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7 Photovoltaic, Community Shared Solar, Battery Storage, and Solar Ready Buildings

7.1 Overview

Chapter 7 describes the compliance requirements for photovoltaic (PV) systems, battery storage systems, and solar ready for newly constructed residential dwellings, including single-family, and low-rise (three or fewer habitable floors) multifamily buildings. The PV requirement is a new prescriptive requirement for newly constructed single-family and low-rise multifamily buildings. The prescriptive PV requirement also sets the standard design budget for the performance compliance method. Installation of battery storage system is a new compliance option for 2019 and this chapter describes the qualification requirement for this credit. The requirements for solar ready buildings are mandatory measures for newly constructed single-family homes and new low-rise multifamily residential buildings that do not have a photovoltaic system due to an exception in Section 150.1(c)14. The solar ready requirement is implemented when designing the building's 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.

For information about solar water heating system, please see Chapter 5.

7.2 Prescriptive Requirements for Photovoltaic System

7.2.1 Photovoltaic System Size

§150.1(c)14

To comply with the prescriptive requirements, all low-rise single family and multifamily buildings are required to have a PV system installed unless the building qualifies for an exception. The minimum qualifying size of the PV system is based on the projected annual electrical usage as described by the Equation 7-1 below.

Equation 7-1

kW_{PV} required = (CFA x A)/1000 + (NDwell x B)

WHERE:

kW_{PV} = kW_{dc} size of the PV system

CFA = Conditioned floor area

NDwell = Number of dwelling units

A = Adjustment factor from Table 7-1

B = Dwelling adjustment factor from Table 7.1

Table 7-1 – CFA and Dwelling Adjustment Factors

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

7.2.2 Exceptions to PV requirements

Annual Solar Access: The annual solar access is the ratio of solar insolation including shading over the solar insolation without shading. Refer to Example 7-12 for an example of how to calculate solar access.

Effective Annual Solar Access: The effective annual solar access shall be 70 percent or greater of the output of an unshaded PV array on an annual basis.

Effective Annual Solar Access Roof Areas: Are roof areas that meet the Effective Annual Solar Access requirements and are at least 80 contiguous square feet.

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

Exception 1 may apply if there is limited unshaded roof space. No PV is required if the effective annual solar access is restricted to less than 80 contiguous square feet by shading from existing permanent natural or manmade barriers external to the dwelling, including but not limited to trees, hills, and adjacent structures.

Exception 2 may apply to climate zone 15 and the required PV size may be reduced, if there is inadequate space on the roof to accommodate the PV size specified in Section 7.2.1. The PV size shall be the smaller of a size that can be accommodated by the Effective Annual Solar Access Roof Areas, or a PV size required by the equation above, but no less than 1.5 Watt DC per square foot of conditioned floor area.

Exception 3 may apply to two stories residential buildings and the required PV size may be reduced if there is inadequate space on the roof to accommodate the PV size specified in Section 7.2.1. The PV size shall be the smaller of a size that can be accommodated by the Effective Annual Solar Access Roof Areas, or a PV size required by the Equation 150.1-C, but no less than 1.0 Watt DC per square foot of conditioned floor area

Exception 4 may apply to three stories or higher residential buildings and the required PV size may be reduced if there is inadequate space on the roof to accommodate the PV size specified in Section 7.2.1. In all climate zones, for low-rise residential dwellings with three habitable stories and single family dwellings with three or more habitable stories, the PV size shall be the smaller of a size that can be accommodated by the Effective Annual Solar Access Roof Areas, or a PV size required by the Equation 150.1-C, but no less than 0.8 Watt DC per square foot of conditioned floor area.

Exception 5 For a dwelling unit plan that is approved by the planning department prior to January 1, 2020 with available solar ready zone between 80 and 200 square feet, the PV size is limited to the lesser of the size that can be accommodated by the effective annual solar access or a size that is required by the Equation 150.1-C.

Exception 6 may apply to buildings with battery storage system. The required PV sizes from Equation 7-1 may be reduced by 25 percent if a battery storage system is installed. For single family building, the minimum capacity of the battery storage system must be at least 7.5 kWh. For multifamily buildings, the battery storage system must have a minimum total capacity equivalent to 7.5 kWh per dwelling. In all case the battery storage needs to meet the qualification requirements specified in Joint Appendix JA12 and be listed with CEC.

Example 7-1 Exceptions

Question:

I'm an energy analyst simulating a 2-story building, can you explain in plain English the requirements of exception 2 for climate zone 15, exception 3 for 2-story buildings, and exception 4 for 3-story buildings?

Answer:

Exceptions 2, 3, and 4 were created to account for unusual roofs that may not have enough space to accommodate the PV size that would offset the annual kWh of the dwelling. If the exception is used, the requirement is to install as much PV capacity as possible, but no less than 1.5 Wdc per square foot in CZ 15, or 1 Wdc per square foot for 2-story buildings, or 0.8 Wdc per square foot for 3-story buildings.

Example 7-2

Question:

How do you demonstrate compliance with the exception 3 to the PV sizing requirements for a 2-story building?

Answer:

If the energy analyst does not know have the roof layout plan or does not anticipate a roof area limitation issue, then the building must be modeled without the exception (prior to final approval, the energy analyst may update the simulation run and resubmit the updated CF1R, if the roof plans become available and indicate an area limitation issue). However, if the energy analyst has the roof plans that indicate area limitation, then exception 2 may be used to model the building. If the exception is used, then the energy analyst must specify, in the compliance software or CF1R, the maximum PV size that can be accommodated by the roof, but no less than 1 Wdc per square foot. If the exception is used, prior to final approval, proof must be provided that documents roof area limitations that justifies using the exception. Documentation may include roof plans, aerial photos, satellite images, 3D model, or other documentation that clearly shows the available roof areas that meets the solar access requirements.

Compliance with exceptions 2 and 4 follows the same procedure as above.

7.2.3 Joint Appendix 11 (JA11) Requirements

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

7.2.3.1 **System Orientation**

For prescriptive path compliance, if a PV system is installed with a pitch greater than 2:12 or 10 degrees, the arrays must be oriented between 90 to 300 degrees from true north. If the pitch is less than 10 degrees, then it is considered a low-slope (flat) installation, and orientation has insignificant impact on the array's performance and therefore it can be ignored.

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 needed to achieve compliance. So, it is best to orient the panels as close to southwest as possible to maximize the system performance with the smallest array size.

In order to use the California Flexible Installation (CFI) simplified modeling option in the performance method, 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.

7.2.3.2 **Shading**

For prescriptive path compliance, the PV system must not have any obstruction to the array. Obstructions include the following:

(a) Any vent, chimney, architectural feature, mechanical equipment, or other obstruction that is on the roof or any other part of the building.

(b) Any part of the neighboring terrain.

(c) Any tree that is mature at the time of installation of the PV system.

(d) 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.)

(e) Any existing neighboring building or structure.

(f) Any planned neighboring building or structure that is known to the applicant or building owner.

(g) Any telephone or other utility pole that is closer than 30 feet from the nearest point of the array.

In general, the distance between edges of the arrays and any obstruction must be at least twice the height of the obstruction that extends above the PV array as seen in Figure 7-1 below. Note that any obstruction located north of the array does not count as shading obstruction.

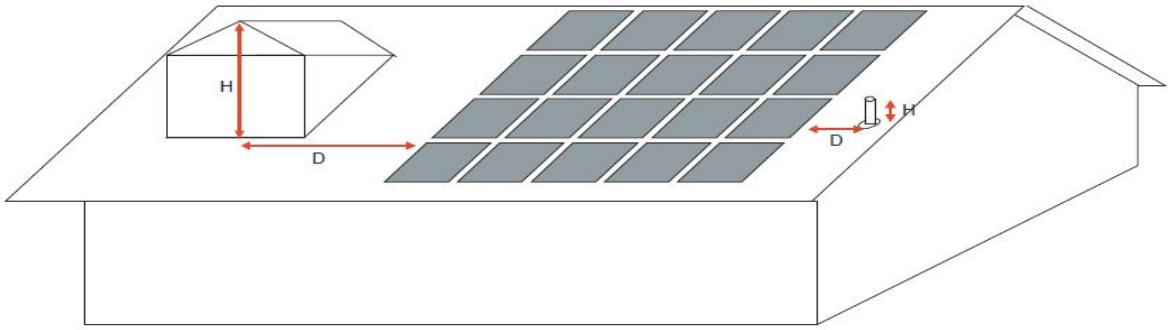


Figure 7-1: The Minimal Shading Criterion Artistic Depiction of "H" and "D"

For performance path compliance, if there is any shading to the array, the detail orientation and location must be input in the software.

In summary, if the arrays are unshaded, then both prescriptive and performance methods can be used to demonstrate compliance with the Standards; however, if an array is shaded, then the detailed approach under the performance method must be used to model the actual shading conditions of the arrays. For more information on software inputs, please refer to the software user's manual.

Example 7-3 Shading

Question:

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

Answer:

Prescriptively the PV array cannot have any shading and must meet the minimum shading criteria in JA11. Under the performance path the shading condition must be modeled as it is present, and it will result in a larger PV size that meets the same TDV budget as a smaller unshaded PV system.

7.2.3.3 Solar Access Verification

A solar assessment tool that is approved by the Executive Director must be used to document the shading conditions of the PV system. Measurements shall be made at all the major corners of the array. Additional measurements will be needed if they are more than 40 feet apart, and the additional points of measurement should be evenly distributed evenly. See Figure 7-2 for example of measurement locations for a typical roof.

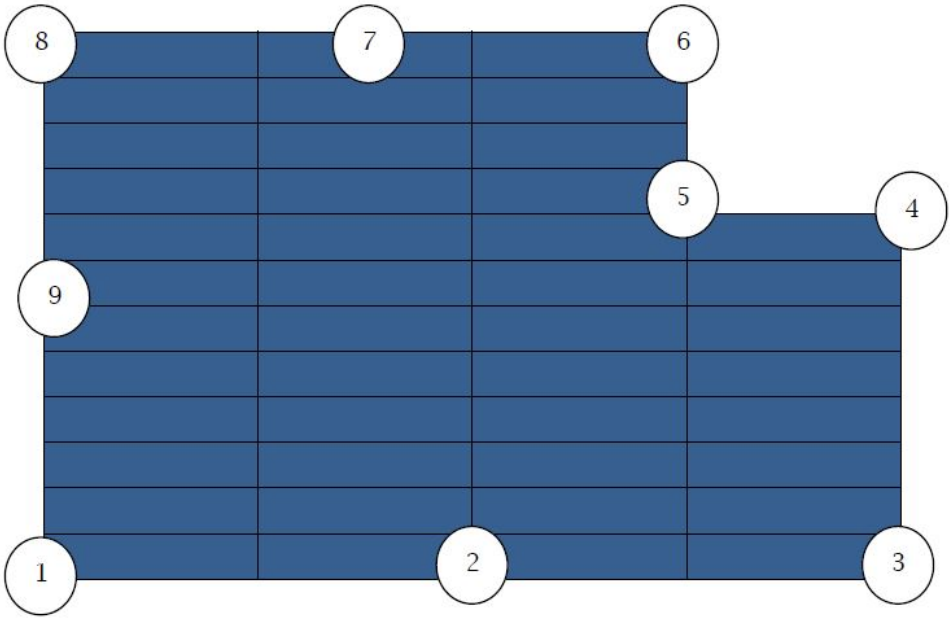


Figure 7-2: Example of Points Where Measurement Shall Be Made Using a Solar Assessment Tool

The approved solar assessment tool can be a physical tool that measures the available solar energy at the installation site, or software based tool that model the physical features of the building and surrounding shading conditions including roofs and trees, and then calculates their solar potential by analyzing it against historical weather data.

The installer must provide documentation that verifies the shading conditions of the array(s). This is done by using a CEC approved solar assessment tool or CEC approved alternative verification method

Alternative Methods - Aerial photos that document the positions of shading obstructions in relation to the location of the array may be use as an alternative to solar assessment tools. These methods include satellite images, drone images, digital image taken using long masts or from adjacent high grounds or structures. These images must provide unobstructed, sharp, and clear view of the PV array(s) and nearby obstructions casting shadows. The images must document:

a. Images' horizontal distance scale
b. The location of the array(s)
c. The position of the obstruction(s) and their height above the array(s)
d. The horizontal distance between the obstruction(s) and nearest point of the array(s)

The Executive Director may approve additional alternate methods that can be used to evaluate the solar access availability of the location.

7.2.3.4 **Remote Monitoring Capability**

The PV system must have a web portal and a mobile device application that enable the occupants 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:

(a) The nominal kW rating the PV system.

(b) Number of PV modules and the nominal watt rating of each module.

(c) Hourly (or 15-minute interval), daily, monthly, and annual kWh production in numeric and graphic formats for the system.

(d) Running total of daily kWh production.

(e) Daily kW peak power production.

(f) Current kW production of the entire PV system.

7.2.3.5 **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 the CPUC Electric Tariff Rule 21, which governs CPUC-jurisdictional interconnections for all net energy metering (NEM) customers. 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 when activated, can autonomously contribute to 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 PV array geometries used in the performance calculation if applicable. The Certificate of Installation shall be available on the building site for inspections.

Enforcement Agency Responsibilities: The local enforcement agency shall verify that the Certificate of Installation is valid complete and correct, and uploaded into a Commission-approved registry.

Example 7-4 Remote Monitoring

Question:

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

Answer:

There are multiple options. Many inverters can connect via ethernet and wireless to the homeowner's internet, and others use independent cellular connections. For cellular, the data should be updated to the monitoring portal periodically as allowed by the cellular plan.

7.3 Performance Approach Compliance for Photovoltaic System

7.3.1 Energy Budget Calculation

The computer performance approach allows for the modeling of the PV system performance by taking into account PV system size, climate, panel orientations, inverter efficiency, and shading characteristics. The standard design PV system size is determined by the modeled annual electrical consumption of the mixed-fuel proposed design building, regardless of the actual fuel type of the proposed design building. The performance method allows for modeling different PV sizes, solar thermal systems, more energy efficiency measures, battery storage system and other demand response measures.

7.3.2 Exceptions to PV requirements

The six allowable exceptions to the prescriptive PV requirements listed in 7.2.2. 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.

7.3.3 Additional Requirements

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

Example 7-5 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 couple with a battery storage system and energy efficiency measures? How about a standalone battery storage system?

Answer:

Beginning with the 2019 Standards, the performance path no longer allows installing a larger PV system in exchange for less energy efficiency measures; 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.
When the PV systems is coupled with at least a 5 kWh battery storage system, the performance path will allow a portion of the available credit to be used for efficiency measure tradeoffs; this is a modest credit that can be used to achieve compliance in buildings that have marginal difficulty achieving compliance.
The Standards do not recognize standalone battery storage systems that are not coupled with a PV system and no compliance credits are granted for these systems.

Example 7-6 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 as part of the efficiency EDR score, and can be used for efficiency measures tradeoff, or installing a smaller PV system. The requirements for solar thermal water heating systems are described in Chapter 5, Water Heating Requirements.

Example 7-7 Precooling

Question:

Can you explain precooling strategy requirements and how to comply with them?

Answer:

Precooling is a strategy that allows cooling the house by two or three degrees below the setpoint in the hours preceding the onset of peak time-of-use (TOU) hours, when the electricity rates are relatively low, and then turning off the air conditioning during the TOU peak hours, resulting in significant cost savings for the building occupants.

To obtain this credit, a JA5 compliant communicating thermostat must be installed in the dwelling unit, and indicated on both CF1R and CF2R forms.

The precooling credit may only be used to lower the EDR score towards a more stringent EDR goal set by a reach code such as a local ordinance; this credit cannot be used to tradeoff the energy efficiency features of the building.

Finally, if the dwelling unit is already equipped with a battery storage system coupled with a PV system, the precooling strategy may have negligible impact on further lowering the EDR score.

7.4 Community Shared Solar Electric Generation and Storage Systems

7.4.1 Photovoltaic System Size

§150.1(c)14

The 2019 Building Energy Efficiency Standards allow the possibility for the Standards requirements for photovoltaics on the site of the residential building to be fully or partially 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 site. Also, the batteries that can be installed in combination with photovoltaics on the building site to gain performance standards compliance credit can be fully or partially offset by Community Shared Battery Storage Systems that are installed at a different site. Community Shared Solar Electric Generation Systems and Community Shared Battery Storage Systems could be installed in combination or separately. Such systems are hereinafter referred to just as Community Shared Solar 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 Energy Commission for approval, demonstrating that several criteria specified in Section 10-115 of the Standards are met, to ensure that the Community Shared Solar Generation System provides equivalent benefits to the residential building expected to occur if photovoltaics or batteries had been installed on the building site. The Energy Commission will carefully consider these applications to determine if they meet these criteria. If approved, Energy Commission approved compliance software will be modified to enable users to take compliance credit for buildings served by that Energy Commission 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 twenty-year period for each building that uses shares of the Community Shared Solar Electric Generation System for partial or full offset of 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 Energy Commission, and other parties who relied on these systems for offset of full or partial 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 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 Energy Commission Building Standards Office for further discussion and explanation of the criteria as necessary.

In general, the Community Shared Solar Electric Generation System must meet the following:

7.4.2 Enforcement Agency

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 in 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 shall 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 Electric Generation System to verify the validity and accuracy of compliance documentation.

7.4.3 Energy Performance and Minimum Community Shared PV and Battery Storage Size

Energy Commission approved compliance software must be used to show that the energy performance of the building's share of the Community Shared Solar Electric Generation System is equal to or greater than the partial or full offset claimed for the solar electric generation and batteries, which would otherwise be required for the building to comply with the Standards.

The minimum community shared solar size dedicated to the building and the annual kWh equivalence may be measured in one of two ways: (1) Using the CBECC-Res Simplified approach for PVs and the CFI orientation option, or (2) by modeling the actual attributes of the system using the detailed approach. When the detailed approach is used, the compliance software will determine a minimum kW size that will represent the portion of the community solar resource dedicated to the building, based on PV system component performance characteristics, azimuth (orientation and tilt), inverter type, tracking versus fixed systems, climate zone and CEC weather files containing solar availability data.

Additionally, If the community shared solar resources is coupled with a community shared battery storage system, in the CBECC-Res, the modeled PV system must also be coupled with at least a 5 kWh battery storage system to determine the size share of the community solar resource dedicated to the building. Also, the portion of the community shared battery storage system dedicated to the dwelling must match the battery storage size modeled in CBECC-Res.

7.4.4 Dedicated Building Energy Savings and Bill Reduction Benefits

A specific share of the Community Shared Solar Electric Generation System, determined to comply with the Energy Performance requirement above, must be dedicated on an ongoing basis to the building. The energy savings benefits dedicated to the building shall be provided in one of the following ways:

A. Actual reductions in the energy consumption of the building;

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

C. 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 Electric Generation System dedicated to the building shall be greater than the cost that is charged to the building to obtain that share of the Community Shared Solar Electric Generation System. 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.

7.4.5 Durability

The benefits from the specific share of the Community Shared Solar Electric Generation System must be provided to each dedicated building for a period not less than 20 years.

7.4.6 Additionality

The specific share of the Community Shared Solar Electric Generation System must provide the benefits to the dedicated building that are in no way made available or attributed to any other building or purpose. Renewable Energy Credits that are unbundled from the Community Shared Solar Electric Generation System do not meet this additionality requirement.

Example 7-8

Question:

To help entities that might want to apply to the Energy Commission 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 7.4.3.2.3.

Answer:

Examples would include:

Actual reductions in the energy consumption of the building: This could be accomplished by locating the PV systems for several houses 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 home's site. For homes 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 houses 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 building's energy consumption that is subject to energy bill payments: This could be accomplished for qualifying multi-family dwellings by participation in an approved virtual net metering program, which has PVs installed on the multi-family project site, and energy bill credits that reduce each dwelling unit's monthly electricity bill 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 home, and energy bill credits are that reduce monthly electricity bills are allocated based on the homes' shares, 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 that 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 homes they build. The homes 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 homes for the home's 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 home. All other requirements of Section 10-115 would have to be met.

Example 7-9

Question

Could you also explain what the cost requirements are in the last sentence of Section 7.4.3.2.3 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 nut shell, regardless of the three options above is chosen, it must be cost effective to the home for the home to participate in a community shared solar electric generation system program. The home will pay for its share of the community renewable resource, and will receive either energy bill reductions, credits or cash payments for the electricity that is generated by the community renewable resource. The $ value of the bill reductions, credits or cash payments must exceed the cost to the home to pay for its share of the community renewable resource.

Let's take a hypothetical example of a Green Tariff Shared Renewables Program (GTSR) that is required by statute to be operated by the Investor Owned Utilities. The following shows the costs that the program charges a home to obtain shares of the program's community solar resources, and the energy bill credit. The charges and credit are allocated per KWh generated by the home's share of the community renewable resource.

Example Green Tariff Shared Renewables Program Details	
Solar Charge	6.48 cents per kWh
Program Charge	2.956 cents per kWh
Power Charge Indifference Adjustment (PCIA) Charge	3.346 cents per kWh
Total Program Charges	12.782 cents per kWh
Generation Credit	-10.78 cents per kWh

The total cost that the home pays per kWh for its share of the community renewable resource is 12.8 cents per kWh and the energy bill credits for generation from the home's share of the community renewable resource is 10.8 cents per kWh. Since the value of the home's energy bill credit does not exceed the cost for the home to participate in the community solar program, the cost requirement of Section 7.4.3.2.3 is not met. Cost requirements can be brought into compliance through a combination of an increase in the generation credit and reductions in solar charge, program charge, and power charge indifference adjustment (PCIA) charge. In this example, if the generation credit raises by one cent, up to 11.8 cents, and combined charges decrease by 1.1 cents, down to 11.7 cents, then the program meets the cost requirements of Section 7.4.3.2.3.

7.5 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 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. This 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.

Battery storage system is available as a compliance credit in the performance compliance method and also as Exception 6 to the prescriptive PV requirements in section 150.1. 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 7.5.2 below, allow reaching specific target Energy Design Rating Targets (EDR) with a smaller PV system than otherwise would have been possible. This is a useful and cost effective strategy for meeting lower target EDRs that may be required by reach codes, with a smaller and grid harmonized PV system.

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

http://www.energy.ca.gov/title24/equipment_cert/

7.5.1 Minimum Performance Requirements

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

a. Usable capacity of at least 5 kWh.

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

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

7.5.2 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 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 7.5.3 below:

1. The battery storage system shall have the capability of being remotely programmed to change the charge and discharge periods.

2. During discharge, the battery storage system shall 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 response signal from the local utility or a third-party aggregator.

3. The battery storage system shall 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. The device must have the algorithm

that would enable export to be built in at the time of installation. It can be in the off mode and be turned on later with a remote signal.

4. The battery storage system shall perform a system check on the following dates, to ensure the battery is operating in one of the control strategies listed section 7.5.3 below:

    a. Within 10 calendar days before the onset of summer TOU schedule, and

    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 1 May and 1 November.

7.5.3 Controls Strategies

JA12 includes three 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:

Basic Control: Designed as a simple control that can be employed as the default control in the absence of TOU or Advanced Demand Response Controls, or where communication between batteries and outside parties are not possible. This control strategy does not allow discharging into the grid. 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 photovoltaic system when the photovoltaic system production is greater than the on-site electrical load. The battery storage system shall discharge only when the photovoltaic system production is less than the on-site electrical load.

Time-of-Use (TOU) Control: Designed to take advantage of TOU rates where they are available. This control strategy generally results in a greater Energy Design Rating (EDR) impact than the Basic Control. This control strategy does not allow discharging into the grid. To qualify for the TOU Control, the battery storage system shall be installed in the default operation mode to allow charging from an on-site photovoltaic system. The battery storage system shall begin discharging during the highest priced TOU hours of the day. 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.

Advanced Demand Response Control: 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 is the only control strategy that 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. To qualify for the Advanced Demand Response Control, the battery storage system shall be programmed by default as Basic Control or TOU control as described above. The battery storage control shall meet the demand responsive control requirements specified in Section 110.12(a). Additionally, 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

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 ones listed above in Section 7.5.2. 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, and/or other strategies that achieve equal or greater. This alternative control option shall be accompanied with clear and easy to implement algorithms for incorporation into the compliance software for compliance credit calculations.

7.5.4 Other Requirements

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

Safety Requirements: The battery storage system shall be tested in accordance with the applicable requirements given in UL1973 and UL9540. 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).

Enforcement Agency: The local enforcement agency shall verify that all Certificate of Installations are valid. The battery storage systems shall be verified as a model certified to the Energy Commission as qualified for credit as a battery storage system. In addition, the enforcement agency shall verify that the battery storage system is programmed and operational with one of the control listed in Section 7.5.2 above. The programmed control strategy at system final inspection and commissioning shall be the strategy that was used in the Certificate of Compliance.

Example 7-10 Battery Storage Credit

Question:

Can you explain the battery storage credit requirements and how to comply with them?

Answer:

The performance path allows a compliance credit for a battery storage system with at least a 5 kWh capacity that is coupled with a PV system; standalone battery storage systems are ineligible for a compliance credit. The PV/storage credit may be used to lower the EDR score towards a more stringent EDR goal set by a reach code such as a local ordinance; however, the software will allow a portion of the available credit to be used for efficiency measures tradeoff; this is a modest credit that can be used to achieve compliance in buildings that have marginal difficulty achieving compliance.

The manufacturers must self-certify to the Commission 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 Commission. The self-certification form may be downloaded from the Commission's website:

Example 7-11 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 Commission provide a compliance credit for 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. A compliance credit is available because 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 compliance credit of a battery storage system coupled with a PV system, the Energy Commission'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 homeowner, the grid, or the environment.

Example 7-12 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 1 May and 1 November 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.

7.6 Solar Ready Overview

The solar ready provisions are mandatory for low-rise residential buildings that do not have a PV system due to an exception in Section 150.1(c)14. There are exceptions to the "solar zone" requirements, and these are described in the corresponding sections of this chapter. Because solar ready is mandatory, CF1R-SRA-01-E compliance forms must be submitted with the building permit application, even when using an allowable solar zone exception.

Please note: In §110.10 of the *Energy Standards*, the solar zone, interconnection pathways, and design load requirements for low-rise multifamily buildings are located with the high-rise multifamily requirements in §110.10(b)1B. Because most of the low-rise multifamily requirements are identical to high-rise (including three Exceptions), Chapter 9 of the "Nonresidential Compliance Manual" is an additional resource for technical assistance.

7.6.1 Covered Occupancies

§110.10(a)

The low-rise residential solar-ready requirements only apply to new single-family homes and low-rise multifamily buildings that do not have a PV system, as described in A and B below.

A. Single-Family Residential Buildings

The solar-ready requirements apply to the following newly constructed single-family homes without a PV system, and:

- located in a subdivision with 10 or more residences and
- the Tentative Subdivision Map is complete and approved by the enforcement agency.

B. Low-rise Multifamily Residential Buildings

The solar ready requirements apply to low-rise multifamily buildings having three habitable stories or fewer without a PV system.

A note about Mixed Occupancy Buildings: The Energy Standards apply to mixed occupancy buildings. Low-rise buildings with nonresidential space on the ground floor and multi-family residential floors above are common examples. The Solar Zone requirements include mixed occupancy buildings.

7.6.2 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.

For single-family homes, the solar zone must be located on its roof or overhang.

For low-rise multifamily buildings, the solar zone can be located on any of the following locations:

1. Roof of the building.
2. Overhang of the building.
3. Roof or overhang of another structure located within 250 feet of the primary building.
4. Covered parking installed with the building project.

See Figure 7-6 for some acceptable solar zone placement techniques.

7.6.2.1 **Solar Zone Minimum Area**

§110.10(b)1

The total area of the solar zone may be composed of multiple subareas - if they meet minimum size specifications. No dimension of a subarea can be less than five feet. If the total roof area is equal to or less than 10,000 square feet, each subarea must be at least 80 square feet. If the total roof area is greater than 10,000 square feet, each subarea must be at least 160 square feet.

7.6.2.2 Solar Zone Area for Single-Family Residential Buildings

The solar zone must be located on the roof or overhang of the building. The "designated" solar zone's total area must be no less than 250 square feet (§110.10(b)1A).

There are six allowable exceptions to the required solar zone area. Exceptions 1 and 6 allow alternate efficiency measures instead of an actual solar zone, so the requirements for zone shading, azimuth and design load; interconnection pathway, owner documentation, and electric service panel do not apply either.

Submit a CF1R-SRA-01-E to the building department with the building permit application for all projects covered by solar ready, even when using a Solar Zone Exception. In addition, submit a CF1R-SRA-02-E solar zone worksheet for all projects with a solar zone, including Exceptions that allow a reduced solar zone area.

Solar Zone Exceptions for Single-family Buildings:

Exception 1 may apply when a domestic solar water-heating (SWH) system is permanently installed at the time of construction. The SWH system must comply with the installation criteria in the Reference Residential Appendix RA4, and have a minimum solar savings fraction of 0.50. Note: These buildings are also exempt from the interconnection pathway, documentation and electrical panel requirements because there is no solar zone.

Exception 2 may apply if the single-family home has three or more habitable stories and a total floor area ≤ 2,000 square feet. The designated solar zone may be reduced. The area must be ≥ 150 square feet.

Exception 3 may apply if the single-family home is in the Wildland-Urban Interface Fire Area (as defined in Title 24, Part 2). The solar zone area may be reduced to ≥ 150 square feet. In addition, a whole-house fan must be permanently installed at the time of construction. This exception is intended to accommodate attic- and roof-venting requirements in these fire areas. *New in the 2019 Energy Standards: this exception may be used in all Climate Zones.*

Exception 4 reduces 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 square feet 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.

Exceptions for Reduced Solar Zone Due to Shade

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.

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

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 7-4).

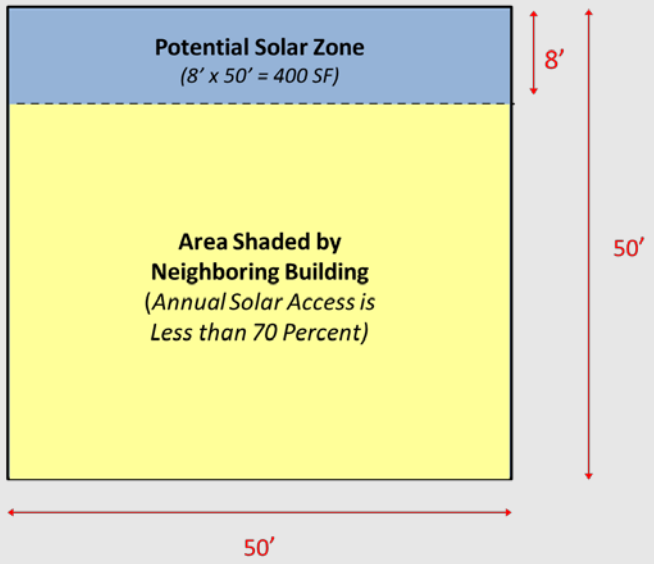
Step 2: Determine the Potential Solar Zone Area: On low-sloped roofs, the potential solar zone is the area where annual solar access is ≥ 70 percent.

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.

Step 3: Determine the size of the designated solar zone. The designated solar zone must be ≥ 50 percent of the potential solar zone area. If the roof is shaded such that there is no potential solar zone area, then no solar zone is required. See Figure 7.1. Document the method/tools used to demonstrate that the solar access is less than 70 percent in the compliance form CF1R-SRA-02-E (Minimum Solar Zone Area Worksheet).

Example 7-13

Question:
A house has a total roof area of 2,500 SF. The neighbor's house and trees shade the roof, so 2,100 SF 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 were to have an annual solar access of 70 percent or greater, the minimum solar zone would have been 250 SF. Since the potential solar zone is only 2,500 – 2,100 = 400 SF, however, the minimum solar zone can be reduced to 50 percent of the potential solar zone, or 200 SF.

Exception 5 allows a reduced solar zone of ≥ 150 square feet if all thermostats have demand responsive controls. See Appendix H of this compliance manual for guidance on compliance with the demand responsive control requirements.

Exception 6 allows no solar zone when the following energy efficiency features are installed:

All thermostats have demand responsive controls that comply with Section 110.12(a) and Joint Appendix JA5. (please see Exception 5, above, for more details). AND one of the following four measures (i – iv):

i. Install a dishwasher that meets or exceeds the ENERGY STAR® program requirements with a refrigerator that meets or exceeds the ENERGY STAR program requirements, OR one of the followings:

- a whole-house fan driven by an electronically commutated motor, OR
- an SAE J1772 Level 2 Electric Vehicle Supply Equipment (EVSE or EV Charger) with a minimum of 40 amperes. SAE J1772 is the SAE International document titled "SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler" (SAE J1772_201710).

ii. Install a home automation system that is capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand response signals; OR

iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the *California Plumbing Code*; OR

iv. Install a rainwater catchment system designed to comply with the *California Plumbing Code* and uses rainwater flowing from at least 65% of the available roof area.

Example 7-14 Solar Ready Zone

Question:

What are the examples of how the solar ready zone requirements can be avoided using Exception 6?

Answer:

Exception 6 provides three options for avoiding the solar ready zone requirements altogether:

1. Install only demand responsive capable (DRC) thermostats with ENERGY STAR® dishwasher and refrigerator, or

2. Install only DRC thermostat(s) and a whole-house fan driven by an electronically commutated motor, or

3. Install only DRC thermostat(s) and a level 2 EV charger with a minimum of 40 amperes.

Any of these three options can be used to avoid the solar ready zone requirements.

Solar Zone Area for Low-Rise Multifamily Residential Buildings

The solar zone requirement for low-rise multifamily buildings is located in the 2019 Energy Standards with the requirements for high-rise multifamily, hotel/motel and nonresidential buildings in §110.10(b)1B. The solar zone requirement for low-rise multifamily buildings applies to mixed occupancy buildings as well.

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 feet of the building, or on covered parking installed with the building project. The solar zone's total area must be ≥ 15 percent of the building's total roof area. Subtract any skylight area when calculating the roof's total area.

Four solar zone exceptions apply to low-rise multifamily buildings in the 2019 Energy Standards. Exception 3 allows a smaller solar zone under certain circumstances. Exceptions 4 and 5 allow alternate efficiency measures in lieu of a solar zone. Therefore, the requirements for solar zone shading, azimuth and design load; interconnection pathway, and documentation do not apply.

Exceptions 1 and 2 do not apply to low-rise multifamily buildings.

Exception 3 reduces 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 reduced-size solar zone is called the "designated" solar zone. The designated solar zone may be reduced to ≥ 50 percent of the potential solar zone area when solar access is limited. Solar access is the ratio of solar

insolation including shade to amount of solar insolation without shade. Shading from obstructions on the roof or other parts of the building cannot be included to determine annual solar access.

See Figure 7-2 for more information about calculating the designated solar zone.

- Low-sloped roof: the potential solar zone area is the total area of any roof where annual solar access is 70% or greater.
- Steep-sloped roof: The potential solar zone area is the roof area where annual solar access is 70% or greater and oriented between 90 and 300 degrees of true north.

Exception 4 says multifamily residential buildings do not need a solar zone if all thermostats have demand responsive controls that comply with Section 110.12(a) and Joint Appendix JA5. See Exception 5 for single-family homes (above) for more thermostat details. In addition to the compliant thermostats, choose A or B below:

A. One of the following four measures installed in each dwelling unit (i. – iv.):

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

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

iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the *California Plumbing Code*; or

iv. Install a rainwater catchment system designed to comply with the *California Plumbing Code* and that uses rainwater flowing from at least 65 percent of the available roof area.

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

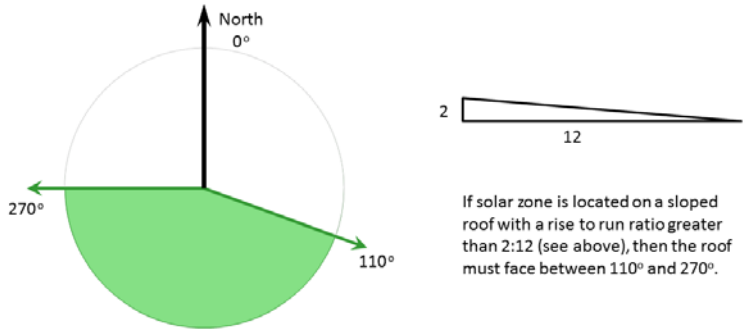
Exception 5 includes low-rise multifamily buildings and says a solar zone is not required when the roof is designed and approved to be used for vehicular traffic, or parking, or a heliport.

7.6.3 Azimuth (Solar Zone)

§110.10(b)2

For both single-family residential and low-rise multifamily buildings, all sections of the solar zone on steep-sloped roofs (ratio of rise to run of greater than 2:12) must be oriented between 90 degrees and 300 degrees of true north. The orientation is important because it ensures a reasonable solar exposure if a solar energy system is installed in the future. On a low-sloped roof (ratio of rise to run of 2:12 or less), the azimuth requirement does not apply.

Figure 7-4: Orientation when solar zone is located on a steep-sloped roof



7.6.4 Shading (Solar Zone)

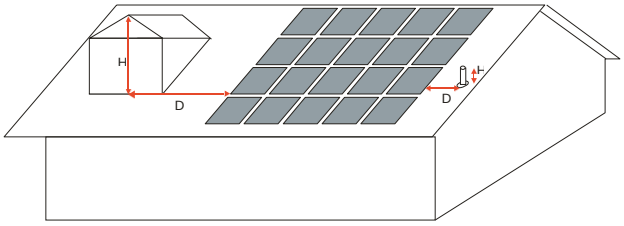
§110.10(b)3

For both single-family residential and low-rise multifamily buildings, the solar zone must be free from roof penetrations and shall not have any obstructions such as vents, chimneys, architectural features, or roof-mounted equipment located in the solar zone. This requirement ensures that 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 in order to reduce the resulting shading of the solar zone. For each obstruction, the horizontal distance (“D”) from the obstruction to the solar zone shall 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.

Shading Equation: D ≥ 2 X H

Figure 7-5: Schematic of Allowable Setback of Rooftop Obstructions



Source: California Energy Commission

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

7.6.5 Structural Design Loads (Solar Zone)

The structural design loads for roof dead load and roof live load must be clearly indicated on the construction documents for the designated solar zone areas. The structural load information will be easily available if the building owner considers a solar energy system installation in the future. It is not necessary to estimate the collateral loads for future solar energy systems.

The structural design loads requirement applies to the solar zone on both single-family residential and low-rise multifamily buildings.

7.6.6 Interconnection Pathways

§110.10(c)

All buildings that comply by designating a solar zone must also include a plan for connecting a future PV and SWH system to the building's electrical or plumbing system. The construction documents must indicate:

1. A reserved location for inverters and metering equipment for solar electric systems.
2. A reserved conduit route from the solar zone to the point of interconnection with the electrical service. There is no requirement to install any conduit.
3. For single family residences, and multifamily buildings with a central water heating system, a reserved plumbing pathway from the solar zone to the water-heating system connection. There is no requirement to install any plumbing.

This requirement applies to both single-family residential and low-rise multifamily buildings.

7.6.7 Documentation

§110.10(d)

A copy of the construction documents or a document containing the required solar-ready information must be provided to the occupant. The building occupant must also receive a copy of compliance forms CF1R-SRA-01-E and CF1R-SRA-02-E. Providing this information to the building occupant is required so the information is available if the owner decides to install a solar energy system in the future. Construction documents must include information about the as-designed structural loads, solar zone location, and the reserved interconnection pathways. This requirement applies to both single-family residential and low-rise multifamily buildings.

7.6.8 Main Electrical Service Panel

§110.10(e)

This requirement applies only to single-family residential buildings. The main electrical service panel must have a minimum Busbar rating of 200 amps. The panel must also include space to install a double-pole circuit breaker in the future, if one is not installed during construction. These items are required to simplify the possible future installation of a solar electric system.

7.7 California Fire Code Solar Access Requirements

Under 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 the installation of rooftop solar photovoltaic systems. These regulations cover the marking, 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 brief summary of the fire code requirements for residential buildings.

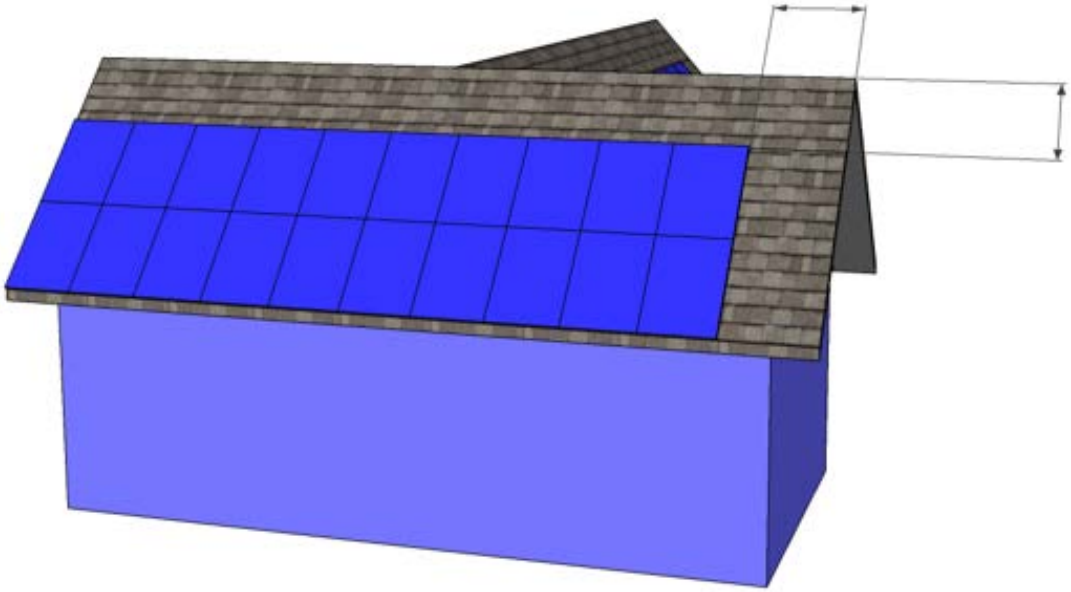
PV arrays shall not have dimensions in either axis greater than 150 feet. Residential buildings with hip, ridge/valley roof features shall provide a 3-foot access pathway away from applicable eave to hip/ridge/valley features. To provide adequate smoke ventilation, PV arrays shall not be located higher than 3 feet below the ridge. Builders shall refer directly to the relevant sections of Title 24 (most currently Part 2.5 Section R324.3, and Part 2.5 Section 324.7) for detailed requirements.

In addition to the requirements in the fire code, the California Department of Forestry and Fire Protection − Office of the State Fire Marshal (CAL FIRE-OSFM), local fire departments (FD), and the solar photovoltaic industry previously developed a *Solar Photovoltaic Installation Guideline* to increase public safety for all structures equipped with solar photovoltaic systems. The intent of this guideline is to provide the solar photovoltaic industry with information that will aid in the designing, building, and installation of solar photovoltaic systems in a manner that should meet the objectives of both the solar photovoltaic industry and the requirements now set forth in the California Fire Code.

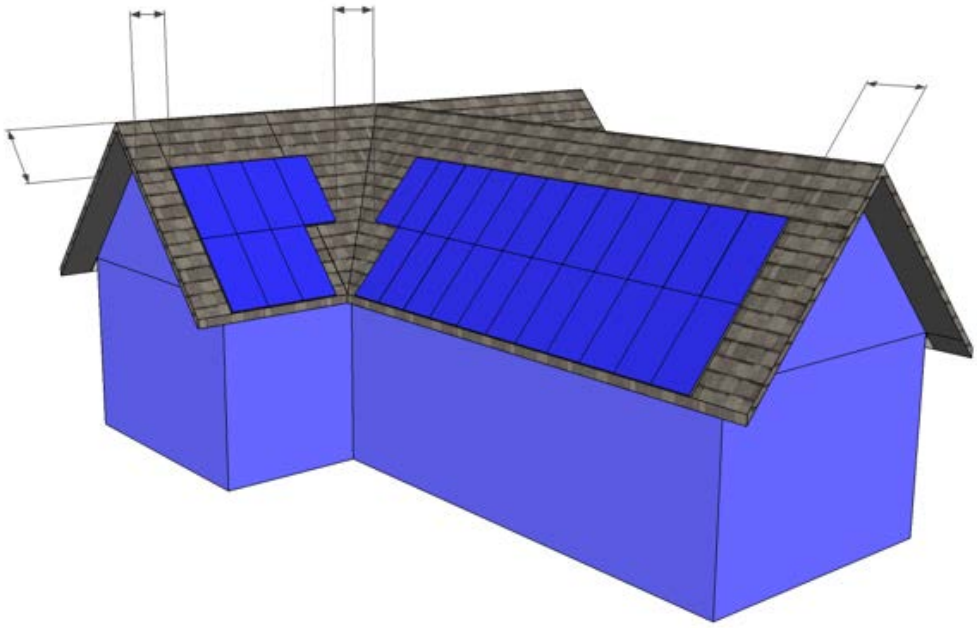
The entire Solar Photovoltaic Installation Guideline can be accessed at http://osfm.fire.ca.gov/pdf/reports/solarphotovoltaicguideline.pdf

Figure 7-6: The following illustrations demonstrate some acceptable solar access techniques.

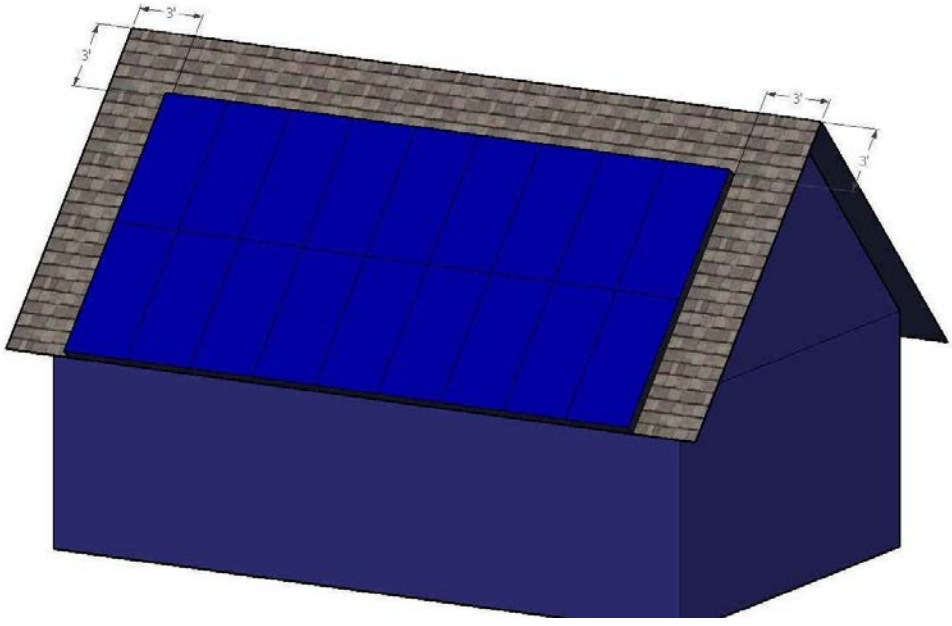
Cross Gable Roof



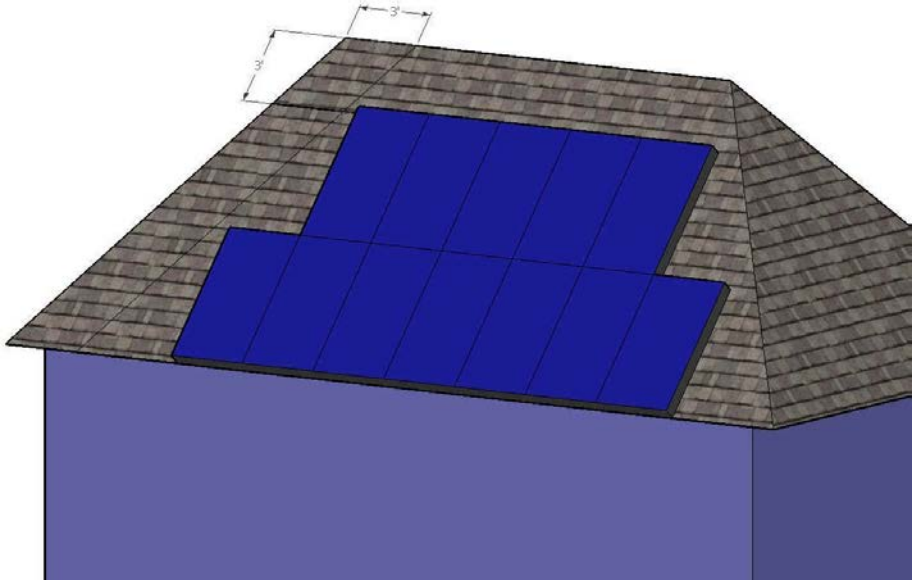
Cross Gable Roof with Valley



Full Gable Roof



Full Hip Roof



7.8 Compliance and Enforcement

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

There are four forms associated with the low-rise residential solar-ready requirements. Each form is briefly described below.

1. **CF2R-SRA-01-E:** Certificate of Compliance: Residential Solar Ready Areas

This form is required for every project where the solar-ready requirements apply: newly constructed single-family residential and low-rise multifamily buildings.

2. **CF2R-SRA-02-E:** Certificate of Compliance: Minimum Solar Zone Area Worksheet

This form is required when buildings comply with the solar-ready requirement by including a solar zone. That is, an appropriately sized solar PV system is not installed, an appropriately sized solar water heating system is not installed, the building does not comply with all the OCST and high-efficacy lighting requirements or the roof is not designed for vehicle traffic or a heliport.

3. **CF2R-STH-01-E:** Certificate of Installation – Solar Water Heating System

Single Family Residential Only: This form is required when the building is using solar zone Exception 1 because a compliant solar water heating system has been installed on the home.