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Greater Sacramento Region

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CENTER OF EXCELLENCE
Northern California Region

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SACRAMENTOWORKS

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The Sacramento Region's solar industry has nearly doubled in the last four years, expanding from 700 jobs in 2007 to 1,300 jobs in 2011.

— Source: Center of Excellence Employer Surveys

Executive Summary

Weathering the recession, the solar industry has grown significantly over the last four years. Employment in solar firms has nearly doubled in the last four years, expanding from 700 jobs in 2007 to 1,300 jobs in 2011. In the Greater Sacramento region, employers expect to add more than 200 jobs over the next 12 months and about 950 jobs over the next three years.

The objectives of this study were to identify the workforce trends and challenges of occupations across the solar supply chain, involving installation, wholesale/distribution and manufacturing. The Sacramento solar supply chain is fairly robust with an estimated 110 solar firms: ~55 that specialize primarily in installation, ~36 that specialize in wholesale trade, and ~19 that specialize in manufacturing.

Some of the key findings from this research effort include:

- Sacramento solar installer firms employ approximately 400 PV installers, sales representatives, solar designers, and managers/foreman who spend at least half of their time on solar installation and related services.
- Solar wholesale trade and manufacturing firms employ about 260 production, accounting and sales/marketing workers in the Sacramento Region.
- Solar installer firms are having the most difficulty finding qualified sales representatives, followed by solar designers/engineers and solar technicians.
- Solar wholesale trade and manufacturing firms are experiencing the most difficulty finding qualified sales and marketing professionals.
- Close to 70 percent of solar firms across the supply chain reported difficulty finding qualified applicants with adequate work experience.
- Solar installer firms typically engage their existing skilled tradesmen, such as electricians, roofers, HVAC techs, and plumbers, to work on solar installations.

Two community colleges in the region offer ongoing certificate programs. These programs provide a sufficient supply of trained solar installers in the Sacramento region. Each program also provides courses in energy systems designs, estimating, and sales techniques, to support the training needs of other occupations in the supply chain.

Although this report finds there is not a need for new training programs, the education and training community can further support the workforce needs of the solar sector by (1) developing a regional advisory committee to annually review the training programs and offer recommendations; (2) adding a course on solar installations to existing electrician programs to prepare students for multiple pathways; and (3) continuing to monitor the industry's expansion and respond with new courses and programs as the need develops.

Introduction

In 2010, the California Workforce Investment Board awarded a Regional Industry Cluster of Opportunity (RICO) grant to the Sacramento Employment and Training Agency (SETA) to develop and implement an economic and workforce strategy for the clean energy technology sector in the Sacramento region.¹ Roundtable discussions with green businesses in the clean energy sector were held to inform the economic and workforce strategy.

Through these roundtable discussions, the solar industry was identified as a potential growth area for the region. To further understand the solar industry's workforce needs and challenges, an employer survey was conducted. Contrasting with recent national and statewide studies, this study identifies the regional workforce needs, such as:

- Establishing employment estimates and projections for the Sacramento Region
- Identifying local employer workforce issues and challenges; and,
- Profiling key occupations in the solar industry.

In this report, the solar industry is examined through an industry assessment, occupational projections, employer needs and challenges, training preferences, and recommendations for education and training providers.

Industry Overview

The nation's solar industry has grown substantially over the last year. Between 2009 and 2010, the solar market grew by 67 percent from \$3.6 billion to \$6 billion. Grid-connected PV installations doubled, utility photovoltaic (PV) installations more than tripled, and PV components manufacturing increased by more than 60 percent.² According to the *U.S. Solar Market Insight 2010 Year in Review*, the solar industry has also diversified its market segmentation. While historically the PV market in the U.S. consisted of non-residential installations (such as commercial and public sector projects), it has rapidly shifted to include residential and utility segments.

Fueled by growth in these secondary markets, California led the nation in installed PV capacity in 2010. As shown in Exhibit 1, California's annual installed capacity is significantly higher than any other state in the nation, increasing from 212 to 259 MW of PV. However, California's rate of growth over the last year was somewhat slower, adding 80 MW of installed capacity. Other states, such as New Jersey, are experiencing significant growth – often for the first time, as in the case of Nevada, New Mexico and Pennsylvania.

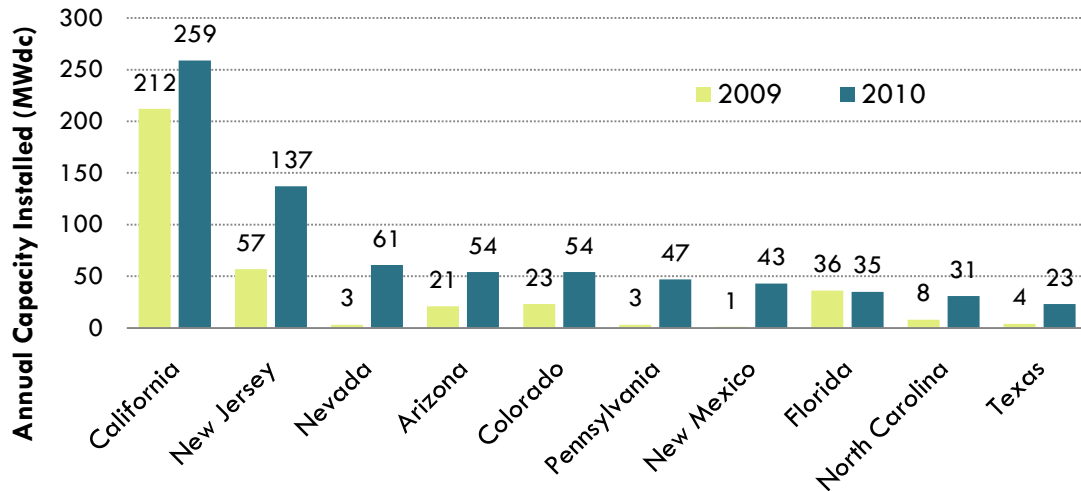
Concentrated solar power (CSP) or utility scale projects are starting to gain moment in California – an impact of Assembly Bill 32 (AB 32) that requires utility companies to use renewable energy to produce 33 percent of their power by 2020.³ Utility companies have submitted 34 requests to develop large solar thermal power plants that could produce up to 24,000 megawatts of power. Many of these projects are under construction with operation dates starting as early as 2012.⁴

¹ The Sacramento Region includes Sacramento, Nevada, El Dorado, Placer, Yolo and Yuba Counties.

² U.S. Solar Market Insight, 2010 Year in Review, SEIA and GTM Research, 2010.

³ AB 32 also required utilities to meet an earlier goal of 20 percent of renewable energy power by 2010.

⁴ California Energy Commission website, <http://www.energy.ca.gov/siting/solar/index.html>. Accessed May 17, 2010.

Exhibit 1: Installed PV Capacity of the Top 10 States, 2009-2010⁵

Solar Technology

Solar power is an excellent source of electricity. It derives energy from a free and infinite source, emits no carbon dioxide (CO₂) or other harmful gas emissions, requires little maintenance, and is generally viewed as safe and reliable. According to Willow River Wealth Responsible Investments, “Solar energy is now widely accepted as the only long-term solution to human energy consumption.” Further, the technology has evolved significantly over the last few years. It is now more efficient and less expensive to produce than it was at the turn of the century. Since 1998, the installed cost of PV systems has declined by 3.6 percent each year through 2008.⁶ By some estimates, solar power is nearing cost parity with other power sources and is less expensive than fossil fuel over the long run.⁷

There are four applications of solar in the market today: photovoltaic (PV), concentrated solar power, solar heating/cooling and solar water heating. Each technology has its strengths and weaknesses in terms of effectiveness, cost, and environmental constraints. Below is a description of each technology. Photovoltaic is the most common technology installed in the Sacramento region.

Photovoltaic (PV) systems convert sunlight into electricity with layers of semi-conducting cells/materials. The light passes through the cells which creates an electric field across the layer, generating electricity. Although it works best with direct sunlight, the system works on cloudy and rainy days as well. PV systems can be connected directly to the grid or a battery and have a typical life of 25 years. PV systems are versatile, often installed on homes and businesses or used to develop utility-scale power plants.⁸

⁵ U.S. Solar Market Insight, 2010 Year in Review, SEIA and GTM Research, 2010.

⁶ Tracking the Sun II: The Installed Cost of Photovoltaics in the U.S. from 1998 to 2008.

⁷ Willow River Wealth Responsible Investments, Solar Industry Report, 2010.

⁸ Solar Generation 6: Solar Photovoltaic Electricity Empowering the World, 2011.

Concentrating Solar Power (CSP) uses heliostats (optical mirrors) to focus the sun's radiation on electronic receivers. These, in turn, heat liquid that drives a conventional turbine. This process generates electricity that is then connected to the grid or an off-grid network. CSP technology is typically produced at a lower cost than PV and is often used for utility-scale projects.

In California, there are three prominent CSP technologies:

- Power Tower Systems – focuses sunlight at the tip of the tower where the receiver containing a fluid transfers heat, creating steam that drives a turbine;
- Parabolic Trough Systems – uses curved mirrors to circulate and heat a liquid, which is pumped to heat exchangers to produce steam that drives a turbine; and,
- Stirling or Dish Concentrated System – uses parabolic dishes to collect concentrated sunlight that heats hydrogen or helium gas to drive a Stirling engine generator.⁹ Dish Concentrated technology is the only CSP technology that does not use steam to drive the turbine, making it a better choice for locations that do not have direct access to water. It is also the most efficient heat-to-electricity conversion system currently available on the market.¹⁰

Solar Space Heating and Cooling Systems uses thermal solar technology to heat and/or cool residential or commercial buildings. For example, passive solar heating systems are integrated into the design of a building (walls and floors) to collect and store heat during the day and radiate into the living spaces in the evening when the temperature drops. If integrated into the initial design of the building, there is little to no additional cost of construction. However, the annual savings required to operate the building is significant.¹¹

Solar Water Heating (including pool heating systems). Apply thermal solar technology to heat water, typically for domestic use. Solar water heating systems may be either passive or active in design.

Policy Driving Growth

The State of California has set ambitious goals to reduce greenhouse emission and reduce the reliance on fossil based energy sources. One of the larger bills released to address these goals is Senate Bill 1 (SB1), which utilizes ratepayer funds to support the installation of solar energy technologies across the state. This section reviews the key programs in SB1 that are driving growth in the solar industry market.

California Solar Initiative (CSI). In 2006, SB1 authorized the California Public Utilities Commission (CPUC) to launch the California Solar Initiative. With a budget of \$2.2 billion, the goal of the program is to (1) install 1,940 MW of solar capacity by the end of 2016 and (2) reduce the cost of solar so that it is cost competitive and self-sustaining. According to the CPUC's 2010 Annual Program Assessment report to the legislation, 342 MW of solar plants or projects have been installed under the CSI program with another 387 MW of pending projects and hundreds of proposals in review.¹²

Not only does this program create jobs in the construction and operation phases of the project, it also attracts investor funds. For every dollar spent, the CPUC estimates that another \$2.62 is

⁹ Solar Industry Report: A Trend Towards Solar Thermal

¹⁰ Willow River Wealth Responsible Investments, Solar Industry Report, 2010.

¹¹ Arizona Solar Center, <http://www.azsolarcenter.org/>, accessed May 19, 2011.

¹² Go Solar California, California Solar Initiative Annual Program Assessment, June 2010.

invested in solar technology from other sources. These investments have contributed to a drop in the average cost of solar PV systems. Between 2007 and 2009, the price of small PV systems (less than 10 kW) has declined by 15 percent and the price of large PV systems (more than 10 kW) has declined by nearly 10 percent.

In addition to utility scale solar projects, the California Solar Initiative has established several other programs to increase the installed solar capacity in the state. Specifically, the CSI program has:

- Installed more than 117 systems on eligible low-income qualifying homes as part of their Single-family Affordable Solar Homes project;
- Launched the Multi-family Affordable Solar Housing project to install solar on multi-family housing units;
- Established a solar hot water systems rebate program for single-family homeowners and multi-family/commercial owners;
- Awarded \$9.3 million in research and development (R&D) grants related to the integration of solar technologies into the grid; and,
- Issued a solicitation for R&D grant proposals that focus on improving PV production technologies and innovative business models.

New Solar Homes Partnership. The New Solar Homes Partnership, also funded by SB1, is administered by the California Energy Commission (CEC). The primary goal of this program is to install 400 MW of PV solar on new residential buildings by 2016. To achieve this goal, the CEC is offering financial incentives and non-financial assistance for projects that integrate solar and energy efficiency aspects in their design. The budget for this program is \$400 million. As with other CSI projects, affordable housing is integrated into this incentive program.¹³

Public Owned Utilities Rebate. As part of SB1, public owned utility companies have been tasked with developing and administering rebate programs for their constituents. Each utility company runs the program a bit differently, but the primary objective is to install 700 MW of solar capacity by the end of 2016. The total budget for this program is \$784 million. Table 1 provides a summary of each program funded under the SB1, including the program authority, program name, budget and MW capacity goal.

Table 1: Senate Bill 1, Go Solar California Budget and Goal¹⁴

Program Authority	Program Name	Budget (Millions)	Solar Goal (MW)
California Public Utilities Commission	California Solar Initiative (CSI)	\$2,167	1,940
California Energy Commission	New Solar Homes Partnership	\$400	360
Publicly Owned Utilities	Various Program Names	\$784	700
Total		\$3,351	3,000

¹³ California Energy Commission, <http://www.energy.ca.gov/renewables/06-NSHP-1/index.html>, Accessed May 19, 2011.

¹⁴ Go Solar California, <http://www.gosolarcalifornia.ca.gov/>. Accessed May 19, 2011.

Regional Projects

There are a variety of efforts to green the community and reduce the carbon footprint in the Sacramento region. Through the Sacramento Greenwise¹⁵ and RICO planning efforts, the region has established several goals to create a self-sustaining green sector. Some of these goals include: (1) Double the number of green jobs from 14,000 to 28,000; (2) Reduce pollution levels by 20 percent, and (3) Create a \$1 billion investment in the Sacramento region's green economy.¹⁶

The solar industry plays an important role in achieving these goals. So far, the region has approximately 49 megawatts of installed capacity or 217 kilowatts of installed capacity for every 10,000 residents.¹⁷ As the installed capacity grows, it will create jobs, reduce pollution levels and generate economic activity in the region. Below are a few examples of large solar projects in the region.¹⁸

- Construction of a 30 megawatt PV solar plant in Elk Grove and Galt. Owned by Constellation Energy Group, this utility-scale solar plant will sell electricity directly to SMUD under a power purchase agreement. The plant will begin generating electricity at the end of 2011.
- Installation of a 6 megawatt PV solar system at Aerojet to offset electricity costs associated with their water remediation program and manufacturing operations. The system was manufactured and installed by Solar Power Inc.
- Installation of a 4 megawatt solar system at UC Davis to achieve zero-net energy for a planned community that will include student housing, recreation facilities, retail establishments, and an educational center. The solar system is being designed, manufactured and installed by SunPower Corp. The planned completion date is fall 2011.
- Installation of a 2.5 megawatt solar system that provides 40 percent of the annual electricity needs for Depot Park. Depot Park is a Superfund site that houses 3 million square feet of industrial warehouse, manufacturing and office space. SPG Solar and Stronergy Co. manufactured and installed the solar system.
- Installation of a 690 kilowatt system to power the City of Auburn's upgraded wastewater treatment plant. Pacific Power Renewables installed the system.
- Installation of a 670 kilowatt system at Marshall Medical Center in El Dorado Hills to offset the hospitals operating costs. The solar system was installed by Solar Power Inc.
- Construction of more than 4,000 SolarSmart homes in Sacramento and Placer counties. Sponsored by SMUD, these homes reduce energy costs by up to 60 percent per residence.

¹⁵ Sacramento Greenwise is an initiative launched by the City of Sacramento. In 2010, the Greenwise taskforce convened over 275 experts and community leaders to develop a 20-year action plan to accomplish the following goals: (1) Create a Self-Sustaining Sector; (2) Become the Greenest Region in the Country; and (3) Brand the Sacramento Region as the Emerald Valley.

¹⁶ Greenwise Sacramento Regional Action Plan, <http://www.uptownstudios.net/greenwise/>.

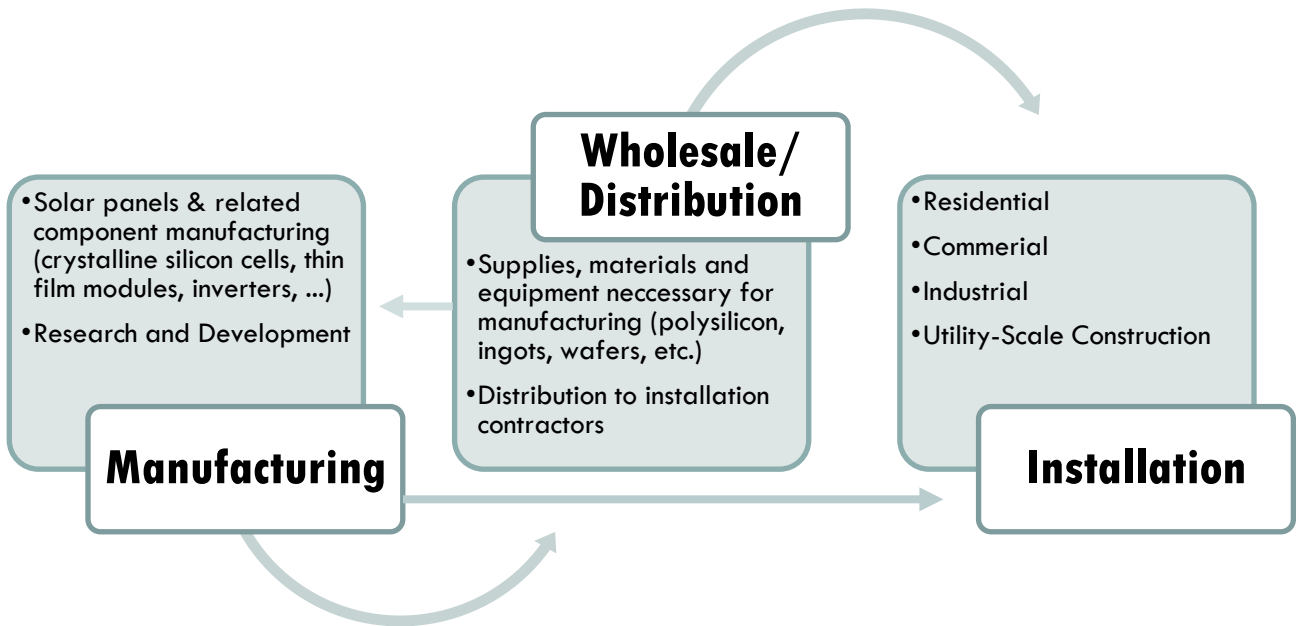
¹⁷ Sacramento Regional Clean Energy Technology Cluster Characteristics and Competitive Analysis, January 2011.

¹⁸ Information compiled from a review of company websites and Sacramento Business Journal articles published between March 1 and May 31, 2011.

Solar Supply-Chain

The solar supply chain includes installation, wholesale/distribution and manufacturing. The clustering of these businesses reduces the cost of local installation by decreasing the travel time of materials and enabling local negotiations. Further, supply-chain clusters attract other solar businesses to the region so that they may gain access to the infrastructure – available vendors, research and development, professional networks, etc. Exhibit 2 provides a simple overview of the solar market supply chain.

Exhibit 2: Solar Market Supply Chain

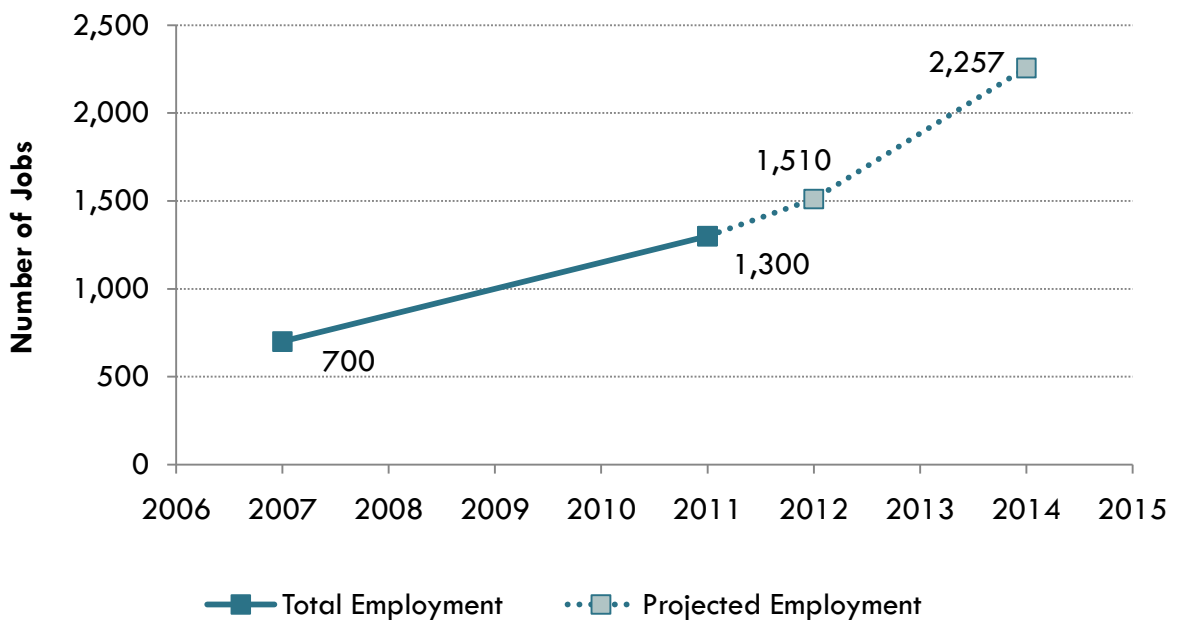


In the Sacramento Region, the solar supply chain is fairly robust. There are about 110 solar firms in the Sacramento region, with about 19 specializing in manufacturing, approximately 36 specializing in wholesale trade, and at least 55 that specialize primarily in installation. This study reviews the workforce trends in each element of the supply chain.

Industry Projections

The solar industry has grown significantly since the COE's first report on the industry in 2007. As shown in Exhibit 3, total employment in the solar industry has nearly doubled in the last four years, increasing from 700 jobs in 2007 to 1,300 jobs in 2011. Sacramento solar employers expect to add more than 200 jobs over the next 12 months (16 percent growth) and about 950 jobs over three years (73 percent growth). The number of solar firms has also increased in the Sacramento Region from 70 firms in 2007 to 110 firms in 2011. This is nearly a 60 percent increase.¹⁹

Exhibit 3: Current and Projected Solar Employment in the Sacramento Region²⁰



¹⁹ The 2007 solar employment and firm estimates are based on the Northern California COE Solar Industry Study, published in 2008. The report is available at www.coecc.net/solar.

²⁰ COE Solar Industry Surveys, 2007 and 2011.

Occupational Overview

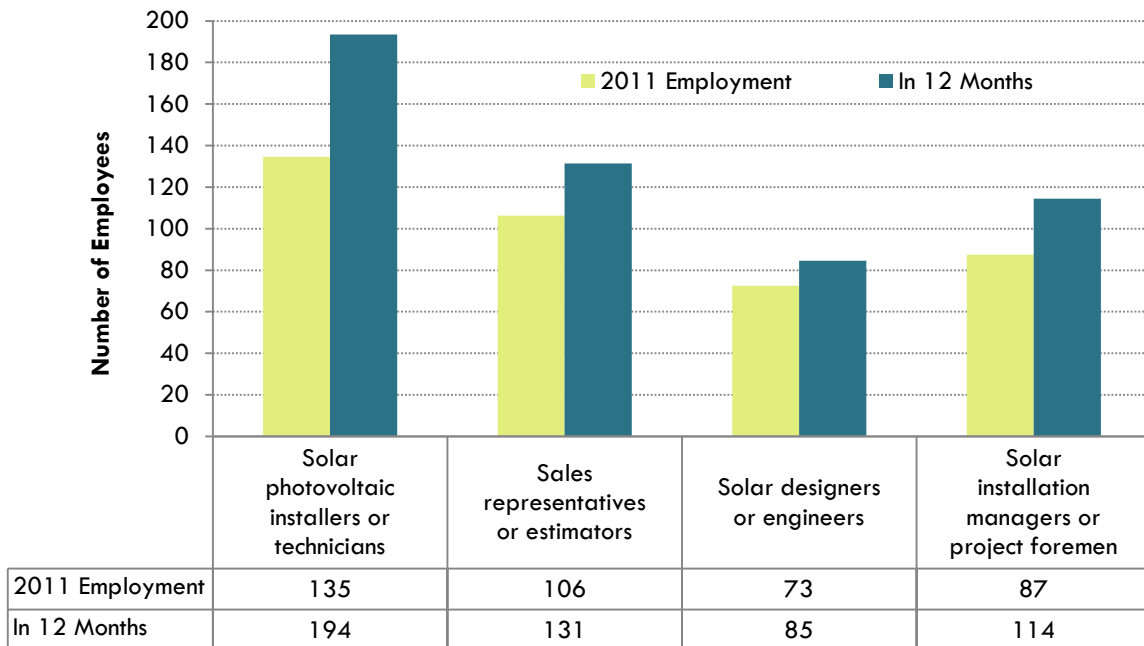
This section profiles four occupations in the installer segment of the solar industry and four occupations in the wholesale trade and manufacturing segments, including employment estimates, employment projections, hiring challenges, training preferences, and career pathway options.

Solar Installation Occupations

In the Sacramento Region, solar installer firms employ about 400 PV installers, sales representatives, solar designers, and managers/foreman who spend at least half of their time on solar installation and related services. Local employers expect to add about 125 positions over the next 12 months.

These employment estimates do not include workers that spend some time, but less than 50 percent of their day, on solar installations and related services.²¹ In addition, these estimates exclude seasonal or contract employees, which about 20 percent of installer firms hire on a regular basis.

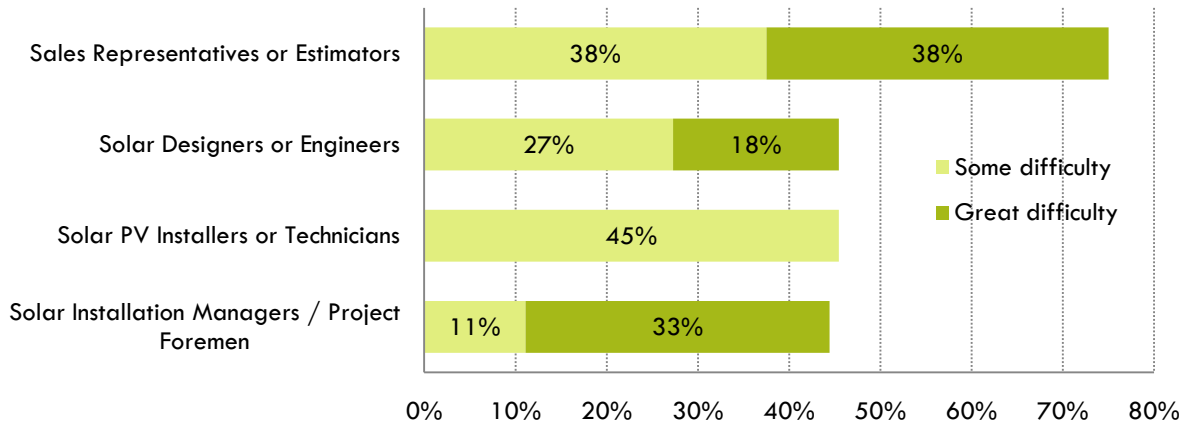
Exhibit 4: Current and Future Employment Estimates for Solar Installer Occupations in the Sacramento Region



Employers were asked to report on the level of difficulty finding qualified applicants for each occupation. As shown, employers are having the most difficulty finding qualified sales representatives, followed by solar designers/engineers and solar technicians. However, these findings are significantly different than the 2007 survey. In 2007, three out of four employers expressed difficulty finding qualified applicants for all four occupations. As such, it is likely that an increase in training programs and a larger pool of qualified applicants has made it easier for employers to find qualified workers.

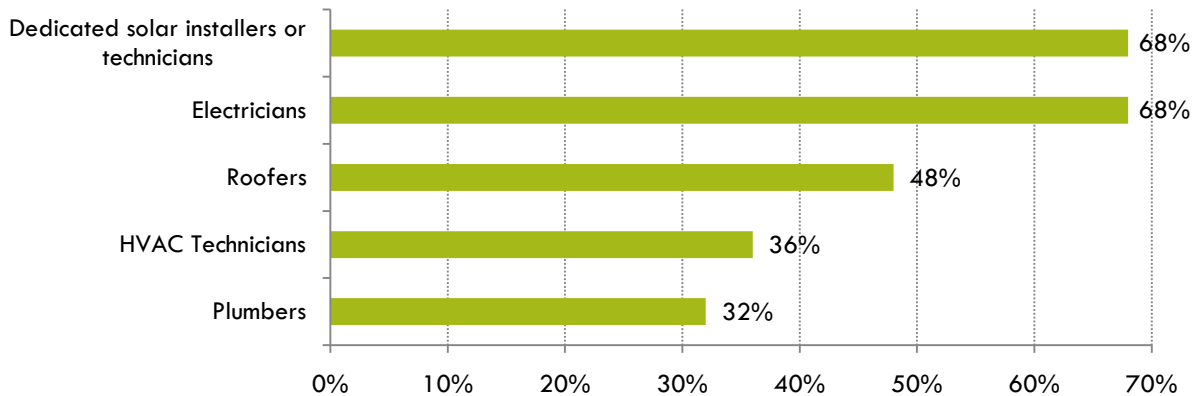
²¹ This screening question was not included in the 2007 COE solar industry survey. As such, it is not possible to use the 2007 occupation data as a benchmark for measuring the change in employment from 2007 to 2011.

Exhibit 5: Level of Difficulty Finding Qualified Solar Installer Candidates



Many firms in the region engage their existing skilled tradesmen to work on solar installations. As shown below in Exhibit 6, in addition to hiring trained solar technicians, Sacramento firms may also employ electricians, roofers, HVAC technicians, and plumbers to work on solar installations. Displaced workers in these trades could transition to solar installation positions.

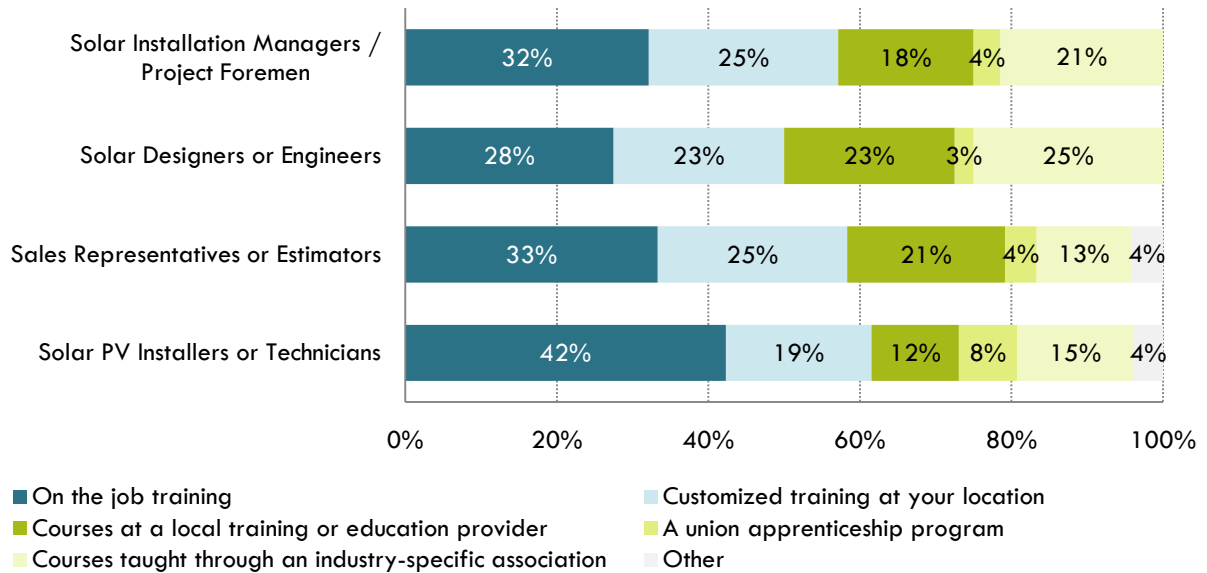
Exhibit 6: Types of Individuals that Conduct Solar Installations



Training incumbent workers on safety and technical operations is often a challenge for solar firms. As shown below, most solar installer firms train their workers through on-the-job training, followed by customized training provided at their worksite, or courses taught through an industry-specific association.

Local training and education provides play a small role in providing training to existing workers with fewer than 10 percent of employers utilizing this resource for employee training. In addition, only about 16 percent of the firms surveyed have collaborated with a regional community college on training, recruitment or other employee development practices. However, nearly half are willing to assist faculty develop new curricula or provide technical expertise. This represents an opportunity for community colleges and other local education providers to outreach to the solar industry.

Exhibit 7: Training Preferences for Solar Installer Employees



Solar Wholesale Trade and Manufacturing Occupations

Solar firms hire a range of support staff to operate their businesses. As shown below, solar wholesale trade and manufacturing firms currently employ about 260 production, accounting, and sales/marketing workers in the Sacramento Region. Over the next 12 months, solar firms expect to add 60 new positions to support these job classifications.²² These positions require specialized skills and knowledge related to the solar industry, such as a general understanding of energy and power systems, solar technologies, and laws and regulations impacting the industry.

Exhibit 8: Current and Future Employment Estimates for Solar Wholesale Trade and Manufacturing Occupations

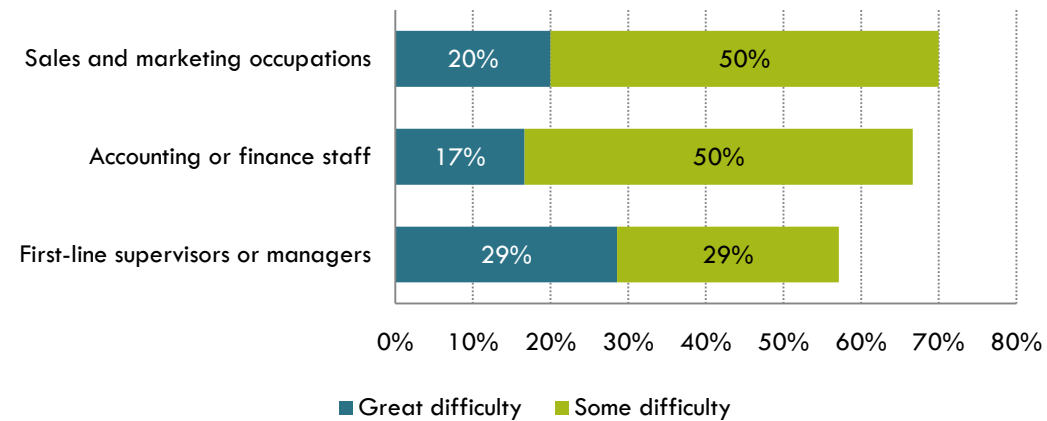


²² Sample size for each occupation in this dataset is less than 30.

Exhibit 9 displays the reported level of difficulty solar firms have in finding qualified production managers, accounting/finance staff, and sales/marketing workers. Similar to solar installer firms, solar wholesale trade and manufacturing firms are experiencing the most difficulty finding qualified sales and marketing professionals. The ideal candidate for a sales position has an aptitude for sales along with technical expertise.

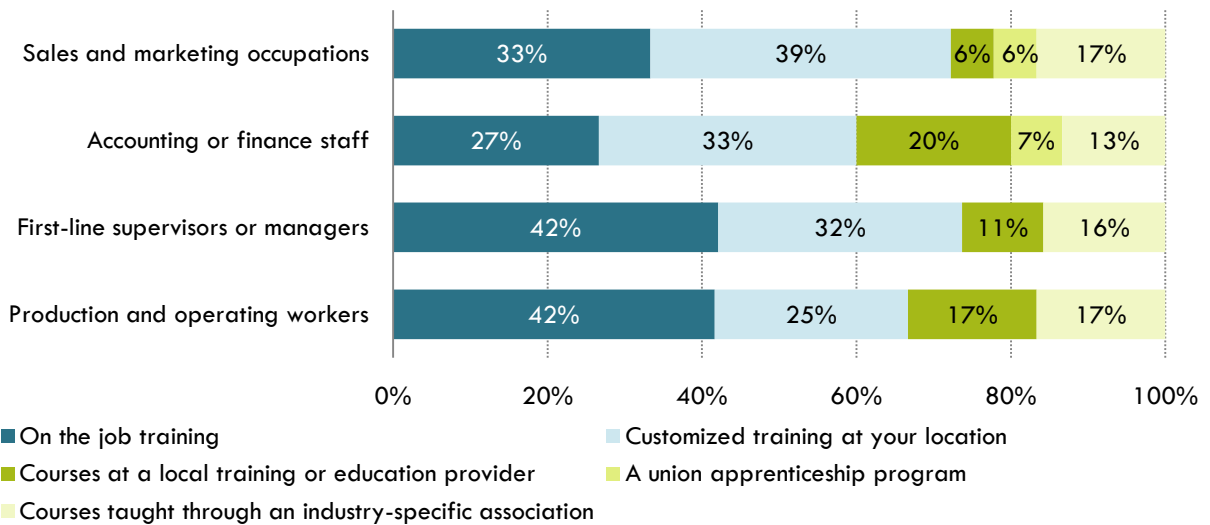
The majority of solar wholesale trade and manufacturing firms reported difficulty finding accounting/finance staff as well as first-line supervisors or managers of production workers.

Exhibit 9: Level of Difficulty Finding Qualified Solar Wholesale Trade and Manufacturing Candidates²³



Overall, wholesale trade and manufacturing firms tend to train their current employees using on-the-job training or providing customized training through a vendor at their worksite. Due to the specialized nature of their business, these methods provide the most flexibility.

Exhibit 10: Training Preferences for Solar Wholesale Trade and Manufacturing Employees



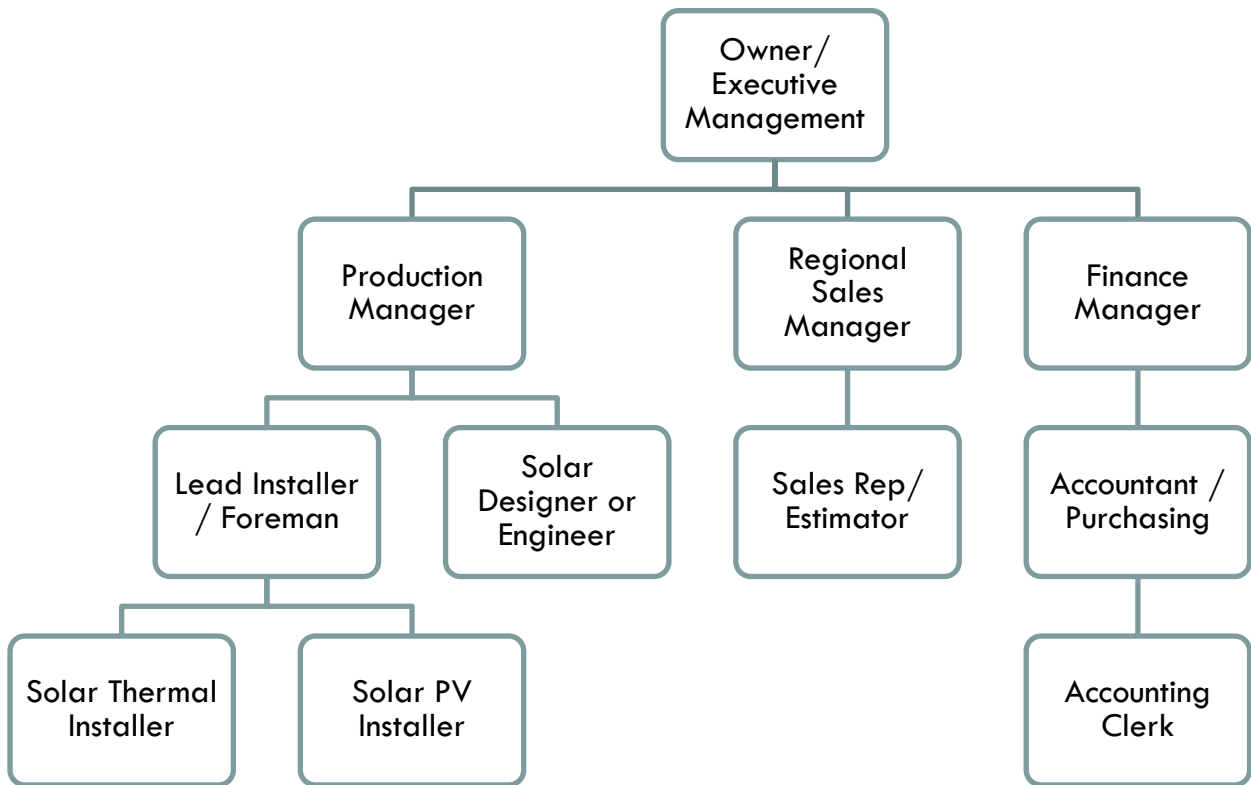
²³ Production and operating workers and engineers is not included due to a small sample size.

Career Pathways for Solar Occupations

The following chart displays the promotional and career pathway options of a mid-size solar installer firm. Entry-level positions, such as solar thermal installers or PV installers, may promote into a lead or foreman position with the appropriate training and experience. From lead or foreman, it is often necessary to obtain a Bachelor’s degree to continue progressing in the organization.

On the sales and marketing side of the business, sales representatives with excellent managerial skills may promote to a regional sales manager position. There is also a career pathway option in the finance department from accounting clerk to accountant with additional education and training.

Exhibit 11: Sample Career Pathway for Solar Industry Occupations

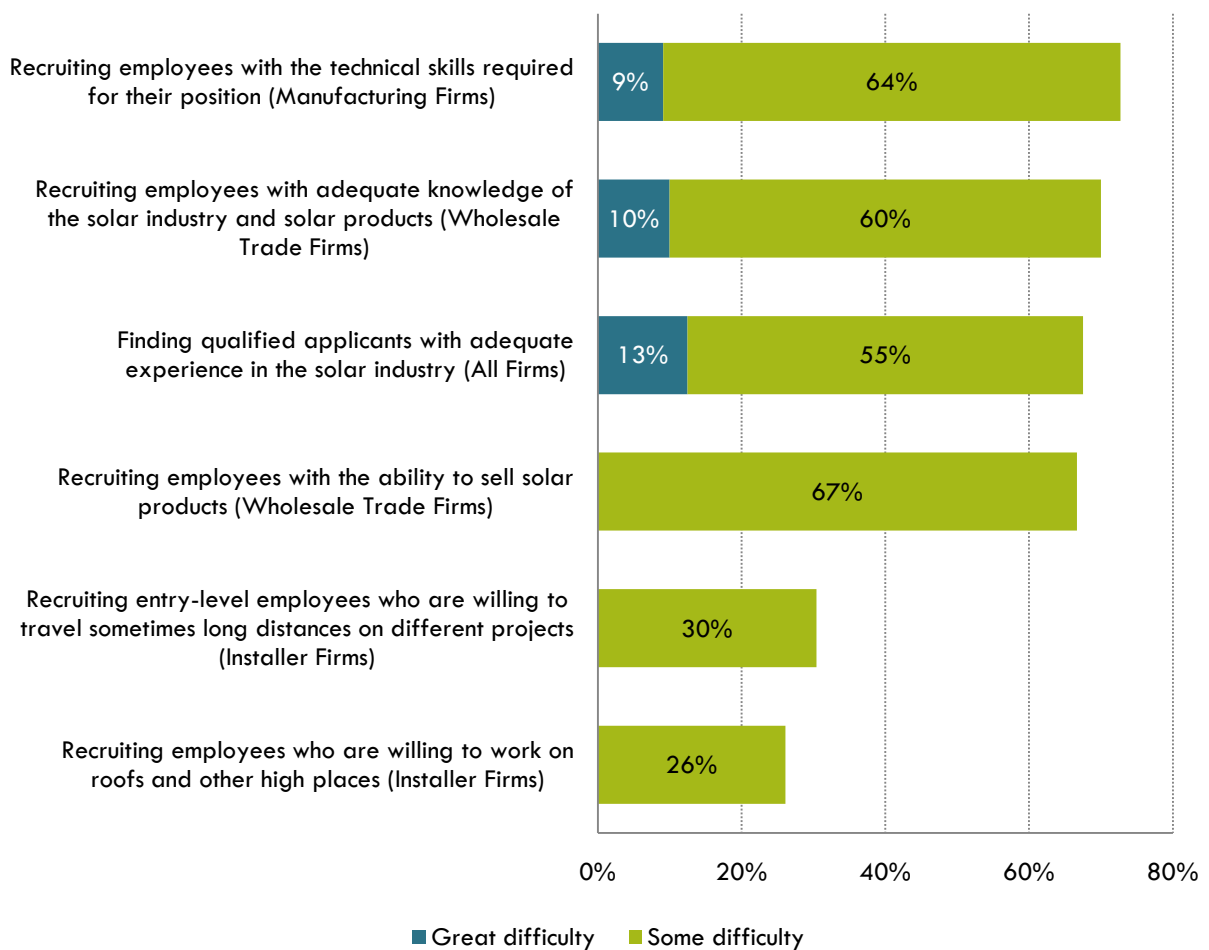


Employer Needs and Challenges

Nearly 70 percent of solar firms in the Sacramento Region reported difficulty finding qualified applicants with adequate work experience. Manufacturing firms reported difficulty finding employees with the technical skills required for the position and wholesale trade firms find it challenging to recruit employees with adequate knowledge of the solar industry and products. These findings suggest that individuals who would like to transition to the solar industry could strengthen their resume by taking an introductory course on solar technology, or other related courses, that detail the industry’s processes, products and systems.

The majority of installer firms are not experiencing difficulty finding qualified applicants willing to travel long distances or who are willing to work on roofs or other high places. This may be due to an increase in applicants transitioning from the construction sector. Some firms reported difficulty finding workers with knowledge of electric tariffs, permitting issues, environmental laws, and general electrical concepts. One firm reported that “finding individuals with a good attitude and work ethic is far more difficult than finding ones with experience.”

Exhibit 12: Workforce Development & Training Challenges



Community College Programs

Two community colleges in the Sacramento region offer solar training programs. In 2008, the California Community College Chancellor's Office awarded Sierra College an Industry Driven Regional Collaborative (IDRC) grant to develop a solar training program serving Nevada and Placer counties. Sierra College developed two certificates slated to launch this fall and added a Photovoltaics concentration to their Environmental Studies & Sustainability Associate degree program (available spring 2012).

American River College recently introduced two solar certificate programs that prepare students for solar design, sales, estimating and installation careers. Sacramento City College also offers several courses in solar thermal, which may expand to a certificate program sometime in the future.

Table 2: Solar Programs in the Sacramento Region

College	Degrees / Coursework	Occupations for which program prepares students
Sierra College	Certificate in Photovoltaics (Fall 2011) Certificate in Advanced Photovoltaics (Fall 2011) A.S. in Environmental Studies & Sustainability with a concentration in Photovoltaics (Spring 2012)	Solar Photovoltaic Technician; Sales Rep; Solar Designer; Solar Installation Manager
American River College	Solar Energy Systems Design, Estimation, and Sales Certificate (24 Units) Solar Energy Technology Certificate (18 Units)	Solar Designer; Sales Representative; Solar Installation Manager; Solar Photovoltaic Technician
Sacramento City College	Various course on photovoltaic and solar hot water systems	Solar Photovoltaic Installers, Operations and Maintenance Technicians, Active and Passive Solar Hot Water Installers

Conclusion and Recommendations

In the last four years, the solar industry has nearly doubled, adding more than 600 jobs in the Sacramento region. There are about 110 solar firms in the region, with about 55 that specialize primarily in installation, 36 that specialize in wholesale trade, and 19 that specialize in manufacturing. Over the next 12 months, the solar industry is expected to grow by 16 percent adding workers to support operations among all three segments of the supply chain.

Sacramento community colleges have responded to the industry's growing demand by developing several training programs. These certificate programs offer courses related to solar installations, estimating, solar sales, and system designs. Students and job seekers applying for traditional positions with solar firms (such as production manager, marketing analyst or sales representative) would benefit by taking courses from one of these programs. Training would give applicants an edge in the hiring process by introducing them to key solar concepts.

Given the size of the industry and projected demand for new workers, there is a sufficient mix of training programs available in the Sacramento Region. The Center of Excellence recommends the following action steps to respond to the solar industry's growing workforce needs.

Ongoing enhancements

- Develop a regional advisory committee to annually review training programs and offer recommendations.
- Identify employers willing to sponsor student and faculty internships, allow onsite visits, provide guest lecturers or collaborate on other learning opportunities.

Programmatic adjustments

- Add a course on solar installations to existing electrician programs to prepare students for multiple pathways.
- Add a distance learning course on energy production, estimating, and solar technologies to reach rural areas of the state.
- Continue to monitor the industry's expansion and respond with new courses and programs as the need develops.

Increase awareness about occupations in demands across the supply chain

- Raise awareness about the variety of solar occupations among career counselors to promote all of the industry's career options – not just solar installation careers.
- Get involved with the Green Capital Alliance or other regional efforts to stay connected with business owners and informed as to the industry's workforce needs.

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Appendix A: Solar Survey Methodology

Methodology

The table below briefly outlines the methodology and sample composition for this study. Between April and June of 2011, the COE conducted a survey of 42 solar employers across three segments of the supply-chain in the seven-county Sacramento Region. The Sacramento Region includes Sacramento, El Dorado, Placer, Nevada, Sutter, Yolo and Yuba counties.

Internet/Telephone Survey Methodology

Technique	Internet and Telephone Survey of Solar Installer, Wholesale Trade and Manufacturing Firms
Universe	110 Firms
Number of Respondents	42
Field Dates	April to June 2011

Sample Composition

The sample includes firms that specialize in installation, wholesale trade, and manufacturing. As shown in Exhibit A1, 81 percent of the firms surveyed provide solar installations, 52 percent focus on sales or distributes of solar products, and another 28 percent produce or assembly solar panels and related components. The percentages total to more than 100 percent as some companies specialize in more than one area of the supply chain.

Exhibit A2 displays the firm size of the sample. Sixty-four percent of the firms surveyed employ fewer than 10 workers, 29 percent employ between 10 and 49 workers, and only about 7 percent have more than 50 workers. The size distribution of firms in the Sacramento Region has not significantly change in the last four years.

Exhibit A1: Types of Solar Firms

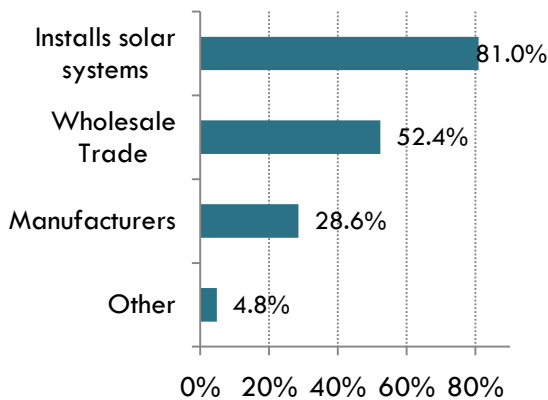
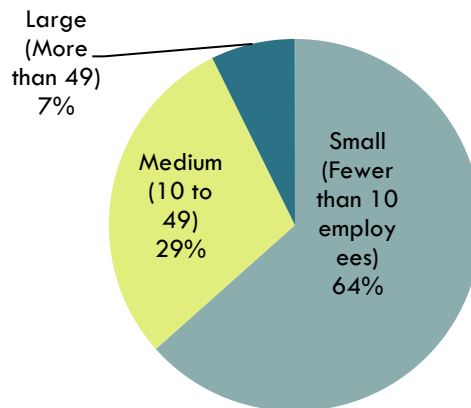


Exhibit A2: Size of Solar Firms



As shown below, the majority of installer firms work with photovoltaic solar panel systems; about half provide solar thermal installations and a few install heating and cooling systems. Firms providing PV installations are engaged mostly with residential systems (65 percent); 30 to 40 percent work with small to large scale commercial systems.

Exhibit A3: Types of Solar Products Installed by Installer Firms

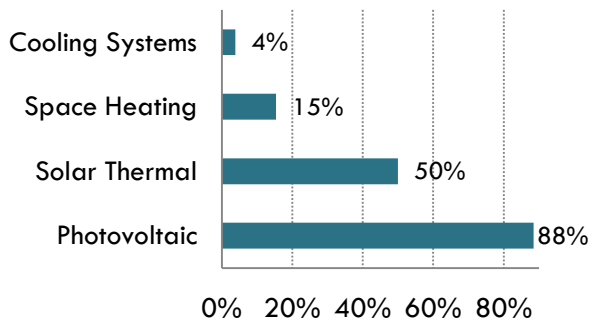
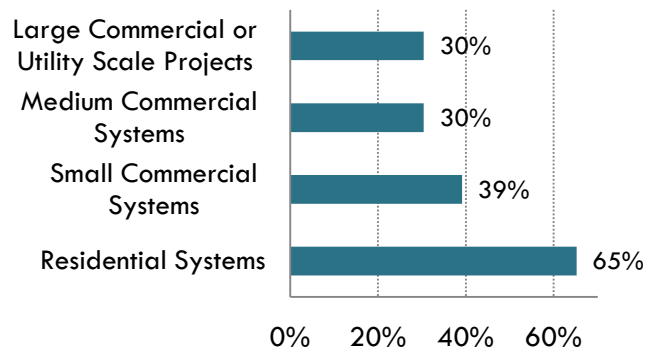


Exhibit A4: Types of PV Projects Installed by Installer Firms



Wholesale trade firms sell and distribute a range of solar products from photovoltaic panels to concentrated solar power systems. As shown below, four out of five firms sell or distribute PV panels, one-half distribute solar pool and/or other water heating products, and about 20 percent focus on CSP and/or solar space heating and cooling systems. Solar manufacturing firms in the region primarily produce PV panels and related components (73 percent), followed by concentrated solar power (36 percent) and solar water heating systems (27 percent).

Exhibit A5: Types of Products Sold/Distributed by Wholesale Trade Firms

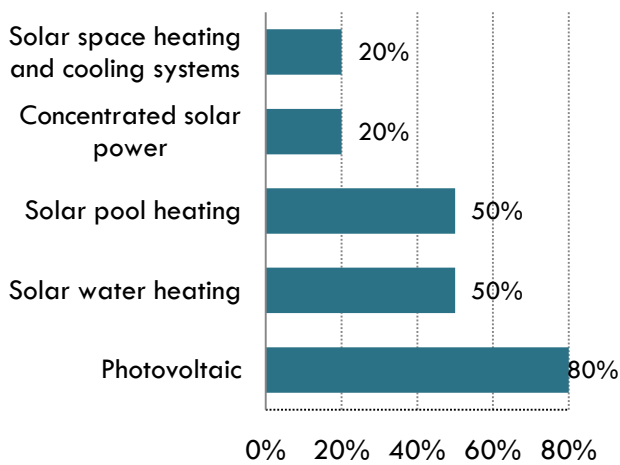
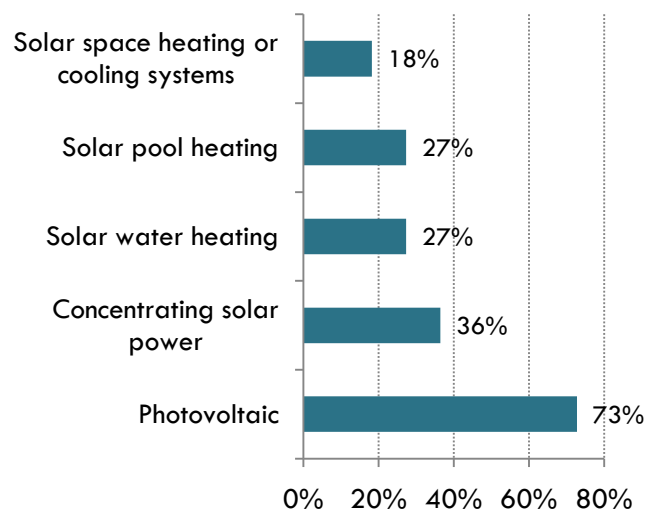


Exhibit A6: Types of Products Assembled by Manufacturing Firms



Appendix B: Occupational Profiles

Solar Water or Pool Heating Installers or Technicians

Solar Thermal Technicians install and repair solar-energy systems designed to collect, store, and circulate solar-heated water or other medium for residential, commercial, or industrial use. Some of the key job functions include:

- Design active direct or indirect, passive direct or indirect, or pool solar systems.
- Perform routine maintenance or repairs to restore solar thermal systems to baseline operating conditions.
- Apply operation or identification tags or labels to system components, as required.
- Assess collector sites to ensure structural integrity of potential mounting surfaces or the best orientation and tilt for solar collectors.

The minimum hiring requirements for this occupation include on-the-job training or a certificate/degree from a community college or vocational school. Entry-level workers earn \$14.10 per hour and more experienced workers earn \$25.05 per hour.

Solar Photovoltaic (PV) Installers or Technicians

Solar PV Technicians install the systems that generate solar electricity to heat and cool entire buildings or connect to the grid. Some of the key job functions include:

- Assemble solar modules, panels, or support structures, as specified.
- Install active solar systems, including solar collectors, concentrators, pumps, or fans.
- Install photovoltaic (PV) systems in accordance with codes and standards using drawings, schematics, and instructions.
- Perform routine photovoltaic (PV) system maintenance on modules, arrays, batteries, power conditioning equipment, safety systems, structural systems, weather sealing, or balance of systems equipment.

The minimum hiring requirements for this occupation include on-the-job training or a certificate/degree from a community college or vocational school. Entry-level workers earn \$15.09 per hour and more experienced workers earn \$27.45 per hour.

Sales Representatives or Estimators (also called Site Assessors)

The position of Sales Representative or Estimator in the solar industry cannot be easily defined. The tasks assigned to this occupation are likely to be particular to individual employers and span a wide range of work activities. In general, solar sales representatives were expected to have some knowledge or experience in construction, accounting, and electrical systems.

In addition the following background is desired: (1) General business skills and customer service skills were also considered important assets for this position; (2) Energy system cost estimation and site analysis may require additional training on-the-job or previous work experience; and (3) Knowledge of government requirements, such as building inspections, construction permits, energy costs, government incentives, tax implications and municipal codes, is another critical component to this occupation. Some of the key job functions include:

- Contact new and existing customers to discuss their needs, and to explain how these needs could be met by specific products and services.

- Answer customer questions about products, prices, payback period availability, product uses, and credit terms.
- Quote prices, credit terms and other bid specifications.
- Emphasize product features based on analyses of customers' needs, and on technical knowledge of product capabilities and limitations.

This position generally requires a business-related Associate or Bachelor's degree, depending on individual employer requirements. Entry-level workers earn \$20.97 per hour and more experienced workers earn \$39.80 per hour.

Solar Designers or Engineers

Solar Designers or Engineers are primarily responsible for generating system designs and supporting documentation for PV and solar hot water systems. This includes production of plans for building permit applications and construction, specification of components, design of systems, and mechanical and electrical points of connection. The position works with a multi-disciplined team to design and produce construction plans for photovoltaic or solar thermal projects. Some of the key functions include:

- Designs solar domestic hot water and space heating systems for new and existing structures, applying knowledge of energy requirements of structure, local climatological conditions, solar technology, and thermodynamics.
- Estimates energy requirements of new or existing structures, based on analysis of utility bills of structure, calculations of thermal efficiency of structure, and prevailing climatological conditions.
- Determines type of solar system, such as water, glycol, or silicone, which functions most efficiently under prevailing climatological conditions.
- Calculates on-site heat generating capacity of different solar panels to determine optimum size and type of panels which meet structure's energy requirements.

This position generally requires a related Associate degree or completion of a related vocational program. Entry-level workers earn \$22.17 per hour and more experienced workers earn \$37.83 per hour.

Solar Installation Managers or Project Foremen

The position of Solar Installation Manager or Project Foreman in the solar industry cannot be easily defined. The management levels of the tasks assigned to this occupation are likely to be particular to individual employers and span a wide range of work activities. For this reason, typical duties may be recognized as belonging to one of two sub-occupations:

- Solar Installation Operation Managers provide project management for the installations, the oversight of installation services, and the training of the project management team. The Manager also provides guidance and contributes to the development of the supply chain strategy and system design activities.
- Solar Installation Managers or Project Foremen may also incorporate knowledge, skills, and abilities similar to those assigned to the broader occupation "First-Line Supervisors/Managers of Construction Trades and Extraction Workers." It should be noted that the position of Solar Installation Operations Managers may require additional education and training, depending on employer preference.

Some of the key tasks for a Solar Energy Foreman that leads work crews installing residential and commercial photovoltaic (PV) or thermal systems include:

- Working as an installer, with some additional office planning time, the foreman is responsible for installation, commissioning, troubleshooting and repair as well as managing the job site, reviewing and finalizing system design, managing equipment and materials, and writing safety plans.
- Examine and inspect work progress, equipment, and construction sites to verify safety and to ensure that specifications are met.
- Read specifications such as blueprints to determine construction requirements and to plan procedures.
- Estimate material and worker requirements to complete jobs.
- Supervise, coordinate, and schedule the activities of construction or extractive workers.

Most Solar Installation Managers or Project Foremen are required to have related on-the-job experience or/and an Associate degree. Some positions may require a Bachelor's degree. Entry-level workers earn \$24.60 per hour and more experienced workers earn \$37.11 per hour.

Production and Operating Workers

Production and operating workers assemble products, pull supplies, manage inventory and clean the warehouse or equipment. In the manufacturing environment, they may also perform the following roles: inspector, precision worker, machine setter and operator, assembler, fabricator, and plant and system operator. Some of the key functions include:

- Operate machinery used in the production process, or assist machine operators.
- Examine products to verify conformance to quality standards.
- Observe equipment operations so that malfunctions can be detected, and notify operators of any malfunctions.
- Lift raw materials, finished products, and packed items, manually or using hoists.
- Count finished products to determine if product orders are complete.

These are entry-level positions that require only a high school diploma or equivalent. Entry-level workers earn \$8.49 per hour and more experienced workers earn \$12.34 per hour.

First-line Supervisors or Managers of Production and Operating Workers

First-line supervisors or managers supervise and coordinate the activities of production and operating workers, such as inspectors, precision workers, machine setters and operators, assemblers, fabricators, and plant and system operators. Some of the key functions include:

- Enforce safety and sanitation regulations.
- Direct and coordinate the activities of employees engaged in the production or processing of goods, such as inspectors, machine setters, and fabricators.
- Read and analyze charts, work orders, production schedules, and other records and reports to determine production requirements and to evaluate current production estimates and outputs.

- Confer with other supervisors to coordinate operations and activities within or between departments.
- Plan and establish work schedules, assignments, and production sequences to meet production goals.
- Inspect materials, products, or equipment to detect defects or malfunctions.

Most Solar First-line supervisors or managers of production workers are required to have related on-the-job experience or/and an Associate degree. Entry-level workers earn \$15.49 per hour and more experienced workers earn \$33.98 per hour.

Accountants and accounting clerks or finance staff

Accountants analyze financial information and prepare financial reports to determine or maintain record of assets, liabilities, profit and loss, tax liability, or other financial activities within an organization. The minimum hiring requirement is typically a four year degree in accounting. Entry-level accountants earn \$25.78 per hour and more experienced workers earn \$34.58 per hour.

Accounting Clerks compute, classify, and record numerical data to keep financial records complete. Perform any combination of routine calculating, posting, and verifying duties to obtain primary financial data for use in maintaining accounting records. May also check the accuracy of figures, calculations, and postings pertaining to business transactions recorded by other workers. The minimum hiring requirement is typically related on-the-job experience and/or an Associate degree. Entry-level workers earn \$17.93 per hour and more experienced workers earn \$23.04 per hour.

Engineers

Solar Energy Engineers perform site-specific engineering analysis or evaluation of energy efficiency and solar projects involving residential, commercial, or industrial customers. Design solar domestic hot water and space heating systems for new and existing structures, applying knowledge of structural energy requirements, local climates, solar technology, and thermodynamics. Some of the key functions include:

- Design or coordinate design of photovoltaic (PV) or solar thermal systems, including system components, for residential and commercial buildings.
- Create checklists for review or inspection of completed solar installation projects.
- Create electrical single-line diagrams, panel schedules, or connection diagrams for solar electric systems using computer-aided design (CAD) software.
- Create plans for solar energy system development, monitoring, and evaluation activities.
- Develop design specifications and functional requirements for residential, commercial, or industrial solar energy systems or components.

Solar engineers are required to have a Bachelor's degree in engineering. Entry-level workers earn \$26.93 per hour and more experienced workers earn \$56.09 per hour.

Marketing Staff

Marketing staff, such as marketing managers, determine the demand for products and services offered by a firm and its competitors and identify potential customers. They develop pricing strategies with the goal of maximizing the firm's profits or share of the market while ensuring the firm's customers are satisfied. They may also oversee product development or monitor trends that indicate the need for new products and services.

- Formulate, direct and coordinate marketing activities and policies to promote products and services.
- Identify, develop, and evaluate marketing strategy, based on knowledge of establishment objectives, market characteristics, and cost and markup factors.
- Direct the hiring, training, and performance evaluations of marketing and sales staff and oversee their daily activities.
- Evaluate the financial aspects of product development, such as budgets, expenditures, research and development appropriations, and return-on-investment and profit-loss projections.
- Develop pricing strategies, balancing firm objectives and customer satisfaction.

Marketing managers are typically required to have a Bachelor's degree plus work experience. Entry-level managers earn \$31.08 per hour and more experienced workers earn \$75.97 per hour.

Source and Notes:

- Entry-level and experienced wage data for Thermal and PV Solar Installers, Sales Representative, Solar Designers, and Project Foreman is based on the Solar Foundation 2010 Survey. The wage data is an estimate of the average entry-level wages (less than 12 months of experience) and experienced wages (3 or more years of experience) in California.
- Entry-level and experienced wage data for Production and Operating Workers; First-line supervisors or managers of production and operating workers; Accountants and accounting clerks or finance staff; Engineers; Sales occupations; and Marketing staff is based on Economic Modeling Specialist hourly wage data. The entry-level data estimates the average wage for the bottom 10 percent of workers and the experienced data estimates the wage for the top 25 percent of workers in this occupation in California.
- Job descriptions, functions and educational requirements are compiled from O*NET's occupational descriptions, <http://online.onetcenter.org>.

Appendix C: About the Centers of Excellence

The Center of Excellence (COE), in partnership with business and industry, delivers regional workforce research customized for community college and workforce system decision making and resource development. The Northern California COE is one of five regional Centers of Excellence supported by the Chancellor's Office of the California Community Colleges and is tasked with conducting environmental scanning, partnership development and technical assistance activities.

The COE's research team represents expertise in labor market analysis, labor-management partnership projects, project management, and primary research. COE staff are experienced researchers with a focus on research design, partnership development, educational and training program mapping, and identifying skill sets for emerging occupations as well as key skill sets and geospatial analysis.

The COE maintains strategic alliances with research organizations whose relationships and technical expertise enhance COE's research efforts. These alliances enable COE to access information from over 80 public databases through the use of EMSI economic modeling software, GIS technology via the use of customized geo-mapping software that ties industry codes (NAICS) to a private business database of over 1 million business records. The COE maintains robust partnerships with industry associations that assist in validating research findings, ensuring that the most recent industry and labor market conditions are captured.

COE studies are used to inform policy discussions, industry-wide legislative efforts, and regional workforce development strategies, as well as guide program and resource development efforts by the California Community Colleges. These reports can be accessed at www.coecc.net.