



California Occupational Guides

Guide for



Solar Photovoltaic Installers in California

May also be called: PV Technicians; Solar Energy Technicians; Solar Installers; Solar Panel Installers; Solar Panel Technicians; Solar Photovoltaic Installers; Solar System Installers; Solar Technicians

What Would I Do?

Ancient Egyptians, Romans, and Native Americans used the sun to heat their structures during the day. By the 1800s people were aware that certain materials could produce electricity from the sun. The use of silicon-based solar cells began in the mid-1950s and advanced due to the desire to become less dependent upon oil.

The term photovoltaic refers to the process of converting the sun's energy into electric energy. Solar Photovoltaic Installers, or Solar PV Installers, assemble, install, and maintain solar photovoltaic systems on roofs or other structures. They do so in compliance with site assessment, plans, and schematics. Solar PV panels convert sunlight into electricity, making solar panels a source of renewable, low-pollution energy.

Solar PV systems consist predominately of panels (or modules) positioned on top of roofs. However, technology has been improving the look of photovoltaic solar cells by building them into shingles and other building-integrated products. Solar PV panels may also be mounted onto ground structures, which is typical of large utility-scale systems. In either case, PV systems provide energy directly to the grid or to the surrounding site.

Entry-level job activities include lifting, carrying, staging, mounting, and assisting the installation crew. Installation skills include measuring, cutting, drilling, and fastening structural support elements and mounting solar modules. Electrical work on a PV installation should only be performed by electricians trained in the area of photovoltaics, or under the direct supervision of a qualified, licensed electrician. The electrical work may include installing grounding systems, circuit conductors, conduit/raceways, and individual components. Electrical work may also include wiring the inverter to the grid via the customer service panel. Electrical measurements, such as AC/DC current and voltage, may also be part of the job. How much electrical work Solar PV Installers perform depends upon the firm employing them and which licenses and certifications the Installers hold.

Tools and Technology

Solar PV Installers use a variety of power and hand tools including drills, conduit benders, torque wrenches, and crimping tools. On larger installations, they may operate forklifts or front-end loaders. Tape measures, laser-assisted measuring devices, digital cameras, and site evaluation tools are standard devices for most jobs. Diagnostic gear including multimeters and amp clamps are also important. Computers are increasingly important with remote monitoring, GPS-assisted site evaluation, and diagnostic procedures. While entry-level PV Installers are not involved in system design, including layout, they need to be able to read blue prints and plans.

Important Tasks and Related Skills

Each task is matched to a sample skill required to carry out the task.

<i>Task</i>	<i>Skill Used in this Task</i>
Assemble solar modules, panels, or support structures, as specified.	Mechanical
Install active solar systems, including solar collectors, concentrators, pumps, or fans.	Installation
Install photovoltaic (PV) systems in accordance with codes and standards using drawings, schematics, and instructions.	Reading Comprehension
Perform routine photovoltaic (PV) system maintenance on modules, arrays, batteries, power conditioning equipment, safety systems, structural systems, weather sealing, or balance of system components.	Equipment Maintenance
Activate photovoltaic (PV) systems to verify system functionality and conformity to performance expectations.	Operation Monitoring
Apply weather sealing to array, building, or support mechanisms.	Manual Dexterity
Check electrical installation for proper wiring, polarity, grounding, or integrity of terminations.	Quality Control Analysis
Determine appropriate sizes, ratings, and locations for all system overcurrent devices, disconnect devices, grounding equipment, and surge suppression equipment.	Judgment and Decision Making

Source: U.S. Department of Labor [Occupational Information Network \(O*NET\)](https://online.onetcenter.org/) at online.onetcenter.org.

Working Conditions

Solar PV Installers primarily work outdoors. Weather plays a big role in these workers' lives. Rain often means a day off as wet conditions can make installation dangerous. They may also work in the hot sun, high humidity, or other extreme weather. Installation work may be at residential, commercial, or utility-scale sites. Most Solar PV Installers work 40-hour weeks, though schedules may be heavier during spring and summer. Then, they may work four 10-hour days plus overtime on Fridays.

Heavy lifting is part of the job as solar panels generally weigh between 30 and 40 pounds. Batteries can weigh more than three times that amount. In addition, Solar PV Installers need to be prepared to safely navigate ladders and rooftops. Roofs vary in heights, some of which may have steep slopes or may be made of fragile material, such as clay tiles. Safety precautions are critical, requiring protective gear such as hard hats, boots, gloves, eye protection, and safety harnesses.

This occupation is not heavily unionized. However, some Solar PV Installers may belong to unions for construction workers, electricians, glaziers, or roofers.

Will This Job Fit Me?

The job of Solar PV Installer may appeal to those who enjoy working outdoors performing practical, hands-on work. Attention to detail is important as the work requires following diagrams and instructions.

What Wages and Benefits Can I Expect?

Wages

A formal salary survey is not available. However, references to annual salaries range from \$24,000 to \$44,664. Hourly wages range from \$11.50 to \$21 per hour. Installers with a supervisory role may expect to earn up to \$24 per hour or more. All salaries depend on the pay structure established by each employer for work performed, the nature of the project, and the skill of the specialist. Public sector prevailing wage jobs pay considerably more. Those who have passed the North American Board of Certified Energy Practitioners (NABCEP) Entry Level Exam often start at a higher salary than those who have not have this proof of basic solar knowledge.

Benefits

While smaller installation companies may not offer benefits, larger companies are more likely to provide them. Benefits generally include medical, dental, life, and vision insurance as well as vacation, sick leave, and retirement plans. Those who are self-employed are responsible for their own insurance and retirement plans.

What is the Job Outlook?

As this is an emerging occupation, the number of Solar PV Installers in California is unknown at this time. However, California employs the largest number of solar workers in the country according to the Solar Foundation's *National Solar Jobs Census 2010*. The solar industry is expected to continue to grow. Financial incentive programs have helped the market for rooftop solar energy systems by reducing costs over time. In addition, demand for solar PV systems should increase as the permit and inspection processes are streamlined, reducing the overall cost of installation. Solar PV Installers will benefit from these developments as they are the fastest-growing occupation in this industry.

How Do I Qualify?

Education, Training, and Other Requirements

In general, employers look for persons who have a high school diploma or GED. Some employers are willing to provide solar PV installation training. However, they often hire workers with roofing, electrical, and general construction knowledge. Construction workers and electricians have fundamental skills to perform the job duties after receiving short-term training in the mechanics and engineering of solar energy systems. Numerous community colleges offer a variety of courses in photovoltaics ranging from short, 40-hour courses to a series of courses over several semesters. Community colleges offer noncredit/certificate training, for-credit training, and degree programs. Private training programs also offer solar courses. Distributors and manufacturers of PV panels and other components offer instruction in the use of their equipment. However, these courses are usually for their contractors or customers. So, they are not available to the general public. Some training providers offer online solar training and workshops. Courses vary from providing fundamentals of solar PV theory to intensive training that includes hands-on activities.

Employers typically want individuals who have no prior felonies, a current driver license, and a clean driving record. In addition, candidates commonly need to pass a drug test. Employers usually require applicants have their own basic construction tools and reliable transportation.

Experience

Many employers prefer candidates with construction experience, specifically roofing and electrical experience. Often employers, especially those offering higher wages and benefits, want applicants who have over one year prior experience in solar PV installations.

Early Career Planning

High school courses that would benefit those planning to work as a Solar PV Installer are basic math, English, and drafting. Knowledge of algebra, geometry, and trigonometry are necessary for those interested in becoming a certified Installer through the NABCEP. Those interested in entering an apprenticeship program may need to provide proof of earning a minimum of a C in high school algebra for two semesters or one semester in college. Shop courses also provide an initial background for those interested in installing solar photovoltaic systems. Part-time jobs in the construction trades or with building supply or hardware stores will provide exposure to tools and materials of the construction industry.

Some Regional Occupational Programs (ROP) offer construction technology courses which can provide an introduction to roofing or general construction. To find an ROP program near you, go to the California Association of Regional Occupational Centers and Programs Web site at www.carocp.org/carocps.html.

Apprenticeship Programs

In California, the Solar PV Installer was recognized as an occupation for apprenticeship in 2011, which opened the door to establish training programs. However, some training facilities were already offering journeyman electricians continuing education courses in solar PV installation.

Apprentices regularly attend classes for technical training while receiving on-the-job training. Many programs also require that the applicant be at least 18 years of age, possess a high school diploma or the equivalent, have a valid California driver license, and pass an entrance exam. Contact the Division of Apprenticeship Standards under the California Department of Industrial Relations for more information.

Licensing and Certification

Solar PV Installers who want to go into business for themselves are required to be licensed through the California Contractors State License Board (CSLB) to perform solar installations. Applicants must be over 18 years old, have the appropriate experience, pass an exam, and pay the required fees. Some employers require that Solar PV Installers have an electrician's license in order to perform electrical work. For additional information on the licenses for contractors and for electricians, contact the CSLB.

The NABCEP offers a PV Entry Level Exam. Passing this exam shows a basic understanding of the operations of a solar PV system, but not the ability to install a solar PV system. Candidates must first complete training through a registered NABCEP provider in order to take the exam. Passing the PV Entry Level Exam can help employment opportunities for those trying to enter the solar industry.

The voluntary NABCEP PV Installer certification is for highly experienced installers. To qualify, applicants must meet the experience and training criteria and pass an exam. This certificate is appropriate for those who supervise system installations, such as a contractor or journeyman. Many employers prefer that their installation supervisors have the NABCEP certification. The California Energy Commission encourages this certification for Installers of systems that are partially paid for through solar incentives.

Some employers hire qualified electricians to install solar PV systems. Electricians are certified through the California Department of Industrial Relations. Applicants must provide evidence of required experience or completion of a State-registered apprenticeship program, pass an exam, and pay the fee. The certification is good for three years. To renew, the electrician must certify on the application of working 2,000 hours in the industry and provide proof of continuing education credit. For more information, go to the U.S. Department of Labor's Career InfoNet Web site at www.acinet.org and scroll down to "Career Tools." Click on "Certification Finder" at www.acinet.org/certifications_new/default.aspx and follow the instructions to locate certification programs.

Continuing Education

As with any industry, it is important to keep up with current technology. Those with NABCEP Installer certification are required to complete 18 hours of approved continuing education within three years of their initial certification. Installers who are journeyman electricians are required to earn 32 hours of continuing education every three years in order to maintain their electrical certification.

Where Can I Find Training?

There are two ways to search for training information at www.labormarketinfo.edd.ca.gov/?Pageid=1013:

- [Search by Field of Study](#) to find what programs are available and what schools offer those programs. You may use keywords such as: Solar or Solar Energy.
- [Search by Training Provider](#) to find schools by name, type of school, or location.

Contact the schools you are interested in to learn about the classes available, tuition and fees, and any prerequisite course work.

Where Would I Work?

According to the 2009 *California Green Economy Survey*, the largest industry employing Solar Photovoltaic Panel Installers in California is the Specialty Trade Contractors industry, which includes electrical and plumbing, heating, and air-conditioning contractors. Installers also work in the Utilities industry.

Finding a Job

Direct application to employers remains one of the most effective job search methods. Applicants can also find employment opportunities through placement offices at colleges and other training facilities. Newspaper classified ads, professional associations, and the Internet provide additional sources for job listings. Union members in construction trades may find solar jobs through their union. **Online job opening systems** include JobCentral at www.jobcentral.com and CalJOBSSM at www.caljobs.ca.gov.

To find your nearest One-Stop Career Center, go to [Service Locator](http://www.servicelocator.org) at www.servicelocator.org. View the [helpful job search tips](http://www.labormarketinfo.edd.ca.gov/occguides/JobSearchTips.pdf) at www.labormarketinfo.edd.ca.gov/occguides/JobSearchTips.pdf for more resources. (requires [Adobe Reader](#)).

Yellow Page Headings

You can focus your local job search by checking employers listed online or in your local telephone directory. Below are some suggested headings where you might find employers of Solar Photovoltaic Panel Installers.

- Photovoltaic
- Solar
- Solar Energy
- Solar Installation
- Solar Power

Find Possible Employers

To locate a list of employers in your area, use "[Find Employers](#)" on the LaborMarketInfo Web site at www.labormarketinfo.edd.ca.gov/aspdotnet/databrowsing/empMain.aspx?menuChoice=emp

- Select the search for employers by occupation.
- Select a geographic area.
- Search for an occupation by keyword, occupation, or category.
- Select one of the top industries that employ the occupation.
- This will give you a list of employers in that industry in your area.
- Click on "View Filter Selections" to limit your list to specific cities or employer size.
- Click on an employer for the street address, telephone number, size of business, Web site, etc.
- Contact the employer for possible employment.

Where Could This Job Lead?

Experienced Solar PV Installers may promote to supervisor or Senior Installer, providing training and leadership of a crew. They may go into sales of solar energy systems or become system designers. With

additional education, Solar PV Installers may advance to executive management positions or start their own solar installation business.

Related Occupations

Below is a list of occupations related to Solar Photovoltaic Installers.

- Carpenters (47-2031)
- Electricians (47-2111)
- Heating, Air Conditioning, and Refrigeration Mechanics and Installers (49-9021)
- Roofers (47-2181)

Other Sources

- California Department of Consumer Affairs, Contractors State License Board
www.cslb.ca.gov
- California Department of Industrial Relations, Division of Apprenticeship Standards
www.dir.ca.gov/das
- California Solar Energy Industries Association
www.calseia.org
- American Solar Energy Society
www.ases.org
- North American Board of Certified Energy Practitioners
www.nabcep.org
- Solar Energy Industries Association
www.seia.org

These links are provided for your convenience and do not constitute an endorsement by EDD.

For the Career Professional

The following codes are provided to assist counselors, job placement workers, or other career professionals.

System	Code
SOC – Standard Occupational Classification at www.bls.gov/soc	47-4099
O*NET – Occupational Information Network at online.onetcenter.org	
Solar Photovoltaic Installers	47-4099.01
CIP – Classification of Instructional Programs at nces.ed.gov/ ipeds/cipcode/cipdetail.aspx?y=55&cipid=88263	150505
Solar Energy Technology/Technician	
TOP – Taxonomy of Programs Taxonomy of Programs at www.cccco.edu/ Portals/4/AA/TopTax6_rev0909.pdf (California Community Colleges)	
Electronics and Electric Technology	093400

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