# Solar PV Master Planning for Multi-Family Buildings

*An Owner's Guide to*
*Portfolio-Wide Solar Deployment*

*November 2016*

# PREFACE

Sustainable Energy Roadmap is a 20-month effort launched in early 2015 and is focused on supporting San Joaquin Valley communities to set and pursue goals related to water conservation, smart growth, transportation, land use, climate and energy. The program is sponsored by California's Strategic Growth Council through Proposition 84 funding, and led by a collective of partners. For more information, visit: www.SustainableEnergyRoadmap.com

**The Sustainable Energy Roadmap Team consists of:**

The Strategic Growth Council is a cabinet level committee comprised of representatives from the Governor's Office of Planning & Research; California Health and Human Services; California Natural Resources Agency; California State Transportation Agency; California Business, Consumer Services, and Housing Agency; California Environmental Protection Agency; California Department of Food and Agriculture; and a public member that coordinates the activities of state agencies and partners with stakeholders to promote sustainability, economic prosperity, and quality of life for all Californians.

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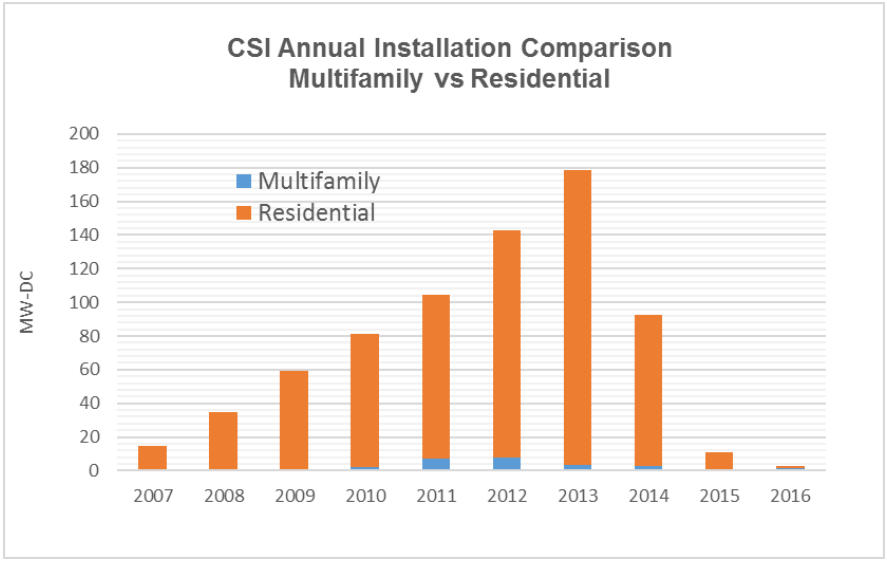
# SECTION I: INTRODUCTION

## A. WHY SOLAR ON MULTIFAMILY HOUSING?

Solar photovoltaic (PV) installations have increased dramatically throughout the residential sector, in part due to new policies designed to drive solar market development, rapidly declining prices, and the resulting economies of scale in manufacturing and installation. However, solar on multifamily housing (MFH) properties has significantly lagged behind this trend. For example, in California, multifamily solar installations account for just ~4% of solar installations, while representing over a third of the population (Fig 1).[1]

Figure 1. CSI Multifamily vs Residential Installations




*Source: California Solar Statistics*

Multifamily buildings offer an untapped opportunity for solar project development in California. Multifamily residences account for 30% of California's households[2] and over a third of total residential energy usage.[3] Other challenging barriers for this market include: the perceived cost of solar, an inability to sell electricity back to the grid through net metering, and the lack of incentives for property owners to invest in energy upgrades for their tenants who reap the energy savings. However, in conjunction with declining in prices, we now see shifting policies, innovative financing methods, and government mandates for solar deployment that offer solutions to these problems.

Figure 2. Multifamily solar energy installation

*Source: NBC San Diego*

The primary benefit of solar on multifamily residences is savings in operational costs. Through solar, multifamily sites produce their own energy, offsetting costs from the more expensive electricity purchased from the utility. These savings are used to recoup solar investments and are typically paid back within a few years. Once the initial investment is recovered, multifamily properties secure essentially free energy for owners and tenants for decades. Multifamily property owners can use

the increased revenue stream for a variety of purposes, including attracting residents by offering lower utility bills or rents, and finding new ways to re-invest in the buildings.

In addition to increasing profitability, providing solar technology to residents of MFH buildings contributes positively to climate change mitigation goals and to environmental justice issues surrounding clean energy access. MFH buildings are home to over 37 million people nationwide[4], yet the overwhelming majority of these residents do not have access to the clean, cheap energy choices that higher income and single-family housing residents typically have greater access to. In response to this inequity, state and federal legislation has been passed, aiming at increasing the amount of solar installations on MFH properties. In 2015, President Obama announced a mandate to provide 300 MW of installed solar on federally assisted multifamily housing.[5] Similarly, in 2015, California passed a bill allocating over $1 billion for a solar rebate program designed to enable multifamily affordable units to adopt solar.[6]

As MFH accommodates a significant portion of the population statewide and nationally, effective planning for solar deployment in this sector can make a significant contribution toward achieving renewable energy and carbon reduction goals. Additionally, as a large portion of MFH residents are low-income, solar on their facilities impact social equity and environmental justice issues as well.

## B. HOW TO USE THIS GUIDEBOOK

The purpose of this guidebook is to create a replicable model for aggregated solar photovoltaic (PV) project development at multifamily housing properties across California's San Joaquin Valley, statewide, and nationally. This guidebook encompasses the general steps required to convert existing multifamily properties into solar energy generating assets that demonstrate leadership in sustainability and equity in their communities.

Sustainable Energy Roadmap (SER) partner communities and organizations are the intended primary beneficiaries. With the release of this guidebook, which contains a case study from the San Joaquin Valley, participating communities have a blueprint for a portfolio approach to solar PV deployment that reduces installed costs and administrative time by leveraging economies of scale from project aggregation.

Aggregated approaches to solar PV project development help accelerate the installation of clean energy generating capacity and the displacement of grid energy, which can reduce greenhouse gas emissions and utility costs for multi-family housing owners and residents.

# SECTION II: IS SOLAR RIGHT FOR YOUR PROPERTY?

## A. WHY SOLAR, WHY NOW?

### Cost Competitiveness

Solar PV technology is becoming an attractive investment for multifamily building owners for a variety of reasons, beginning with the economic sense it makes for multifamily buildings with high electricity costs and particularly when they house low-income residents. Solar prices are in a historic decline, and solar electricity costs have decreased by more than 80% since 2009.[7] At the same time, conventional sources of energy are rising and the electricity retail rates are forecast to continue to increase through the foreseeable future.[8] Because of these price differentials, solar power has already reached *retail rate parity* in many markets, which means that solar energy is comparable or cheaper than utility grid-supplied electricity.[9]

### Incentives at Peak Value

In addition to reductions in costs, there is an abundance of rebates, policies, and financing structures designed to encourage solar adoption in the residential market. Several of these key policies, including federal tax incentives and net energy metering agreements, are currently in full effect. However, these prominent policies are slated to decline or sunset entirely in just a few years. By pursuing solar now, property owners can take full advantage of the incentives available to reduce the costs of solar investments.

### Economic Development & Job Creation

Solar deployment positively impacts property owners through direct financial benefits, as well as the local community by broadening economic stimulus through industry development and job creation. Distributed solar generation fosters local participation in a growing market with high quality jobs.

In 2015, California created 75,000 solar jobs – 36% of total solar jobs nationwide. As a whole, the number of solar jobs in the U.S. grew 123% between 2010 and 2015, and are expected to continue rising as solar PV installation capacity increases. California is projected to add over 14,000 new solar jobs in 2016, a growth of 18% over last year. Comparatively, the total state workforce is expected to grow just 1.1% over the same time period. [10]

In addition, the median wage of U.S. solar installers in 2014 was almost three dollars an hour higher than the U.S. average median wage. The opportunity for high quality employment combined with lower utility bills provides both economic and social benefits for the whole community.

### Carbon Emissions Reduction

In addition to being an economically viable option, solar energy is good for our environment. Solar technology generates electricity without the combustion of fossil fuels, therefore it doesn't emit greenhouse gases (GHGs) and other pollutants into the atmosphere. This improves local air quality, public health, and contributes to global climate change mitigation. Even considering a lifecycle analysis of photovoltaics, carbon emissions are much lower than compared to conventional forms of electricity, such as natural gas, oil, and coal.[11]

This transition to clean energy is an important component of California's GHG emission reduction goals. As part of Assembly Bill 32 implementation, which requires a reduction of GHG emissions to 1990 levels by 2020, it was found in 2013 that 85% of GHG emissions in California came from the energy sector, with about 40% of that from electricity and natural gas consumption.

The bill calls out the need for "Renewable DG (distributed generation, such as rooftop solar) to develop localized energy sources that do not create GHGs."[12] Additionally, the California Renewables Portfolio Standard (RPS), an innovative standard initially adopted in 2002, has set a goal for at least 33% of utility electric service to come from renewable energy sources.[13]

### Energy Independence & Resiliency

There are many ancillary benefits to solar PV as well. Unlike conventional sources of electricity, PV doesn't rely on volatile energy supplies like natural gas and coal. In addition, solar modules are reliable, durable, and require very low maintenance costs. Instead of relying on utility power, solar energy provides a predictable, stable electricity source and rate for the lifetime of the system (25+ years).

When combined with energy storage, an electricity supply is no longer completely reliant on vast infrastructure nor fuel supplies that can be disrupted via natural and political events. This enables a reliable supply of energy in critical times such as power outages or when time of use rates are high.

## B. BENEFITS FOR MULTIFAMILY PROPERTIES

### Owners

As MFH properties tend to be inherently energy-intensive buildings, energy costs can account for a significant portion of operating budgets. Research shows that conservatively, building owners pay on average up to 10% of their annual budget on energy costs, which can be much higher for those that pay for all residential energy use on the property.[14]

Solar enables property owners to ***reduce operating expenses***, which gives them greater flexibility in how they use their budget. These savings can be used to increase the profitability of multifamily portfolios, attracting residents by offering lower utility bills or rents, and reinvesting in the buildings. As an ancillary benefit, property owners can market their building portfolios as sustainable and 'green' living spaces.

### Tenants

Installing solar technology can also help reduce the amount of energy costs for residents of MFH properties. This is important for low-income housing because the tenants may be particularly burdened by their energy costs. The regressive nature of energy costs on this population is well-documented. Research suggests that low-income residents can spend up to 30% of their income on energy costs.[15] Due to the larger proportion of household budgets that low-income residents spend on energy costs, they may find that it negatively impacts the amount of money they have available for other basic needs such as education, transportation, healthcare and other family needs.[16] In some cases, energy costs may be so high that it serves as a barrier to low-income residents in being able to afford certain housing.

## C. CHARACTERISTICS OF A GOOD HOST SITE

Multifamily housing properties are generally characterized by abundant rooftop and parking lot areas, which are excellent sites for solar PV projects.

Figure 3. Multifamily installation at Crescent Park, Richmond

*Source: EAH Housing*

Below we have outlined the key characteristics that make a host site good for solar energy generation. The most important considerations are the integrity of existing roofing, as well as any shading that might obstruct sunlight. If a site has roofing or shading concerns that would make it difficult to site solar installations on rooftop areas, there are alternative arrangements, such as utilizing parking lot areas to install carport solar arrays.

### Roofing

- Roofs should be less than 5-10 years old, as solar modules are warranted for 25 years and typically last longer. Removing solar systems for reroofing is labor intensive, costly, and should be avoided if possible. It's most cost effective to install solar while reroofing.
- Flat roofs tend to be the easiest surface for installing solar and ballasted racking systems do not require roof penetrations. Sloped roofs can also be viable.
- Thermoplastic polyolefin (TPO), ethylene propylene diene terpolymer (EPDM), and bitumen tend to be the easiest and least expensive roofing materials upon which to install solar. Solar can be installed on slate or tile roofs, but it is often more expensive.
- The roof must be structurally capable of supporting the increased load on the roof, in addition to its normal load of snow and other additions.

### Shading

- In addition to reducing the energy generation of shaded modules, shading can also reduce the production from unshaded modules depending on system hardware. Losses from shading can be minimized with the addition of micro-inverters, which are designed to mitigate such losses.
- Solar experts recommend that shading be limited to 10-15% annually in order for projects to make economic sense and qualify for certain incentives.
- It is important to ensure that no major developments, such as the construction of a high-rise building, are expected to occur on adjacent land parcels to the south that could shade the host site roof.

### Electrical

- Assess the integrity of the existing electrical system prior to installing solar to ensure that the system can accommodate the solar energy system.
- Any upgrades to the electrical system should take place prior to installing solar and costs should be integrated into the project budget.
- Ensure that proximity of the solar equipment to infrastructure is close enough to minimize long wire runs, which result in energy losses.

### Utility Considerations

- Net metering valuation structures tend to offer the best return on investment because the excess solar energy is credited to the customer at the retail rate. However, the benefit varies based on the existing utility rate structure.
- Customers with high energy (kWh) rates generally experience the greatest economic benefit from solar power under a net-metering valuation structure. Customers with high demand (kW) rates generally experience the least economic benefit from solar power under a net metering valuation structure without other demand-side technologies, such as energy storage and demand response, to help reduce demand charges.

### Other Considerations

- Potential sites should incorporate the long-term expected life of solar installations, and ensure no future redevelopment plans for 20 – 25 years. As mentioned, parking lots can make great host sites for solar. Additionally, installations can be paired with complementary technologies, such as integrated LED lighting and electric vehicles charging stations.

## D. POTENTIAL CHALLENGES

Solar installations on multifamily housing properties can face a number of unique challenges. Below is an outline of key issues facing the sector, and the best practices and policies that work to overcome such issues.

### Financial Parameters

One of the primary barriers to solar adoption at multifamily housing facilities is the lack of access to capital. In many cases, economic priorities for multifamily property owners and tenants - including energy, housing, health care, and food - can make renewable energy procurement seem unworthy of attention.

For low-income residents, there are several factors that can compound financial consideration for installing a solar energy system. Multifamily tenants and owners may lack adequate credit needed to participate in loan options that can reduce upfront costs and/or lack the necessary tax liability that can allow participants to take advantage of certain tax rebates and incentives. Furthermore, tenants and owners may receive discounted electricity rates through relief programs such as the CARE. These rates, while providing needed assistance to low income residents on their energy bills, can make investing in solar energy systems even more financially unfeasible.

Furthermore, installing solar on large multifamily facilities can be inherently more expensive than installation on single family residences. The additional costs come from a combination of increased construction tools (such as cranes for taller buildings), and multifamily facilities' higher likelihood of needing energy efficiency and/or building upgrades. These factors combined make the scope of a potential project greater for multifamily housing than single family buildings.

To confront some of these financial challenges, there are many direct incentives and financing structures available, such as low and no up-front cost financing measures (such as third party ownership), and extensive direct rebate programs specifically targeted for multifamily properties.

## Split Incentive

One fundamental challenge facing multifamily housing as they pursue solar PV is the lack of incentives for owners of multifamily buildings to invest capital and effort into solar energy upgrades. If the tenant pays their own utility bill and will be the direct beneficiary of any energy savings from the solar installation, how can a building owner receive a payback on their investment? Similarly, while tenants may be burdened by high energy costs, they rarely have the capital or other options for installing solar, which would help reduce their electricity bills. This gridlock dynamic, known as "split incentives", is one of the major obstacles hindering solar energy upgrades on multifamily buildings. Additionally, many tenants have short-term leases that are not compatible with the long-term Power Purchasing Agreement (PPA) contracts or payback periods for solar.

## Overcoming the Split Incentive

There are several policies and best practices in place to help overcome the split incentive problem, and some of these are discussed later in this report. These solutions work by allowing an individual solar energy system to be beneficial to both the property owner and residents living in the facility by equally distributing the costs and benefits to each party.

## Stakeholder Approval

There are likely to be a number of internal stakeholders involved in a solar installation project at a multifamily residential site, and their approval may be required in order to proceed with the project. When preparing for solar deployment, it is important to address all of the questions and concerns of your stakeholders, while simultaneously fostering their excitement for the environmental and cost benefits it will create.

It is recommended to seek board approval early in the process, identifying a board champion to support the project, and addressing any concerns with data if possible. It is a good practice to have very open lines of communication with MFH boards and management regarding all project financing and installation considerations. It is also recommended to leverage positive press regarding how the solar installation will improve energy cost stability.

When communicating with residents about the installation, they will likely to be most interested in understanding how it will impact their energy bills, and whether it might create potential disturbances during the installation. It is a best practice to provide residents with both key information, as well as avenues for voicing additional concerns. It may be necessary to alert residents about the potential need to update leases to account for the costs and benefits of a solar installation or the need for additional agreements with their utility if pursuing virtual net metering or on-bill financing options.

Another key internal stakeholder is the facilities O&M staff, who should be consulted early in the process. They often have valuable insights into the condition of the property and may be responsible for ongoing system maintenance.

## Homeowners Associations

There are a number of levels of regulation to consider when preparing for solar installation on a MFH facility. At the local level, home-owner associations may have aesthetic regulations that impede rooftop solar installation. These associations aim to protect the value of all homeowners within the neighborhood, often by maintaining uniform aesthetic guidelines that restrict rooftop installations. To support increased solar deployment, however, many states passed legislation to protect property owners' rights to independently generate clean energy.

These "solar rights" policies are an important step in promoting solar on regulated neighborhood housing, but it is still important to foster local support. This can be done by holding community association meetings to openly discuss the benefits of solar, to provide information on regulations by an expert, and to present clear guidelines on the best practices for solar installation within that community.[17]

# SECTION III: SOLAR FINANCE AND INCENTIVES

Solar financing options have become increasingly more broad and accessible, and have played an important role in the rapid growth of solar adoption in California. In most cases, multifamily property owners opt for financing options that limit upfront costs. Multifamily properties do not typically have capital reserves or excess operating income to invest in upfront solar costs, and complex ownership structures may make it difficult to add new debt to a property. By choosing a form of financing that reduces initial investment, property owners are relieved of the financial burden and can take advantage of immediate savings. Below are some of the key options for financing solar installations.

## A. COMPENSATION METHODS

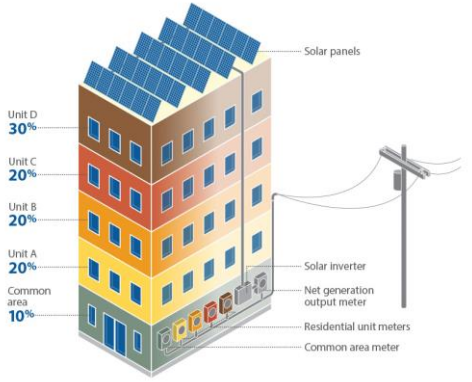
There are several policies and strategies that can be implemented to improve the financial viability of solar installations for multifamily properties, including virtual net metering, green leases, and on-bill financing. These mechanisms are designed to ensure that there is compensation for solar energy generation on multifamily property, therefore helping those who invest in solar energy recoup costs over time. The absence of these policies would make solar adoption much more challenging.

### Virtual Net Metering (VNM)

One of the most important policies for enabling the distribution of solar benefits at multifamily properties in California is Virtual Net Metering (VNM). The traditional practice of Net Energy Metering, often referred to as "running a meter backwards," allows excess solar energy to be exported to the grid and purchased by the utility at the retail rate. If a system produces more than the building uses, credits are allocated to the electrical meter that can be applied to a future surplus in energy consumption. VNM relies on the same principle, but the credits can be distributed across multiple electrical meters – meaning more participants can benefit from a single solar energy system.

VNM works with multifamily properties by having the local utility monitor the solar energy delivered to the grid and 'virtually' allocate the solar credits to the common area *and* tenant accounts on a predetermined basis – without the expensive and impractical wiring connections to be made to each tenants' electrical meter formerly needed in traditional net energy metering. The virtual allocation makes it feasible for the tenants and owners to share the benefits of a single solar energy source – simultaneously reducing common area and residences' utility bills while enabling a diverse revenue stream from those obtaining solar energy credits.

Figure 4. Virtual Net Metering Diagram




*Source: Energy Center*

Because Virtual Net Metering relies on the utility purchasing excess solar energy at the *retail rate,* it is important to investigate a multifamily properties' applicable rate schedule with the participating utility. Differing rate schedules will impact the value of a solar kWh exported to the grid. Often, it is advisable to transfer to a 'solar friendly' rate schedule – one that will maximize the value of electricity generated at the peak time of solar production.

### On-Bill Financing/Repayment

On-bill financing and repayment is another compensation method that allows tenants to take a loan for a solar energy system and repay it over time through their utility bill. There are several different variations of this model, depending on whether the loan originates from the utility (on-bill financing) or a bank (on-bill repayment). Additionally, on-bill repayment allows for a streamlined process as utilities already have a billing relationship with their customers, access to information about their energy usage patterns, and payment history. In some on-bill repayment programs, the payment can be tied to an electricity account rather than the occupant and may be transferable to the next owner or tenant.

### Green Leases

Through a Green Lease, the cost of a solar installation is incorporated into a subdivision of the rent payment. Tenants then make payments each month for the ability to receive the benefits of the solar system, primarily via a reduction in energy costs. Similar to On-Bill Financing, costs of the solar installation can be distributed to each tenant and repaid to the property owner or investor. Coupled with Virtual Net Metering, this results in net savings due to the decreased costs of utility electricity for the residents. This creates a win-win scenario for property owners and residents of multifamily homes; solar investments are recouped and everyone enjoys cheaper, clean energy onsite.

## B. PURCHASE

Direct, upfront cash payment has been a traditional way to finance and own a system, which tends to offer the best return on investment because there are no financing charges involved such as interest and fees. In addition, the system owner can directly take advantage of rebate and incentive programs available for solar installations. However, for tax-exempt entities, it may be advantageous to look into third-party ownership options, such as power purchase agreements, that offer the ability for a third-party owner to take advantage of federal tax-related incentives and pass the savings on via lower cost in the contract.

It is also important to note that as the owner, direct purchasers also take on some liability associated with owning a solar system. Although solar systems are stable and generally require little maintenance, the owner will be responsible for operations and maintenance, such as cleaning, addressing system malfunctions, and monitoring to ensure maximum production. In practice, many property owners do not have the capital to invest in solar system or would like to use their budget elsewhere. This is where loans or third-party ownership becomes attractive.

## C. LOAN

Solar loans are becoming an increasingly convenient way to finance solar installations. Financing through a loan allows the systems cost to be spread out over time and also offers a way to purchase a system without the need for a high upfront payment. Solar loans also allows the owner to directly benefit from the rebate and incentive programs available for solar adoption, which can be used to quickly pay down the over a third of the principal.

To obtain a loan, owners may be required to use an asset as collateral, known as a secured loan, or pursue an unsecured loan. Secured loans typically offer low interest rates, tax deductible interest, and greater long term savings but require using property as collateral and have prerequisites such as a favorable debt-to-income ratio. Unsecured loans are generally easier to obtain, but may require better credit scores. Interest rates can be higher and interest is not tax deductible, leading to a decrease in long term savings.

Many local governments are increasing options for obtaining solar loans, but most are readily available via a variety of sources, including:

- National Lending Institutions
- 'Green' Banks
- Banks and Credit Unions
- Solar manufacturers and installers
- Private solar financing companies

Loans can be arranged with a variety of payment plans and interest rates that can be customizable depending on the customers' situation. Typically, the faster the loan is paid off, the greater the overall savings. This allows flexibility for the customer in deciding if initial savings or a greater overall return on investment is more important.[18]

### Property Assessed Clean Energy (PACE) Programs

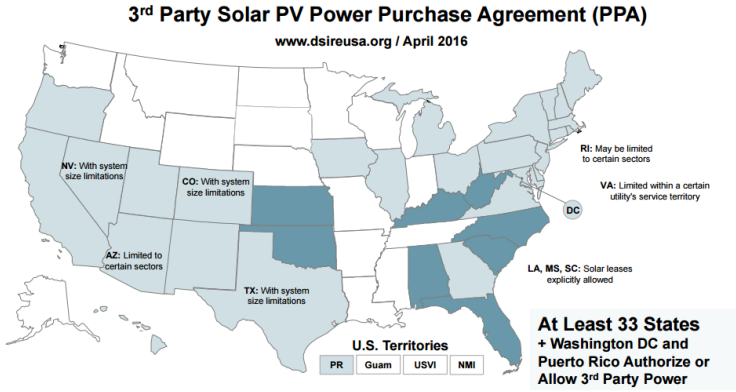
PACE financing enables a property owner finance a solar system over time as a special assessment on the building's property tax bill. Similar to a traditional loan, the property owner assumes ownership of the solar system and is eligible for the tax incentives and other rebates. This reduces upfront costs to the owner by spreading out the payments with low interest rates. The owner saves money because the PACE payments are lower than the previous energy payments to the utility. PACE financing also makes selling a property with solar simpler because the solar system is attached to the property, rather than the owner.

Although PACE financing is not available everywhere, many cities are have adopted it and are extending it to multifamily properties. For example, California is now establishing a Multifamily PACE Pilot program that will enable PACE financing for certain multifamily properties in California. This will help spur energy upgrades in the multifamily affordable housing sector and contribute towards reaching federal and state renewable energy goals for multifamily properties.[1920]

## D. THIRD-PARTY OWNERSHIP

This form of innovative financing is primarily responsible for the success of multifamily housing solar projects. [21] As of 2016, third-party ownership is legal in 33 states. This model enables a separate entity, usually the solar developer, to retain ownership of the solar energy system and be responsible for the commissioning, operation, and maintenance of the solar PV system, while the 'host' site pays for the use of the system. At the end of the TPO contract term, property owners can extend the contract and or opt to purchase the solar energy system from the developer.

Figure 5. Third Party Financing Region




*Source: Dsire.org*

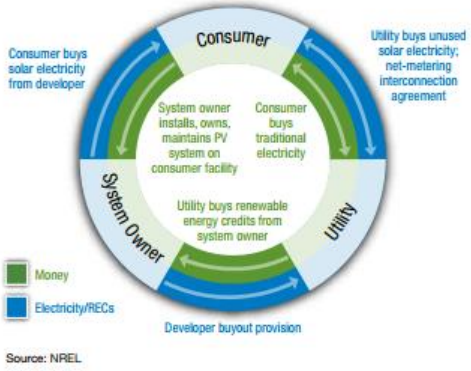
Third-party ownership is especially attractive to multifamily housing stakeholders because it eliminates the upfront cost and mitigates risks associated with installation and maintenance. In addition, this model allows for key tax rebates and incentives, including the Federal ITC and MACRS, to be utilized by the installer, which are usually reflected in reduced payments from the host site. This allows for public entities and other parties with limited tax liability to benefit from the tax breaks and incentives they would otherwise be ineligible to claim. Over 60% of

homeowners opt for this type of financing model.[22] Third-party financing of solar energy primarily occurs through two models: power purchase agreements (PPAs) and solar leases.[23]

### Power Purchasing Agreement (PPA)

Through a PPA, the solar developer retains ownership of the solar energy system and the customer hosts the solar energy system and agrees to purchase the power generated on-site. This price can be fixed for the length of the contract, usually about 20 years, or with an escalation rate typically between 0 – 3%. The host party will pay for solar energy per kilowatt hours (kWhs) at a rate competitive with the local utility or slightly higher than current electric prices, but lower than projected future prices. Fixed PPA's are expected to offer more long-term savings than compared to contracts with escalator rates.

Figure 6. PPA Overview




### Lease

Similarly, in the lease option the developer retains ownership of the solar energy system but the customer will pay for the use of the system over a period specified amount of time, usually 15 to 25 years. This typically involves fixed monthly payments for the use of the equipment. Unlike PPA's, payments for lease agreements are not directly tied to the energy generation of the solar energy system.

## E. REBATES AND INCENTIVE PROGRAMS

### Federal Incentives

*Investment Tax Credit*

The Investment Tax Credit (ITC) is a federal solar rebate program providing 30% of installed cost tax credit for solar installations until 2019, before phasing down to an eventual 10% in 2022. This is a key policy that reduces significant costs of solar installations and is credited for both the dramatic growth in the number of solar installations and solar job creation over the past ten years. MFH property owners can utilize this incentive to reduce the installation cost by 30%. It is important to note that tax-exempt properties that cannot monetize the tax credits can still access them through third-party financing structures, such as PPAs.[24]

*MACRS: Accelerated Depreciation*

Complementary to the federal ITC, the Modified Accelerated Cost Recovery System, also known as accelerated depreciation, is another tax incentive available to solar energy projects. MACRS benefits solar projects by allowing equipment to be depreciated at a faster rate under the tax code. Qualifying solar energy equipment is eligible for a 5-year cost recovery period. Together, the ITC and MACRS can reduce installed costs by over 40%.

*Low-Income Housing Tax Credits (LIHTC)*

LIHTC offers a dollar for dollar tax rebate for private investment in new low-income affordable housing. In addition to the ITC and MACRS, this rebate can be applied towards photovoltaic installations. This federal rebate is usually administered by state regulators. For example, in California, the Tax Credit Allocation Committee (TCAC) is the state agency that allocates Federal Low Income Housing Tax Credits to eligible affordable housing projects. Developers can include renewable energy systems in their projects and receive a rebate increase equal to the

lesser of the net cost of the solar energy system or 5% of the total basis limits.

*Weatherization Assistance Program (WAP)*

WAP is a Department of Energy initiative providing grants to designed to increase energy efficiency, reduce energy costs, and improve the health and safety of low-income housing. Similar to the LIHTC, this program is administered by state regulators. In California, this program is administered by the California Department of Community Services and Development (CSD). Prior to solar installation, WAP funds can be used to reduce the energy demand of a building, therefore reducing the overall costs of the solar project.

## State Incentives

*Multifamily Affordable Solar Housing program*

The Multifamily Affordable Solar Housing (MASH) program is a dollar per watt rebate program designed to reduce installation costs of solar systems on multifamily affordable housing buildings throughout California. Launched in 2009 under the California Solar Initiative (CSI), the MASH program offers generous rebates with the goal of establishing more solar installations in California and reducing energy costs for low income residents. Over the past six years, the program has helped installed over 23 MW of power in over 350 low-income multifamily residences. Additionally, there are another 36 MW reserved and/or under review in multifamily residences throughout the state.[25]

*Multifamily Affordable Housing Solar Roofs (MAHSR) Program*

Also known as Solar CARE, this California program dedicates $100 million per year to low-income tenants of multifamily affordable housing projects for onsite solar installations. Financed from 2017 to 2027, the goal of the program is to establish 300 MW of solar on over 210,000 affordable housing units in California within the next decade. The installations are required to help decrease energy bills for low-income families and benefits all utility ratepayers because the solar offsets (the income) reduces the amount of funds needed to subsidize the California Alternate Rates for Energy (CARE) discounts. To qualify, multifamily housing properties must have at least five units and be identified as both a disadvantaged community and as housing low-income residents by the California EPA.[26]

*California New Solar Homes Partnership*

The NSHP is a program within the California Solar Initiative that provides financial incentives to encourage the adoption of solar and other energy efficient measures for new homeowners. Although not exclusively for low-income participants, this program does allocate a small portion of its funds for multifamily housing developments to aid in solar installations. The incentives are based on the energy produced by the system, known as an Expected Performance-Based Incentive (EPBI). This type of rebate is beneficial because it incentivizes the solar system to be as cost and performance efficient as possible.

To be eligible, the solar energy must be used in part by the residents of building and the solar array must be installed at the same time as the construction of the multifamily building. In addition, there are energy efficiency requirements that must be met in accordance with the California Building Code.[27]

*Solar Property Tax Exclusion*

This policy allows for adopters of solar systems complete installations without a reassessment of their property taxpayers. This incentive is available in California, along with many other states. Without this the property tax exclusion, the value of the solar systems would be subjected to increases in property taxes and would likely hinder solar adoptions because it makes them less cost-effective. [28]

## Local Incentives

*Database of State Incentives for Renewables & Efficiency*

Established in 1995, the Database of State Incentives for Renewables and Efficiency (DSIRE) is operated by the N.C. Clean Energy Technology Center at N.C. State University and is funded by the U.S. Department of Energy. DSIRE is the most comprehensive source of information on incentives and policies that support renewables and energy efficiency in the United States. DSIRE maintains a comprehensive list and summaries of federal, state, local, and utility policies and incentives, which is publicly available at www.dsireusa.org.

# SECTION IV: SOLAR PROJECT IMPLEMENTATION

## A. ENERGY EFFICIENCY UPGRADES FIRST

When planning for the installation of a solar PV system, it is important to first reduce the amount of electricity that needs to be generated by installing energy efficiency upgrades. Solar systems are sized according to the electricity usage of a building and are typically designed to generate less than 100% of a facility's usage. Therefore, reducing electricity usage through efficiency reduces the number of solar modules needed, which ultimately reduces the solar system size, cost, and maintenance required to meet the facility's needs.

The potential for energy efficiency savings is significant across the country. It has been shown that energy efficiency upgrades can reduce energy demand in multifamily buildings by 15 - 30%.[29] While solar can be a capital-intensive investment, energy efficiency represents a low-cost strategy to decrease building energy demand with shorter payback periods. Additionally, efficient buildings with limited space on-site to install solar panels are able to cover a greater portion of their energy needs.

Typical energy efficiency measures include a mix of high-efficiency products and building design improvements. Potential upgrades include interior and exterior lighting, HVAC systems, domestic hot water systems, weatherization and insulation of building envelopes, and a variety of appliances. Additionally, behavior-based energy efficiency has very few (if any) upfront costs.

To begin an energy efficiency upgrade program, it is important to first establish an initial benchmark of energy consumption. This often involves collecting energy usage data and performing an energy audit to analyze the potential energy saving opportunities.

One of the best tools for energy benchmarking is the Energy Star Portfolio Manager, which allows building owners to measure and monitor energy consumption in buildings. The EPA's Energy Star program also provides professional assistance. These energy auditor partners can quickly identify, prioritize, and implement custom energy efficiency projects for each building.

Finally, research energy efficiency rebate programs offered by your local utility. To fulfill energy efficiency goals, utilities and governments often offer rebates and incentives to increase the efficiency of their service areas. In California, there are a multitude of programs designed specifically to aid in energy efficiency measures within multifamily properties, including the statewide Multi-Family Energy Efficiency Rebate Program and Energy Upgrade California for Multifamily, as well as many other programs implemented at a regional level.

### Does Battery Storage Make Sense for You?

Incorporating battery storage with photovoltaics is quickly emerging as a viable option to increase the benefits of multifamily housing solar installations.

Energy storage technologies offer the ability to store the solar energy onsite and disperse it according to a buildings' needs. Although it usually increases initial costs, energy storage techniques can increase savings by mitigating the risks from unfavorable changes in the net energy metering mechanism and, in some cases, reducing costly peak demand charges. Amid changing net metering agreements and rate schedules, independently storing and utilizing solar energy onsite may be a solution to preserving the value of solar investments. In addition, solar-plus-storage technologies allow the ability to provide clean,

reliable power during an emergency. To determine if incorporating battery storage makes sense for your multifamily portfolio, talk to a solar professional about your site's energy usage, rate schedule, and long-term energy goals.

## B. ESTABLISH SITE PORTFOLIO

There are many factors that determine if a site is viable candidate for installing solar. These includes solar resource, orientation, tilt, physical space for modules, and potential shading issues. Correctly siting solar PV installations is key to designing efficient and cost-effective projects. As the host you should also keep in mind that the array will be there for 25+ years when considering where it can be installed.

### Preliminary Assessment

First, determine the available space for your install. This can include obstruction free flat roofs, pitched roofs, and carport areas. Major considerations should be given to the area's orientation and tilt. In the northern hemisphere, solar PV is most efficient facing 15 degrees east of south to 45 degrees west of south and tilted from horizontal at an angle approximately equal to the site's latitude. Correct tilt isn't nearly as important as ensuring the panels have exposure to the southern sky.

Identifying shading obstacles is the next step in determining the best site selection. Even a small amount of shading has the capacity to severely reduce module performance. It is extremely beneficial to avoid and/or mitigate shaded areas prior to siting solar arrays. Many industry standard tools, such as the Solar Pathfinder, can be used to determine annual shading patterns. Key parameters to follow include ensuring solar access between peak sun hours, usually from 9 a.m. to 3 p.m.

### Rooftop vs. Carport Systems

Most solar installations applicable to multifamily properties are one of two system types: rooftop or carport. Rooftop is usually the cheaper and most appropriate place to site solar PV. The arrays can be installed on either pitched or flat roofs. While most solar energy systems are sited on roofs, concerns such as age, structural integrity, or obstacles from pre-existing equipment can necessitate siting the solar energy systems elsewhere.

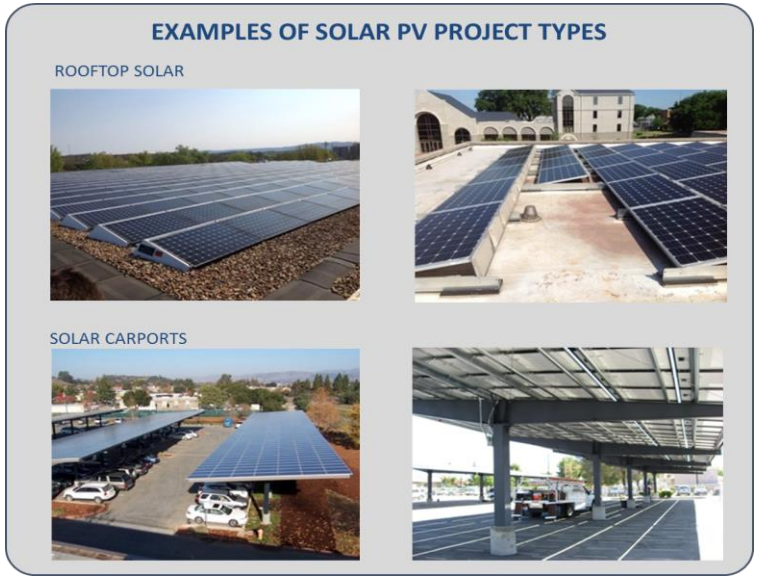
When these issues arise, a potential alternative for installing solar is the carport structure. Carports are an increasingly popular type of installation. In this case, the solar PV is installed on raised structure forming a canopy of modules over parking lot areas. Carport installs are usually slightly more expensive because of the extra substructure needed, but also provide the ancillary benefit of shaded parking. In addition, these structures can turn an unproductive asset – parking lot space – into a revenue stream.

The choice for what type of installation to pursue is usually driven by project goals as well as the layout and viable space of the property. One install type may be easier to install or more cost-effective at a given property; a project developer or consultant will know pretty quickly when looking at a property what is likely to be the optimal system type.

### Determining System Size & Energy Offset

Once a viable installation area has been located, determine how much capacity the available space can hold. On average, efficient solar PV modules will produce ten watts per square foot of solar panel area. Therefore, a rule of thumb that can be used to quickly gauge potential system size in kilowatts (kW) for a given rooftop or carport area is to divide square footage by 100.

There are also user-friendly, online tools to develop initial estimates of solar potential, including capacity (kW), energy production (kWh), and electricity offsets. This is typically performed remotely using satellite imaging and solar mapping tools, which estimates the availability of space and identifies any potential shading and obstruction issues. In addition, it allows for inputs that effect solar PV, such as geographic location, weather patterns, and solar radiation data to approximate the amount of energy that could be generated from the sites.




*Source: Optony, Inc.*

The most popular tools include PVWatts and Helioscope, which can be accessed online for free. These tools can be used to determine if an area has the capacity and potential energy generation needed to deliver a viable for solar installation. In many cases, this preliminary effort will rule out any sites that do not meet the minimum requirements for solar PV.

## Data Collection

*Billing Information*

In order to optimize system size and design, it is vital to collect 12 to 24 months of energy billing data in order to establish baseline energy consumption. This information allows potential project developers to calculate the average electricity demand and anticipate seasonal fluctuations in energy use. The combined twelve-month energy use, in kilowatt hours (kWh), is known as annual energy usage. KWh is the unit primarily used by the energy provider for pricing the electricity charges. The billing documents will also contain key information about a properties' applicable rate structure, usually a tiered or time-of-use rate. These are important to understand because they will impact the value of a solar kWh produced. In addition, the property may be eligible to transfer to a more solar friendly utility rate, which may boost the economic benefits of the installation.

*As-built drawings for buildings*

In addition to the energy billing data, it is necessary to gather as-built drawings of potential buildings to be included in the project. As-built drawings depict the current specifications and working drawings, showing the exact dimensions and locations of the structural and electrical elements in the building.

Using these drawings ensures the roof area or other installation site is capable of handling the desired system size as well as verifying that the structure is capable of handling the additional weight of a PV system. In addition, it allows for project developers to anticipate obstacles and shading features such as chimneys, vent pipes, HVAC systems, and other architectural features that affect PV implementation.

## C. INVESTMENT GRADE FEASIBILITY ASSESSMENT

Expand on the initial prescreen with an investment-grade feasibility assessment for your preferred sites of solar installation. A feasibility assessment extends the scope of the initial evaluation to provide a comprehensive analysis of project economics, energy production potential, financing options, and technical consideration across the entire portfolio of potential sites.

At a high level, the assessment will provide recommendations and solutions that reduce the risks from sub-optimal planning and helps maximize return on investment. Key components of a feasibility assessment include:

- Detailed on-site solar site survey with electrical and structural capacity review
- Identification of site-specific system and technical risks and opportunities
- Detailed economic analysis in the context of overall goals
- Selection and prioritization of sites based on strategic objectives (i.e., energy offset goals, location visibility, utility cost reduction, etc.)
- Evaluation and recommendation of financing mechanisms and incentives
- Project cost benchmarking

It is recommended to have a feasibility assessment conducted by a technical solar consultant who can provide guidance on all aspects of the solar project. The assessment is key because it is used to evaluate projects from potential developers in the next stage of project implementation. A feasibility assessment will greatly enhance the quantity and quality of proposals received from potential solar vendors.

## D. SELECT A PROJECT DEVELOPER

### Request for Proposals

Once the appropriate sites for solar installations have been prepared via the investment-grade feasibility assessment, it is time to select a project developer. This process can be simplified by issuing a solar request for proposal (RFP). An RFP is a solicitation method that is used obtain competitive bids from potential project developers to determine who is best suited for the project completion, including the design, procurement, installation, and commissioning of a solar project. There are many benefits to utilizing the RFP process, such as:

- Identify and communicate the project goals and requirements
- Select the most appropriate project developer
- Create competition and negotiate for a lower project cost
- Determine project management milestones and a realistic timeline

RFP's can be prepared to include multiple multifamily property sites concurrently. This aggregated approach reduces administrative time and decreases the cost of the solar installations by leveraging economies of scale. The RFP can also be issued for various financing options, allowing participants to compare pricing from different methods.

The RFP will provide an overview of project goals and desired system attributes and components. Details will vary on a project by project basis, but key provisions to include are:

*Technical Specifications:*

- Require information on the proposed technical approach and system equipment used. The RFP should name each of the listing

agencies, code standards, and warranties that must be complied with
- Focus on outcome-based RFP's with Performance Guarantees to ensure system quality and allow more flexibility in system design
- Require pricing estimates for the production lifecycle to allow bid reviewers to easily compare bids
- Require monitoring to ensure system quality and to demonstrate benefits to the community

*Permitting, Interconnection, and Financial Incentives Responsibility*
- Make obtaining the required permits, interconnection agreements, and applications for financial incentives the responsibility of the developer

*Workforce Qualifications and Goals*
- Verify past experience and require qualifications to determine the quality and financial stability of potential developers.
- If there is a goal to provide workforce and/or community development in the region, any requirements should be included here.

*Operations and Maintenance*
- Although solar is relatively maintenance free, every installation should have an O&M Plan.
- Outline responsibility of operations and maintenance and require training and O&M manuals for the responsible party.

*Project Timeline and Milestones*
- Require a timeline of major project development and schedule meetings in which progress can be checked.

## Understanding Terms

In order to fully evaluate contracts and proposals, it is important to have a base understanding of some common terms typically encountered in solar procurement.[30]

- *Contract Term*: Most PPA and Lease contracts are 5 – 20 years. Warranties for other PV components, such as panels and inverters, should extend 25 years and 10 years, respectively.

- *Buyout Options*: Most third party financing options will allow for participants to purchase the system after a certain point in the term agreement.

- *Utility Rate Projections*: Many solar contracts will estimate potential savings based on the utility rate projections over the lifetime of the system. Typically, the increase in utility electricity is estimated around 3%.

- *Escalation Clause*: Most third party ownership models will include an escalation rate in the contract, typically between 1 – 3%, that increases per year. Lower escalation rates typically increase savings over time, but may hinder immediate savings.

- *Production Estimates*: This specifies the amount of energy the system is expected to generate. It is important because it will ultimately determine the value of the solar energy system.

- *Minimum Production Guarantees*: Most third party ownership contracts should include a minimum production guarantee, typically in kilowatt-hours, that the system must generate. In cases where production is less than the contract agreement, the owner of the system must provide compensation.

- *Operations and Maintenance*: In a PPA or lease, the installer is typically contracted for any O&M issues, but it is important to specify the responsibilities beforehand.

- *Building Ownership Transfer Provisions*: This will outline the process of solar energy system obligations in case of a change in building ownership.

## Hire a Solar PV System Expert

Property owners and agencies who have expertise in developing request for proposals may be able to complete this process on their own. Sample RFP's are available online and can be used to draft an initial solar RFP. For participants unfamiliar with renewable energy procurement and/or RFP creation, it is recommended to hire independent, technical consultant who can manage the process, including RFP assistance in document creation, system specifications, and statements of work. This can remove administrative burdens and ensures a quality solar RFP creation and evaluation.

## Evaluating Proposals

Following the solicitation period, bids are evaluated according to the goals of the issuing agency and a vendor is selected. The evaluation process is best accomplished with a detailed scoring matrix of evaluation criteria that match project goals. Although there is no standard procedure regarding evaluating proposals, it is best practice to develop and weight the criteria according to project goals and stakeholder feedback during the RFP design phase. An independent, technical consultant is recommended to assist in the evaluation phase. After the bids are reviewed, contracts are then negotiated with potential vendors. Once a vendor has been selected, a "Notice to Proceed" can be issued.

## Construction Management

Once the Notice to Proceed is given, the vendor will prepare the means and methods by which the project will be constructed. Typically, a construction management team will also prepare an overall project scheduling and provide periodic updates to stakeholders involved in the project. It is important for stakeholders of multifamily properties to have a hands on approach to construction management, as may impact normal facility and tenant operations on a day to day basis. The process will vary greatly according to size and scope of the project, but the typical construction development phase is divided into three stages:

- Site development: 3 – 5 Weeks
    - Consisting of a site audit and acquiring necessary conditional permits needed to host the construction team and equipment.
- Pre-construction: 6 – 8 weeks
    - Consisting primarily of design review, building and utility permitting, and materials procurement. This includes obtaining necessary PV equipment, finalizing array layouts, electrical, and mechanical designs, and obtaining city and utility permit approvals.
- Construction: 4 – 12 Weeks
    - Construction is mobilized at this stage. Necessary areas are surveyed and limited to outsider access, and any site preparation activities, such as tree removal, are conducted at this stage. Then the PV equipment, components, and electrical work are carried out to design specifications. Once installation is complete, the project moves into project commissioning phase.

## E. PROJECT COMMISSIONING

Commissioning is a key process designed to verify the quality of installed PV systems. At a high level, the process ensures that the owner's requirements have been met and ensures that systems are operational, safe, and performing as expected. As one of the last steps in project implementation, it should allow observation and participation from the multifamily property owners and/or representatives. Commissioning is beneficial to project developers and participants by facilitating a prompt project closeout.[31]

Commissioning should be outlined in the RFP process and will include required documentation, checklists, testing procedures, and performance testing. It is also important to designate commissioning responsibility and specify a timeline of the process. Contracting a technical consultant for commissioning is highly encouraged to offer independent results and insights.

Most of the PV system commissioning will occur after installation is complete and before project closeout. It should include the following elements:

- Verify that the installation is complete, safe, and performing as expected.
- Document as-built conditions.
- Complete any required documentation.
- Train the host of system on operations, including safety, maintenance, and monitoring

### Performance Testing

One the most important aspect of commissioning a PV system is evaluating whether it is performing as outlined in the contract. To do this, the system should be inspected and tested under load to ensure the expected performance matches the actual performance. To verify this, several electrical tests are needed, including: insulation, open circuit string voltage, string current, and inverter power. Performance testing is especially important for PPA contracts because the performance will dictate the amount of power purchased from the PV system.

### Training

As part of the commissioning process, the vendor should offer educational training of the newly installed system. This should be performed on site and give training on all aspects of operation, including how the PV systems work, what procedures to follow in an emergency situation, maintenance procedures, and successful monitoring protocols. Monitoring is a critical component of the training. Before the project closes out, participants will need to learn how to access and understand system monitoring, how frequently to look at it, and how to interpret any deviations from normal output. If the monitoring is web based, participants will need to know website URL's and passwords. Lastly, training should review O&M manuals, maintenance contracts, and warranties.

# CASE STUDY: SELF-HELP ENTERPRISES

Self-Help Enterprises (SHE) is a nationally recognized community development organization whose mission is to work together with low-income families to support sustainable, healthy, and vibrant communities across eight counties in the San Joaquin Valley – Fresno County, Kern County, Kings County, Madera County, Mariposa County, Merced County, Stanislaus County, and Tulare County. Throughout these eight counties, the group provides affordable multifamily housing to assist low-income residents and farmworkers. SHE manages 27 multi-unit properties offering over 1,300 affordable units to support disadvantaged communities.

Self-Help Enterprises is a committed leader in building sustainability efforts. Each SHE property is built with a variety of energy efficient measures to meet or exceed California's stringent CALGreen energy code. In addition, Self-Help Enterprises initiated low cost renewable energy strategies through a partnership with Grid Alternatives, a nonprofit dedicated to providing free solar installations on low-income properties. This endeavor has brought clean solar energy to more than 100 Self-Help Enterprise units throughout the San Joaquin Valley.

To expand on their success in sustainability and to capitalize on untapped multifamily solar potential, Self-Help Enterprises launched an initial feasibility assessment investigating solar deployment on all 27 low-income multifamily housing properties. Installing solar on these facilities will increase clean energy usage at these properties and reduce operating costs for more than 300 buildings and 1,300 individual tenant living spaces. This will increase Self-Help Enterprises' ability to provide affordable housing, decrease costs to their tenants, and will help fulfill Self-Help Enterprises' mission of sustainability for their residents. The preliminary report on SHE's multifamily housing properties provides a foundation for establishing a strategic approach to aggregated solar opportunity identification. It also serves as the first step to future feasibility assessments, data analysis, and solar deployment planning.


*SHE Multifamily Property Locations*

## Property Portfolio

The Self-Help Enterprises multifamily residences represented in the solar feasibility study include 27 multi-unit (>45 units on average) properties across the San Joaquin Valley region. The properties are characterized by high energy usage associated with multifamily residences, as well as an abundance of unshaded, viable space for rooftop and carport solar deployment. Typical of these building types, the combined energy use of multiple building occupants and common areas leads to a substantial overall building energy load. The annual electricity consumption ranged from 3,000 kWh to 710,000 kWh, with an annual median tenant electricity consumption of 200,000 kWh, and an annual median owner electricity consumption of 30,000 kWh.

## Preliminary Solar PV System Design

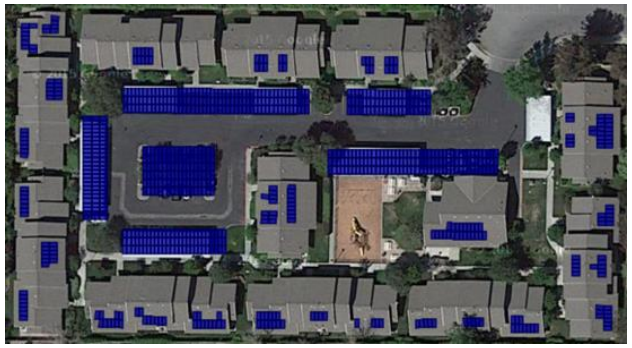
The pre-screen report developed for Self-Help Enterprises identifies areas of viable solar implementation and incorporates energy usage from each site. The findings determined the most beneficial installations comprised of a combination of rooftop photovoltaic (PV) and solar carports, however, some locations utilized only carports.

In accordance with best practices, recommended system sizes were based on an 85% offset of energy usage in the common and tenant areas. This sizing allows for energy bill reductions of up to 95% (with the remaining 5% being fixed costs), through the Net Energy Metering mechanism. It also reduces the risks of an oversized system and incentivizes future energy efficiency upgrades. The onsite solar arrays were designed to offset both the owner's power usage from the common areas of the building – community rooms, hallways, and stairwells, as well as the individual tenants' electricity consumption.

## Results

Ultimately, the multifamily properties were found to be able to accommodate an average of 275 kW of solar power per property, but will only need to install 64% of that capacity (176 kW) in order to achieve the recommended 85% electricity offset. In total, the recommended solar installations would:

- Deploy over 4.9 MW of solar power on multifamily properties
- Generate over 7.4 million kWh annually
- Mitigate over 3,100 metric tons of carbon dioxide per year



*Almond Court: Preliminary Solar PV System Design*

Implementing solar on Self-Help Enterprises multifamily properties is a viable option to reduce costs, and achieve environmental, economic, and social sustainability throughout its multifamily communities. The recommended amount of solar to be developed would benefit the environment, significantly reduce electricity bills for residents, increase housing affordability, and act a proponent of environmental justice to low-income communities through access to clean energy.

**Contact Self-Help Enterprises: 8445 W. Elowin Court, P.O. Box 6520, Visalia, CA 93290**
**Phone: (559) 651-1000 | Fax: (559) 651-3634 | www.selfhelpenterprises.org**

# ABOUT US

## About Optony

Optony Inc. is a global research and consulting services firm focused on enabling government and commercial organizations to bridge the gap between clean energy goals and real-world results. Optony's core services offer a systematic approach to planning, implementing, and managing commercial and utility-grade renewable power systems, while simultaneously navigating the dramatic and rapid changes in the solar industry; from emerging technologies and system designs to government incentives and private/public financing options. Leveraging our independence, domain expertise and unique market position, our clients are empowered to make informed decisions that reduce risk, optimize operations, and deliver the greatest long-term return on their solar investments. Based in Silicon Valley, Optony has offices in Santa Clara, Washington DC, Chicago, and Beijing.
optonyusa.com

## About Strategic Energy Innovations

Strategic Energy Innovations (SEI), a nonprofit organization established in 1997, creates green communities by designing sustainability programs around the four key sectors that make up the foundation of all communities: education, housing, government, and the workforce. And because we understand the many facets of sustainability, we're able to see the big picture and pinpoint opportunities to help these communities reach their goals. Under the leadership of our creative and resourceful team, our clients reduce their consumption of natural resources and enjoy quantifiable savings.
seiinc.org

## About Colorado Energy Group

Founded in 1997, CEG is a customer-focused strategic energy planning advisor to governments, utilities, homebuilders, developers and energy efficiency and renewable energy providers and suppliers. Headquartered in Boulder, Colorado, CEG has satellite offices in Stockton, CA, Dallas, TX and Washington, DC. CEG is known for their energy efficiency and solar *Best Practice* implementation experience with industry and local and state governments, relationship-building and facilitation services, stakeholder engagement strategies, codes and standards knowledge, writing expertise, survey capabilities and the integration of clean energy technologies within the built environment.
coloradoenergygroup.com

# Collaborate with Us

This guidebook was created by the Sustainable Energy Roadmap (SER) program through funding by the California Strategic Growth Council. The purpose of this guidebook is to create a resource for aggregated solar PV project development at multifamily housing properties across California's San Joaquin Valley, statewide, and nationally.

To learn more about the Sustainable Energy Roadmap endeavors and to contact us directly, please visit my.cleanenergyroadmap.com/partner/sanjoaquinvalley

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