotels, Motels, Multifamily Buildings and Mixed-use Buildings



# Energy Storage Systems

The primary function of the battery storage system is to harmonize the on-site PV system with the grid in order to maximize benefits to the grid, environment and the occupants. The battery system does this by daily cycling for the purpose of load shifting.

## Energy Storage Systems Installation

§§140.10(a), 170.2(g)

 **Prescriptive Requirement**

 **Performance Requirement**

### Commonly Applicable Project Scopes

All buildings required by §140.10(a) or §170.2(g) to have a PV system must also have a battery storage system meeting the minimum qualification requirements of Reference [Joint Reference Appendix JA12](#).

### Non-applicable Projects and Exceptions

No battery storage system is required when:

- ✦ The installed PV system size is < 15% of the size determined by [Equation 140.10-A](#) or [170.2-D](#) due to SARA.
- ✦ The building has battery storage system requirements with < 10 kWh rated capacity.
- ✦ A single-tenant building has less than 5,000 ft<sup>2</sup> of conditioned floor area.
- ✦ The building is an office, school or warehouse in Climate Zone 1.

For multi-tenant buildings, the energy capacity and power capacity of the battery storage system must be based on the tenant spaces with more than 5,000 ft<sup>2</sup> of conditioned floor area.

### Requirements

When required, the battery storage system must meet the minimum qualification requirements of Reference [Joint Reference Appendix JA12](#).

The rated energy capacity and rated power capacity must be at least the values determined by:

- ✦ Nonresidential Buildings: [Equation 140.10-B](#) and [Equation 140.10-C](#)
- ✦ Multifamily Buildings ≥ 4 Stories: [Equation 170.2-E](#) and [Equation 170.2-F](#)

If the building includes more than one of the space types listed in [Table 140.10-B](#) or [170.2-V](#):

- ✦ The total battery system capacity for the building must be determined by applying the equations to each of the listed space types and then summing the capacities determined for each space type and equation.
- ✦ Battery values are based upon a ratio of the kW rating of the PV that is required.

### Battery Energy Capacity Formula

Battery energy capacity is the amount of energy that a battery can store. [Equations 140.10-B](#) and [170.2-E](#) set the minimum rated **energy** capacity for battery storage systems when they are required for nonresidential and multifamily buildings.

$$kWh = kW_{PVdc} \times B / D^{0.5}$$

**kWh** = Rated Useable Energy Capacity of the battery storage system in kWh

**kW<sub>PVdc</sub>** = PV system capacity required by §140.10(a) or §170.2(g) in kW<sub>dc</sub>

**B** = Battery **energy capacity factor** specified in **Table 5** for the building type

**D** = Rated single charge-discharge cycle AC to AC (round-trip) efficiency of the battery storage system

### Battery Power Capacity Formula

Battery power capacity is how quickly energy can be stored in and pulled out of the battery. [Equations 140.10-C](#) and [170.2-F](#) set the minimum rated **power** capacity for battery storage systems when they are required for nonresidential and multifamily buildings.

$$kW = kW_{PVdc} \times C$$

**kW** = Power capacity of the battery storage system in kW<sub>dc</sub>

**kW<sub>PVdc</sub>** = PV system capacity required by §140.10(a) or §170.2(g) in kW<sub>dc</sub>

**C** = Battery **power capacity factor** specified in **Table 5** for the building type

Battery Capacity Factors		
Building Types	Factor B Energy Capacity	Factor C Power Capacity
Grocery	1.03	0.26
High-rise Multifamily	1.03	0.26
Office, Financial Institutions, Unleased Tenant Space	1.68	0.42
Retail	1.03	0.26
School	1.87	0.46
Warehouse	0.93	0.23
Auditorium, Convention Center, Hotel, Motel, Library, Medical Office Building or Clinic, Restaurant, Theater	0.93	0.23

**Table 5.** Battery Capacity Factors  
(Adapted from [Table 140.10-B](#) and [Table 170.2-V](#))



## Energy Storage System Qualification Requirements

### Joint Reference Appendix

JA12 provides the qualification requirements for a battery storage system.

Requirements include:

- ✦ Safety
- ✦ System performance
- ✦ Controls
- ✦ Interconnection and net metering
- ✦ Certificates

The battery storage system must be a model certified to the CEC as qualified for credit as a battery storage system. The list of qualified JA12 products can be found on the CEC's Solar Equipment Lists Home page at [solarequipment.energy.ca.gov/Home/Index](http://solarequipment.energy.ca.gov/Home/Index).

## Examples – Nonresidential, Multifamily, Mixed

When using the Performance Approach for Energy Code compliance, tradeoffs between the efficiency of the building and its renewable energy systems (PV and ESS) are possible. If the building design is more efficient than the Standard Design, that allows you to include either a smaller PV system, or a smaller ESS, or a combination of the two. In some cases, it may be possible to completely eliminate the need for an ESS if the building incorporates high-performance features and a larger than standard PV system, for example.

## Determining Nonresidential and Multifamily ≥ 4 Stories Battery System Sizing

Task	Question	When Exempt
Determine if the scope of the <b>project is subject to the battery storage requirements</b> of the Energy Code.	Is the project required to provide PV? (See the <a href="#">PV System Sizing flowchart</a> on page 9.)	<b>No battery storage system is required to be installed.</b>  <b>*Tenant spaces ≤ 5,000 ft<sup>2</sup> are not included in the battery storage assessment. This exception does not apply to ≥ 4 story multifamily buildings.</b>
	Is the project type and location anything <b>other than</b> an office, school or warehouse in Climate Zone 1?	
	Is the project either a single-tenant building with conditioned floor area > 5,000 ft <sup>2</sup> , or is the project a multi-tenant building in which one or more of the tenant spaces are > 5,000 ft <sup>2</sup> ?	
	Is the required PV system size ≥ 15% of the size determined by PV Prescriptive Approach <a href="#">Equation 140.10-A</a> ?	
Determine the <b>minimally required battery energy and power capacity</b> per the Energy Code using either of the two approaches.	<b>Prescriptive Approach</b> A battery storage system is required to be installed with the battery energy capacity determined using <a href="#">Equation 140.10-B</a> or <a href="#">170.2-E</a> and the battery power capacity determined using <a href="#">Equation 140.10-C</a> or <a href="#">170.2-F</a> .	
	<b>Performance Approach</b> 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.	
	When using the required PV kW to calculate required battery storage (Prescriptive, Performance or SARA method), is the required battery storage size ≥ 10 kWh?	
	If the project is a mixed-use building and uses the SARA Approach for minimum required PV kW, please see Blueprint #141. <a href="http://www.energy.ca.gov/publications/2023/blueprint-newsletter-january-march-2023-issue-141">www.energy.ca.gov/publications/2023/blueprint-newsletter-january-march-2023-issue-141</a> .	

## Example

**The office building located in Climate Zone 3 with a CFA of 100,000 ft<sup>2</sup> and SARA of 15,000 ft<sup>2</sup>**

PV Size = 210 kW

Energy Capacity Factor B = 1.68

Power Capacity Factor C = 0.42

Factor D = 95%

**Minimum rated energy capacity is:**

$$\text{kWh} = \text{kW}_{\text{PVdc}} \times B / D^{0.5}$$

$$\text{kWh} = 210 \times 1.68 / 0.95^{0.5}$$

$$\text{kWh} = 362 \text{ kWh}$$

**Minimum rated power capacity is:**

$$\text{kW} = \text{kW}_{\text{PVdc}} \times C$$

$$\text{kW} = 210 \times 0.42$$

$$\text{kW} = 88 \text{ kW}$$



## Solar and Battery Compliance Forms and Process

Nonresidential buildings, hotels, motels, multifamily Buildings  $\geq 4$  habitable stories and mixed-use buildings require the NRCC and NRCI forms noted below.

Solar and Battery System Compliance Forms for Nonresidential and Multifamily Buildings $\geq 4$ Habitable Stories				
Performance Method	Certificates of Compliance	Certificates of Installation	Certificates of Verification	Certificates of Acceptance
	NRCC-PRF-01-E			
<b>Prescriptive</b> Solar PV and Battery Systems	NRCC-SAB-E	NRCI-SAB-E	N/A	N/A
<b>Prescriptive</b> Solar Readiness	NRCC-SAB-E	NRCI-SAB-E	N/A	N/A

**Table 6.** Energy Code Compliance Forms for Photovoltaic and Energy Storage Systems for Nonresidential Buildings, Hotels, Motels, Multifamily Buildings  $\geq 4$  Habitable Stories and Mixed-use Buildings

### Fire Code Requirements

Photovoltaic (PV) systems must meet fire code requirements in *California Residential Code* (CRC) §§R324.3 and 324.7.

Energy storage systems (ESSs) also must comply with the requirements in *California Fire Code* (CFC) §1206.

The California Department of General Services Buildings Standards Commission offers subscriptions to view these codes at [www.dgs.ca.gov/BSC/Codes](http://www.dgs.ca.gov/BSC/Codes).

## For More Information

### CALIFORNIA ENERGY COMMISSION

[www.energy.ca.gov](http://www.energy.ca.gov)

#### Energy Code Hotline

Call: 1-800-772-3300 (Free)

Email: [Title24@energy.ca.gov](mailto:Title24@energy.ca.gov)

#### Online Resource Center

[bit.ly/CEC-ORC](http://bit.ly/CEC-ORC)

Use these online resources developed for building and enforcement communities to learn more about the Energy Code.

#### 2022 Nonresidential and Multifamily Compliance Manual, Ch. 9, 11.9

[bit.ly/nonresidential-multifamily-compliance-manual](http://bit.ly/nonresidential-multifamily-compliance-manual)

#### Joint Reference Appendix JA11: Qualification Requirements for Photovoltaic System

[bit.ly/Joint-Ref-Appendix-JA11](http://bit.ly/Joint-Ref-Appendix-JA11)

#### Joint Reference Appendix JA12: Qualification Requirements for Battery Storage System

[bit.ly/Joint-Ref-Appendix-JA12](http://bit.ly/Joint-Ref-Appendix-JA12)

#### 2022 Energy Code Compliance Software

[bit.ly/CEC-2022-Compliance-Software](http://bit.ly/CEC-2022-Compliance-Software)

Use CEC-approved software when following the Performance Approach of compliance for the 2022 Energy Code.

#### 2022 Nonresidential and Multifamily Alternative Calculation Method Reference Manual

[bit.ly/CEC-2022-NR-MF-ACM-Ref-Manual](http://bit.ly/CEC-2022-NR-MF-ACM-Ref-Manual)

#### Solar Equipment Lists

[solarequipment.energy.ca.gov/Home/Index](http://solarequipment.energy.ca.gov/Home/Index)

Find equipment that meets established national safety and performance standards.

#### Solar Assessment Tools

A list of CEC-approved solar assessment tools is available at [bit.ly/CEC-Solar-Assessment-Tools](http://bit.ly/CEC-Solar-Assessment-Tools).

**(continued)**







[www.energycodeace.com](http://www.energycodeace.com)

Stop by this online “one-stop-shop” for no-cost tools, training and resources designed to help you comply with California’s Title 24, Part 6 and Title 20.



## Tools

[www.energycodeace.com/tools](http://www.energycodeace.com/tools)

Explore this suite of interactive tools to understand the compliance process, required forms, installation techniques and energy efficiency regulations in California.

## Reference Ace

[www.energycodeace.com/content/tools-ace/](http://www.energycodeace.com/content/tools-ace/)

Navigate the Title 24, Part 6 Energy Code using an index, keyword search and hyperlinked text.

## Virtual Compliance Assistant

[bit.ly/ECA-virtual-compliance-assistant](http://bit.ly/ECA-virtual-compliance-assistant)

Get help filling out NRCC and NRCI forms and determining if your project complies with the Energy Code.

## Q&Ace

[www.energycodeace.com/QAndAce](http://www.energycodeace.com/QAndAce)

Search our online knowledge base or submit your question to Energy Code Ace experts.



## Training

[www.energycodeace.com/training](http://www.energycodeace.com/training)

- ◇ 2022 Title 24, Part 6 Essentials – Residential Standards: What’s New  
[bit.ly/ECA-training-2022-res-whats-new](http://bit.ly/ECA-training-2022-res-whats-new)
- ◇ 2022 Title 24, Part 6 Essentials – Nonresidential Standards: What’s New  
[bit.ly/ECA-training-2022-nonres-whats-new](http://bit.ly/ECA-training-2022-nonres-whats-new)
- ◇ 2022 Title 24, Part 6 Essentials — Nonresidential & Multifamily Standards: Solar & Battery Storage  
[bit.ly/ECA-training-2022-nr-mf-solar-battery](http://bit.ly/ECA-training-2022-nr-mf-solar-battery)
- ◇ 2022 Title 24, Part 6 Essentials — Nonresidential Standards for Architects and Designers  
[bit.ly/ECA-training-2022-NR-architect-designer](http://bit.ly/ECA-training-2022-NR-architect-designer)
- ◇ 2022 Photovoltaic Systems Online Self-study Course (coming soon)  
[www.energycodeace.com/training](http://www.energycodeace.com/training)



## Resources

[www.energycodeace.com/resources](http://www.energycodeace.com/resources)

Downloadable materials provide practical and concise guidance on how and when to comply with California’s building and appliance energy efficiency standards.

Of Special Interest:

### Fact Sheets

- ◇ Single-family and Low-rise Multifamily Solar and Battery Systems Fact Sheet

## ADDITIONAL RESOURCES

### Reach Codes

[LocalEnergyCodes.com](http://LocalEnergyCodes.com)

Collaborating with cities, counties and stakeholders to drive reach code development and adoption for long-term climate and energy efficiency benefits. View a list of adopted ordinances at [www.LocalEnergyCodes.com](http://www.LocalEnergyCodes.com).

Check [EnergyCodeAce.com](http://EnergyCodeAce.com) for our latest 2022 tools, training and resources!

**Create an account on the Energy Code Ace site and select an industry role for your profile in order to receive messages about all our offerings!**

