



**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 Institute – PART I

Intro to Solar PV for Multifamily Affordable Properties

California Housing Partnership | chpc.net

Presenters and Panelists



Rachael Diaz (she/her), Sustainable Housing Program Manager
California Housing Partnership



Staci Givens (she/her), Senior Associate - Programs
Association for Energy Affordability



Zara Jamshed (they/them), SOMAH Technical Manager
GRID Alternatives

Zoom Functions

Zoom Meeting

- Please rename yourself with the following
 - Name
 - Pronouns
 - Organization
- Use the “Raise Hand” feature to ask a question, or type in the chat
- Please keep your sound on mute, and unmute only when speaking
- Keep your camera on, if possible

Agenda

1. Introduction to Solar PV
2. Pre-Development Considerations
3. Installation Considerations
4. Post-Installation Considerations
5. Overview of Solar Funding Resources
6. Q&A



Goals

PART I

- Foundational understanding of solar photovoltaics (PV)
- Solar benefits for housing providers and the residents they serve
- Support the affordable housing community's sustainability and resiliency goals.
- Available solar funding resources



The Partnership's Mission

The California Housing Partnership creates and preserves affordable and sustainable homes for Californians with low incomes by providing expert financial and policy solutions to nonprofit and public partners.

→ chpc.net

→ [@CHPCnews](https://twitter.com/CHPCnews)



Sustainable Housing Team

Affordable Energy and Water Programs



California Climate Investment Programs



Sustainable Housing Technical Assistance

GREEN Network



Trainings

Thank You to Our Sponsor



SOMAH

SOMAH helps deliver financial and environmental benefits to your tenants.

Learn more at CalSOMAH.org

Introductory Poll Questions

Poll #1

Introductory Poll Questions

Poll #2

Introductory Poll Questions

Poll #3



**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

The Importance of Solar PV on Multifamily Affordable Housing

Statewide Building Decarbonization Policy Trends

- 50 cities in California have passed all or near-all-electric reach codes
- Affordable housing funding programs allocating application points for all-electric developments
- CARB considering zero-emission standard for appliances beginning in 2030
- 2022 CEC Energy Code includes mandates for rooftop solar, storage, electric heat pump space heating under prescriptive approach

Solar 101

Why install solar on multifamily housing?



Solar 101

Why install solar on multifamily housing?



CALIFORNIA
ENERGY COMMISSION





**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

Solar PV Components and Terminology

Solar PV Terminology

Term	Definition
Solar Module	Often used interchangeably with solar panel
Solar Array	An interconnected assembly of solar modules
Photovoltaic(s) or PV	Pertains to the direct conversion of light into electricity
Watt (W)	Unit of electric power a PV system can generate; solar panel output is expressed in units of Watts (ex. 250-400W)
Kilowatt-hour (kWh)	Amount of energy being used; units utilities use to bill electricity consumption
Azimuth	The direction that your roof faces; measured in degrees, representing the angle between the roof and true north

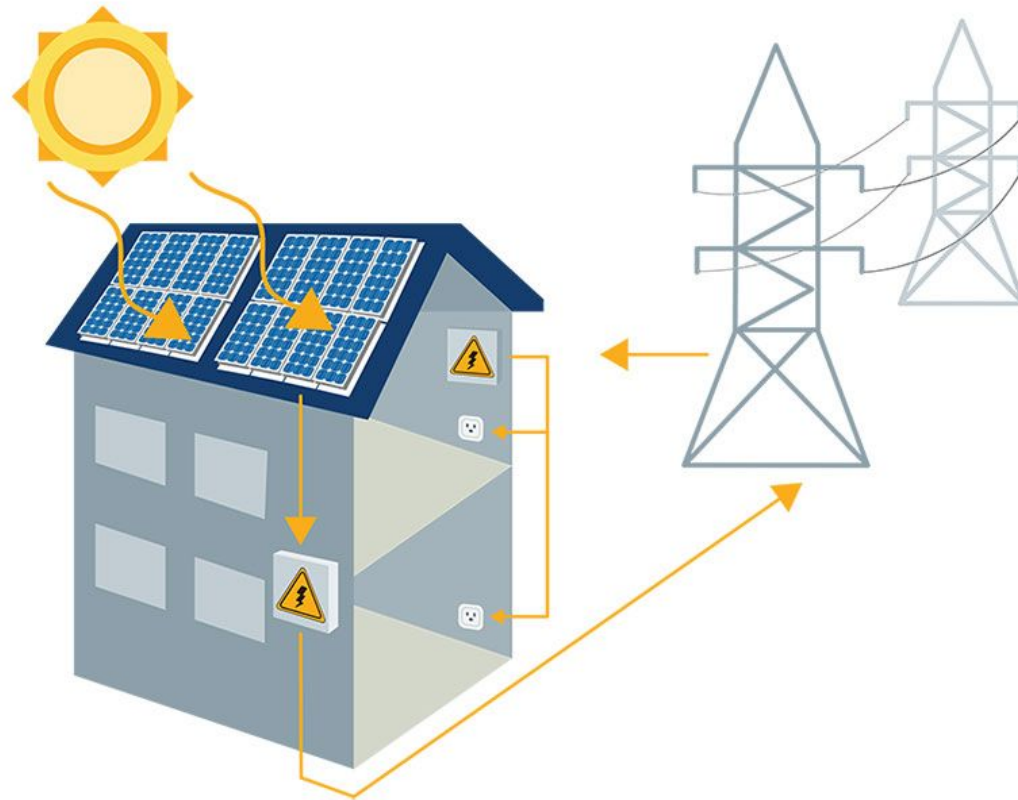
Solar PV Components

Solar PV (photovoltaics): photon (packets of sunlight) and voltaics (generate a voltage)



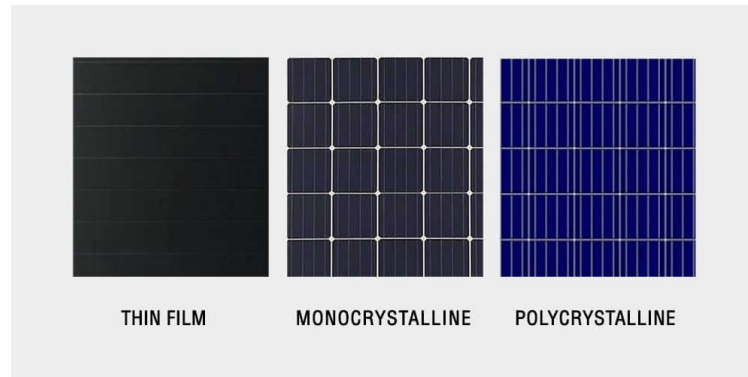
Solar thermal: uses solar energy to heat water

Solar PV Components



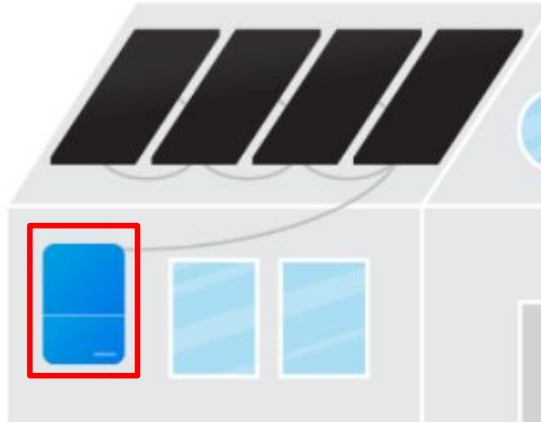
Solar PV Components

Solar panel type	Advantages	Disadvantages
Monocrystalline	<ul style="list-style-type: none">• High efficiency/performance• Aesthetics	<ul style="list-style-type: none">• Higher costs
Polycrystalline	<ul style="list-style-type: none">• Low cost	<ul style="list-style-type: none">• Lower efficiency/performance
Thin-film	<ul style="list-style-type: none">• Portable and flexible• Lightweight• Aesthetics	<ul style="list-style-type: none">• Lowest efficiency/performance

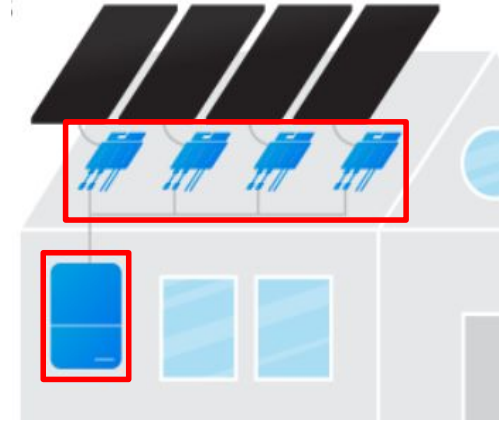


Solar PV Components

String Inverters



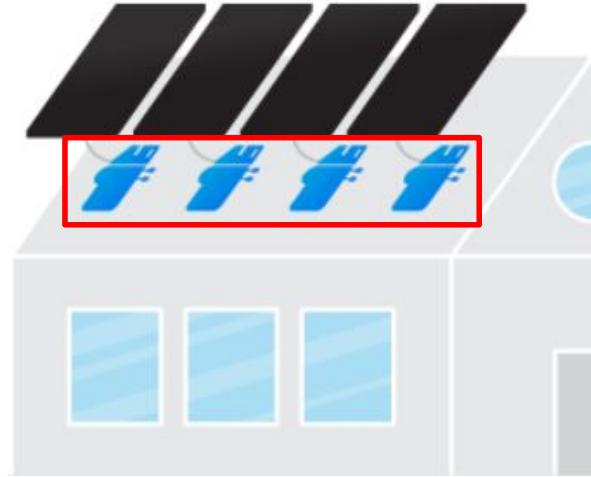
String Inverters with Power Optimizers



Inverter type	Advantages	Disadvantages
String with Power Optimizers	<ul style="list-style-type: none">• Easier system maintenance• Known for durability and reliability• Least expensive option	<ul style="list-style-type: none">• Only offers string-level monitoring

Solar PV Components

Microinverters

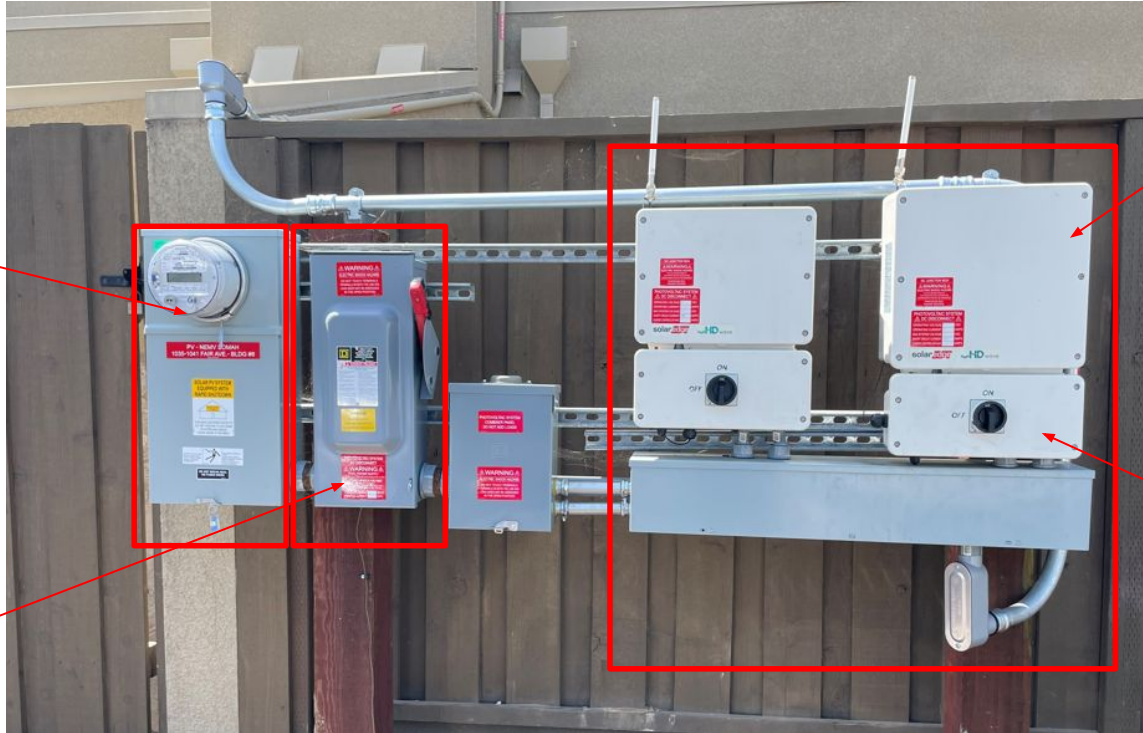


Inverter type	Advantages	Disadvantages
Mircoinverters	<ul style="list-style-type: none">• Power output of each panel is optimized independently• System size can be expanded easily in the future	<ul style="list-style-type: none">• Additional electronics are added on the roof• Most expensive option

Solar PV Components

Net
Generation
Output
Meter

AC
Disconnect



Inverters

DC
Disconnects

Solar PV Components



Solar PV Components





**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

Solar Benefits

Solar Benefits



Save on utility costs



Increase property value



Reduce carbon emissions



Support economic growth



Protect against rising energy costs



Solar Benefits in Real Time



“We are excited for our residents at Sand Creek Apartments, who will be saving nearly \$50 a month on their utility bills. This means more money in their pockets for other necessities such as groceries and transportation.”

– Tom Collishaw, CEO, Self-Help Enterprises



**California
Housing
Partnership**

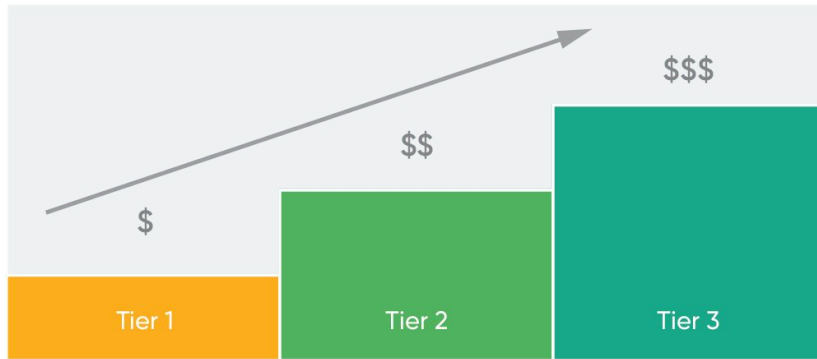
*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

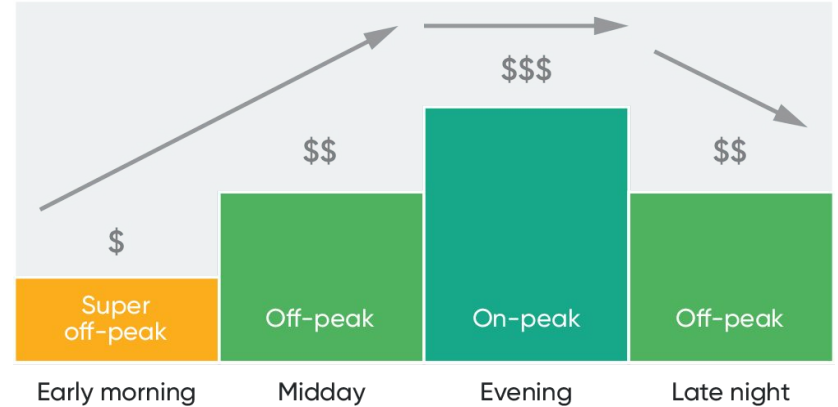
Sharing Solar Benefits with Residents

Types of Utility Rates

Tiered Rate



Time-of-Use (TOU) Rate



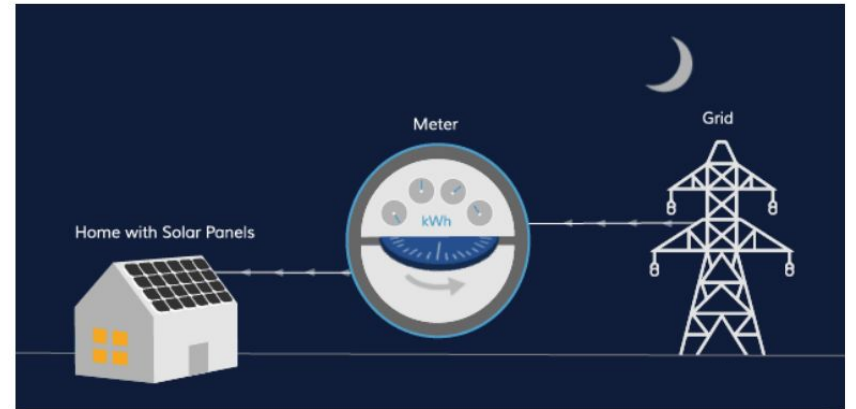
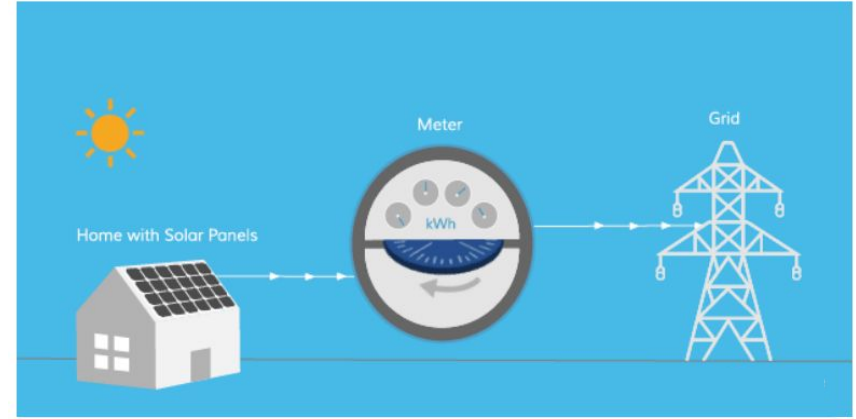
Billing After Solar Installation

- Residents within certain utilities will remain on their existing rate
- Residents in the SDG&E utility territory will be switched to a TOU rate
- Residents may opt out of the TOU plan to a tiered rate
- Common areas will be required to switch to a TOU rate



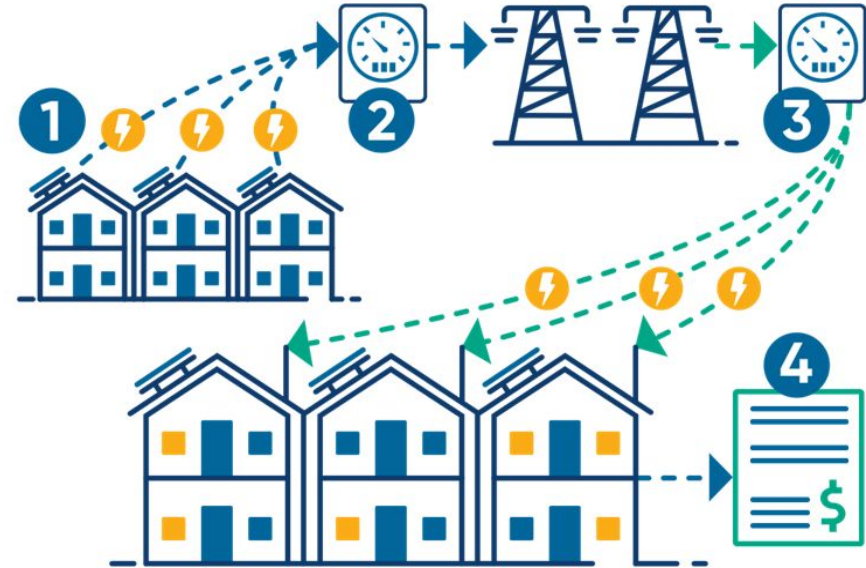
Net Energy Metering (NEM)

Billing arrangement	Features
Net Energy Metering	<ul style="list-style-type: none">• Receive financial credits on utility bills for the electricity that is added to the grid• "Running a meter backwards"• Only billed for the "net" electricity use

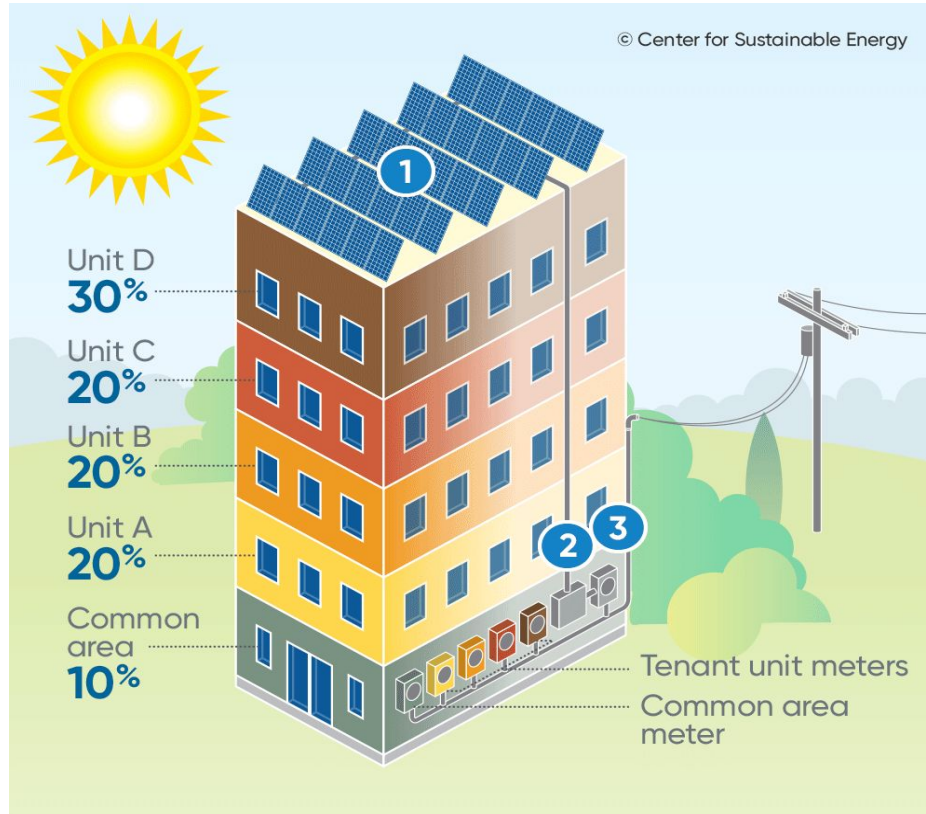


Virtual Net Energy Metering (VNEM)

Billing arrangement	Features
Virtual Net Energy Metering	<ul style="list-style-type: none">• Receive financial credits on utility bills for the electricity that is added to the grid• Credits can be distributed across multiple electric meters• Utility "virtually" allocates the credits to the common area and resident accounts on a predetermined basis

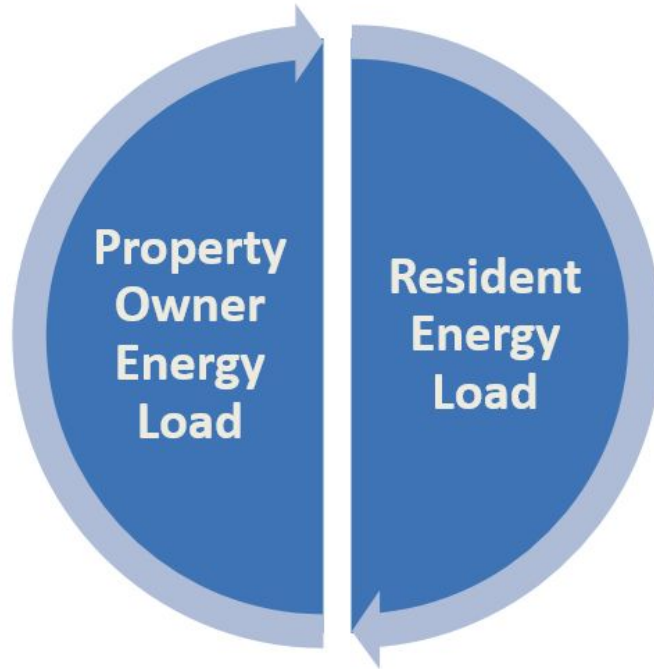


Virtual Net Energy Metering (VNEM)



Property Owner vs. Resident Offset

A multifamily solar PV system is generally broken into two parts:





**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

Pre-Development Considerations

Pre-Development Considerations – Existing Properties

Roofing

- Roofs should be less than 5-10 years old
- Flat roofs tend to work best
- The roof must be structurally supportive
- Solar panels are compatible with most roofing materials

Shading and Orientation

- Should be installed where the panels receive the most sunlight
- Nearby trees and buildings that may provide rooftop shade
- Panels should face south or west

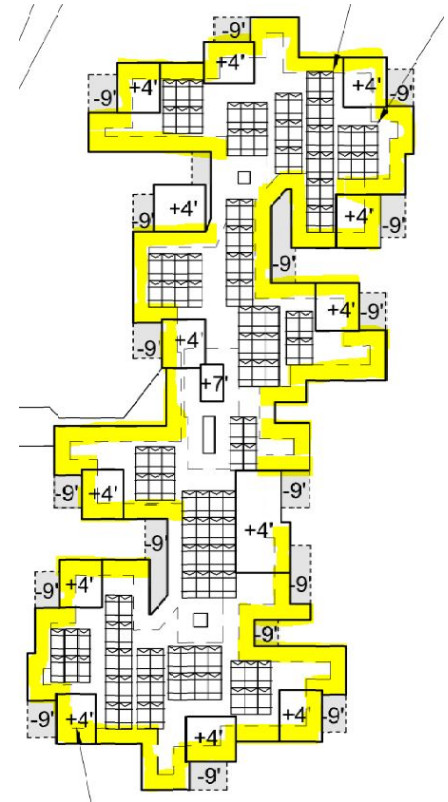


Pre-Development Considerations – Existing Properties

Roof size

Rooftop obstructions

Fire setbacks



Pre-Development Considerations – Existing Properties

Roof vs Carport vs
Ground

Electrical

Energy Efficiency
Upgrades or
Electrification



Pre-Development Considerations – New Construction

- Set expectations with design team to optimize solar from start
- Maximize roof space for a sufficient solar zone
- Minimize shading and equipment obstructions on roof
- Consult a solar contractor and others to correctly estimate the future system's capacity and size
- Plan connections for the future system with electrical engineer and provide adequate space for electrical equipment
- Consult local zoning ordinances that may affect future system installation

Ideal Building Types for Solar

- Low-rise apartment buildings are considered to be the ideal building type
- Low-rise apartment buildings offer more usable roof space



Ideal Building Types for Solar





**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

Solar Process Overview

Process of Going Solar

1. Understand your goals
2. Estimate system size
3. Review financing options
4. Find a contractor
5. Complete site assessments
6. Install your system
7. Ongoing monitoring



Process of Going Solar

How to obtain the estimated historical resident consumption:

Ask the residents	Ask your utility	Use a rule of thumb
<ul style="list-style-type: none">• Residents can identify their apartment's annual consumption from the utility.• They may use their online utility account or call their local utility.	<ul style="list-style-type: none">• Residents can sign an authorization form. Contact your local utility to request a copy of this form.• Or, if your property has 5 or more apartments, you can email your utility's benchmarking office.	<ul style="list-style-type: none">• Resident usage can be estimated by using a calculation of 2 watts per square foot of livable space.• For example, an 800 sq. ft. apartment may benefit from a system size up to 1,600 watts or 1.6 kW.• Apply this approach to all apartment types and add together for a resident offsetting system size.

Process of Going Solar

How to estimate your system size:

- Use an online solar calculator
- Enter:
 - Estimated annual kWh consumption (common areas + resident)
 - Solar hours per day (CA averages 5 solar hrs per day)
 - % offset



ACTUAL ENERGY USE QUOTE

Use this solar calculator to determine a precise system size for your actual energy use.

1. Your kWh used per year (no commas):

2. Solar Hours per Day (see map below):

3. % of Electricity Bill to Offset:

Solar Array Size Estimate: kW

Solar Contractor Selection

- Where can you find multifamily contractors?

CSE/EnergySage	energysage.com/cse-multifamily
CALSSA	calssa.org/member-directory
SOMAH	calsomah.org
CA DG Stats	californiadgstats.ca.gov

- ASK AROUND!



Solar Contractor Selection

Seek multiple bids	Obtain project proposals from at least three solar contractors
Get references	Consult third-party review resources such as the Better Business Bureau
Licensed contractors	Ask for the contractor's state contractor license number and check the licensing board; nascla.org
Insured contractors	Inquire about the contractor's general liability insurance and if they have all the necessary insurance policies



Solar Contractor Selection

Does the solar contractor have a good reputation within the affordable housing community?

How long have they been in business? How many solar systems have they installed? While more is not necessarily better, this will give you some idea of their experience.

Does the solar contractor have experience with designing solar projects for multifamily dwellings? If not, ask why they feel confident taking on your project.

What is the contractor's proposed cost/watt? Again, evaluate several bids to understand the range of costs.

How much money will you save? Whether you are thinking about purchasing your solar PV system or know that a solar lease/power purchase agreement (PPA) is right for you, the first thing you'll want to know is how much money you will save.

How much will you pay up-front? There are all sorts of different solar offers out there, and the payment structures vary significantly.

Does the solar contractor design and install the systems themselves or do they subcontract to local companies? If they do use subcontractors, are the subcontractors licensed and have they undergone background checks?

What about maintenance and warranties? How many different warranties are there total for the system's components and what do they cover? What happens if the system does not produce as much power as was promised? Does the company offer a performance guarantee?

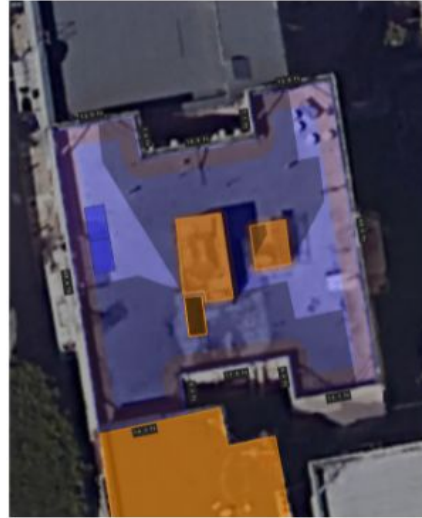
Design

- Satellite imaging and modeling software to "draw" in system designs
- Determines the maximum number of solar panels
- Determines how large of a system is needed and solar panel placement

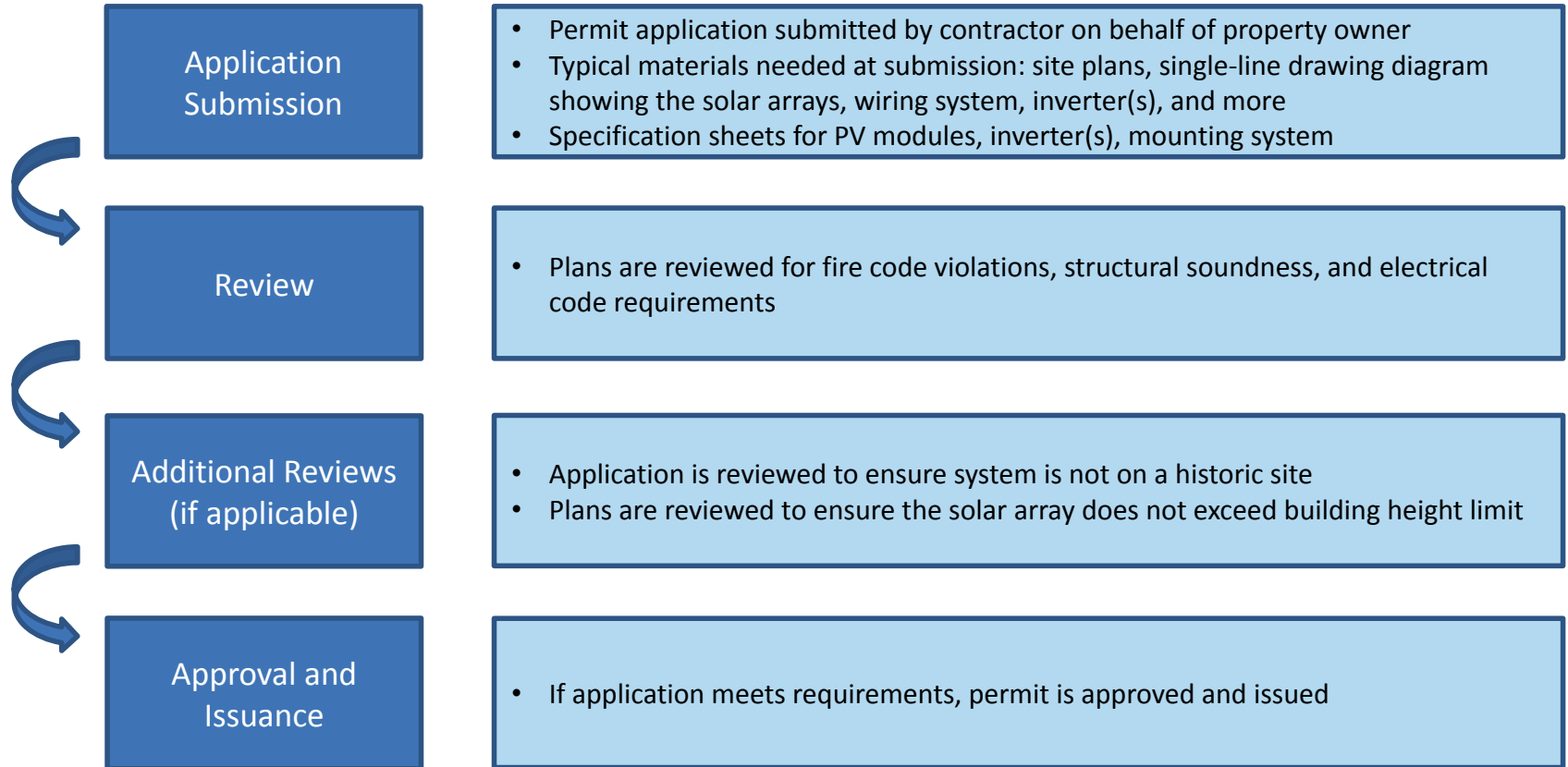


Design

- Shading from trees and other buildings impacts design
- Changes to design based on equipment selections



Permitting



Solar PV Financing Models

There are three main solar PV financing models:

- System Ownership
- Third-Party Ownership
 - Power Purchase Agreement (PPA)
 - Solar Lease

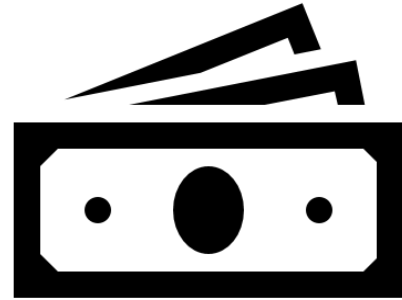


System Ownership

- When purchasing the solar system, customers can either utilize:
 - Cash, or
 - Financing
- Customer pays for the upfront costs and takes on responsibility of the solar system in exchange for reduced or eliminated electricity bills
- Under system ownership, the customer is responsible for:
 - Maintenance
 - Repairs

System Ownership Financing

- For purchased systems, providers can layer:
 - Cash
 - Federal Investment Tax Credit (ITC)
 - Loans
 - Renewable energy rebates
- What is the ITC?
 - A 26% tax credit for solar systems on both residential and commercial properties



2022	2023	2024
26%	22%	10% (commercial) 0% (residential)

System Ownership Considerations

PROS

- Maximized electricity bill savings
- Tax credits can be leveraged
- Own an asset
- Increased property value
- Multifamily rebate programs can offset majority of the costs

CONS

- Requires upfront capital investment
- Owner is responsible for maintenance and repairs
- Performance monitoring services may not be included
- Insurance coverage may need to be increased to insure the system

System Ownership Takeaways

System ownership might be the right option if:

- You want to maximize energy bill savings
- Upfront cost is not an issue
- You have sufficient tax liability to utilize the ITC

Items to consider before purchasing a solar system:

- Equipment warranties
- Performance guarantees



Third-Party Ownership

- Two types of third-party ownership options:
 - Power Purchase Agreement (PPA)
 - Solar Lease
- The customer enters contract with a third-party owner who will be responsible for:
 - System design
 - Permitting
 - Installation
 - Operation & Maintenance
- Customer incurs no upfront solar system costs and agrees to pay a monthly fee

Third-Party Ownership Options

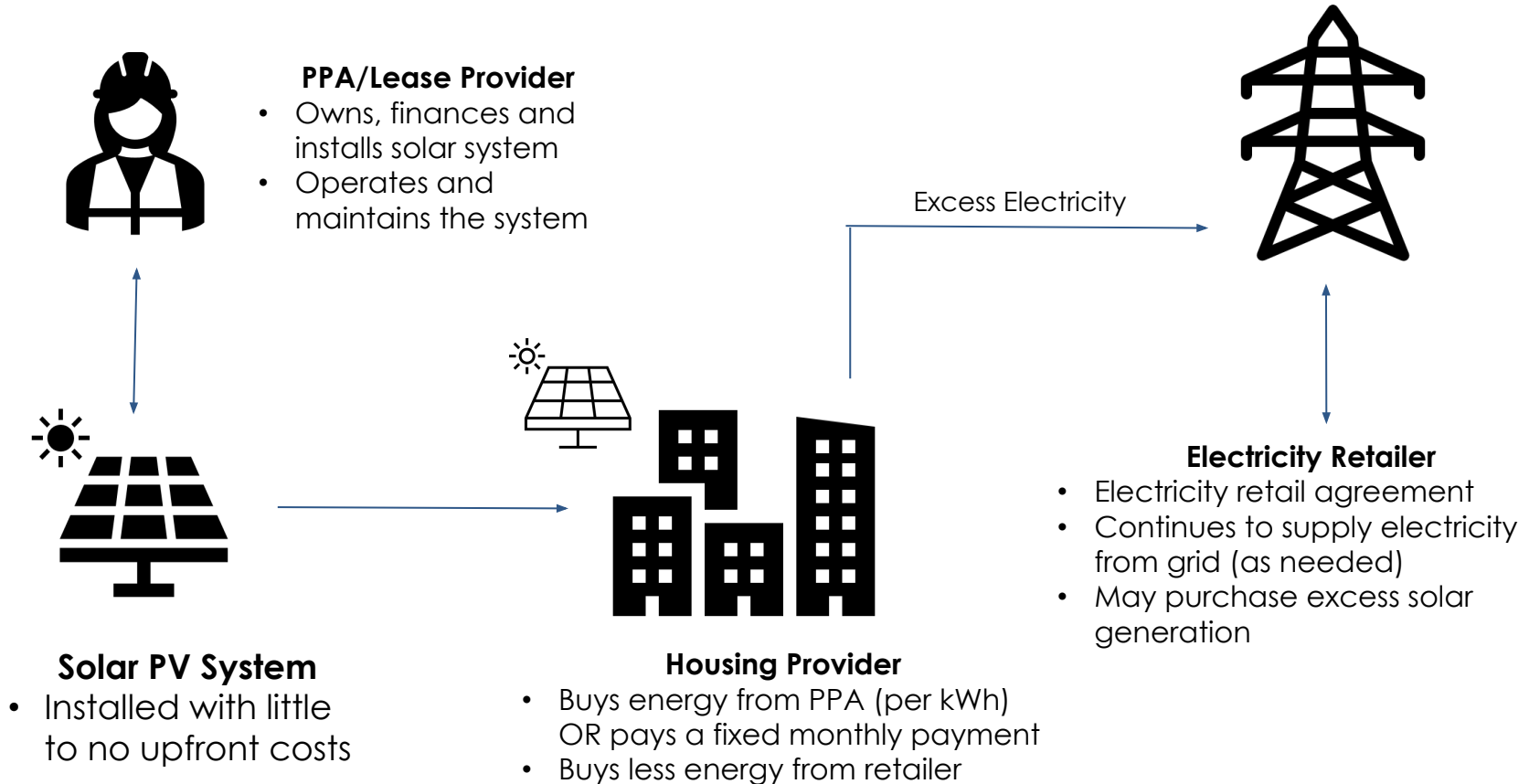
Power Purchase Agreement (PPA)

- Pay for each kilowatt hour (kWh) of solar energy used
- No upfront or maintenance costs
- Contracts will:
 - Have 20-to-25-year terms
 - Include a price escalator

Solar Lease

- Flat monthly fee for the use of the solar system
- No upfront or maintenance costs
- Contracts will:
 - Have 10-to-25-year terms
 - Include a price escalator

How Does Third-Party Ownership Work?



Third-Party Ownership Lifecycle

- PPA and solar lease terms usually cover a term of 10-25 years
- At the end of a PPA/solar lease contract owners can either:
 - Renew the PPA/lease agreement
 - Purchase the panels at a fair market value
 - Remove the PV system



Solar PPA Comparison

PROS

- No or low upfront costs
- Rates are typically lower than electricity bill
- Payments are dependent on amount of energy produced
- Solar contractor is responsible for system maintenance
- Performance monitoring services are included

CONS

- Must enter long-term contracts
- Lower savings potential
- Cannot utilize federal tax credit
- Rates will increase annually
- Longevity of solar provider
- Requires approval from existing lenders
- 3rd-party owning an asset on your roof

Solar Lease Comparison

PROS

- No or low upfront costs
- Rates are typically lower than electricity bill
- Solar contractor is responsible for system maintenance
- Performance monitoring service is included

CONS

- Must enter long-term contracts
- Lower savings potential
- Cannot utilize federal tax credit
- Includes an annual escalator fee
- Longevity of solar provider
- Requires approval from existing lenders
- Third-party owns an asset on your roof

Solar PPA/Lease Takeaways

Solar PPAs/Leases might be the right financing option if:

- You do not have the upfront capital to finance the solar system
- Prefer to not be responsible for maintenance and repairs
- You are not eligible to utilize the ITC

Items to consider before entering a solar PPA/lease:

- Contract terms and escalator fees
- Savings potential
- Site upgrades that need to take place prior to installation

Solar PV Ownership Models: Comparison

	Ownership	Third Party Owned
What you are buying	An asset	A service, usually with the option to purchase
What is included in the purchase?	Generally will not include inverter replacement, O&M, insurance, may include monitoring	O&M, equipment replacement, monitoring
What are the tax implications?	Need to have the tax liability to make use of the ITC	Solar provider has control of ITC and other rebates
What are the risks?	Responsible for O&M	Longevity of the solar services provider
What are the financial benefits?	ROI in the form of reduced/eliminated electricity bills	Little or no upfront cost

Experience With Solar Financing Models

Poll #4



**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

Installation Considerations

Installation Checklist

Typical Installation Process	Role	Associated Fees
Apply for building permit with appropriate city or county agency	Contractor	Check with your city or county for solar permitting fees
Submit interconnection and virtual net metering application to the utility	Contractor	One-time origination fee and interconnection application fee ranging from \$75-\$150 (based on utility)
Install the solar PV system	Contractor	Contract cost
City/county onsite system inspection; submit approval to utility	City/county	-
Utility onsite interconnection/meter inspection	Utility	For virtual net metered systems, an additional utility “net generation output” meter (NGOM) is required
Turn system on upon written permission to operate	Contractor/ customer	-
Receive first utility bill post-installation under virtual net energy metering with solar bill credits	Customer	-

Construction Timeline

- The construction timeline may be influenced by the system size
- Typical construction timeline is divided into three stages:
 - Site development: 3-5 weeks
 - Pre-construction: 6-8 weeks
 - Construction: 4-12 weeks



What is Interconnection?

- Interconnection is connecting the solar system to the utility grid
- Ensures that backup power is available when the system does not produce enough energy to meet demand
- Excess solar energy can be sold back to the utility in exchange for future energy bill credits
- There are two major steps involved in the interconnection process:
 - Applying for interconnection
 - Receiving permission to operate (PTO)

Interconnection Timeline and Costs

- The interconnection timeline and costs vary by the utility and the system size

**Interconnection
Application & Approval**



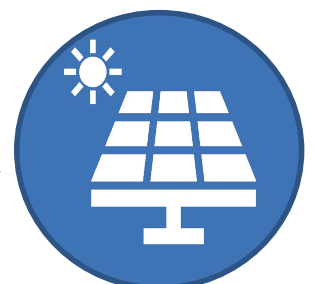
Construction



**Utility Inspection &
PTO Approval**



System Ready for Use!



Applying for Interconnection

- Utilities require solar systems to meet both electrical safety standards and net metering guidelines before granting PTO
- Applications for interconnection must be submitted either by the property owner or solar contractor
- Application requires information on:
 - Property details
 - System configuration (e.g. equipment, system size, production estimates)

Receiving Permission to Operate (PTO)

- PTO is the final step towards connecting to the grid
- Before granting PTO, utilities will send a representative to the property for a system inspection
- During an inspection, utilities will examine the following:
 - Inverter(s)
 - Connection at the electrical panel
 - Functionality of the system
- Following the inspection, owners will receive official confirmation that the system is ready to be turned on



**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

Post-Installation Considerations

Post-Installation Checklist

- Save a copy of your contract and warranty policy
- Apply for federal investment tax credit (if applicable)
- Call your insurance provider
- Monitor your system performance weekly



System Maintenance

- Solar panels typically require minimal maintenance to function
 - Manual cleaning is recommended 2 to 4 times a year
- A drop in energy production is a clear indicator that your solar system may need maintenance
- To examine your system's energy production, you can check your:
 - Electricity bill
 - Performance Monitoring Software

Performance Monitoring Reporting Services

- Performance monitoring services can provide information on:
 - Energy consumption
 - Current and lifetime energy generation
 - How to optimize energy usage
 - Potential solar system damage



How Does Performance Monitoring Work?

- Solar monitoring systems operate through your system's inverter(s)
 - Solar monitoring system used will depend on your system and the type of inverters
- As your system converts the energy into AC current, information about power levels and production is sent to cloud-based monitoring systems
- Mobile apps are the most common way to access performance information

Solar Warranties

	Performance Warranty	Equipment Warranties
What does it cover?	Guarantees the system will maintain an energy output over the course of the system lifespan	Covers the integrity of the system and protects against <ul style="list-style-type: none">• Manufacturing defects• Environmental issues• Wear and tear
Average period of coverage	80% energy production at 25 years	10-12 years
Extension available?	N/A	Yes

How Long Do Solar Panels Last?

- The standard industry lifespan of solar panels is 25-30 years
- On average, solar panel output falls by 0.8 percent each year
 - Decline in solar output is called degradation
 - Example:

Year 1	Year 2	Year 3	Year 4	Year 25
100% output	99.2% output	98.4% output	97.6% output	82.5% output

- Solar warranties include performance guarantees



**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

SOLAR 101 INSTITUTE

Preview of Solar 101 Part II

Solar 101 Institute Part II

EVENT INFORMATION

PART II: Solar PV Implementation Case Studies and Financing Forum

- Date: May 17, 2022
- Time: 10:00-12:00 pm PT

AGENDA

1. Introductions and Housekeeping
2. Context Setting: Recap of Part I
3. Developer Case Studies
4. Breakout Activity
5. Multifamily Solar PV Financing
6. Q&A

Let's Keep in Touch!

- The Partnership's Sustainable Housing team is available to help providers identify clean energy programs for your portfolio
 - Reach out to rdiaz@chpc.net to get started
- Interested in learning more about building decarbonization? [Sign up to receive updates from the Partnership's Sustainable Housing team](#)





**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

QUESTIONS?



**California
Housing
Partnership**

*California's Experts on Affordable
Housing Finance, Advocacy & Policy*

THANK YOU!

Your feedback is valuable! [Complete our survey](#)