

Guide to

Going Solar



Together, Building
a Better California





Now featuring
solar water heating

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This guide is for utility customers of Pacific Gas and Electric Company only. Get information about solar in the San Diego Gas & Electric Company and Southern California Edison service territories at gosolarcalifornia.com.



Tap the state's most abundant natural resource—the sun.

California: Leading the Way to a Brighter Future

The California Solar Initiative

Since its launch in 2007, the California Solar Initiative (CSI) has been helping make clean and reliable energy from the sun even more accessible in a state that has long been a national leader in environmental stewardship.

With assistance from rebates provided by the CSI Program, more than 2.3 gigawatts of solar generation have been installed since 2007; and many of your friends, neighbors and relatives now tap into the state's most abundant natural resource—the sun—for their power.

Due to overwhelming response in PG&E's service area, program incentives are no longer available. Federal tax incentives and/or other credits may still be available to help reduce the cost associated with installing a solar system. PG&E recommends that you consult with a tax professional to determine eligibility.

Purchasing a solar photovoltaic (PV) system for your home or business is a smart investment, and this guide can help you make educated decisions to maximize that value. While this guide provides an easy-to-understand overview of solar energy, you should contact an experienced solar contractor for comprehensive technical or economic considerations unique to your energy needs.

By "going solar," you reinforce California's commitment to a healthy environment and a strong economy, leaving a legacy of clean energy for generations to come.

Did You Know?

Solar electricity is no different from the electricity delivered by your local utility. Solar generation systems connect directly to your electrical panel or circuit breaker box and interface seamlessly with your utility power.

How Solar Generation Works

Solar PV systems capture sunlight and convert it into electricity that can be used to power everything traditional electricity powers—from lights and appliances to electric cars.

Solar PV systems are composed of individual solar cells that are configured onto a solar panel or module. When sunlight shines on a solar cell, the cell absorbs the light's energy and produces a flow of electrons, known as direct current (DC) electricity.

Because appliances and machinery operate on alternating current (AC), a device called an inverter converts the DC electricity to the AC power necessary to power your home or business.

PV cells work any time the sun shines and will produce more electricity when sunlight strikes the PV modules directly rather than at an angle.



- 1 Individual PV cells are connected to panels. Solar panels convert sunlight into DC electricity.
- 2 **Inverter** converts DC into AC for powering electric units in the home.
- 3 The **utility meter** records the net amount of energy generated through the PV system. When you are creating more electricity than you are using, your meter will spin backward and the excess electricity is sent to the electric grid. This helps offset the cost of your electricity usage at night or on cloudy days when your system cannot produce electricity.

A Closer Look: Types of PV Panels and Inverters

Types of Solar Panels

Crystalline Silicon: Rigid panels comprised of silicon cells sandwiched between protective glass sheets are the dominant solar technology on the market. They are generally the most cost effective and efficient in energy production; however, they are more susceptible to the effects of shade and high temperatures, which reduce the amount of electricity these types of panels can produce.

Thin-Film: These relatively inexpensive, flexible panels are less susceptible to the effects of shade and heat but are not as efficient as traditional crystalline silicon panels. This technology is often suitable for buildings with a larger rooftop area because it takes more thin-film panels to produce the same amount of electricity as traditional silicon panels.

Building-Integrated Photovoltaic (BIPV): BIPV are PV materials incorporated into the construction of an actual building—such as roof tiles, windows or part of a building's facade. Typically made from thin-film cells, BIPV systems tend to be less efficient in terms of producing electricity but can be more aesthetically appealing.

Types of Inverters

Central Inverter: A central inverter converts the DC electricity produced by the entire solar array into AC electricity. In residential installations, the inverter is usually located on the side of the house or garage that is close to the utility meter.

Microinverters: Microinverters are smaller devices connected to the back of each individual panel in a solar array. Although generally more expensive than a single central inverter, microinverters diminish the effects of shading on a solar system's total energy output because any loss of efficiency in one panel does not diminish the output from the rest of the array.

Talk to your contractor about which technology best suits your needs. A list of commonly used panels and inverters is available at gosolarcalifornia.com/links/equipment_links.php.

Net Energy Metering

California investor-owned utilities offer solar customers the benefits of net energy metering (NEM), a special billing arrangement that credits customers' accounts for the solar energy their systems supply.

How Net Energy Metering Works

A solar PV system may produce more or less electricity than a customer needs at any given time. When the system's production exceeds the customer's electrical use, the excess energy automatically flows through the electric meter to the utility grid. At times when the customer's electricity use is higher than the solar system's production, the customer relies on additional power from the utility.

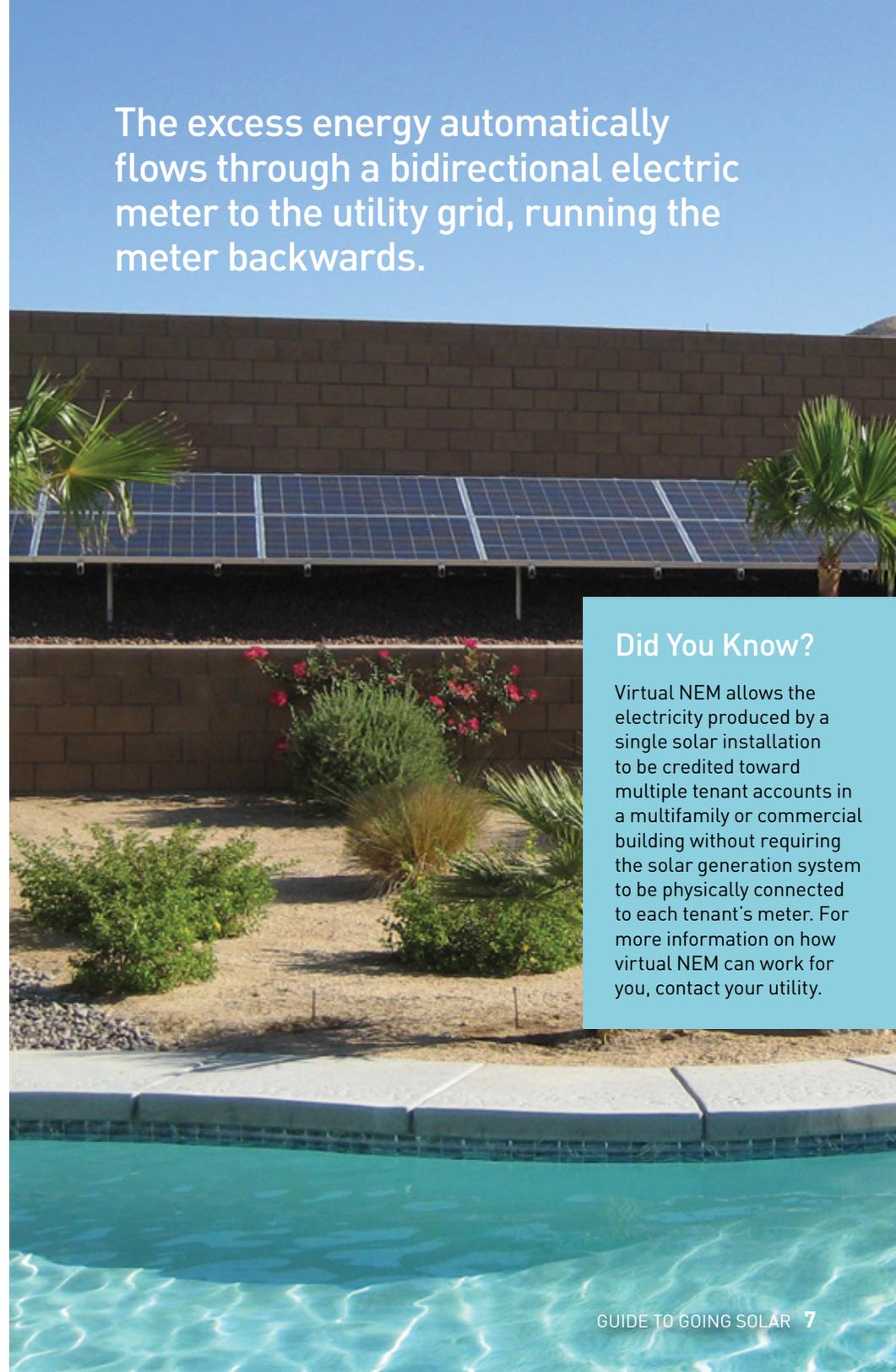
Under a NEM agreement, your utility reads your meter monthly and sends a statement summarizing the net amount of electricity you consumed from or supplied to the grid during that billing period. This results in either a credit or a charge to your account. If you are a residential or small commercial customer, the charges and credits are reconciled every 12 months, after which you must pay any remaining balance.

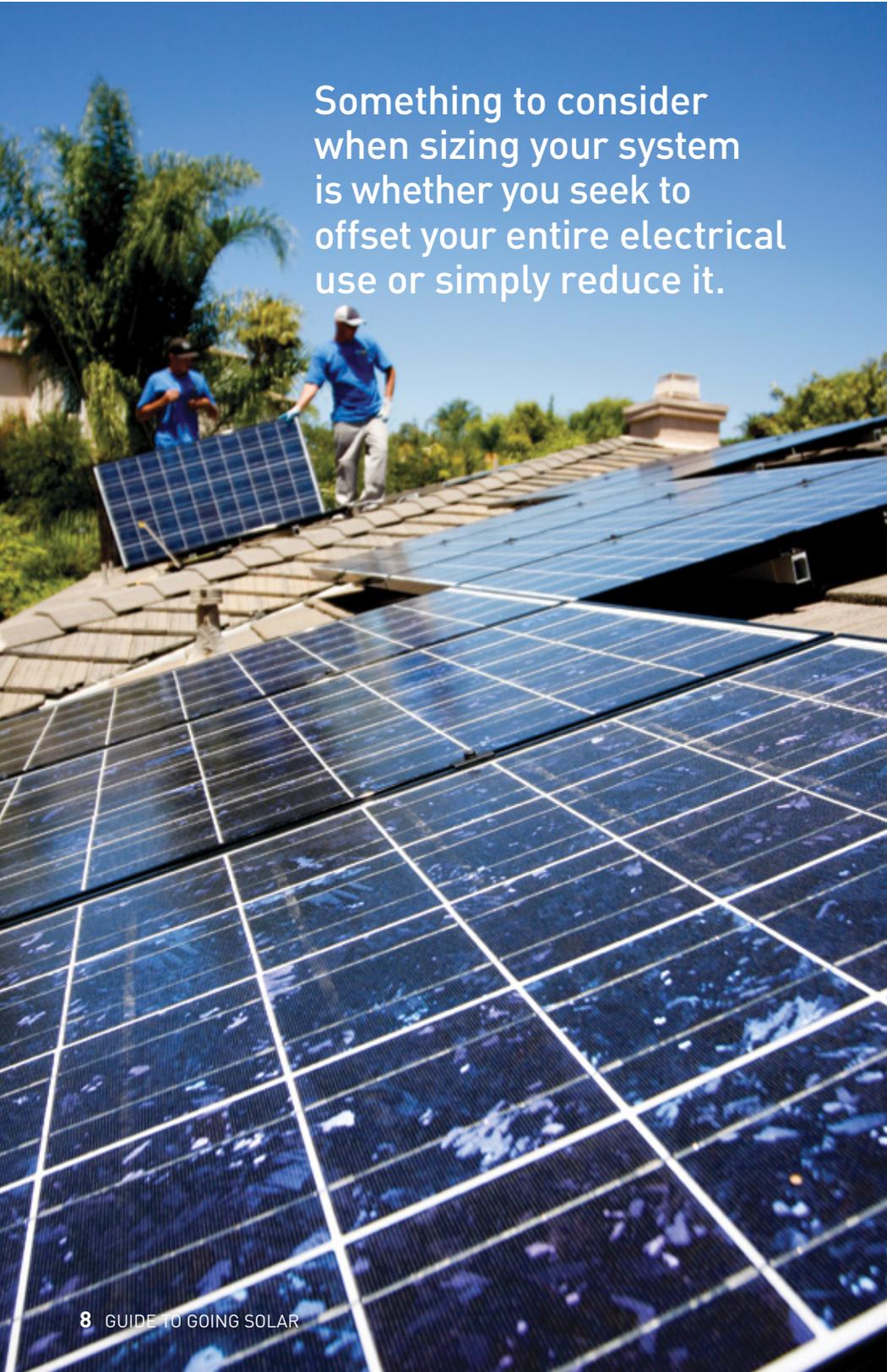
Customers with net surplus energy after their 12-month billing period has ended (meaning the system generated more electricity in total than was consumed) will be given a monetary value for the excess kilowatt-hours (kWh) at a special rate. Options for receiving payment vary, so contact your utility for more details.

The excess energy automatically flows through a bidirectional electric meter to the utility grid, running the meter backwards.

Did You Know?

Virtual NEM allows the electricity produced by a single solar installation to be credited toward multiple tenant accounts in a multifamily or commercial building without requiring the solar generation system to be physically connected to each tenant's meter. For more information on how virtual NEM can work for you, contact your utility.





Something to consider when sizing your system is whether you seek to offset your entire electrical use or simply reduce it.

Solar Generation System Costs

With the help of the California Solar Initiative (CSI) Program, the cost of solar power in California has decreased nearly 30 percent since 2007.

The up-front cost of a PV system depends on factors such as how much of your electrical requirements you would like to offset (system size), equipment options, location, labor costs and local permitting costs. Long-term cost depends on your utility rate and financing terms.

Costs are measured in terms of dollars per watt. Through 2013, the average installed cost for residential-sized systems (i.e. less than 10 kW) was \$4–\$6 per watt. Therefore, a typical 5-kW residential system would cost \$20,000–\$30,000. State rebates and federal tax incentives reduce this cost even further. To find out more about current solar costs in your area, visit www.californiasolarstatistics.com and click on “Cost by Quarter.”

Customers who “go solar” may be eligible to receive the 30 percent federal investment tax credit (ITC), which reduces the cost of a solar generation system. Be sure to consult a tax professional to determine your eligibility for the federal ITC and any other credits that might be available.

Sizing Your System

System size is the first factor in determining the cost of a solar generation system. Although the average residential system size is about 5 kW, several factors impact the optimal system size for you, including your 12-month prior electricity usage, desired bill and energy offset and available space for the system. Something to consider when sizing your system is whether you seek to offset your entire electrical use or simply reduce it. Many customers install smaller systems that offset only the highest, most expensive billing tiers, saving money in up-front costs as well as on their utility bills. Other customers realize the cost savings of solar by utilizing time-of-use (TOU) rates from their local utility because peak solar generation (typically summer afternoon hours) offsets the highest cost of electricity. When choosing the system size for your home, be sure you clearly understand your utility rate options and the potential impact on your utility bill. As a rule of thumb, you will need approximately 100 square feet of roof space for each kW installed. For reference, 1 kW will produce about 1,500 to 1,800 kWh per year; however, actual production may vary.

Costs for all goods and services, including electricity, increase with normal inflation. In some years, utility costs increase and other years they may decrease. When forecasting future energy costs, it's a good idea to check with your utility about historical inflation of electric rates.

Financing Options

Many contractors are able to offer their customers a variety of financing options to help them go solar. The three most common financing options include purchasing the solar generation system, leasing the system or entering into a power purchase agreement (PPA).

System Ownership	Lease/Power Purchase Agreement (PPA)
What are you paying for?	
The cost of a solar generation system that offsets some or all of your electricity needs.	Lease: A fixed monthly rate no matter how much electricity is produced. PPA: A fixed amount of money per kWh produced.
What are you buying?	
All components of the PV system including solar panels, inverter and metering equipment. You can also buy performance monitoring software, extended service agreement and other options.	A service that may or may not have a purchase option.
What is included in the purchase?	
All the equipment, labor, state and local taxes, a minimum standard warranty, administrative paperwork (permitting, interconnection application, etc.) and, sometimes, monitoring.	Generally labor, state and local taxes, administrative paperwork (permitting, interconnection application, etc.), operations and maintenance, inverter replacement, insurance, monitoring and production guarantees.
What is not included in the purchase?	
Generally inverter replacement after the warranty period ends, operating costs, maintenance costs, insurance and monitoring service.	The solar generation system.
What are the tax implications?	
Check with your tax consultant to determine if you qualify for the 30 percent federal ITC. If financed through a home equity loan, you may also be eligible for a tax deduction.	As the system owner, the solar services provider typically receives the 30 percent ITC and may receive commercial depreciation tax benefits.
What are the risks?	
Owner is responsible for operations and maintenance costs and should always be aware of system performance to ensure it is maximizing energy production. (Data monitoring systems are critical.) Note: Additional risks may exist.	Solar services provider may go out of business and be unable to provide operations and maintenance under the contract. PPAs usually have rates that escalate over time and usually have long-term commitments of 25 or more years. Be sure to discuss buyout options, if not specified in the contract. Some maintenance may not be covered under the PPA/Lease agreement. Note: Additional risks may exist.
What happens if I move?	
New homeowner buys the asset in the purchase price of the house.	Work with solar service provider to transfer lease/PPA obligation to new homeowner or buy out the remainder of the contract at "fair market value." Note: New homeowners would need to financially qualify to take over the lease/PPA.
What are the financial benefits?	
Possible greater return on investment compared to other investment opportunities and increased home value. Lower electricity bills, although homeowner still responsible for paying amount that solar PV system does not offset.	Little or no up-front cost. Prepaid leases may help reduce monthly payments. Typically cash positive or neutral in first year. Lower electricity bills, although homeowner still responsible for paying amount that solar PV system does not offset.

Solar Water Heating

What is solar water heating?

A solar water heating system captures the warmth of the sun, transfers that heat to water and helps your conventional water heater or boiler use less energy.

Unlike solar electric systems (photovoltaics or PV) that collect light energy from the sun and convert it into electricity, solar water heating systems absorb the heat energy of the sun and use it to heat water. Since it involves heat energy, the technology is referred to as solar thermal.

What are its benefits?

Solar water heating can have a number of benefits for single-family residences, multifamily dwellings and commercial enterprises. They include:

- Reducing the amount of energy used to heat your water
- Lowering the cost of heating your water
- Reducing harmful greenhouse gas emissions
- Helping your home or business become more sustainable

The more hot water you use in your home or business, the more energy savings you can achieve. Your solar water heating system can be scaled to meet your needs by installing a tank with sufficient hot water storage capacity and adjusting the number of solar collectors installed.

How do I get started?

Contact PG&E to learn about available incentives and for a directory of qualified, local contractors who can help you get started with solar water heating. You may also be eligible to receive a federal tax credit for installing a qualified solar water heating system.

Visit pge.com/solarwaterheating for more information.



Three Steps to Go Solar!

- 1 Improve the energy efficiency of your home or business
- 2 Choose the right solar contractor for your needs
- 3 Install system



Stop leaks with sealing and insulation.

Keep cool in summer and stay warm in winter with energy-efficient windows.

Save water and energy with high-efficiency water heaters and shower flow control devices.

Save energy with efficient heating and cooling systems.

1 Energy Efficiency Before You Go Solar

Making your home or business energy efficient before going solar is an essential first step.

Energy-saving actions—such as changing incandescent bulbs to CFLs or LEDs and replacing old, inefficient appliances with ENERGY STAR® products—are the best way to reduce your energy use and save money before you go solar.

By reducing your overall energy use before going solar, you can reduce the size of your solar generation system, potentially saving thousands of dollars in up-front costs.

We recommend you complete a simple energy efficiency audit of your home or business before choosing a solar contractor. This will help you understand how you can save energy and allow you to better estimate your future energy use, which will help you ensure your system is sized appropriately. In addition, understanding your energy usage will help prepare you to talk with solar contractors.

PG&E can provide you with an easy online energy audit form at pge.com/energyanalyzer.

Did You Know?

PG&E allows self-installation of solar generation systems for those with the technical knowledge to do so. Self-installers will be responsible for submitting the program, interconnection and NEM applications. Visit PG&E's website for an overview of the application process.

2 Choosing the Right Solar Contractor

Hiring a qualified and competent solar contractor is key to getting a productive solar generation system for your home or business.

While California has many capable solar contractors, the resources below will provide you tools to pick the one who will best suit your needs.

How to Research Contractors

Contractors State License Board (CSLB): Make sure your contractor has an active A, B, C-10 or C-46 license at cslb.ca.gov.

California Solar Initiative (CSI) Contractor Database: The CSI Program has compiled a list of contractors who have previously completed projects; however, any licensed solar contractor may work on your project. Although PG&E no longer offers incentives, you can still research contractors by ZIP code to see how many projects they have completed in your area and filter results by the average cost per watt to learn how much money average customers are paying at californiasolarstatistics.com/search/contractor.

Ask for references: Talk with friends and neighbors who have already installed solar, request references from contractors' previous customers and review past installations to ensure the costs were reasonable, the customers satisfied and the systems are performing properly.

What to Expect from Contractors

Just as you would for any other type of home improvement, you should obtain bids from at least three solar contractors to ensure you receive the most competitive and comprehensive bid. Solar contractors typically provide free site evaluations, comprehensive quotes and payback information. Your contractor should analyze your past energy consumption and costs, as well as your future energy needs and desired offset, to help you determine the appropriate system size.

A qualified solar contractor also will evaluate factors that will affect the performance of your PV system, such as roof size, orientation (tilt and direction) of the system, shading and other factors.

In addition, the solar contractor should be able to develop a financial plan for you. You will want to evaluate all your options to determine if a purchase, lease or PPA works best for you.

3 The Installation Process

The table below outlines a typical solar installation process. Some steps can take place simultaneously and your contractor will probably take care of most of them.

Your project will need a building or electrical permit from the city or county building and safety department before you can legally begin installation. After obtaining the required permits, a typical residential installation can be completed in as little as one to three days. Typically, at least two installers work on site during an installation, but several more may be required depending on the size and scope of your individual project.

Once your system is installed, the city or county will inspect it. After your new system passes this initial inspection, your local utility may also inspect the system to ensure it is interconnected properly and meets all safety requirements. Be sure not to turn your system on until you receive official permission to operate from your utility.

	Typical Solar Installation Steps	Role
1	Research contractors and compare bids*	Customer
2	Design system (site visit and usage evaluation to determine size)	Contractor
3	Sign contract**	Customer
4	Apply for interconnection and net metering; submit application(s) to your utility	Contractor
5	Apply for building permit with appropriate city or county agency	Contractor
6	Install the solar PV system	Contractor
7	City/county onsite system inspection; submit approval to utility	Contractor
8	Utility onsite interconnection/meter inspection	Utility
9	Turn system on upon written approval from utility	Customer
10	Receive first utility bill post-installation under Net Energy Metering	Customer

*Obtain HOA approval, as needed, upon receipt of bids and prior to signing the contract.

**Discuss and clarify roles with your contractor before finalizing the contract to ensure you understand who is responsible for each step in the process.



Glossary of Commonly Used Terms

Alternating Current or AC

AC is the form of electricity that is delivered to your home or business by an electric utility. Solar PV systems produce DC, which must be converted to AC by an inverter.

Array

Any number of electrically connected PV panels providing a single electrical output.

Capacity Rating

The rating given to a PV system by its manufacturer denoting the load the system is able to meet or supply when operating at full capacity in direct sunlight with no shade.

CEC-AC Rating

The calculation that provides a total estimated energy output of a solar generation system, factoring in the efficiency of the panels and inverter.

Conversion Efficiency

The amount of the sun's energy that a solar cell can convert into electricity; the balance is lost as heat or reflected light.

Direct Current or DC

Solar PV systems produce electricity in DC, which is defined as the continuous flow of electricity through a conductor. DC power is converted to AC by an inverter to power homes and businesses.

Greenhouse Gas or GHG

The gases responsible for trapping heat from the sun within Earth's atmosphere (i.e., water vapor, carbon dioxide, methane, ozone, chlorofluorocarbons and nitrogen oxides). GHGs are released from many sources, including industrial processes such as power generation from fossil fuels.

Grid

A network of power stations, transmission circuits and substations that conduct electricity and provide it to homes and businesses for their use.

Grid-Connected or Grid-Tied PV System

A PV system in which the PV array is wired into buildings or residences that are connected to the utility grid. This allows customers to feed excess electricity into and pull needed electricity from the grid.

Interconnection Agreement

A legal document between the customer and their electric utility authorizing the connection of the customer's solar generation system to the utility's grid. This agreement is required prior to the utility granting permission to operate.

Inverter

A device that converts DC electricity produced by a solar generation system into AC electricity that can be used in a home or business. Some energy is lost when this conversion takes place (see CEC-AC rating).

Inverter Efficiency

The AC power output of the inverter divided by the DC power input. Inverter efficiency is lowest when operating at low loads; thus, it is important to select inverters of the proper size relative to the PV array.

Kilowatt or kW

A unit of electrical power equal to 1,000 W, which constitutes the basic unit of electrical demand. The watt is a metric measurement of power (not energy) and is the rate (not the duration) at which electricity is used. 1,000 kW is equal to one megawatt (MW).

Kilowatt-Hour or kWh

A unit of electrical energy, equivalent to the use of one kW of electricity for one full hour. Utilities measure customers' electric energy usage based on kWh, and electricity rates are most commonly expressed in cents per kWh.

Load

The amount of power consumed by an electric customer at a specific time. Base load is the minimum constant level of electricity required by utility customers; peak load is the amount of electricity required at the time of greatest demand.

Megawatt or MW

Unit of electric power equal to 1,000 kW or 1 million watts.

Meter

A device used to measure and record the amount of electricity used and/or generated by a consumer.

Modules

A module is the smallest protected assembly of interconnected PV cells. Modules are rated typically from 40 to 300 watts.

Orientation

A term used to describe the direction that a solar module faces. The two components of orientation are the tilt angle (the angle of inclination a module makes from the horizontal) and the azimuth (the compass angle that the module faces, with north equal to 0 degrees and south equal to 180 degrees).

Photovoltaic or PV

The technology that uses a semiconductor (such as silicon) to convert sunlight directly into electricity.

Renewable Energy Credits or RECs

Also known as green certificates, green tags or tradable renewable certificates, RECs represent the environmental attributes of the power produced from renewable energy projects. By installing a renewable energy system (such as solar), you become the owner of these environmental attributes, or RECs.

System Size

System size is the electricity generating capacity of a given photovoltaic system based on CEC-AC rating standards. The system size should be limited to no greater than the amount of total electricity consumed at a site during the prior 12 months.

Time-of-Use or TOU Rates

An electricity pricing plan in which the cost of electricity varies depending on the time period in which the energy is consumed or produced. In a TOU rate structure, higher prices are charged during utility peak-load times. Such rates can provide an incentive for consumers to curb power use during peak times. Solar PV panels tend to produce power during peak times, so they have higher value when used in conjunction with TOU rates.

Tracker or Tracking Array

A number of PV modules mounted such that they track the movement of the sun across the sky to maximize energy production, either with a single-axis or dual-axis mechanism.

Watt or W

A unit of measurement of electric power, named after physics pioneer James Watt.



How to Make Smart Choices When Going Solar

Qualified contractors are your key to getting the most productive solar generation system for your home or business, which is why Go Solar California joins with the Contractors State License Board (CSLB) in advising Californians to be smart shoppers when selecting a solar contractor and comparing bids.

Here are some guidelines to help ensure you select a qualified, licensed solar contractor.

- 1 Start by visiting www.GoSolarCalifornia.ca.gov** for a list of licensed solar contractors. Read about how to hire a contractor—such as checking references, obtaining detailed information in writing about all materials to be used, and confirming the contractor’s classification—in the Resources section.
- 2 Verify that the contractor has an active A, B, C-10 or C-46 license** (or C-36 for solar water heating installations) through the CSLB at cslb.ca.gov or by calling **1-800-321-2752**.

Ask the contractor to show his/her CSLB “pocket license” to make sure you’re meeting with an authorized person and a photo ID to confirm identification.
- 3 You should interview at least three solar contractors** and compare their bids—including the amount of electricity the system will produce and the net cost of the system per watt—before hiring. Take caution against automatically selecting the contractor with the lowest bid, which may be a red flag that the contractor is cutting corners. Also be on the watch for unusually high bids. You can obtain detailed information from the California Solar Initiative about average project costs at GoSolarCalifornia.ca.gov to see if your bids are within the average range.
- 4 Read the fine print!** Make sure you fully understand everything contained within the contract—including warranties and maintenance agreements—**before** signing a contract.
- 5 Finally, under California state law, you should never pay more than \$1,000 or 10 percent of the contract price** (whichever is less) for a down payment.

Comparing Contractor Bids

Use this solar bid comparison worksheet to organize information and make a smart solar decision.

		ITEM	BID #1	BID #2	BID #3
Contractor Information	<input type="checkbox"/>	Company/Rep Name			
	<input type="checkbox"/>	Company Phone #			
	<input type="checkbox"/>	CSLB License #			
	<input type="checkbox"/>	Check Status at www.cslb.ca.gov			
System Description	<input type="checkbox"/>	System Nameplate Rating (DC kW)			
	<input type="checkbox"/>	System Size in CEC-AC kW			
	<input type="checkbox"/>	Percent of Electric Load Offset			
System Cost	<input type="checkbox"/>	Base System Cost			
	<input type="checkbox"/>	Adders			
	<input type="checkbox"/>	Estimated Permit Fees			
	<input type="checkbox"/>	Total Cost			
	<input type="checkbox"/>	Cost Per Watt Total Cost/(System Size kW x 1,000)			
	<input type="checkbox"/>	Down Payment			
Project Value	<input type="checkbox"/>	Year One Expected Savings			
	<input type="checkbox"/>	# Years for Payback			
Other Factors	<input type="checkbox"/>	Contractor Financing Options (if applicable)			
	<input type="checkbox"/>	Warranty Terms			

How to Contact Your Utility

PG&E

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San Francisco, CA 94120

Email: Solar@pge.com

Phone: 1-877-743-4112

Fax: 1-415-973-2510

www.gosolar.energycenter.org

Online Resources

GENERAL CSI-RELATED WEBSITES

CPUC and CEC Website

gosolarcalifornia.ca.gov

CSI Program Data

californiasolarstatistics.com

SOLAR CONTRACTOR RESEARCH WEBSITES

Contractor State License Board

cslb.ca.gov

California Solar Statistics Contractor Database

californiasolarstatistics.com/search/contractor

Go Solar California Contractor Database

gosolarcalifornia.ca.gov/database/search-new.php

CSI Program-Approved Equipment List

gosolarcalifornia.com/links/equipment_links.php



cpuc.ca.gov



gosolarcalifornia.ca.gov

The CSI and CSI-Thermal Programs are funded by California investor-owned utility customers and are administered by regional program administrators under the auspices of the California Public Utilities Commission.

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