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9 Photovoltaic, Community Shared Solar, Battery Storage, and Solar-Ready Buildings

9.1 Overview

Chapter 9 describes the compliance requirements for photovoltaic (PV) systems, battery storage systems, and solar readiness for newly constructed nonresidential, and hotel/motel buildings. The prescriptive PV and battery storage requirements for particular non-residential buildings determine the standard design energy budgets for the performance compliance method. Additional total TDV or hourly source energy compliance credit is available for installation of PV and battery storage systems that exceed the energy performance of the prescriptive requirement. For both prescriptive and performance compliance, the PV system must meet the requirements of JA11 Qualification Requirements for Photovoltaic Systems, and the battery storage system must meet the requirements of JA12 Qualification Requirements for Battery Storage Systems.

The Energy Standards allow the requirements for photovoltaics to be offset by community-shared solar electric generation. The community-shared solar program must be approved by the Commission. For more information, please see section 9.4.

The requirements for solar-ready buildings are mandatory measures for newly constructed nonresidential and hotel/motel buildings that do not have a PV system because the building either qualifies for an exception in Section 140.10(a) or complies with the PV requirements using community shared solar as a performance compliance option. The solar-ready requirement must be addressed when designing the roof and associated equipment of a building. The intent is to reserve a penetration-free and shade-free portion of the roof for the potential future installation of a solar energy system. There are no requirements to install panels, conduit, piping, or mounting hardware.

For information about requirements and compliance options for solar water heating systems, please see Chapter 4.

9.1.1 What's New for 2022

9.1.1.1 Prescriptive Measures

Photovoltaic (PV) and battery storage systems are now required for some nonresidential building categories and hotel/motel buildings. See Section 9.2 for details.

9.1.1.2 Performance Compliance

PV and battery storage system requirements also can be met by using the performance approach. See Section 9.3.1. A community-shared solar electric

generation system, or other renewable electric generation system, and/or community shared battery storage system can be used to offset the solar electric generation system or battery storage system TDV energy required to comply using the performance compliance method. See Section 9.4.

9.2 Prescriptive Requirements for Photovoltaic System

9.2.1 Photovoltaic System Size – Nonresidential and Hotel/Motel

§140.10(a) and §170.2(g)

To comply with the prescriptive requirements the following building types are required to have a PV system installed unless the building qualifies for an exception.

- Grocery
- Office, Financial Institutions, Unleased Tenant Space
- Retail
- School
- Warehouse
- Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater

For all building types listed in Table 9-1, the PV size in kW dc must be not less than the smaller of the PV system size determined by Equation 9-1, or the total of all available Solar Access Roof Areas (SARAs) multiplied by 14 W/ft².

SARAs include the area of the building roof, covered parking areas, carports, and all other newly constructed structures that are capable of structurally supporting a PV system per Title 24, California Code of Regulations, Part 2, (California Building Code or CBC) Section 1511.2. SARA does not include any roof area with less than 70 percent annual solar access, occupied roofs as specified by CBC Section 503.1.4, or roof space that is not available due to compliance with other building code requirements if confirmed by the Executive Director.

The annual solar access is the ratio of solar insolation including shading to the solar insolation without shading. 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. Refer to Exceptions for Reduced Solar Zone Due to Shade in Section 9.6.2 for an example of how to calculate annual solar access.

Equation 9-1

kWPV required = (CFA x A)/1000

WHERE:

kWPV = kWdc size of the PV system

CFA = Conditioned floor area

A = Capacity factor from Table 9-1

Mixed-occupancy buildings, where 80 percent or more of the floor area is for one, or more, of the building types listed in Table 9-1, must comply with these prescriptive requirements. Where the building includes more than one of the space types listed in Table 9-1, the total PV system capacity for the building shall be determined by applying Equation 9-1 to each of the listed space types and summing the capacities determined for each.

Table 9-1: PV Capacity Factors

Climate Zone	1,3,5,6	2,4,6-14	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	3.8
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/Clinic, Restaurant, Theater	0.39	0.44	0.58

Factor A – Minimum PV Capacity (W/ft² of conditioned floor area)

Source: California Energy Commission

9.2.2 Photovoltaic System Exceptions – Nonresidential, Hotel/Motel

§140.10(a)

There are five allowable exceptions to the prescriptive PV requirements as listed below.

Exception 1: No PV system is required if the total SARA is less than 3 percent of conditioned floor area.

Exception 2: No PV system is required when the minimum PV system is less than 4 kWdc.

Exception 3: No PV system is required if the SARA is less than 80 contiguous square.

Exception 4: Buildings with enforcement-authority-approved roof designs, where the enforcement authority determines it isn't possible for the PV system, including panels, modules, components, supports, and attachments to the roof structure, to meet the snow load requirements of Ch. 7 in the American Society of Civil Engineers (ASCE) Standard 7-16.

Exception 5: No PV is required for multi-tenant buildings in areas where a load serving entity does not provide either a virtual net metering (VNEM) or community solar program.**Example 9-1: PV Exceptions**

Question

I am designing a warehouse with less than 4,000 square feet of conditioned floor area in Climate Zone 12. Is PV required for my building?

Answer

First determine the kWdc required by using Equation 9-1 and Table 9-1. A warehouse in Climate Zone 12 has a PV capacity factor of 0.44.

kWPV required = (CFA x A)/1000 = (4,000 x 0.44) / 1000 = 1.76 kWdc

Since the required PV is less than 4 kWdc, it qualifies for Exception 2, and a PV system is not required.

Example 9-2:

Question

The local utility serving my new multitenant building does not offer VNEM or provide any community solar program. Am I required to find a third-party provider for VNEM?

Answer

No. Since the local utility do not offer either VNEM or community solar, PV is not required under Exception 5.

9.2.3 Joint Appendix 11 (JA11) Requirements

The installed PV system whether using the prescriptive or performance approach must meet the applicable requirements specified in JA11.

9.2.3.1 System Orientation

For prescriptive path compliance, a PV system with module pitches greater than 2:12, or 10 degrees, must be oriented with an azimuth between 90 to 300 degrees measured clockwise from true north. Module pitches smaller than 2:12 or less than 10 degrees (low-slope) can be installed in any orientation since the azimuth of low-slope modules has an insignificant impact on array performance.

When using the performance approach, the array may be oriented in any direction, including due north; however, the more the orientation deviates from the optimum orientation of southwest, the worse the system performs, resulting in a larger PV system size to be needed to achieve compliance. It is best to orient the panels as close to southwest as possible to maximize the system performance with the smallest array size.

There are two options for using a California Flexible Installation approach to simplity computer compliance modeling. To use the California Flexible Installation 1 (CFI1) , the PV array must be installed between 150 to 270 degrees from true north, with all modules at the same tilt as the roof for pitches up to 7:12. When the CFI2 option is selected in the performance calculation, the PV array can be installed in a larger azimuth range; the PV array must be installed between 105 and 300 degrees from true north, with all modules at the same tilt as the roof for pitches up to 7:12. When selecting CFI2, the performance of the proposed system is derated by approximately 10 percent, which results in a larger PV size being necessary to comply.

If the PV array does not meet either CFI1 or CFI2, then the actual orientation and tilt of the PV array shall be described.

9.2.3.2 Shading

Shading from obstructions must be limited to meet the performance or prescriptive requirements. Any obstruction located north of the array does not need to be considered. Obstructions include the following:

- Any vent, chimney, architectural feature, mechanical equipment, or other obstruction that is on the roof or any other part of the building.
- Any part of the neighboring terrain.
- Any tree that is mature at the time of installation of the PV system.
- Any tree that is planted on the building lot or neighboring lots or planned to be planted as part of landscaping for the building. (The expected shading shall be based on the mature height of the tree.)
- Any existing neighboring building or structure.

- Any planned neighboring building or structure that is known to the applicant or building owner.
- Any telephone or other utility pole that is closer than 30 feet from the nearest point of the array.

Example 9-3: Shading

Question:

What would be the impact of shading on the PV sizing requirement?

Answer:

Prescriptively the PV array cannot have any shading, and the weighted average annual solar access as measured by an approved solar assessment tool must be at least 98 percent by panel count. Under the performance path, there is no minimum requirement for annual solar access; however, the increase in shading (lower annual solar access) will necessitate a larger PV size to meet the same TDV budget as a smaller unshaded PV system.

9.2.3.3 Solar Access Verification

A solar assessment tool that is approved by the executive director must be used to demonstrate the shading conditions of the PV system or to claim an exception based on limited amount of solar access.

The installer must provide documentation that demonstrates the actual shading condition of the installed PV system using an approved solar assessment tool. To be certified by the executive director, the solar assessment tool:

- Must calculate the annual solar access percentage of each solar array and a weighted average of the PV system. The calculation must include all known obstructions, including any tree that is planted on the building lot or neighboring lots or planned to be planted as part of landscaping for the building.
- Must not include horizon shading in the calculation by default.
- Must produce a shade report with a summary of the PV system, including the address of the project, individual array panel count, orientation, annual solar access percentage, and a weighted average of the PV system as a whole.
- Must ensure that annual solar access percentage values are comparable to on-site measurements if the model shading condition of the tool is based on satellite or aerial images. Documentation must be provided to the CEC as proof.

9.2.3.4 Remote Monitoring Capability

The PV system must have a web portal and a mobile device application that enables the building owner, manager, or occupants to monitor the performance of

their PV system to identify, report, and correct performance issues with the panels, inverters, shading, or other issues that may adversely impact the performance of the PV system. At a minimum, the occupants must have access to the following information:

- The nominal kW rating the PV system
- Number of PV modules and the nominal watt rating of each module
- Hourly (or 15-minute interval), daily, monthly, and annual kWh production in numeric and graphic formats for the system
- Running total of daily kWh production
- Daily kW peak power production
- Current kW production of the entire PV system

9.2.3.5 Additional Requirements

In addition to the requirements above, the PV system must also meet the following requirements in JA11:

Interconnection Requirements: All inverters in the PV system must comply with all requirements in the CPUC Electric Tariff Rule 21. Rule 21 requires that inverters have certain capabilities to ensure proper operation of the electrical grid as more renewables are interconnected. The inverters must perform functions that can autonomously contribute grid support during excursions from normal operating voltage and frequency system conditions by providing dynamic reactive/real power support, voltage and frequency ride-through, ramp rate controls, communication systems with ability to accept external commands, and other functions.

Certificates and Availability: The PV installer shall certify on the certificate of installation that all provisions of JA11 are met and provide a solar assessment report meeting one of the following conditions:

- A satellite, drone, or other digital image used in the solar assessment report must be created and dated after the PV system is installed.
- If the satellite, drone, or other digital image used in the solar assessment report is dated before the PV is installed, additional on-site pictures must be attached to clearly show that the installed system matches the system modeled in the solar assessment report.

The certificate of installation must be available on the building site for inspections.

Enforcement Agency Responsibilities: The local enforcement agency must verify that the certificate of installation is complete and correct, and uploaded into a Commission-approved registry.

Example 9-4: Remote Monitoring

Question:

How do I implement monitoring to meet JA11.5.1 including the current reading?

Answer:

There are several options. Many inverters can connect to the building owner's internet, via ethernet or wireless or both. Others use independent cellular connections. For cellular, the data should be updated to the monitoring portal periodically as allowed by the cellular plan

9.3 Performance Approach Compliance for Photovoltaic Systems

9.3.1 Energy Budget Calculation

The performance approach allows for modeling of the PV system performance by taking into account the PV system size, climate, panel orientation, panel and inverter efficiency, and shading characteristics. For nonresidential and hotel/motel buildings, the standard design PV system size is determined by the smaller of the PV system size determined by Equation 9-1, or the total of all available Solar Access Roof Areas (SARAs) multiplied by 14 W/ft². The performance method allows for modeling different PV sizes, solar thermal systems, more energy efficiency measures, additional battery storage and other demand-response measures.

9.3.2 Exceptions to PV Requirements

The allowable exceptions to the prescriptive PV requirements listed in 9.2., for nonresidential, hotel/motel and high-rise multifamily buildings or low-rise multifamily buildings, respectively, can also be used under the performance approach. The user must select the appropriate exception in the software and provide documentation to the building department with the building permit application.

9.3.3 Additional Requirements

The installed PV system must meet the applicable requirements specified in JA11.

Example 9-5: Efficiency Tradeoff

Question:

Does the performance path allow tradeoffs between PV systems and energy efficiency measures? How about tradeoffs between a PV system that is coupled with a battery storage system and energy efficiency measures?

Answer:

Beginning with the 2019 Standards, the performance path no longer allows installing a larger PV system in exchange for less energy efficiency measures for showing compliance with the TDV energy-based compliance metrics; however, the software will allow installing more energy efficiency, demand-responsive measures; battery and storage; and thermal storage systems in exchange for a smaller PV system. Larger PV systems can gain compliance credit for the hourly source energy-based metrics.

Example 9-6 Solar Thermal System

Question:

Does a solar thermal water heating system still qualify for compliance credit in the performance path?

Answer:

Yes, although a solar water heating system cannot serve as a substitution for the prescriptively required PV system, it can still be installed along with PV for optional compliance credit in the performance path. Solar water heating systems are modeled along with the remainder of the water heating and distribution systems and can be used for trading off efficiency measures or installing a smaller PV system. The requirements for solar thermal water heating systems are described in Chapter 4, Water Heating Requirements.

9.4 Community-Shared Solar Electric Generation and Storage Systems

9.4.1 Photovoltaic System Size

§140.1(b)

The 2022 Building Energy Efficiency Standards allow the possibility for the standards requirements for photovoltaics. which would otherwise be installed for the building site, to be offset by community-shared solar electric generation. "Community-shared solar electric generation" means solar electric generation or other renewable technology electric generation that is installed at a different location. Also, the batteries that otherwise would be installed in combination with photovoltaics on the building site to comply with battery storage requirements or to gain performance standards compliance credit potentially could be offset by a community-shared battery storage system that is installed at a different location. Community-shared solar electric generation systems and community-shared battery storage systems possibly can be combined or separate. All of these possibilities are hereinafter referred to as just "community-shared solar electric generation systems."

For these offsets to become available, entities who wish to serve as administrators of a proposed community-shared solar electric generation system must apply to the CEC for approval, demonstrating that several criteria specified in Section 10-115 of the standards are met. The CEC will carefully consider these applications to determine if they meet these criteria. If approved, CEC-approved compliance software will be modified to enable users to take compliance credit for buildings participating in that CEC-approved community-shared solar electric generation system.

Any entity may apply to serve as administrator of a proposed community-shared solar electric generation system, including, but not limited to, utilities, builders, solar companies, or local governments. The entity will be responsible for ensuring that the criteria for approval are met throughout (at least) a 20-year period for each building that uses shares of the community-shared solar electric generation system to offset the onsite solar electric generation and batteries, which would otherwise be required for the building to comply with the Standards. Throughout that period the administrator will be accountable to builders, building owners, enforcement agencies, the CEC, and other parties who relied on these systems for offset compliance with the standards. Records demonstrating compliance with the criteria must be maintained over that period, with access to those records provided to any entity approved by the Energy Commission.

Entities interested in applying to serve as an administrator of a proposed community-shared solar electric generation system should become thoroughly familiar with the criteria for approval specified in Section 10-115 and contact the CEC Building Standards Office for further discussion and explanation of the criteria as necessary.

To date, only the Sacramento Municipal Utility District (SMUD) has applied to be an administrator for a community-shared solar electric generation system. SMUD's application was approved by the CEC. SMUD's application did not include community-shared storage.

9.4.2 Enforcement Agency

A. The community-shared solar electric generation system must exist and be available for enforcement agency review early in the permitting process and shall not cause delay in the enforcement agency review and approval of the building that will be served by the community-shared solar generation system. All documentation required to demonstrate compliance for the building and the compliance offset from the community-shared solar electric generation system must be completed and submitted to the enforcement agency with the permit application. The enforcement agency must be provided facilitated access to the community-shared solar generation system to verify the validity and accuracy of compliance documentation.

9.4.3 Energy Performance and Minimum Community-Shared PV Size

CEC-approved compliance software must be used to show that the energy performance of the share of the community-shared solar electric generation system that is dedicated to the participating building, generates TDV energy that is equal to or greater than the TDV energy, which would otherwise be required for the building to comply with the standards.

The minimum community-shared solar size dedicated to the building, which is necessary to meet the TDV equivalence of the onsite PV system and the onsite battery storage system that otherwise would be required, is determined by the compliance software. The compliance software will determine a minimum kW size that will be the share of the community solar resource that is required to be dedicated to the building, based on the resource's PV system component performance characteristics, orientation (azimuth and tilt), inverter type, tracking versus fixed systems, climate zone and CEC weather files containing solar availability data.

9.4.4 Participating Building Energy Savings and Bill Reduction Benefits

A specific share of the community-shared solar generation system, determined to comply with the energy performance requirement above, must be dedicated on an ongoing basis to the participating building. The energy savings benefits dedicated to the building shall be provided in one of the following ways:

B. Actual reductions in the energy consumption of the building.

C. Energy reduction credits that will result in virtual reductions in the energy consumption of the building, including, but not limited to, generation credit, solar charge, program charge, and power charge indifference adjustment (PCIA) charge; or

D. Payments to the building that will have an equivalent effect as energy bill reductions that would result from one of the other two options above.

For all three options mentioned above, the reduction in energy bills resulting from the share of the community-shared solar generation system or community-shared battery storage system or both dedicated to the building must be greater than the cost that is charged to the building to obtain that share of the community-shared solar generation system or community-shared battery storage system or both.

9.4.5 Durability, Participation, and Building Opt-Out

A) Durability. The benefits from the specific share of the Community Shared Solar Generation System and/or community shared battery storage system must be provided to each participating building for a period not less than 20 years.

B) Participation. Buildings using community shared solar and/or battery storage systems to comply with Sections 140.0(c), 150.1(a)3, or 170.0(a)3, must participate for at least 20 years, regardless of who owns or occupies the building, unless the building

owner fulfills the opt-out requirements. The CEC-approved administrator(s) must require the builder to provide equitable servitude by

a) recording a covenant, or other legally binding method that runs with the land and obligates all owners/tenants to maintain the participation of the building in the community-shared solar and/or community shared battery storage system for at least 20 years or satisfy the opt-out requirements.

B) Compliance Documentation. The administrator must maintain record(s) of the compliance documentation that determined the requirements for the on-site solar electric generation system or battery storage system or both to comply with the standards in effect at the time the builder applied for the original building permit, and that establishes participants' obligations to meet the opt-out requirements. The administrator shall provide a copy of this compliance documentation upon a participating building owner's request, to every new owner of a participating building when the administrator is notified that the title has transferred, and to any participating building owner who requests to opt-out.

C) Building Opt-Out. During the 20-year participation period, the participating building owner has the option to opt out of participation in the community-shared solar electric generation system if the opt-out requirements are met.

a) Before opting out, the building owner must demonstrate that they have installed an on-site solar electric generation system that meets or exceeds the annual TDV energy generation resulting from the on-site PV and battery storage system that would have been required by the Energy Code in effect at the time of the original building permit application for the building. The building owner must also provide documentation from the installer of the on-site solar system or an attestation of the building owner with supporting documentation confirming the installation of the required onsite systems. The building owner is responsible for all costs associated with documentation of the opt-out requirements.

b) The administrator must review opt-out documentation and determine if the installed solar system meets the opt-out requirements. Within 30 days the administrator must provide written confirmation if the building meets the opt-out requirements.

c) All costs and benefits associated with participation in the community-shared solar electric generation system shall cease, and all outstanding balances shall be paid by either party.

d) The administrator (or other approved entity) must not impose any penalty related to a participating building opting out or charge participants for recuperation of unrealized revenue that would have been expected to accrue beyond the end of participation. If the administrator plans to charge any other fees at the time of building opting out, the application for commission approval of the community-shared solar electric generation system shall explain the purpose of those fees.

9.4.6 Additionality

The specific share of the community-shared solar electric generation system must provide the benefits to the participating building that are in no way made available or attributed to any other building or purpose. Renewable Energy Credits (RECs) that are unbundled from the community-shared solar electric generation system do not meet this additionality requirement.

E. The participating building(s) must be served primarily by renewable resources developed specifically for the community-solar electric generation system.

F. Other renewable resources meeting the requirements of Section 10-115(a)4 may be used for each participating building if the building(s) is permitted before the renewable resources developed for the program start operating or after they cease operating.For each renewable resource developed to serve participating buildings, bundled RECs, which satisfy the criteria of Portfolio Content Category 1 of the California Renewable Portfolio Standard regulations, shall be retired and tracked in the Western Renewable Energy Generation Information System (WREGIS) on behalf of program participants to ensure they will not be allocated to or used for any other mandatory or voluntary renewable electricity program requirement or claim.

G. Excess generation from renewable resources may be used to serve other loads but must be isolated from the generation serving participating buildings. This is not considered a violation of Section 10-115(a)5C, the additionality requirement above.

Example 9-8:

Question:

To help entities that might want to apply to the CEC for approval of a community-shared solar energy generation system, please provide examples of each of the three optional ways energy savings benefits could be provided to comply with Section 9.4.3.2.3.

Answer:

Examples would include:

Actual reductions in the energy consumption of the building. These reductions could be accomplished by locating the PV systems for several buildings on a carport on common land in a subdivision, and direct wiring the unique PV panels serving each house to an inverter that is located on the building site. For buildings served by utilities that are subject to compliance with net-energy-metering requirements, the common land that is hosting the PVs on the carport would have to be adjacent to (could be directly across a street) the buildings that are being served by the PV system. All other requirements of Section 10-115 would have to be met.

Utility energy reduction credits that will result in virtual reductions in the energy consumption of the building that is subject to energy bill payments. These reductions could be accomplished for qualifying multifamily dwellings by participation in an approved virtual-net-metering program, which has PVs installed on the multifamily project site, and energy bill credits that reduce the monthly electricity bill of each dwelling unit consistent with net-energy-metering requirements. Alternatively, this could be accomplished through a community-shared solar program administered by a utility (like the Green Tariff Shared Renewables, or GTSR), for which a remote renewable resource is paid for through shares purchased for each building, and energy bill credits are that reduce monthly electricity bills are allocated based on the shares of the buildings, including, but not limited to, generation credit, solar charges, program charges, and nonparticipant charges. All other requirements of Section 10-115 would have to be met.

Payments to the building that will have an equivalent effect as energy bill reductions would result from one of the two options above. This could be accomplished by builders installing PV systems on other properties they own to offset the compliance requirement for onsite PVs on buildings they build. The buildings would pay for a share of the PV systems on the other properties. The builders would be obligated to make an ongoing cash payment back to the buildings for the building share of the electricity generation achieved by the PV systems on the other properties. The share of the ownership of the PV systems on the other properties and the corresponding sharing of the electricity generation achieved by the PV systems on the other properties would not be accounted for through a utility system. The ownership share would not be paid to the utility, and the payment for the share of the electricity generation achieved by the PV systems on the other properties would not be provided through a utility bill. The entire program would be administered by the builder for a 20-year period for each building. All other requirements of Section 10-115 would have to be met.

Example 9-9:

Question:

Could you also explain what the cost requirements are in the last sentence of Section 9.4.3.2.3 that says, "In other words, a building that participates in an approved community solar program, cannot be charged more than the same but nonparticipating building that has no onsite PV system and does not participate in a community-solar program."

Answer:

In a nutshell, regardless of the three options chosen above, it must be cost-effective for the building to participate in a community-shared solar electric generation system program. The participating building will pay for its share of the community renewable resource and receive either energy bill reductions, credits, or cash payments for the electricity generated by the community renewable resource. The value of the reductions, credits, or cash payments to the participating building must exceed its share value of the community renewable resource.

9.5 Battery Storage System

The primary function of the battery storage system is to ~~grid~~ harmonize the onsite PV system with the grid, to ~~bring maximum~~ maximize benefits to the grid, environment, and the occupants.

Grid harmonization: For the purpose of Building Standards, "grid harmonization" is defined as strategies and measures that harmonize customer-owned distributed energy resources assets with the grid to maximize self-utilization of PV array output, and limit grid exports to periods beneficial to the grid and the ratepayer. Grid harmonization is done by charging the battery from the PV system when there is limited electrical load at the building and the cost of electricity is low in midday, and discharging when the cost of electricity is high, usually in the late afternoon and early evening hours.

The battery storage system is available as a compliance credit in the performance compliance method and is a prescriptive requirement for specific nonresidential and hotel/motel as specified in Section 140.10(b). In all cases, the battery storage system must meet all applicable requirements in Joint Appendix JA12 and be self-certified to CEC by the manufacturer as a qualified product.

Coupling a PV system with a battery storage system and appropriate control strategy, described in Section 9.5.2 below, allow reaching specific target time-dependent valuation (TDV) targets and source energy with a smaller PV system than otherwise would have been possible. This strategy is useful and cost-effective for meeting target TDVs that may be required by reach codes, with a smaller and grid-harmonized PV system.

The list of qualified JA12 products can be found at

https://solarequipment.energy.ca.gov/Home/EnergyStorage

9.6 Prescriptive Requirements for Battery Storage System

9.6.1 Battery Storage System Size

§140.10(b) and 170.2(h)

To comply with the prescriptive requirements for specific nonresidential and hotel/motel buildings that are required to have a PV system installed, a battery storage system must also be installed. The minimum qualifying size of the battery storage system is described by the Equations 9-3 and 9-4 below.

Equation 9-3

$kWhbatt = kWPVdc \times B / D^{0.5}$

WHERE:

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

kWPVdc = PV system capacity required by section 9.2 in kWdc

B = Battery energy capacity factor specified in Table 9.6 for the building type

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

Equation 9-4

$kWbatt = kWPVdc \times C$

WHERE:

kWbatt = Power capacity of the battery storage system in kWdc

kWPVdc = PV system capacity required as discussed in section 9.2 in kWdc

C = Battery =power capacity factor specified in Table 9.1 for the building type

Where the building includes more than one of the space types listed in Table 9-6, the total PV system capacity for the building shall be determined by applying Equations 9-3 and 9-4 to each of the listed space types and summing the capacities determined for each.

Table 9-6: Battery Storage Capacity Factors

	Factor B-Energy Capacity	Factor C-Power Capacity
Storage to PV Ratio	Wh/W	W/W
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/Clinic, Restaurant, Theater	0.93	0.23

Source: California Energy Commission

9.6.2 Exceptions to Battery Storage Requirements

There are five allowable exceptions to the prescriptive PV requirements as listed below.

- Exception 1: No battery storage system is required if the installed PV system size is less than 15 percent of the size determined by Equation 9-1.
- Exception 2: No battery storage system is required in buildings with battery storage system requirements with less than 10 kWh rated capacity.
- Exception 3: For multitenant nonresidential or hotel/motel buildings, the energy capacity and power capacity of the battery storage system must be based on the tenant spaces with more than 5,000 square feet of conditioned floor area. For single-tenant buildings with less than 5,000 square feet of conditioned floor area, no battery storage system is required.

- Exception 4: In Climate Zone 1, no battery storage system is required for offices, schools, and warehouses.

Example 9-10: Battery Exceptions

Question:

I am designing a high-rise multifamily building with 20,000 square feet of conditioned floor area in Climate Zone 3. Is PV or battery storage required for my building?

Answer:

First determine the PV requirement by using Equations 9-1 and 9-2. The PV requirement is the smaller of the results from Equations 9-1 and 9-2.

Using equation 9-1 and Table 9-1. A high-rise multifamily building in Climate Zone 3 has a PV capacity factor of 1.82.

kWPV required = (CFA x A)/1000 = (20,000 x 1.82) / 1000 = 36.4 kW

Using Equation 9-2, the kWPV required = (SARA x 14)/1000 = (650 x 14 /1000 = 9.1 kW

The PV requirement is the smaller of the two numbers, therefore this building is required to have a minimum of 9.1 kW PV system. Now we can determine the battery requirement with equation 9-3.Using equation 9-3 and a battery storage system with 90 percent roundtrip efficiency, kWhbatt = kWPVdc x B / $D^{0.5}$ = 9.1 x 1.03 / (0.9)^0.5 = 9.88 kWh.

Since the required battery storage is less than 10 kWh, this building qualifies for Exception 2 and do not need a battery storage system.

9.6.3 Joint Appendix (JA 12) Requirements

9.6.3.1 Minimum System Performance Requirements

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

- Usable capacity of at least 5 kWh.
- For prescriptive compliance, single charge-discharge cycle AC to AC (round-trip) efficiency of at least 80 percent
- Energy capacity retention of 70 percent of nameplate capacity after 4,000 cycles covered by a warranty, or 70 percent of nameplate capacity under a 10-year warranty

9.6.3.2 Controls Requirements

Battery storage systems that remain in backup mode indefinitely bring no grid benefits. The JA12 requirements are designed to ensure that the battery storage system remains in an active control mode and prevent the battery storage system from remaining in the backup mode indefinitely. These requirements also enable

the battery storage system to receive the latest firmware, software, control strategy, and other important updates.

The following JA12 requirements apply to all control strategies, including Basic Control, Time-of-Use (TOU) Control, and Advanced Demand Response Control, described in Section 9.6.5 below:

1. The battery storage system must have the capability of being remotely programmed to change the charge and discharge periods.
2. During discharge, the battery storage system must be programmed to first meet the electrical load of the dwelling unit(s). If during the discharge period the electrical load of the dwelling unit(s) is less than the maximum discharge rate, the battery storage system shall have the capability to discharge electricity into the grid upon receipt of a demand-flexibility signal from the local utility or a third-party aggregator.
3. The battery storage system must operate in one of the control strategies listed in JA12.2.3.1, JA12.2.3.2, and JA12.2.3.3 except during a power interruption, when it may switch to backup mode. If the battery system switches to backup power mode during a power interruption, upon restoration of power, the battery system shall immediately revert to the previously programmed JA12 control strategy.
4. The battery storage system must perform a system check on the following dates, to ensure the battery is operating in one of the control strategies listed in Section 9.6.5 below:
    a. Within 10 calendar days before the onset of summer TOU schedule
    b. Within 10 calendar days before the onset of winter TOU schedule

If the local utility does not offer TOU rate schedule, the default system check dates should be May 1 and 1 November 1.

9.6.3.3 Controls Strategies

JA12 includes four control strategies that are designed to encourage charging the batteries when electricity prices are low, generally in the middle of the day when solar resources are plentiful and demand is low, and discharge the batteries later in the day when demand is high and solar resources are diminished.

9.6.3.3.1 Basic Control

Designed as a simple control that can be employed as the default control in the absence of TOU or Advanced Demand Flexibility Controls, or where communication between batteries and outside parties are not possible. When combined with an on-site solar PV system, to qualify for the Basic Control, the battery storage system shall be installed in the default operation mode to allow charging only from an on-site PV system when the PV system production is greater than the on-site electrical load. The battery storage system shall discharge only when the PV system

production is less than the on-site electrical load.

9.6.3.3.2 Time-of-Use (TOU) Control

This control strategy is designed to take advantage of TOU rates where they are available. This control strategy generally results in a greater energy design rating (EDR) impact than the basic control. When combined with an on-site PV system, to qualify for the TOU Control, the battery storage system shall be installed in the default operation mode to allow charging only from an on-site PV system. The battery storage system shall discharge during the highest priced TOU hours of the day. The operation schedule shall be preprogrammed from factory, updated remotely, or programmed during the installation/commissioning of the system. At a minimum, the system shall be capable of programming three separate seasonal TOU schedules, such as spring, summer, and winter.

9.6.3.3.3 Advanced Demand Flexibility Control

This control strategy is designed to bring the maximum value to the PV system generations by placing the charge/discharge functions of the battery storage system under the control of a utility or a third-party aggregator. This control strategy allows discharging into the gird upon receiving a demand response signal from a grid operator. This option requires robust communication capabilities between the battery storage system and the local utility or the third-party aggregator. When combined with an on-site solar PV system, to qualify for the advanced demand flexibility control, the battery storage system shall be programmed by default as basic control or TOU control as described above. The battery storage control shall meet the demand flexibility control requirements specified in Section 110.12(a). Furthermore, the battery storage system shall have the capability to change the charging and discharging periods in response to signals from the local utility or a third-party aggregator.

9.6.3.3.4 Controls for Separate Battery Storage Systems

When installed separate from (not in combination with) an on-site solar photovoltaic system, including when the building is served by a community solar PV system, to qualify for the compliance credit, the battery storage system shall be programmed by default to start charging from the grid at the onset of lowest priced TOU hours of the day and start discharging at the onset of highest priced TOU hours of the day, or meet all the demand flexibility control requirements specified in Section 110.12(a) and shall have the capability to change the charging and discharging periods in response to signals from the local utility or a third-party aggregator.

9.6.3.3.5 Alternative Control Approved by the Executive Director

The Commission recognizes that there may be other control strategies that bring equal or greater benefits than the ones listed above. Therefore, the executive director may approve alternative control strategies that

demonstrate equal or greater benefits to those strategies listed in JA12. To qualify for alternative control, the battery storage system shall be operated in a manner that increases self-utilization of the PV array output, responds to utility rates, responds to demand response signals, minimizes greenhouse gas emissions from buildings, and/or implements other strategies that achieve equal or greater benefits than those specified above. This alternative control option shall be accompanied with clear and easy to implement algorithms for incorporation into the compliance software for compliance credit calculations.

9.6.3.4 Other Requirements

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

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

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

Electric Rule 21 Tariff provides customers, wishing to install generating or storage facilities on their premises, with access to the electric grid while protecting the safety and reliability of the distribution and transmission systems at the local and system levels.[1]

Enforcement Agency: The local enforcement agency shall verify that all certificates of installations are valid. The battery storage systems shall be verified as a model certified to the CEC as qualified for credit as a battery storage system. In addition, the enforcement agency shall verify that the battery storage system is programmed and operational with one of the controls listed in Section 9.5.2 above. The programmed control strategy at system final inspection and commissioning shall be the strategy that was used in the certificate of compliance.

Example 9-11: Battery Storage Credit

Question:

Can you get compliance credit for battery storage and how to comply with them?

1 "Rule 21 Interconnection," California Public Utilities Commission, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/rule-21-interconnection.

Answer:

Battery storage is a prescriptive requirement for certain nonresidential building types. (See Table 9-6.) Additional compliance credit is available under the performance path allows a compliance credit for a battery storage system larger than the prescriptive requirement. It can be used for compliance tradeoff for a smaller PV system and source energy.

The manufacturers must self-certify to CEC that the battery storage systems meet the requirements of JA12. JA12 lists minimum performance requirements, communication requirements, control requirements, safety requirements, and interconnection requirements, among others, that must be complied with and certified to the CEC. The self-certification form may be downloaded from the Commission's website.

Example 9-12: Battery Storage Credit

Question:

When batteries are used there is a loss of electricity associated with the roundtrip charge and discharge resulting in fewer generated kWh. Why does the CEC require a battery storage system that is coupled with a PV system if there is a loss of energy?

Answer:

Battery storage systems store the PV generated electricity in the middle of the day when the solar resources are generally plentiful and electricity prices are low. The systems discharge the stored electricity later in the day, during the peak hours when solar resources are diminished and electricity prices are high. Battery storage systems have a roundtrip charge and discharge loss of 5 to 15 percent, depending on the type of battery technology and the inverter efficiencies. The electricity price differential between the middle of the day and the peak hours is greater than the battery charge and discharge losses. This means that even with the relatively small loss of electricity, it is still cost-effective for a consumer to store electricity generated onsite around midday and use it later on instead of purchasing additional electricity from the grid.

To calculate the performance of a battery storage system coupled with a PV system, the CEC's compliance software on hourly basis accounts for the PV generation, losses, storage capacity remaining, charge and discharge rates, cost of electricity, house loads, and hourly exports. Similar calculations are also performed to calculate the benefits of storage for CO2 emissions.

Not any battery storage system is eligible for compliance credit; it must comply with the requirements of Reference Joint Appendix 12 (JA12). The requirements ensure that the battery storage system remains in a dynamic mode that allows residents to take advantage of variable electricity costs associated with charge and discharge periods throughout the day. Static batteries that remain mostly in backup mode have little to no value to the building owner, the grid, or the environment.

Example 9-13: Battery Storage TOU Schedule

Question:

How will control requirement be enforced for customers that are not on a TOU schedule? How about customers on TOU rate but wants to be in basic control?

Answer:

If the local utility does not have TOU schedule, to comply with JA12.2.3 the battery storage system should perform a system check on May 1 and November 1 by default. A customer can set the control strategy to Basic Control, regardless of whether a TOU rate is available for the customer; however, this strategy will reduce the benefits of the battery storage for both the customer and the grid and, therefore, is not recommended.

9.7 Performance Approach Compliance for Battery Storage System

9.7.1 Energy Budget Calculation

The computer performance approach allows for the modeling of the battery storage system performance by taking into account battery system size, climate, building type, and battery efficiency. The standard design battery storage system size is determined by the prescriptive PV size required for proposed design building, regardless of the actual fuel type of the proposed design building. The performance method allows for battery storage system, control strategies and other demand-response measures.

9.7.2 Exceptions to Battery Storage Requirements

The five allowable exceptions to the prescriptive PV requirements listed in Section 9.6.2. can also be used under the performance approach. User must select the appropriate exception in the software and provide documentation to the building department with the building permit application.

9.7.3 Additional Requirements

The installed battery storage system must meet the applicable requirements as specified in JA12, above.

9.8 Solar-Ready Overview

§110.10

This chapter of the nonresidential compliance manual addresses solar-ready requirements for hotels/motels, nonresidential, and high-rise multifamily buildings. These requirements are in §110.10 and §141.0 and are mandatory for newly constructed buildings and additions where the total roof area is increased by at least 2,000 square feet.

The solar-ready requirement is implemented when designing the building rooftop and associated equipment. The intent is to reserve a penetration-free and shade-

free portion of the roof for the potential future installation of a solar energy system. There are no requirements to install panels, conduit, piping, or mounting hardware.

9.8.1 Overview

The solar-ready provisions are mandatory; "trade-offs" are not allowed. There are exceptions to the "solar zone" requirements, and these are described in the corresponding sections of this chapter. Because solar ready is mandatory, the NRCC-SRA-E compliance form must be submitted with the building permit application, even when using an allowable solar zone exception.

9.8.2 Covered Occupancies

§110.10(a)

The nonresidential solar-ready requirements apply to:

- Hotel/motel occupancies with 10 stories or fewer.
- All other nonresidential buildings with three stories or fewer.
- See Example 9-15

Mixed-Occupancy Buildings: The Energy Standards apply to mixed-occupancy buildings. Buildings with nonresidential space on the ground floor and multifamily residential floors above are common examples.

9.8.3 Solar Zone

§110.10(b)

The solar zone is a suitable place where solar panels can be installed at a future date if the owner chooses to do so. A solar zone area is designed with no penetrations, obstructions, or significant shade. The solar zone must comply with the access, pathway, smoke ventilation, and spacing requirements in Title 24, Part 9. Requirements from the other parts of Title 24 and those adopted by a local jurisdiction should also be incorporated in the solar zone design.

The solar zone can be located at any of the following locations:

- Roof of building
- Overhang of the building
- Covered parking installed with the building project
- Roof of another structure located within 250 feet (75 meters) of the primary building
- Overhang of another structure within 250 feet (75 meters) of the primary building

Other structures include, but are not limited to, trellises, arbors, patio covers, carports, gazebos, and similar accessory structures.

Multifamily Buildings: Solar-ready requirements for low-rise and high-rise multifamily buildings are in Chapter 11 of the Nonresidential Compliance Manual. In the 2022 Energy Standards, the solar zone requirements for low-rise multifamily buildings are grouped with high-rise multifamily, hotel/motel and nonresidential in §110.10(b)1B.

9.8.4 Solar Zone Minimum Area and Exceptions

§110.10(b)1

Total Area: The solar zone must have a total area of at least 15 percent of the total roof area, after subtracting any skylights. See Example 9-16.

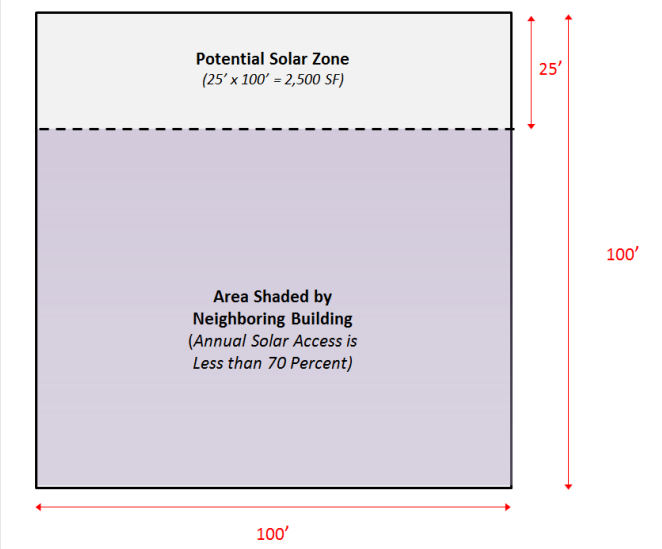
Multiple areas: The solar zone may be composed of multiple subareas if they meet the following minimum size specifications:

1. Each subarea dimension must be at least 5 feet.
2. If the total roof area is equal to or less than 10,000 square feet, each subarea must be at least 80 square feet.
3. If the total roof area is greater than 10,000 square feet, each subarea must be at least 160 square feet.

Example 9-14:

Question:

A roof with no skylights has an area of 10,000 sq. ft. A neighboring building shades the roof, so 7,500 sq. ft of the roof has less than 70 percent annual solar access. How big does the solar zone have to be?



Answer:

If the entire roof had an annual solar access of 70 percent or greater, the minimum solar zone would be 1,500 sq. ft, or 15 percent of the total roof area (10,000 sq. ft.). However, since the potential solar zone is 2,500 sq. ft, the minimum solar zone can be reduced to half the area of the potential solar zone, or 1,250 sq. ft.

Example 9-15:

Question:

The total roof area is less than 10,000 sq. ft., but the potential solar zone is less than the minimum size requirements for any subarea (less than 80 sq. ft. or narrower than 5 feet in the smallest dimension). Does the building still need to comply with the solar-ready requirements?

Answer:

No. If half the potential solar zone is less than 80 sq. ft. (if roof is less than or equal to 10,000 sq. ft) or 160 sq. ft. (if roof is greater than 10,000 sq. ft), then the building does not need to comply with the solar zone requirements.

Example 9-16:

Question:

A portion of an office building will have six stories, and a portion of the building will have two stories. Is the new building subject to the solar zone requirements?

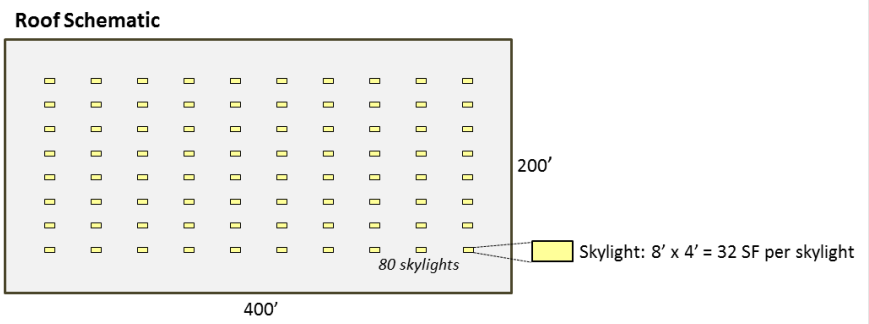
Answer:

No, the solar-ready requirements do not apply to office buildings that have more than three stories. The solar-ready requirements apply only to hotel/motel occupancies and high-rise multifamily buildings with 10 or fewer stories and all other nonresidential buildings with 3 or fewer stories.

Example 9-17:

Question:

A new warehouse has a total roof area of 80,000 sq. ft. Skylights cover 2,560 sq. ft. of the total roof area. What is the minimum solar zone area?



Total roof area = 400’ x 200’ = 80,000 SF
Total area covered by skylights = 32 SF/skylight x 80 skylights = 2,560 SF

Answer:

The minimum solar zone area would be 11,616 sq. ft

$$Minimum\ Solar\ Zone\ Area = 15\%\ x\ (Total\ Roof\ Area - Area\ Covered\ by\ Skylights)$$

$$\mathbf{11,616\ sq.ft} = 15\%\ x\ (80{,}000\ sq.ft - 2{,}560\ sq.ft)$$

Example 9--18:

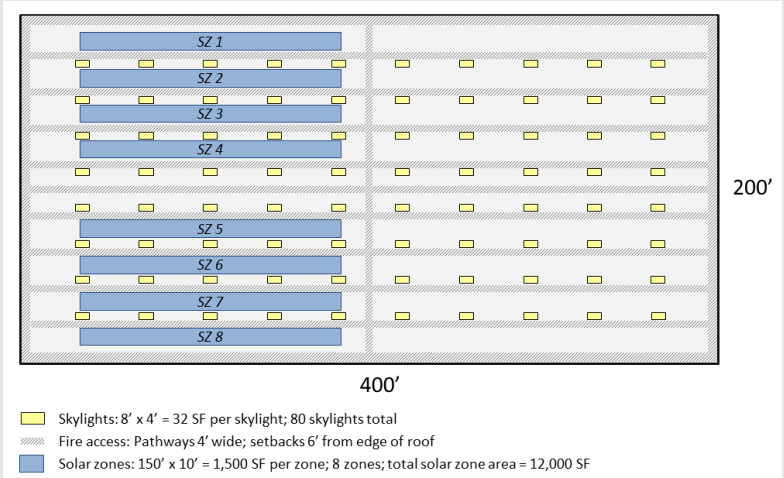
Question:

Does the solar zone have to be one contiguous area?

Answer:

No, the solar zone does not have to be one contiguous area. The total solar zone can be composed of multiple smaller areas. A subarea cannot be narrower than 5 feet in any dimension. If the total roof area is 10,000 sq. ft or less, each subarea must be at least 80 sq. ft. If the total roof area is greater than 10,000 sq. ft, each subarea must be at least 160 sq. ft.

The image below illustrates a solar zone layout that is composed of eight smaller subareas. The sum of all the smaller areas must equal the minimum total solar zone area. In this case, the sum of all areas must be at least 11,616 sq. ft. The solar zones must also comply with fire code requirements, including, but not limited to, setback and pathway requirements. Current fire code requirements can be found in Title 24 Part 2 § 3111, Title 24 Part 2.5 §R331, and Title 24 Part 9 § 903.3.



9.8.5 Solar Zone Exceptions

There are five exceptions to the solar zone area requirement described in §110.10(b)1B. Some exceptions are limited to certain buildings, as noted in the exception details below. Submit an NRCC-SRA-E, the "Solar Ready Areas"

certificate of compliance to the enforcement agency for all building projects subject to solar ready, even if using a solar zone exception.

Exception 3 allows a reduced-size solar zone when solar access is limited by certain circumstances.

Exceptions 1, 2, and 4 allow alternate efficiency measures instead of a solar zone, so the requirements for zone shading, orientation, and design load; interconnection pathway; and owner documentation do not apply either. Any installations must be inspected and verified prior to final approval by the enforcement agency.

Exception 1: A compliant solar electric system is permanently installed on high-rise multifamily, hotel/motel, and nonresidential buildings. The system must have a nameplate direct current (DC) power rating of no less than 1 watt per sq. ft of roof area. The nameplate rating must be measured under standard test conditions. See Example 9-6. To verify compliance with this exception, submit NRCI-SPV-01-E Certificate of Installation: Solar Photovoltaic System.

Exception 2: A solar hot water system (SWH) is permanently installed on high-rise multifamily, hotel/motel, and nonresidential buildings. The SWH system must comply with §150.1(c)8Biii, the prescriptive solar requirements for a system serving multiple dwelling units. To verify compliance with this exception, submit NRCI-STH-01-E Certificate of Installation: Solar Water Heating System.

Exception 3: Reduce the solar zone area when the roof is shaded by objects that are not part of the building project, and therefore beyond the designer's control. The designated solar zone may be reduced to ≥ 50 percent of the potential solar zone area when solar access is limited as described below. When the "potential" solar zone is smaller than the 250 sq. ft minimum, the solar zone can be reduced to half the area of the potential solar zone. The reduced-size solar zone is called the "designated" solar zone.

Exception for Reduced Solar Zone

Step 1: Determine the annual solar access: For the solar-ready requirements, solar access is the ratio of solar insolation including shading to the solar insolation without shading. Annual solar access is most easily determined using specialized software.

$$Solar\ Access = \frac{Solar\ Insolation\ Including\ Shading}{Solar\ Insolation\ Without\ Shading}$$

Solar access does not take into account shading from objects that are included in the building project because the designer has control of potential obstructions. Objects that are not part of the building project cannot be moved or modified as part of the project and include existing buildings, telephone poles, communication towers, trees, or other objects. Objects that are considered part of the building project are objects constructed as part of the building project and include the

building itself, its HVAC equipment, outdoor lights, landscape features and other similar objects.

First, evaluate whether there are any objects outside the building project that will shade the rooftop (or other prospective solar zone areas such as overhangs or parking shade structures). If an existing object is located north of all potential solar zones, the object will not shade the solar zone. Similarly, if the horizontal distance ("D") from the object to the solar zone is at least two times the height difference ("H") between the highest point of the object and the horizontal projection of the nearest point of the solar zone, then the object will not shade the solar zone. (See Figure 9-2.)

Step 2: Determine the potential solar zone area: On low-sloped roofs, the potential solar zone is the area where annual solar access is ≥ 70 percent.

On steep-sloped roofs the potential solar zone is the area where the annual solar access is

≥ 70 percent on the portion oriented between 90 and 300 degrees of true north.

A "demand-responsive control" is defined in §100.1 as an "automatic control capable of receiving and automatically responding to a demand response signal." The technical specifications for compliant demand responsive control thermostats are detailed in JA5.

In addition to the demand-responsive thermostats, choose Option A or Option B (below).

Each dwelling unit must have one of the following four measures (1 – 4):

a) Install a dishwasher that meets or exceeds the ENERGY STAR® program requirements with either a refrigerator that meets or exceeds the ENERGY STAR program requirements or a whole-house fan driven by an electronically commutated motor.

b) Install a home automation system that complies with §110.12(a) and capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand-response signals.

c) Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system. It must comply with the California Plumbing Code and local ordinances.

d) Install a rainwater catchment system that uses rainwater flowing from at least 65 percent of the available roof area. It must comply with the California Plumbing Code and local ordinances.

Meet the Title 24 Part 11, Section A4, 106.8.2 requirements for electric vehicle charging spaces.

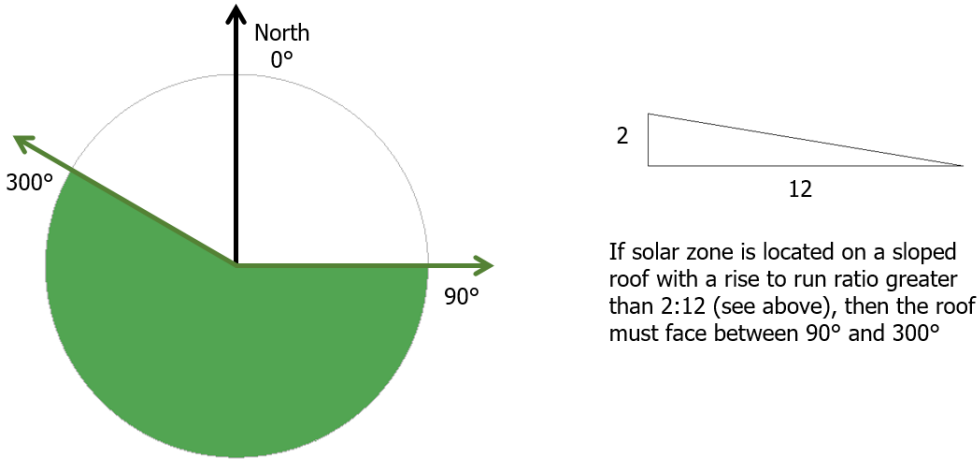
Exception 5: Applies to multifamily, hotel/motel, and nonresidential buildings. If the roof is designed and approved to be a heliport, or used for vehicular traffic or parking, no solar zone is required. Therefore, interconnection pathway and documentation requirements do not apply.

9.8.5.1 Solar Zone Azimuth

150.1(c)8Biii

All sections of the solar zone on steep-sloped roofs (rise-to-run ratio greater than 2:12, or 10 degrees) must be oriented between azimuths of 90 degrees and 300 degrees of true north. This range of azimuths ensures a reasonable solar exposure if a solar energy system is installed in the future. On a low-sloped roof (rise-to-run ratio equal to or less than 2:12, or 10 degrees), the azimuth requirement does not apply.

Figure 9-1: Azimuth of Roof If Solar Zone Is Located on Steep-Sloped Roof



Source: California Energy Commission

9.8.5.2 Solar Zone Shading

§110.10(b)3

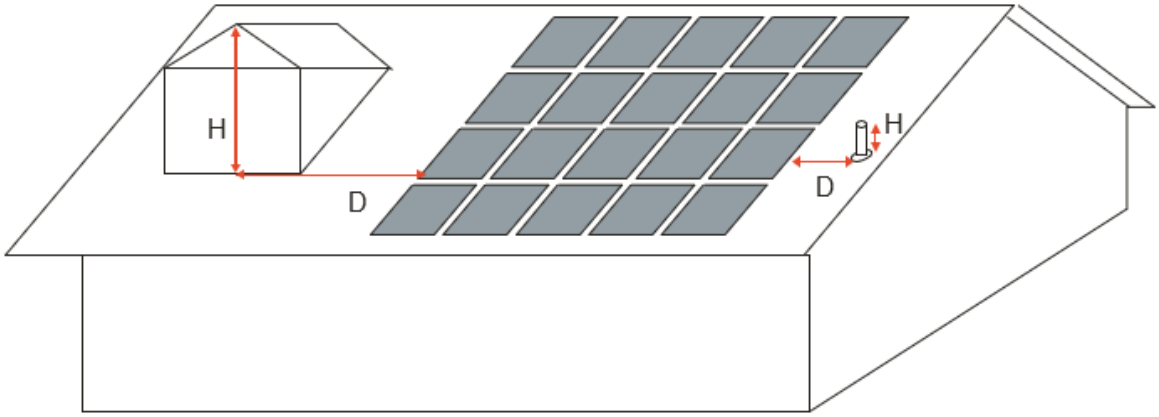
Obstructions such as vents, chimneys, architectural features, or roof-mounted equipment cannot be located in the solar zone. This requirement ensures the solar zone remains clear and open for the future installation of a solar energy system.

Any obstruction located on the roof or any other part of the building that projects above the solar zone must be located at a sufficient horizontal distance away from the solar zone such that the obstruction will not shade the solar zone. Equation 9-5 and Figure 9.2 describe the allowable distance between any obstruction and the solar zone. For each obstruction, the horizontal distance ("D") from the obstruction to the solar zone has to be at least two times the height difference ("H") between

the highest point of the obstruction and the horizontal projection of the nearest point of the solar zone.

Figure 9-2: Schematic of Allowable Setback for Rooftop Obstructions

Equation 9-5: $D \geq 2H$



Source: California Energy Commission

Any obstruction that is not located on the roof or another part of the building, such as landscaping or neighboring building, or is oriented north of all points of the solar zone is not subject to the shading requirement.

9.8.5.3 Solar Zone Structural Design Loads

§110.10(b)4

The structural design load requirements apply if any portion of the solar zone is located on the roof of the building. For the areas of the roof designated as the solar zone, the structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents. This is required so that the structural loads are known if a solar energy system is installed in the future.

The Energy Standards do not require estimating the loads of possible future solar equipment.

9.8.5.4 Interconnection Pathways

§110.10(c)

All buildings that include a solar zone must also include a plan for connecting a PV or SWH system to the electrical or plumbing system of the building. The construction documents must indicate:

1. A location for inverters and metering equipment for future solar electric systems. The allocated space should be appropriately sized for a PV system that could cover the entire solar zone.

2. A pathway for routing conduit from the solar zone to the point of interconnection with the electrical service. The design drawings must show where the conduit would be installed if a system were installed at a future date. There is no requirement to install conduit.
3. A pathway for routing plumbing from the solar zone to the water-heating system connection. The design drawings must show where the plumbing would be installed if a SWH system were installed at a future date. There is no requirement to install piping.

This requirement is not applicable if compliance is achieved by using Exceptions 1, 2, or 4 in lieu of a designated solar zone.

9.8.5.5 Documentation for the Building Occupant

§110.10(d)

A copy of the construction documents that show the solar zone, the structural design loads, and the interconnection pathways must be provided to the building occupant. The building occupant must also receive a copy of compliance document NRCC-SRA-E. The document copies are required so that the solar-ready information is available if the occupant decides to install a solar energy system in the future. This requirement is not applicable if compliance is achieved by using Exceptions 1, 2, or 4 in lieu of a designated solar zone.

Example 9-19:

Question:

An office building has a total roof area of 5,000 sq. ft. The total roof area covered by skylights is 200 sq. ft. A solar PV system with a DC power rating (measured under standard test conditions) of 4 kilowatts (kW) will be installed. The collection panels for the 4 kW system will cover 400 sq. ft. Does the building have to have to include a solar zone in addition to the installed solar PV system?

Answer:

Yes. To be exempt from the solar zone requirement, the solar PV system must have a power rating equal to 1 watt for every sq. ft of roof area, or in this case 5 kW (see equation below).

$$Minimum\ PV\ System\ Power\ Rating\ = Total\ Roof\ Area\ x\ 1\ Watt\ per\ sq.ft$$

$$\mathbf{5,000}\boldsymbol{W} = 5000\ sq.ft\ \times \frac{1W}{sq}.ft$$

The minimum solar zone for this building is 720 sq. ft (See calculation below.) The 400 sq. ft on which the solar PV system is installed does count toward the minimum solar zone area, so an additional 320 sq. ft would need to be allocated to complete the minimum solar zone requirement.

$$Minimum\ Solar\ Zone\ Area = 15\%\ x\ (Total\ Roof\ Area - Area\ Covered\ by\ Skylights)$$

$$\mathbf{720\ SF} = 15\%\ x\ (5{,}000\ sq.ft \times 200\ sq.ft)$$

9.8.6 Additions

§141.0(a)

The solar-ready requirements for additions are covered by the Energy Standards in §141.0(a). Additions do not need to comply with the solar-ready requirements unless the addition increases the roof area by more than 2,000 sq. ft. (200 sq. meters).

9.8.7 California Fire Code Solar Access Requirements

Following regulations established by the Office of the State Fire Marshal, the 2016 version of Parts 2, 2.5, and 9 of Title 24 include requirements for installing rooftop solar photovoltaic systems. These regulations cover the marking and location of DC conductors and access and pathways for photovoltaic systems. They apply to residential and nonresidential buildings regulated by Title 24 of the California Building Standards Codes. Provided below is a summary of the fire code requirements for nonresidential buildings.

PV arrays shall not have dimensions in either axis that exceed 150 ft. Nonresidential buildings shall provide a 6-foot-wide access perimeter around the edges of the roof. Smoke ventilation options must exist between array installations and next to skylights or smoke and heat vents. Builders shall refer directly to the relevant sections of Title 24 (Part 2: Section 3111, Part 2.5 Section R331, and Part 9 Section 903.3) for detailed requirements.

9.8.8 Compliance and Enforcement

At the time a building permit application is submitted to the enforcement agency, the applicant also submits plans and energy compliance documentation. This section describes the documents and procedures for documenting compliance with the solar-ready requirements of the Energy Standards. The following discussion pertains to the designer preparing construction and compliance documents and to enforcement agency plan checkers who are examining those documents for compliance with the Energy Standards.

There are three documents to demonstrate compliance with the nonresidential solar ready requirements. Each document is briefly described below.

- NRCC-SRA-E: Certificate of Compliance: Nonresidential Solar Ready Areas
    - This document is required for every project where the solar-ready requirements apply: newly constructed hotel/motel buildings with 10 or fewer stories, high-rise multifamily buildings with 10 or fewer stories, all other newly constructed nonresidential buildings with 3 or fewer stories, and additions to the previously mentioned buildings that increase the roof area by more than 2,000 sq. ft. This form is required for all covered occupancies, including projects that use any of the solar zone exceptions.

- NRCI-SPV-01-E: Certificate of Installation — Solar Photovoltaic System
    - This document is required when using solar zone Exception 1 to achieve compliance.
- NRCI-STH-01-E: Certificate of Installation — Solar Water Heating System
    - This document is required when using solar zone Exception 2 to achieve compliance.