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Contents

BASED ON A 2008 SURVEY OF SOLAR BUSINESSES AND BUSINESSES TIED TO THE SOLAR INDUSTRY IN THE BAY REGION AND CALIFORNIA, SOLAR OCCUPATIONS IN GREATEST DEMAND WILL GROW BY AN AVERAGE OF NEARLY 50% OVER THE NEXT 12 MONTHS. THIS GROWTH IS PROJECTED TO CREATE ALMOST 1,900 NEW JOBS IN THE BAY REGION SOLAR INDUSTRY AND A TOTAL OF OVER 5,000 NEW JOBS STATEWIDE. SOURCE: BW RESEARCH PARTNERSHIP

Executive Summary

The solar industry is a significant and growing industry in the San Francisco Bay and Greater Silicon Valley regions of California. With increasing employment opportunities, good wages and opportunities for career advancement, the industry's growth presents strong potential for community colleges to build training and education programs.

This report represents the release of the first original research conducted on solar occupations, conducted in collaboration with BW Research Partnership, a firm specializing in workforce research, and the Bay Region's two Advanced Transportation Technology and Energy Centers. The report and the preliminary findings released prior to this report have already generated strong interest from legislators, policymakers, employers, and the leading industry associations who participated in the research phase of this report.

The Bay Region Solar Industry Workforce Study researched five solar-related occupations including: Solar Photovoltaic (PV) Installer, Solar Thermal Installer, Solar Designer/Engineer, Solar Installation Manager/Project Foreman, and Solar Sales Representative/Estimator. Four out of the five solar occupations require no more than an associate degree and are technician-level jobs (complete profiles of the five solar occupations studied can be found in Appendix D.) This confirms a strong strategic opportunity for regional community colleges to prepare the current and future labor force needed by the industry.

Solar industry workforce issues deserve attention from regional community colleges because the industry is:

- Concentrated in California and in the ten-county Bay Region within the state.[1]
- Growing, due to the high cost of fossil fuels, the climate crisis, new state laws that both create incentives for solar installations and require the reduction of green house gases, and federal tax incentives.
- Advancing, due to new manufacturing technologies, such as thin film PV, that hold the promise of being more cost competitive in the marketplace.

[1] See page 8 for the other regions in the state with large concentrations of solar firms or firms tied to the solar industry.

- Infused with large amounts of venture capital, indicating the heightened importance of the industry for investment purposes.

At the same time, the future of the solar industry has significant challenges that must be overcome for the industry to continue to grow and gain a greater percentage of the $2 trillion global energy market. Industry challenges include lowering the cost of generation; establishing industry standards for installation and performance; streamlining the process for acquiring permits, interconnections, inspection and rebates; and financing investment and growth.[2]

An even more critical challenge for the industry is the recruitment and preparation of the workforce needed to fill the new solar jobs. Seventy-five percent of the 77 employers interviewed for this study expect to increase employment in the next twelve months.[3] Three out of four employers expressed at least some difficulty in finding qualified entry-level employees; and four out of five employers are encountering difficulty in finding employees with experience.

Employers indicated in both executive interviews and in their survey responses that they are currently hiring workers who have hands-on experience, and not a degree, for many of the positions they are attempting to fill. However, employers also expressed great interest in the education and training programs that can be developed by community colleges for the solar occupations studied in this report.

A number of Bay Region community colleges are providing or are planning to develop solar PV classes, certificates or programs to respond to the workforce needs of the solar industry. A comprehensive overview of these programs can be found in the College Response and Resources section of this report (p. 22.) There are also a number of solar industry associations and community organizations in the Bay Region that colleges are partnering with or can partner with to build responsive training programs (p. 26).

This report will focus on the solar industry in the Bay Area. The Centers of Excellence in the Sacramento and Los Angeles areas will be releasing similar reports in the near future to describe the solar industry and workforce challenges in their regions.

Finally, it is important to note that the solar industry is only one of the industries in the large and emerging green technology sector. Colleges in the Bay Area and elsewhere in the state also have an opportunity to build programs that train students to enter a number of other areas within the green technology sector such as wind, biofuels, and energy-efficiency.

[2] SolarTech: Creating a Solar Center of Excellence, White Paper, June 2007, www.solartech.org.
[3] This projection from employers may be impacted significantly if the federal solar tax credit, which expires at the end of 2008, is not renewed.

Introduction

The California Community Colleges Economic and Workforce Development Program (EWD) has charged the Centers of Excellence with identifying industries and occupations that have unmet employee development needs. The solar industry has been featured in the media and regional business reports as an emergent and growing sector of the green technology field. However, these reports have not researched and analyzed the workforce development needs of the solar industry. In January 2008, the Bay Region and Greater Silicon Valley Centers of Excellence (COEs), in partnership with the two Advanced Transportation Technology and Energy Centers in the Bay Area launched and completed a survey of 77 of the 257 solar businesses and businesses tied to the solar industry located in the ten-county Bay Area.

The Bay Region Solar Industry Workforce Study, conducted in partnership with solar industry associations, adds to the knowledge base on the industry by contributing original research on workforce issues and by offering recommendations to community colleges on how best to address the industry's future workforce challenges. [4] Specifically, the research study:

- Identifies solar firms in the Bay Area, their geographical concentration, size of firms and major sectors.
- Identifies key solar occupations that are most relevant to community colleges.
- Develops projections of future employment growth.
- Identifies employer challenges in recruiting, hiring and retaining workers.
- Defines skill sets and education requirements needed for the relevant solar occupations.

The research findings, which are being released fully for the first time in this report, provide colleges with timely and credible information for the development or redesign of solar training and education programs.

Industry Overview

Industry Trends

The solar energy industry is expected to be one of the most rapidly growing industries in the U.S. and in California. On average, U.S. solar companies are projecting 30-40 percent annual growth in the next decade.[5] California is by far the leader in the U.S. solar industry with over 75 percent of the market.

California is also one of the largest markets for solar power worldwide. Other leading markets globally are Japan, Germany, Spain, China, Greece, Italy, Austria and the

[4] California Solar Energy Industries Association, Northern California Solar Energy Association and SolarTech. In addition, the Solar Living Institute was a partner in the workforce study.
[5] These numbers are based on interviews with solar companies and their presentations at the Solar Power Conference 2007 in Long Beach, at which 12,500 people participated.

United Kingdom. According to the U.S. Solar Industry Review, the U.S. solar energy industry saw record growth in 2006 due to increased customer and utility demand—a result of rising energy prices, public concerns about energy security and global warming, and the expansion of federal and state support for solar deployment.

In 2006, the federal Energy Policy Act (EPAct) took effect, providing significant tax credits for solar installations.[6] In addition, the California Solar Initiative was passed with $3.35 billion in funding for new solar installations and the President's Solar America Initiative was created to double the funding for research, development, and deployment of solar energy technologies to provide energy alternatives.[7] These recent legislative and policy developments have helped to support the growth expectations in the solar industry and related occupations.

Increased silicon production and new manufacturing technologies are key to the industry's future success. New silicon manufacturing facilities are expected to increase supply that should result in lower future silicon costs.[8] Some cell and module manufacturers are managing costs by employing production methods that require less silicon, while others are exploring technologies that move away from silicon entirely. One non-silicon technology is thin film PV which offers promise for an industry that is seeking to drive down costs through cheaper materials.[9]

Overall, these trends have created demand for solar products and services and have raised expectations that new technologies, cost competitiveness, solar incentives and the imperative of reducing green house gas emissions will continue to drive growth.

Understanding the Industry Structure

There are two major system technologies associated with solar energy: PV systems and Solar Water Heating/Thermal systems.

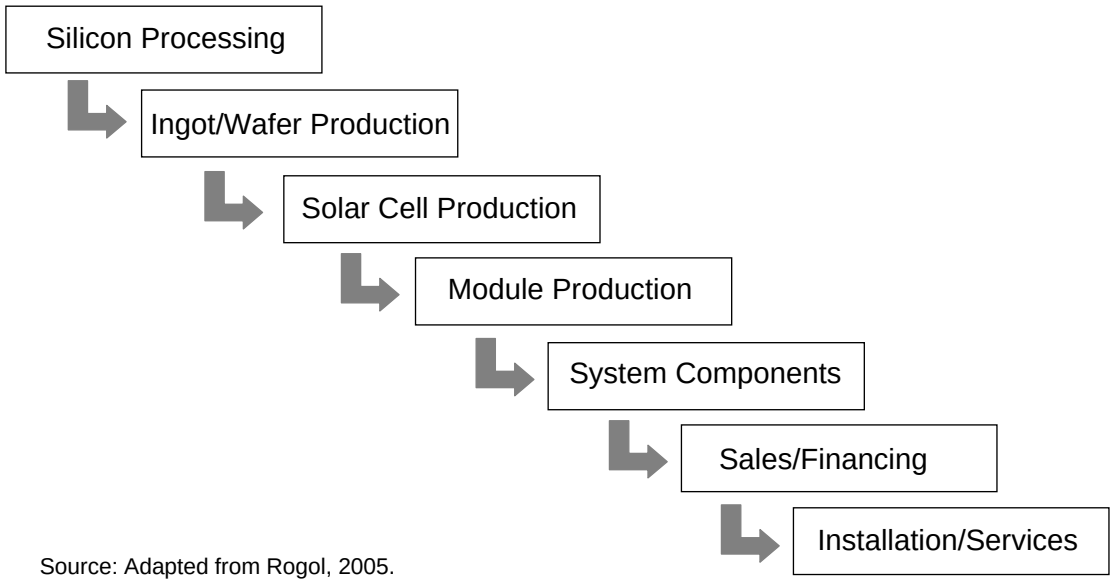
Photovoltaic (PV) systems are high-tech solid state solar modules that convert radiant sunlight directly into electricity. There are generally two types of PV technologies available on the market today: crystalline silicon solar cells and thin film solar cells. Silicon solar cells dominate the market with about 84 percent of worldwide shipments, while thin film accounts for the remainder (Simons and McCabe, 2005).

This converted electricity can be independent of the utility grid (off-grid) or connected to the grid (on-grid). Off-grid installations utilize energy storage systems (batteries) and are typically placed in remote locations, where they are a less expensive alternative to conventional electricity. On-grid installations utilize the utility grid for additional energy needs.[10] The solar PV industry value chain includes the stages outlined in Figure 1.

[6] The current federal subsidies, which expire in December 2008, offer a 30 percent tax credit for the cost of the system, capped at $2,000 for consumers.
[7] U.S. Solar Industry Year in Review, 2006, Solar Energy Industry Association (SEIA).
[8] Sue Kateley, Executive Director, California Solar Energy Industries Association (CALSEIA).
[9] SolarTech: Creating a Solar Center of Excellence, White Paper, June 2007, www.solartech.org.
[10] Ibid.

Occupations highlighted in this report are primarily associated with the Installation and Services stage:

Figure 1: The Solar PV Industry Value Chain



Source: Adapted from Rogol, 2005.

Solar Thermal systems use direct heat from the sun, concentrating it in some manner to produce heat at useful temperatures.[11] Solar water heating system (non-swimming pool) installations have recently been supported by governmental incentives, and their number is expected to grow 50 percent annually.[12] In California, the Public Utilities Commission (CPUC) plans to offer $100 million in incentives over the next ten years for solar thermal technologies under the California Solar Initiative.[13]

Solar Thermal and PV systems are also utilized on a large commercial scale in *concentrating solar power (CSP) plants*. These CSP plants are utility-scale generators that produce electricity by using mirrors or lenses to efficiently concentrate the sun's energy. Most of the existing CSP plants are based on solar thermal systems and located in Southern California.

Location of Businesses

The largest concentrations of solar firms or firms tied to the solar industry in the state are in the ten-county Bay Area, Los Angeles/Orange Counties, the San Diego area, and the Greater Sacramento area. The industry is providing growing employment opportunities for workers and economic benefits for the regions where it is concentrated. Community colleges are located in or near the major cities where solar firms are located. Some of the larger solar businesses in the Bay Area are profiled in Table 1 on the next page:

[11] Energy Information Administration, at www.eia.doe.gov.
[12] U.S. Solar Industry Year in Review, 2006, Solar Energy Industry Association (SEIA).
[13] More information can be found at http://www.gosolarcalifornia.com/csi/solar_thermal.html.

Table 1: Major Bay Region Solar Firms

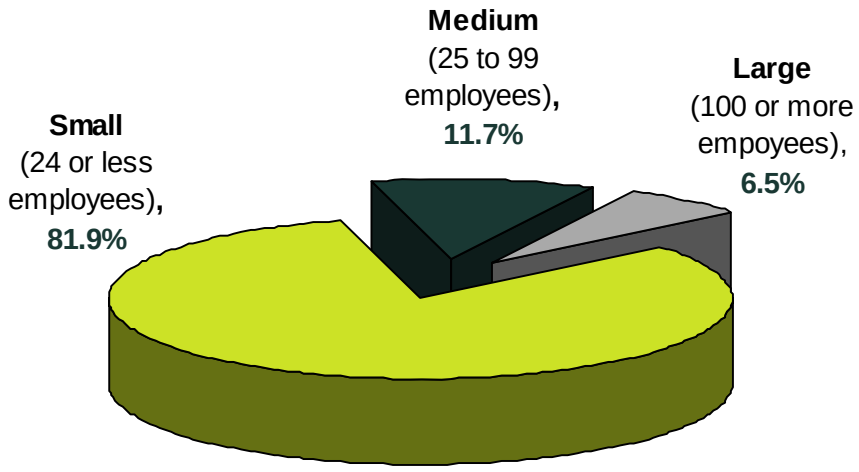
Company	City	Products/Services	Employees
Sun Power Corp.	San Jose	Manufacturing, Design and Installation	350
Nanosolar	San Jose	Manufacturing (Thin Film PV)	250
Solar City	Foster City	Design/Engineering Installation, Financing	215
Akeena Solar	Los Gatos	Design/Engineering Installation, Financing	200
Miasole	Santa Clara	Manufacturing (Thin Film PV)	175
Borrego Solar Systems, Inc.	Berkeley	Design/Engineering Installation, Financing	130
Sun Light & Power	Berkeley	Design and Install Solar PV and Solar Thermal	60
Regrid Power, Inc.	Campbell	Design/Engineering Installation, Financing	50

Source: San Jose Business Journal, Oakland Tribune, New York Times and company web sites.
Note: Employee numbers are best estimates based on available information.

Industry Size and Employment in the Bay Region

There are an estimated 772 solar firms or firms tied to the solar industry in California, of which 33 percent are located in the Bay Area. Figure 2 shows that the majority of Bay Area solar firms (82 percent) are small—less than 25 employees. Most firms (90–95 percent) are non-manufacturing.

Figure 2: Size of Solar Energy Related Businesses in Bay Area



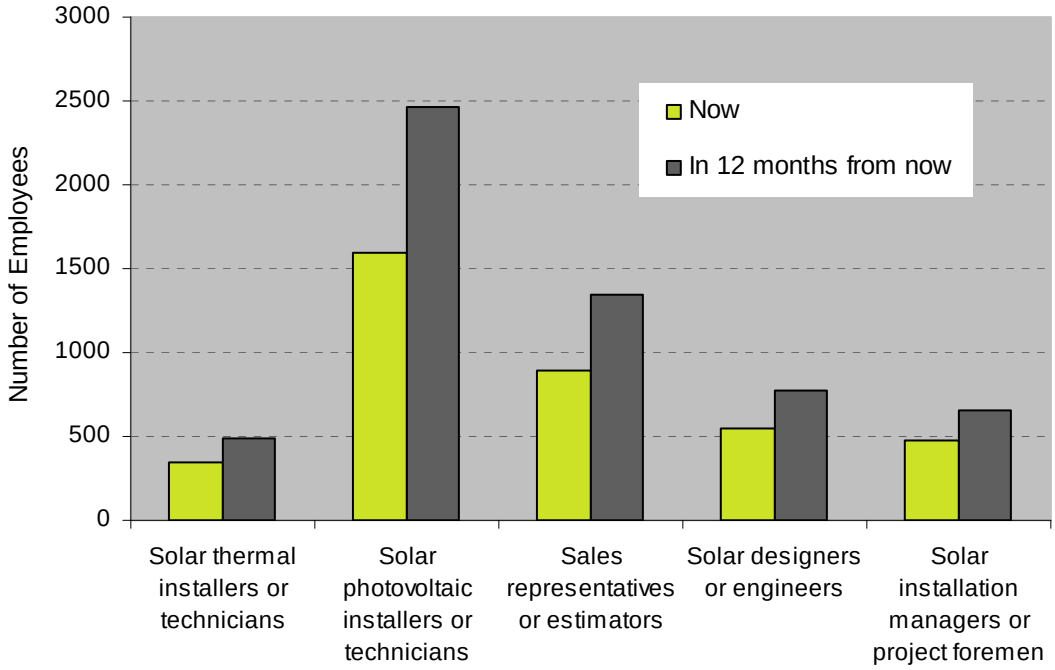
Based on survey data, solar firms or firms tied to the solar industry in California employ between 16,500 and 17,500 workers. The 257 businesses in the ten-county Bay Area

are estimated to employ between 6,900 and 8,000 workers.[14] Current estimated Bay Area employment represents between 42 percent and 46 percent of the statewide industry employment, which is higher than any other region in the state.

The solar industry in California and the Bay Region may be poised for a new wave of growth. Solar businesses or businesses who work in the solar industry in California expect to add approximately 5,000 new jobs over the next 12 months to the current levels, for the five solar occupations studied.[15] Almost 1,900 of these new jobs are projected to be added in the ten-county Bay Region.[16] These solar jobs are good paying jobs, with opportunities for career advancement.

Figure 3 below shows growth over the next 12 months for each of the occupations as estimated by the employers surveyed. Significant growth in all five occupations is projected, resulting in approximately 1,900 new job openings that employers will need to fill.

Figure 3: Estimated Current and Future Employment for Solar Occupations in Bay Region



[14] Current employment range was estimated from the survey data. Employers were asked how many total employees they currently have. Based on the assumption of the current industry makeup, their responses were proportionally extrapolated to estimate the total solar industry employment.
[15] This projection from employers may be impacted significantly if the federal solar tax credit, which expires at the end of 2008, is not renewed.
[16] Employers were asked how many additional employees they expected to hire over the next 12 months for each of the five occupations studied. Their responses and the distribution of employers employing each occupation were used to project the number of new jobs to be added within the Bay Region and the state.

Employers and industry leaders agree that workforce issues are becoming increasingly important for the solar industry. Based on employer survey results:

- Three out of four employers are increasing their hiring in the next 12 months.
- Four out of five employers surveyed say they have difficulty recruiting experienced employees with adequate skills.
- Three out of four employers have difficulty recruiting entry-level employees with appropriate training and education.

Industry Challenges

SolarTech, a collaborative effort in the Silicon Valley, was formed to "lower the costs of producing solar energy, expand the market for solar power, and nurture an industry that is key to our very future."[17] As part of their initiative, SolarTech identified challenges to the industry's success:

1. Cost. Solar power is more expensive to produce than conventional electricity produced with fossil fuels. Cost parity with conventional electricity must be achieved if the industry is to grow.

2. Standards. Industry wide performance and installation standards need to be adopted.

3. Cumbersome Process. The steps a residential or commercial consumer must take to acquire solar power as an energy source are cumbersome and need to be streamlined. These areas include streamlining the process for obtaining building permits, interconnections, inspection approval, and rebates.

4. Financing. Making solar power more accessible and affordable will require the creation of appropriate financing tools.

5. Workforce. Creating training programs for new and incumbent workers that are tied to certifications and industry standards, is a high priority.

Public Policy and Regulation Issues

The following external issues were identified by Sue Kateley, Executive Director of the California Solar Energy Industries Association (CALSEIA), and through a literature review, as the top public policy and legislative issues affecting the solar industry today. Policy makers and regulators will need to continue to work on creating the market stability needed for the solar market to grow. These issues cover both external challenges for the industry as well as the policies that are promoting growth.

1. Artificially low electricity rates constrain market development. Electricity rates do not reflect the true cost of electricity which makes solar projects look less attractive to potential purchasers. Market rules should be put in place to allow solar projects to be compared with the true cost of generating and delivering electricity and reflect the environmental attributes of solar. (The State has plans to switch ratepayers to real-

[17] SolarTech: Creating a Solar Center of Excellence, White Paper, June 2007, www.solartech.org.

time pricing but it may be some time before that actually happens. In the meantime, solar looks less attractive because ratepayers are not paying true costs for conventional energy sources.)

2. High expectations placed on a nascent photovoltaic (PV) industry. The PV industry is challenged constantly to grow the market and bring its installed costs down, while at the same time heavily investing in product Research and Development. The PV industry is still in its youth with regard to new businesses, new products and new business models. The response of the industry to keep its product pricing level or on a downward trend in the face of increased raw material, labor, balance of system, and transportation costs has been remarkable. Less pressure on rapid price decreases will help ensure a stable, long term industry that produces consistently high-quality products.

3. PV-centric thinking. Because of California's focus on electricity, it naturally developed a program to encourage deployment of photovoltaic technologies. Consequently, other solar technologies (particularly solar thermal) were omitted from State and local policies that encourage the use of solar technologies. This is beginning to be addressed as a result of the State's new greenhouse gas emissions awareness. Each therm of natural gas use creates about 12 pounds of CO2 emissions. Solar water heating can significantly reduce natural gas consumption, customer energy bills, and greenhouse gas emissions. In addition, solar thermal technologies can be used to generate electricity.

4. SB 1, Million Solar Roofs Bill: This legislation passed in 2006, and now known as the California Solar Initiative (CSI), is an unprecedented $3.3 billion effort in California that aims to install 3,000 MW of new grid-connected solar over the next decade and to transform the market for solar energy by dramatically reducing the cost of solar for consumers. Major solar energy employers state that the CSI has a “tremendous psychological impact on the industry, giving solar companies a much longer planning horizon to work with, greater confidence in making investments, more volume and market growth, and ultimately a faster pace of innovation."[18]

5. AB 32, Global Warming Solutions Act: This legislation passed in 2006 requires that Green House Gas (GHG) emissions in California be reduced by 25 percent (to 1990 levels) by 2020. As the California Air Resources Board (CARB) implements the regulations for AB 32, the solar industry will likely benefit as businesses and consumers of electricity turn to clean energy alternatives in order to meet state mandated targets for GHG reduction.

6. Municipal Incentives: Additional incentives have come from a small but growing number of municipalities. The city of Berkeley will pay the upfront costs for a resident’s solar installation and recoup the money over 20 years through additional property taxes on a resident’s home. San Francisco is preparing to adopt its own

[18] “Solar: California's Rising Star” by Claudia Graziano, Nov. 10, 2006, RenewableEnergyAccess.com.

subsidy that would range from $3,000 for a home installation to as much as $10,000 dollars for a business.[19]

Economic Impact

The solar industry in 2007 (including modules, system components, and installation) provided $20.6 billion in revenue out of the total world-wide energy market of approximately $2 trillion. To date, the solar industry represents a tiny fraction of the global energy market; however, solar PV is expected to grow from $20.6 billion in 2007 to $74 billion by 2017. Annual installations were just shy of 3 gigawatts (GW) worldwide, up nearly 500 percent from just four years earlier.[20]

Venture capital is extremely important to the solar industry, as it seeks a foothold in the global energy market. State and federal subsidies for the solar industry have prompted a surge in private investment, led by venture capitalists. In 2007, these seed investors put $654 million in 33 solar-related deals in California, up from $253 million in 16 deals in 2006, according to the Cleantech Group, which tracks investments in alternative energy. California received roughly half of all solar power venture investments made in 2007 in the United States.[21]

Table 2 below summarizes the top energy-tech venture deals in the U.S. in 2007, the majority of which were solar companies:

Table 2: U.S. Top 10 Disclosed Energy-Tech Venture Deals (2007)

Company	**Primary Sector**	**Total Invested,** (in millions of dollars)
HelioVolt Corporation	Solar	$100.5
GreatPoint Energy	Efficiency: Supply Side	$100.0
Arcadian Networks	Efficiency: Supply Side	$90.0
Solyndra Inc.	Solar	$79.2
SolFocus Inc.	Solar	$63.6
Calera Corporation	CCS	$58.5
Miasolé Inc.	Solar	$50.0
Solaria Corp.	Solar	$50.0

Source: New Energy Finance, 2008.

[19] "A Green Industry Takes Root in California," The New York Times, February 1, 2008.
[20] Clean Edge Research, 2008.
[21] "A Green Industry Takes Root in California," The New York Times, February 1, 2008.

Occupational Overview

The primary research component of this study focused on demand occupations within the solar industry. To be selected for inclusion, the occupations had to meet at least one of the following criteria: high employment in the region, above average growth, or easily served by community college-level education and training programs. The following five occupations were identified through executive interviews with industry leaders as the key jobs needed within the industry that are accessible to community college students:

- Solar PV Installer
- Solar Thermal Installer
- Solar Sales Representative/Estimator
- Solar Designer/Engineer
- Solar Installation Manager/Project Foreman

The occupational information shown below was compiled using the results from internet and telephone surveys with 77 Bay Region solar employers.

Table 3 below shows the percentage of Bay Region firms employing individuals within each occupational title. As these results exhibit, a majority of firms employed four out of the five occupations surveyed, led by solar designers or engineers (79.2 percent). Almost 40 percent of the employers surveyed employ solar thermal installers or technicians.

Table 3: Occupations employed at Bay Region Solar Firms

Occupation	% of Firms Employing Each Occupation
Solar designer or engineer	79.2%
Sales representatives or estimators	76.6%
Solar installation managers or project foremen	71.4%
Solar photovoltaic installers or technicians	70.1%
Solar thermal installers or technicians	39.0%

Table 4 on the next page shows estimated current employment within the solar industry for the five occupations studied, the number of expected openings from growth, and the median annual wage by occupation for both entry-level and experienced workers.

Table 4: Estimated New Jobs and Median Annual Wage in the Bay Region by Occupation

Occupation	Estimated 2007 Employment	Growth Next 12 Months	Openings from Growth	Wages[22]	
				Type	Median Annual
Solar thermal installers or technicians	340	45.7%	150	Entry	$31,200
				Experienced	$52,000
Solar photovoltaic installers or technicians	1,590	55.8%	880	Entry	$31,200
				Experienced	$60,000
Sales representatives or estimators	890	50.5%	450	Entry	$41,600
				Experienced	$62,400
Solar designers or engineers	550	44.0%	220	Entry	$50,000
				Experienced	$83,200
Solar installation managers or project foremen	480	36.5%	180	Entry	$52,000
				Experienced	$77,500
Totals	**3,850**	**48.8%**	**1,880**		

The employers surveyed anticipate growth of over 35 percent for all five of the occupations studied, and over 44 percent for four out of the five occupations. The highest growth percentages are expected for solar PV installers or technicians (56 percent growth) and sales representatives or estimators (51 percent). The largest absolute job growth is anticipated for solar PV installers or technicians, with 880 new jobs projected for this occupation over the next 12 months.[23]

Career Pathways

It is clear from the employer survey results that in the near future the solar industry needs a large number of both entry-level and experienced workers. But, what about the long-term prospects for employment and career advancement in this relatively new industry? The high cost of fossil fuels, the climate crisis and new state and federal laws that both create incentives for solar installations and require the reduction of green house gases are all positive trends that are helping the industry gain traction and stability in the energy marketplace. Because of these trends, job seekers and college decision-makers can feel assured that the demand occupations profiled in this report have a high likelihood of being around to offer employment opportunities for years to come.

Employers were asked several questions on the survey about employee development practices at their business. When asked if there are career advancement and promotion planning services (career ladders) for employees at their company, 60 percent of employers said that there are. And when asked if it is difficult to provide training to

[22] Median Annual Wage as estimated by the employers surveyed.
[23] Note that the survey did not address longer-term employee requirements, such as PV Maintenance Technicians, that will be needed as PV system components reach their service lives.

employees for advancement purposes, 53 percent of employers said they had some or great difficulty providing such training. So, while employers indicate support for career advancement and promotion, the majority of employers appear to need help in providing this training. This suggests an opportunity for community colleges to partner with solar businesses to provide either contract training, workshops or certificate programs for incumbent employees that are interested in advancing within the solar industry. In addition, community colleges will be a resource for companies who are seeking qualified employees.

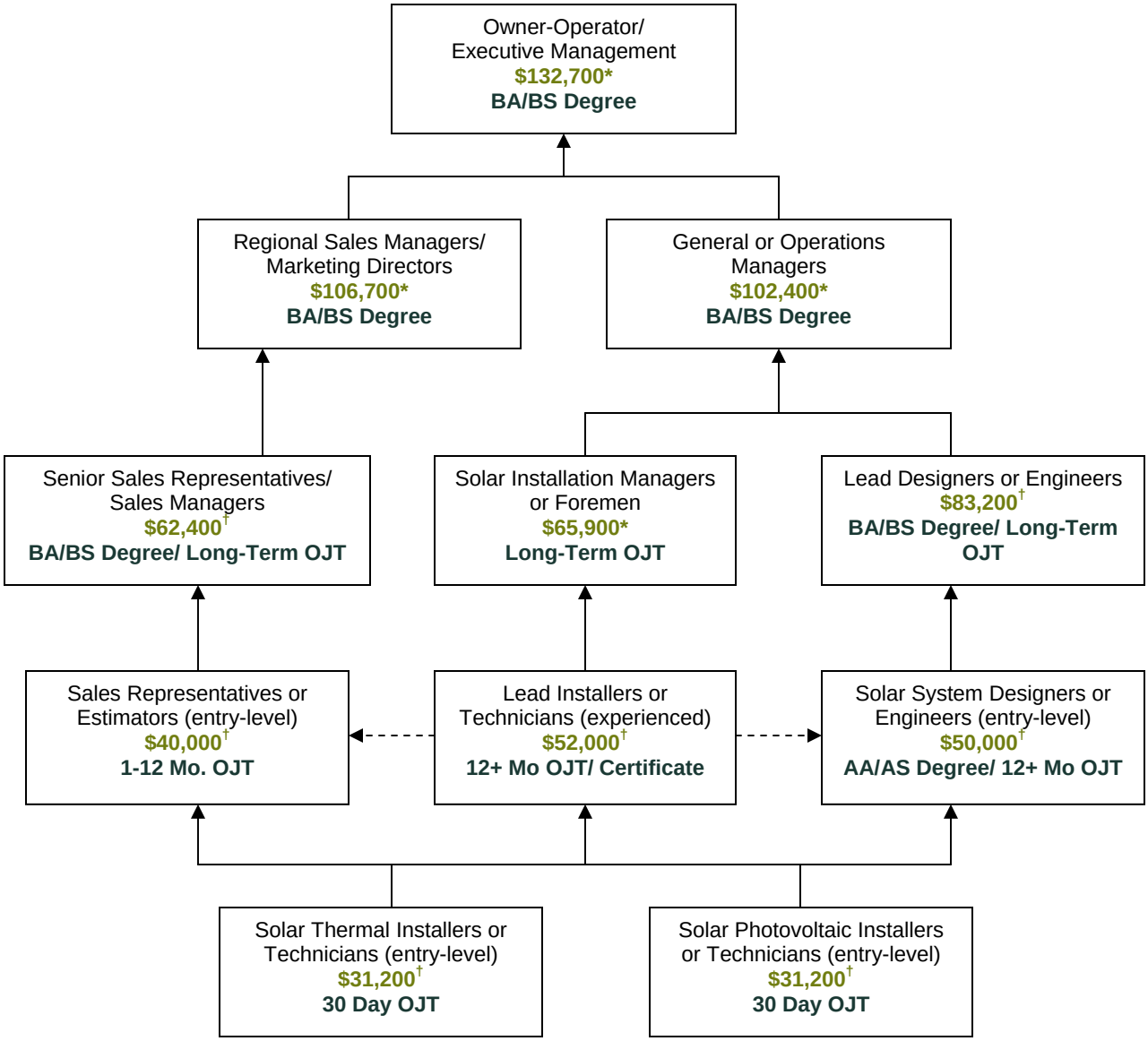
Career pathways do exist in the solar industry, which will provide community college students with excellent opportunities for promotion and career advancement based on their work experience, coupled with additional education and training. In addition, people who already have skills in construction, sales, telecom and other technical industries are well suited for entry-level solar occupations. These job seekers may only need short-term, specialized training to add to their existing skill sets to become employable in this new industry.

There are multiple pathways an employee can take as they advance within the industry. Figure 4 shows the career ladder from entry-level to mid-level to top-level in the solar industry, based on education and experience.

As is shown in the figure, executive management positions generally require a four year degree. However, community colleges could add courses or certificates for individuals who want to start a solar PV company. These courses would prepare individuals experienced in the construction trades and/or the solar industry for the C-46 contractor's license.[24] This would help "grow the industry" by enabling employees with entrepreneurial interests to start their own business.

[24] A C-46 Solar Contractor installs, modifies, maintains, and repairs active solar energy systems.

Figure 4: Career Pathways for Solar Industry Occupations



† Statewide solar industry workforce study entry and experienced level wages as estimated by the employers surveyed. Education and experience requirements are approximate and may vary among different employers.

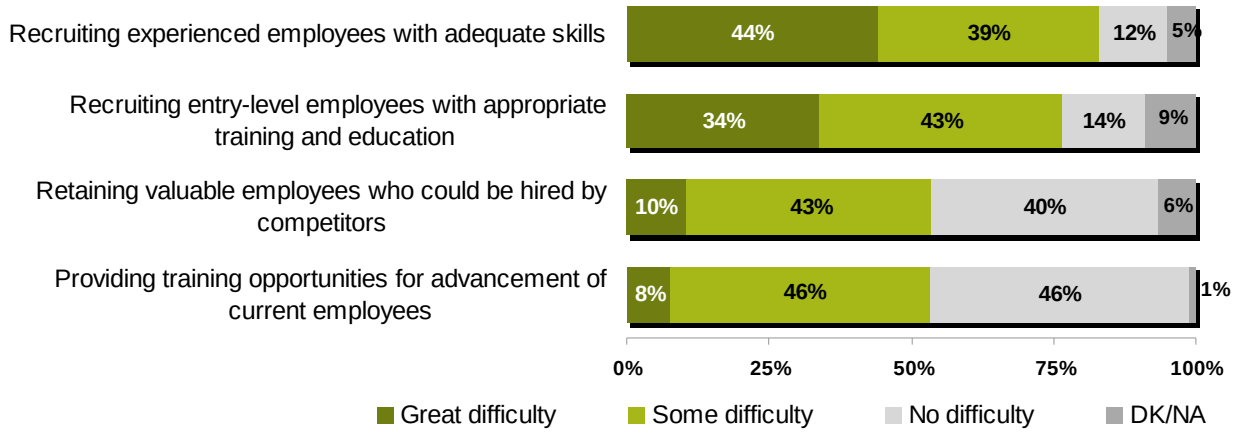
* Median statewide wages for these occupations were taken from the Labor Market Information Division's Occupational Employment Survey, 1st Quarter 2007 at www.labormarket.edd.ca.gov.

Employer Needs and Challenges

Workforce Issues and Challenges

Figure 5 below reveals the difficulty employers are experiencing with workforce issues. Survey results show that four out of five employers have difficulty recruiting non-entry level employees with adequate skills and work experience, and three out of four employers have difficulty recruiting entry-level employees with appropriate training and education. In addition, more than half of the employers surveyed report difficulty providing training opportunities to current employees.

Figure 5: Workforce Issues and Challenges for Bay Region Solar Employers



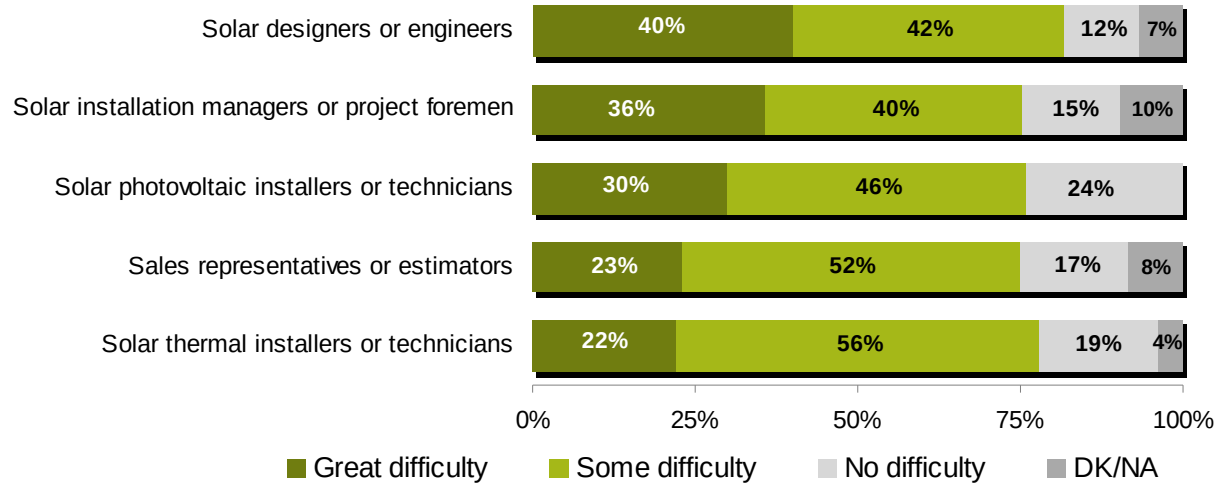
Occupational Outlook

When asked about their business's level of difficulty finding qualified applicants for each of the five occupations profiled, an average of 77 percent of employers surveyed expressed "great" or "some" difficulty, with 30 percent expressing great difficulty (see Figure 6 on the next page).

Employers reported having the most difficulty locating qualified solar designers or engineers, with four out of five employers reporting some level of difficulty; among these employers, 40 percent experienced "great" difficulty finding applicants that meet their hiring standards.

More than 75 percent of employers have difficulty finding solar installation managers or project foremen and solar photovoltaic installers or technicians that meet their organization's hiring standards.

Figure 6: Difficulty Finding Applicants who Meet Hiring Standards in the Bay Region

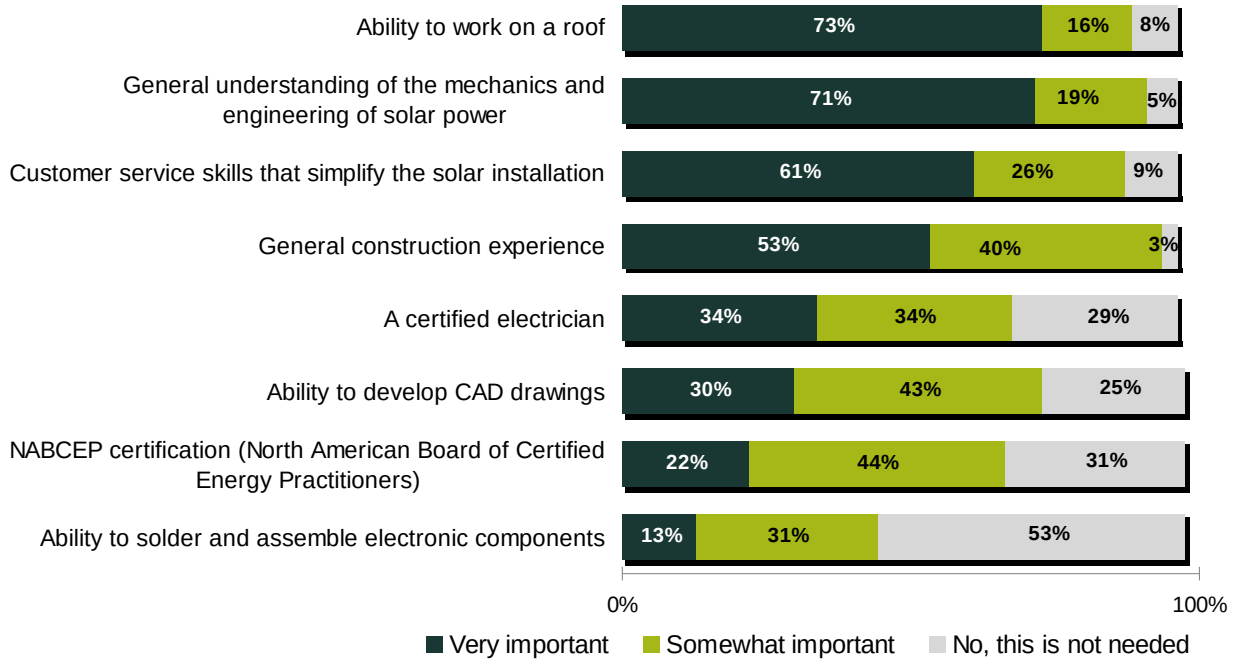


Occupational Skill Requirements

When asked to reflect on current employees in their organization, 89 percent of Bay Region employers considered the ability to work on a roof as important, with 73 percent rating this ability as very important (as illustrated in Figure 7 on the next page).

- Employee knowledge or general understanding of the mechanics and engineering of solar power received the second-highest level of importance to employers (71 percent responded “very important”).
- Customer service skills and general construction experience followed with 61 percent and 53 percent of employers, respectively, considering these very important skill sets for employees to have.
- Being a certified electrician, having the ability to develop CAD drawings, and receiving NABCEP (North American Board of Certified Energy Practitioners) certification, all registered as very or somewhat important to more than half of all employers surveyed.
- More than half of the employers surveyed did not consider the ability to solder and assemble electronic components necessary for employment.

Figure 7: Desired Knowledge, Skills, and Abilities for Solar Employees



Additional information on the knowledge, skills, and abilities associated with the five solar occupations surveyed can be found in Appendix D.

Educational Preferences

Bay Region solar industry employers indicated a preference for an associate degree specific to the position over a general bachelor's degree for four of the five occupations, with the exception of solar designers or engineers.

- The preference for an associate degree was most pronounced for sales representatives or estimators (33.3 percent).
- While one of every four employers prefer solar thermal installers or technicians and solar photovoltaic installers or technicians to have an associate degree, more than half indicated no degree experience was necessary.
- Educational preferences for solar installation managers or project foremen vary greatly among the employers surveyed, with more than 40 percent preferring some kind of postsecondary degree and 35 percent requiring no degree experience, while over 20 percent of employers responded "it depends."

Figure 8: Preferences for Specific Associate or General Bachelors Degrees

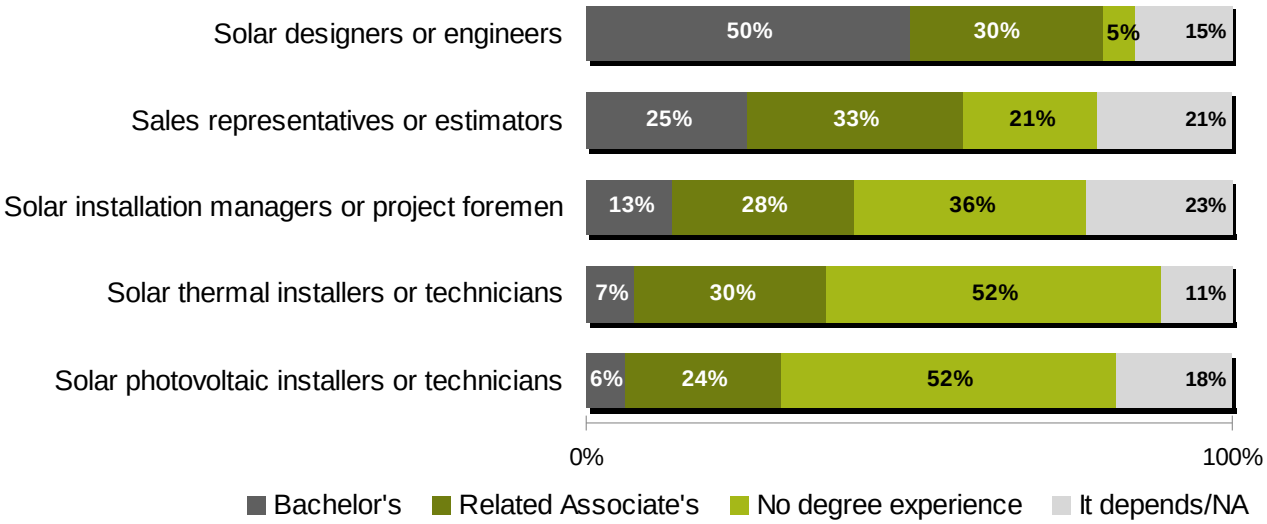


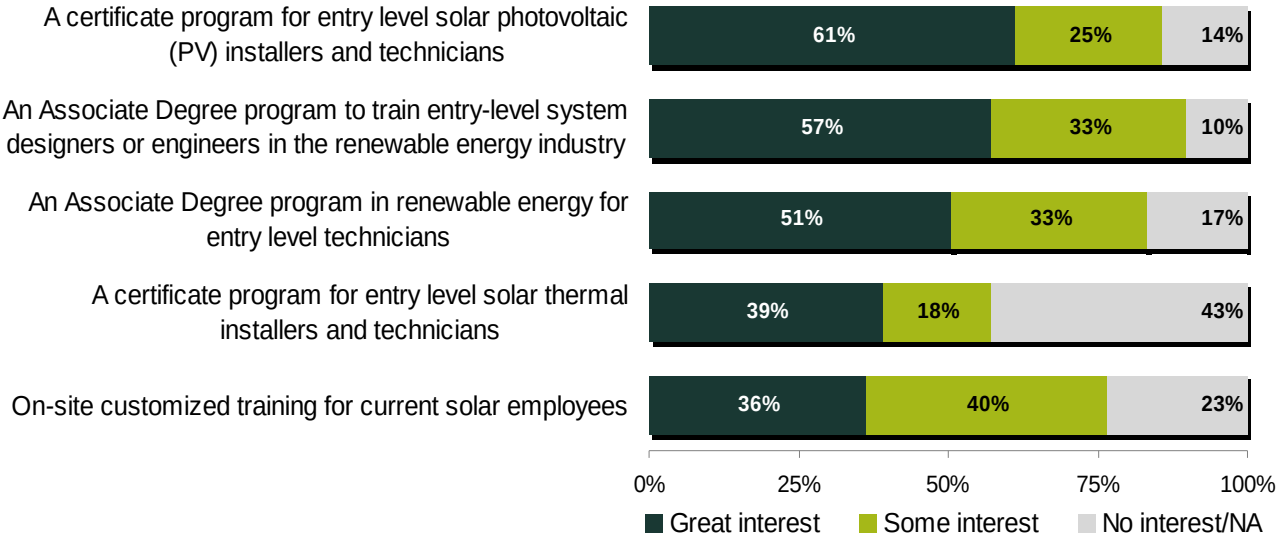
Figure 8 shown above validates that the industry's educational preferences for its workforce is aligned with what community colleges can provide. This information can help shape decisions as colleges consider creating or adapting existing programs to meet industry workforce needs.

Workforce Opportunities

When asked to describe their organization's level of interest in training and educational programs that could be developed by community colleges for the solar industry, an average of 78 percent of those surveyed expressed "great" or "some" interest in the options presented, with almost half (48.8 percent) expressing great interest (see Figure 9 on the next page).

- More than 85 percent of employers expressed interest in a certificate program for entry level solar photovoltaic (PV) installers and technicians, with 61 percent indicating "great interest" in such a program.
- A large majority of employers also expressed "great" or "some" interest in related Associate Degree programs.
- 57 percent of employers surveyed expressed interest in a certificate program for entry level solar thermal installers and technicians.
- Three out of four employers indicated interest in on-site customized training for current employees, with 36 percent expressing "great interest."

Figure 9: Employer Interest in Potential Community College Programs in the Bay Region



College Programs and Response

There are a number of regional colleges that have recently developed solar courses, workshops, certificates or programs to address the need for skilled workers in this emerging industry. In addition, several regional initiatives have been started to build college capacity, coordinate program development and share information. A summary of these initiatives can be found in Appendix E.

Bay Region Community Colleges Offering Solar Courses or Programs

Eight colleges in the Bay Region have or are planning to offer solar training programs. Five of the eight colleges currently offer solar PV courses. Three colleges are planning to offer solar PV courses/certificates by spring 2009. An estimated 743 to 789 students will complete solar PV installer courses at the eight colleges by the end of June 2009 (see Tables 5,6, and 7).

Only one of the five occupations studied for this report—Solar PV Installer—has been widely responded to by regional colleges. Solar Thermal Installer training is being planned as a future offering by three colleges. However, the other three occupations—Sales Representative, Solar Designer/Engineer and Installation Manager/Project Foreman—remain an area of opportunity to which regional colleges can respond.

Table 5: Bay Region College Solar Course/Program Descriptions

College	Program Description
Cabrillo	PV Solar Design and Installation course. 3 credit units. Semester length. Partner with IDRC grant held by DeAnza College. Also offers Sustainable Building & Environment course. 3 credit units. Semester length. Fundamentals of Renewable Energy Systems. 3 credit units. Semester length.
Chabot	PV Solar Installation course primarily for commercial installations, offered in partnership with the Alameda County Joint Apprenticeship Training Committee (JATC), the International Brotherhood of Electrical Workers Local 595, and the National Electrical Contractors Association (NECA). In operation since 2002. This is a 30-hour course.
DeAnza	PV Solar Design and Installation course planned for Fall 2008. Credit-based. Recipient of 2007 IDRC grant to partner with regional colleges to develop Solar PV Installer training described below.
Diablo Valley	PV Solar Design and Installation course. 2 credit units, 54 hours of instruction, 7-8 weeks on Saturdays. Offered 3 times per semester, Offered course for past five years. Recent recipient of a two-year IDRC grant – $500,000 for energy system program, including faculty train-the-trainer opportunities.
Napa Valley	PV Solar Installer course planned for Spring 2009. Could be delivered either through college or through fee-based Contract Education.
Ohlone	PV Solar Installation Certificate planned for Spring 2009. 17 Units. Semester-length. Also, Solar Thermal Installation planned for Spring 2009. Partner with IDRC grant held by DeAnza College. Certificate Courses Under Development: Math for Construction Trades, Basic Electricity/Wiring, Tool Use and Safety, Solar Installation, Basic Environmental Theory. Will coordinate with college's Engineering Dept.
San Jose City	PV Solar Installer course. 4.5 credit units including lab. Partner with IDRC grant held by DeAnza College.
Skyline	RTF grant-funded PV Solar Installer course exclusive for Solar-City incumbent workers (new hires with roofing/construction prior experience.) First course starts April 18, grant ends December 2008. 3 credit units, 8 weeks, 48 hours of instruction. Electronics focus.

Source: Interviews conducted with college dean or instructor. See Appendix F for contact information for each college.

Table 6: Summary of Bay Region College PV Solar Courses, Student Capacity, Estimated Graduates, Future Offerings

College	PV Solar Installer Course			Occupations for which Course Prepares Students (Based on 5 Occupations Studied)	Other Solar Occupations Training	New Courses Planned
	Capacity # of Students Per Course	# of Courses Planned from Current Through June 2009	Estimated Total # Graduates by June 2009			
Cabrillo	25 Currently 33 enrolled	3 Spring 08, Fall 08, Spring 09	75	PV Installer Preparation for Sales Representative; Preparation for Designer or Installation Manager	Sustainable Building & Environment; Fundamentals of RE Systems	Solar Thermal Installer, Spring 09
Chabot	30 Currently 28 enrolled	4	120	PV Installer – Apprentice Level; PV Installer – Journeyman Level upgrade training; Installation Manager/ Foreman	None	
DeAnza (Planned Course)	20-30	Up to 3 per quarter semester (depends on demand)	90	Will train for PV Installer	None	
Diablo Valley	26 Enrollment often exceeds to 32	3 sections each semester = 9 (spring & fall 08 + spring 09) x 95 students each semester	285	PV Installer Sales Representative Solar Designer/Engineer (minimal –residential only) Installation Manager/Project Foreman (background info only)	None	Advanced PV course (design, installation & maintenance of large industrial, commercial systems). Spring 09, 2 credit units
Napa Valley (Planned Course)	20-24	1 x year	20-24	Will train for PV Installer	None	
Ohlone (Planned Cert.)	25-30 (estimate)	1 x semester	25-30	Will train for PV Installer and for Solar Thermal Installer	Solar Thermal Installer	
San Jose	22-30	4 Spring 08, Summer 08, Fall 08, Spring 09	88-120	PV Installer	None	Solar (Theory & Electronics prereq. to PV Solar Installer. Also have infrastructure to develop Solar Thermal Installer
Skyline	15	3 by December, 08	40-45	PV Installer	None	PV Solar Installation and Design institutionalized at the college Spring 09.
TOTAL Estimated Number of Graduates			**743–789**			

Table 7: Summary of College Solar Program Components

College	Difficulty Finding Qualified Faculty	Partnerships	Internships	High School Outreach Activities	Incumbent Worker Recruitment	Customized Training via Contract Education	Advisory Board
Cabrillo	Yes	SVLG & Solartech to develop paid internships; NOVA WIB for job placements	In development	Working with a ROP and CA Conservation Corp (CCC)	Haven't needed to – have a waiting list	No	Recruiting solar companies. Wants a regional advisory board
Chabot	No. Supplied through union	NECA subsidizes training, co-runs program; JATC provides curriculum	Union-required	Yes. Career awareness presentations	Yes	No	NECA
DeAnza (Planned Course)	Probably not. Have potential faculty lined up	In development	Perhaps	Perhaps	Yes. Part of regular recruitment methods	Yes	Will be developed
Diablo Valley	Yes. Applicants don't meet minimum qualifications (AA Degree + 6 yrs/experience)	NABCEP; PV companies; Public Utilities Commission (PUC); CA Energy Association. All advisors to program	No	Activity part of new IDRC grant	Incumbent workers often students in existing PV course	No	25 PV solar companies
Napa Valley (Planned Course)	Yes. Must be NABCEP certified	In development	No. Not planning for	Not yet	Will develop recruitment plan	Yes, may deliver first course through this means	In development. Currently have 3-4 companies
Ohlone (Planned Certificate)	Have only started to inquire	Solartech to develop paid internships; Alameda County WIB	Yes. Will be offered	Yes. With ROP, and will do more through IDRC	Yes, will be recruiting	Yes, will want to offer courses to companies	Wants a regional advisory board
San Jose	Yes. Hard to find for daytime hours	SVLG & Solartech to develop paid internships	In development	Currently working with CA Conservation Corp	Yes, through WIBS (work2future/Nova)	No	In development through IDRC grant
Skyline	No. Solar City provided 2 employees as faculty per grant requirements	Solar City – provides instructors, equipment, curriculum	Grant ensures built-in internship. Workers get 4 days/wk work experience plus 1 day/wk instruction	Not yet	Yes, inherent in grant with Solar City	No, but may be planned	In development

Community Support and Resources

There are excellent opportunities for regional colleges to partner with industry associations, economic development organizations, community organizations, Workforce Investment Boards (WIBs) and Economic and Workforce Development (EWD) initiatives to meet solar employers' needs. The chart below summarizes the existing and potential partnerships that can be leveraged. The organizations marked with an asterisk are currently partnering with the Centers of Excellence to disseminate the findings of this report to regional colleges, WIBs, employers and industry associations.

Partner	Type of Organization	Contribution to Partnership
California Solar Energy Industries Association (CAL SEIA)* www.calseia.org	Industry Association	Access to Employers Partnership Development Policy and Legislative Resources
Northern California Solar Energy Association* www.norcalsolar.org	Educational Association	Access to Employers Partnership Development Resources and Technical Assistance
SolarTech & Silicon Valley Leadership Group (SVLG)* www.solartech.org	Industry Association formed out of SVLG	Access to Employers Industry-defined education & training standards Resources and Technical Assistance
Solar Living Institute* www.solarliving.org	Non-profit focused on Solar Industry	Solar Training and Information Train-the Trainer workshops
California Solar Center www.californiasolarcenter.org	Non-profit	Web Resource for Solar Energy activity in California.
Ella Baker Center/Apollo Alliance www.ellabakercenter.org	Non-profits focused on Green Jobs for low-income communities	Education and Training Advocacy for Public Policy that supports Green Jobs Training
Contra Costa Economic Partnership* www.cceconptnr.org	Economic Development Organization	Studying Green Economy in Contra Costa County. Planning to implement a Green Economy Industry Cluster project.
Solar Richmond www.solarrichmond.org	Community Based Organization	Solar Job Creation Worker Training Affordable Solar for Low-Income residents
Oakland Partnership* Green Academy & Green Corridor Projects www.oaklandpartnership.com	Economic Development Organization	Creating a "Green Academy" to align green training, curriculum, & resources with workforce and education partners in Alameda and Contra Costa counties.
Workforce Investment Boards (WIBs) and One-Stop Centers (NOVA, Work2Future, Oakland, Contra Costa, Richmond, Alameda, San Francisco)	Public Workforce Development	Access to Job Seekers Access to Employers Training Funds Employment Resources

Partner	Type of Organization	Contribution to Partnership
Regional Colleges and Bay Area Community College Consortium (BACCC)*	Workforce Training and Development	Education and Training (Associate Degrees, Certificates, Basic Skills; Incumbent Worker Training via Contract Education) Grant Funding and Assistance
Advanced Transportation Technology and Energy Initiative (ATTE)* (City College of San Francisco and West Valley College)	Community College EWD Program	Technical Assistance Curriculum Development Incumbent Worker Training
Centers of Excellence (COE)* (San Francisco Bay & Greater Silicon Valley Regions)	Community College EWD Program	Forecasts Industry Workforce needs Industry Research Partnership Development

* Existing Partnership

Conclusion and Recommendations

Given the projected growth of the solar industry in the Bay Region and the state, colleges have an excellent opportunity to meet the industry's workforce needs outlined in this report. The following recommendations can help regional colleges respond.

1. Support Development of a Pipeline of Skilled Workers

- Join New Energy Workforce (NEW) Regional Planning Initiative (See Appendix E).
- Work with model programs such as Diablo Valley College's Solar PV Program and the Silicon Valley Solar Industry-Driven Regional Collaborative (IDRC) grant held by DeAnza College (See Appendix E).
- Collaborate with the Advanced Transportation Technology and Energy Centers and Small Business Development Centers, funded by the Economic and Workforce Development (EWD) Program, for technical assistance with program and curriculum development, and building industry partnerships.
- Build enrollment by connecting with Construction and Engineering programs at colleges.

    1. Promote solar courses or certificate programs to returning students who have worked in the construction trades, construction management or engineering fields but who want to change careers.
    2. Advise current community college students enrolled in construction trades, construction management, engineering, and business departments about the benefits of taking elective courses in solar, which can provide advancement opportunities in a growing industry.

- When possible, share instructors, curriculum and best practices among colleges.
- Raise awareness of college career counselors about opportunities in the solar industry.
- Work cooperatively to apply for grants to fund activities, equipment, and outreach.

2. Meet Employer Training Needs

- Address the absence of available courses to prepare students for the following occupations: solar sales representative/estimator, solar designer/engineer, or solar installation manager/project foreman.
- Develop curriculum and training programs that are aligned with industry standards.
- Explore the potential to find instructors from industry and labor unions, as half of the colleges surveyed report difficulty in finding instructors.
- Deliver customized training to employers through college contract education departments.
- Develop faculty and student internship programs.
- Identify employer equipment, facilities and resources for training and coordinate their use with regional colleges.
- Create or strengthen Industry Advisory Boards to maintain open discussion and planning between colleges and industry.

References

"A Green Industry Takes Root in California", The New York Times, February 1, 2008

California Energy Commission, www.energy.ca.gov

California Solar Energy Industries Association (CALSEIA), www.calseia.org

California Solar Initiative, www.gosolarcalifornia.ca.gov

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Clean Edge Research, www.cleanedge.com

Energy Information Administration, www.eia.doe.gov

National Venture Capital Association, www.nvca.org

New Energy Finance, www.newenergyfinance.com

SolarTech: Creating a Solar Center of Excellence, White Paper, June 2007, www.solartech.org

"Solar: California's Rising Star" by Claudia Graziano, Nov. 10, 2006, www.RenewableEnergyAccess.com

U.S. Solar Industry Year in Review, 2006, Solar Energy Industry Association (SEIA)

Appendix A: How to Utilize this Report

About Us - Description of BWPI

The Business and Workforce Performance Improvement (BWPI) initiative is focused on building the capacity of the colleges in the area of economic and workforce development to enhance their ability to deliver education and training services to businesses and workers in high growth industries, new technologies, and other clusters of opportunities.

The Centers of Excellence (COE) within BWPI provide information regarding workforce trends, increasing awareness and visibility about the colleges' economic and workforce development programs and services, and building partnerships with business and industry.

The goal is to position the colleges as THE workforce partners of choice to business and industry and ensure that college programs are current and responsive. This will contribute to the overall economic vitality of the communities in which they serve.

How to Use This Report

The Centers of Excellence within the Business and Workforce Performance Improvement Initiative of the California Community College Economic and Workforce Development Program have undertaken Environmental Scanning to provide targeted and valuable information to community colleges on high growth industries and occupations.

This report is intended to assist the decision-making process of California community college administrators and planners in addressing local and regional workforce needs and emerging job opportunities in the workplace as they relate to college programs. The information contained in this report can be used to guide program offerings, strengthen grant applications, and support other economic and workforce development efforts. This report is designed to provide current industry data that will:

- Define potential strategic opportunities relative to an industry's emerging trends and workforce needs.
- Influence and inform local college program planning and resource development.
- Promote a future-oriented and market responsive way of thinking among stakeholders.

This Environmental Scan included a review of the California Regional Economies Project reports and Employment Development Department (EDD) Labor Market Information (LMID) projections that cover the communities in this region, as well as many other sources as referenced.

Important Disclaimer

All representations included in this Environmental Scan product/study have been produced from a secondary review of publicly and/or privately available data and/or research reports. Efforts have been made to qualify and validate the accuracy of the data and the reported findings. The purpose of the Environmental Scan is to assist the California Community Colleges to respond to emerging market needs for workforce performance improvement. However, neither the Business and Workforce Performance Improvement Centers of Excellence, COE host college nor California Community Colleges Chancellor's Office are responsible for applications or decisions made by recipient community colleges or their representatives based upon this study including components or recommendations.

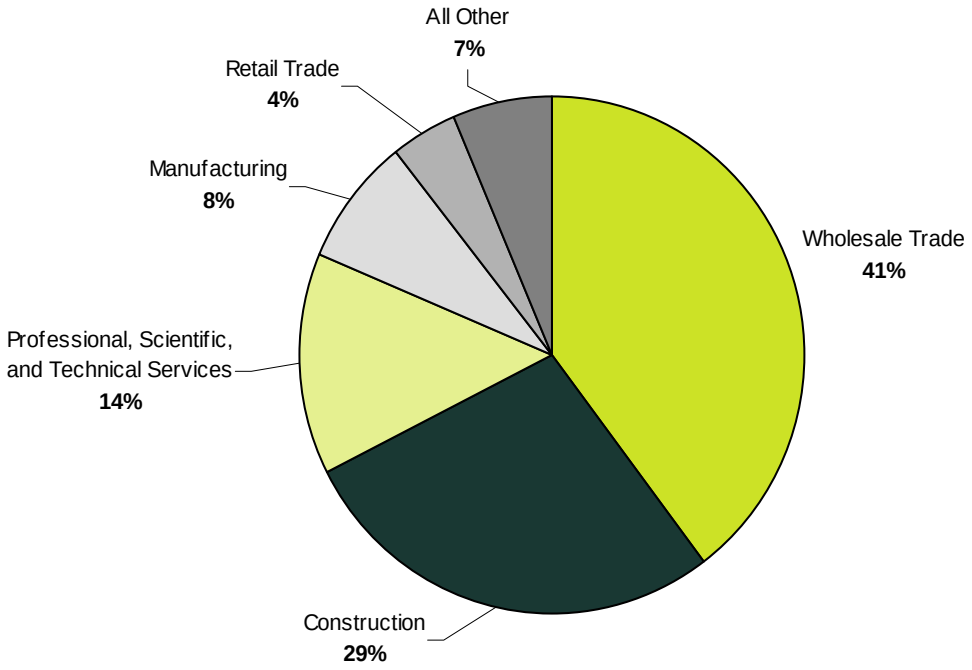
Additional Information

The Business and Workforce Performance Improvement Initiative is funded in part by the Chancellor's Office, California Community Colleges, Economic and Workforce Development Program. The total grant amount (grant number 07-305-012 for $205,000) represents compensation for multiple documents or written reports through the Center of Excellence.

Our mission is to strengthen California's workforce and advance economic growth through education, training and job development.

Appendix B: California and Bay Region Solar Industry and Occupational Data

Industry Sectors for Solar Related Businesses in Bay Region, 2007



* Industry sector analysis uses 2007 data provided by InfoUSA, Inc. Due to the limitations of the InfoUSA database, this analysis represents approximately 60 percent of the 257 Bay Region firms listed in the Centers of Excellence database of solar businesses.

Occupational Summary

Figure 1B and Table B1 on the next page summarize employment and other information for the following five occupations: PV Installer, Solar Thermal Installer, Solar Designer/Engineer, Installation Manager/Project Foreman, Solar Sales Representative

In Figure 1B, the area of each bubble represents the size of current employment for each occupation. As the chart shows, all five occupations show significant growth over the next 12 months, with PV installers (56 percent) and sales representatives (51 percent) having the strongest projected growth. Also, employers indicate difficulty in hiring for all five occupations (75 percent or higher).

Figure 1B- Occupational Employment, Difficulty in Hiring and Expected Growth

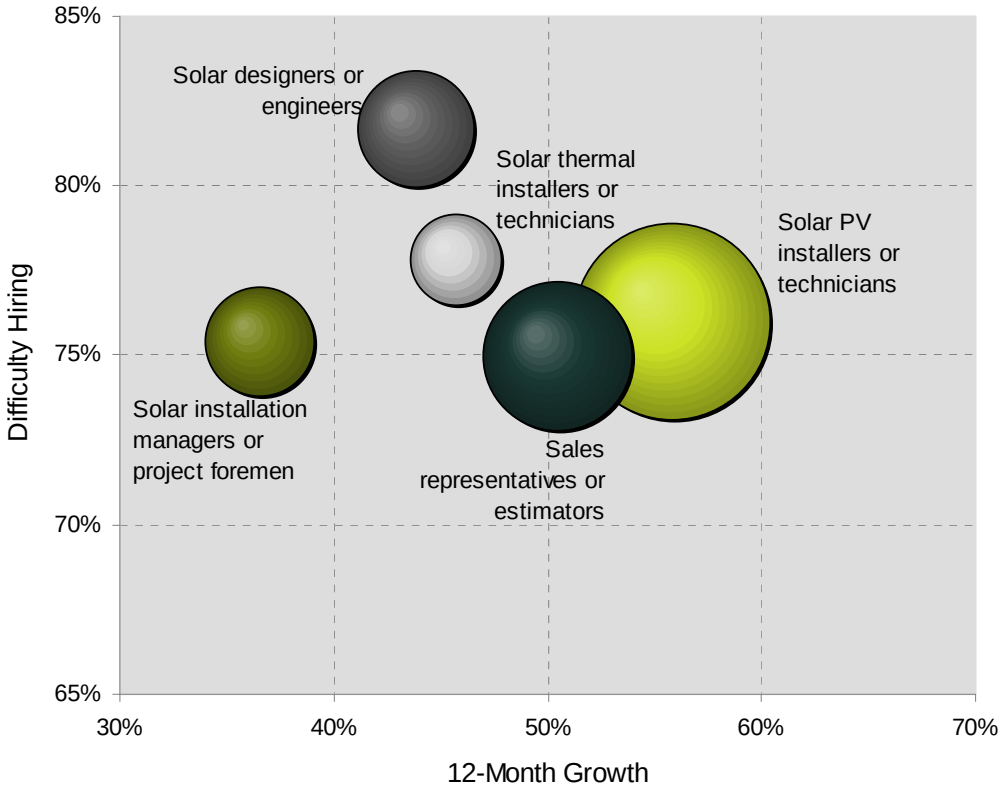


Table B1 – Summary Profile for Five Solar Occupations*

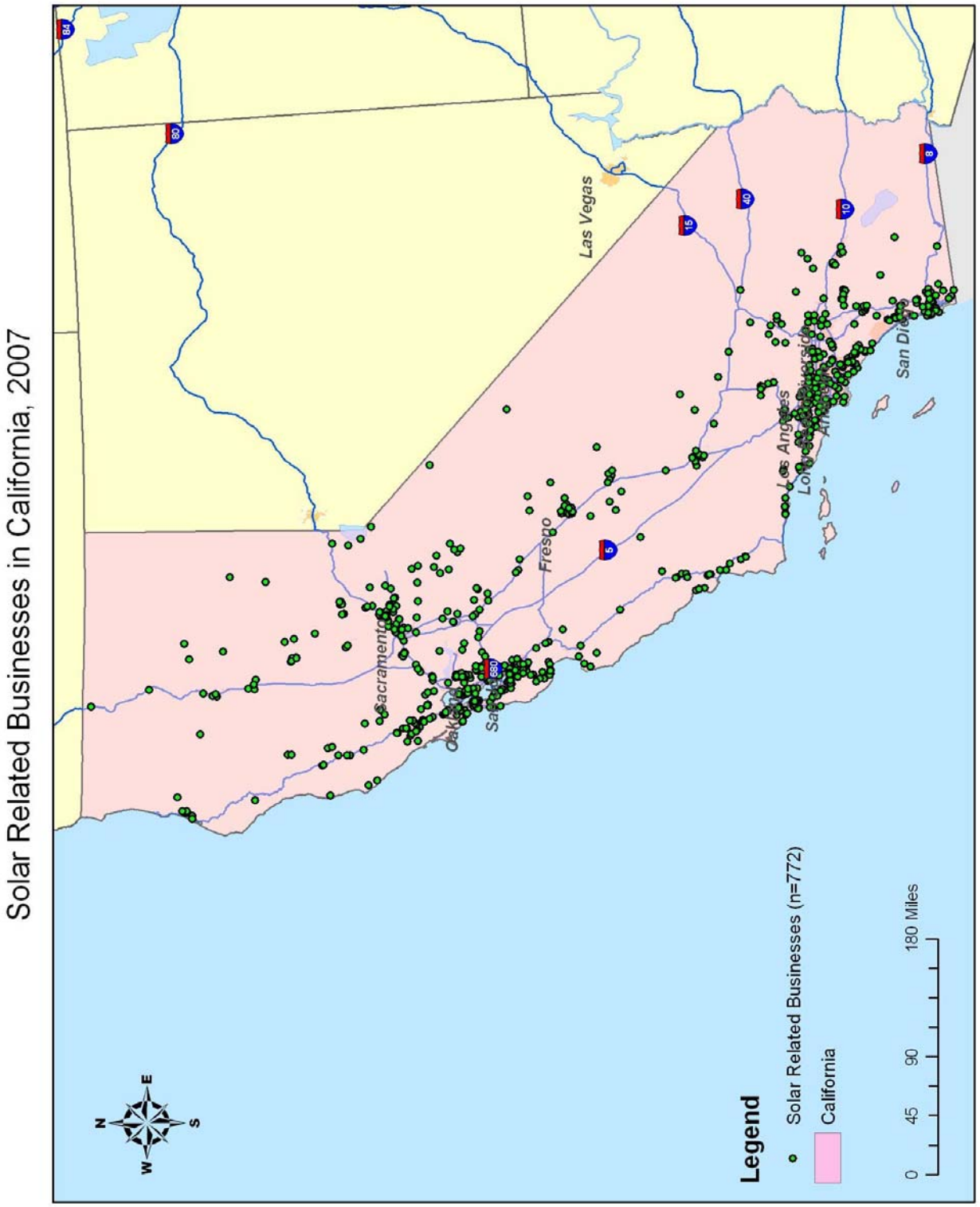
(Color code indicates the highest and the second highest occupation in each category.)

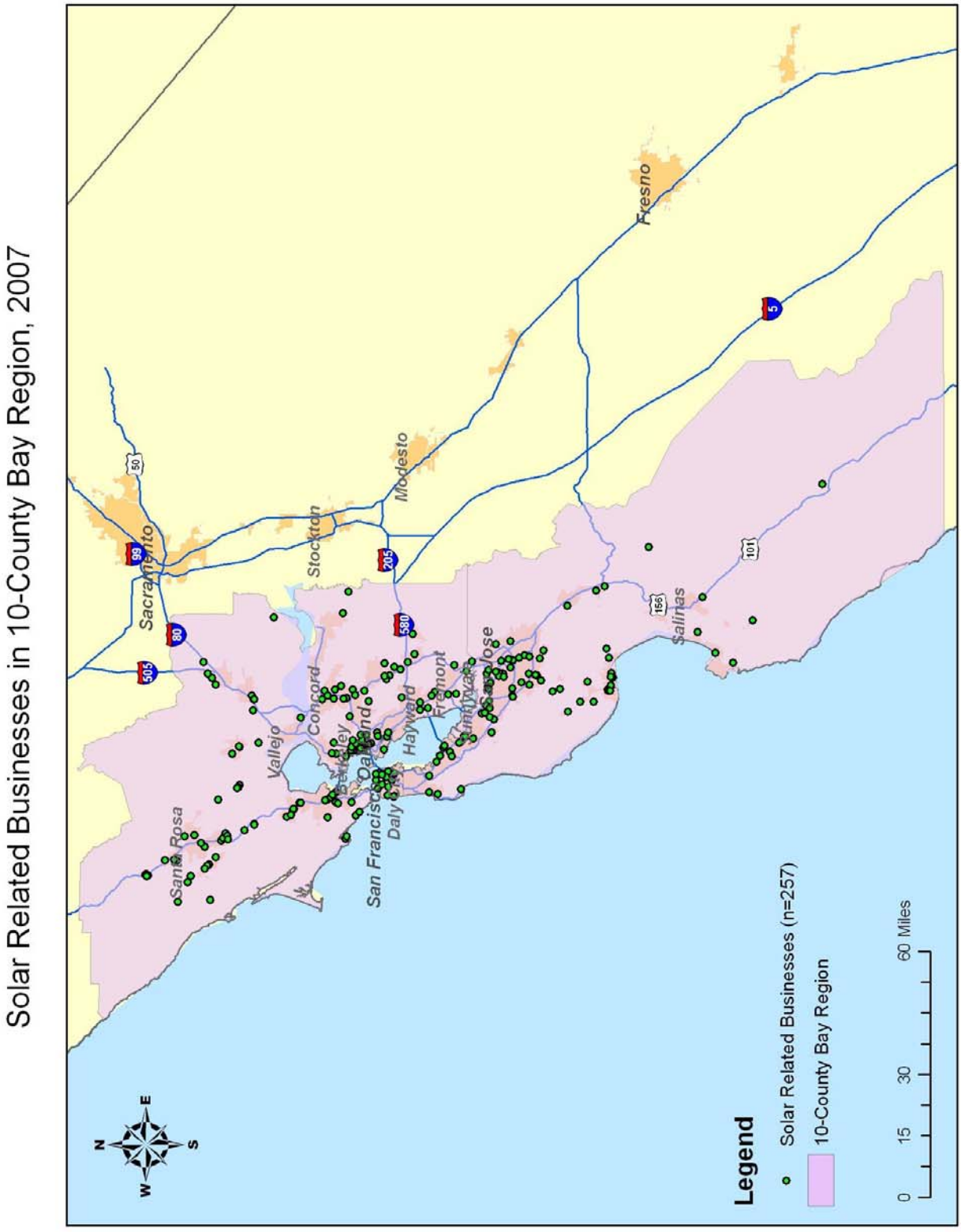
Occupation	Estimated 2007 Solar Industry Employment	Growth Next 12 Months	Openings from Growth	Difficulty Hiring	Median Annual Wage		Degree Preference	
					Entry	Experienced	Bachelor's	Related Associate
Solar thermal installers or technicians	340	45.7%	150	76.9%	$31,200	$52,000	3.8%	21.2%
Solar photovoltaic installers or technicians	**1,590**	**55.8%**	**880**	**77.1%**	$31,200	$60,000	4.2%	20.8%
Sales representatives or estimators	**890**	**50.5%**	**450**	70.6%	$41,600	$62,400	**23.5%**	**30.6%**
Solar designers or engineers	550	44.0%	220	**80.2%**	**$50,000**	**$83,200**	**43.6%**	**31.7%**
Solar installation managers or project foremen	480	36.5%	180	70.4%	**$52,000**	**$77,500**	9.1%	26.1%
Summary	**3,850**	**48.8%**	**1,880**					

Color Code: **- 1st highest** **- 2nd highest**

* Occupational data shown here is from the Bay Region solar industry workforce study conducted by the Centers of Excellence and BW Research in 2007.

Appendix C: Employer Locations




Solar Related Businesses in 10-County Bay Region, 2007
Fresno
Modesto
Stockton
Sacramento
Salinas
San Jose
Fremont
Hayward
Concord
Vallejo
Berkeley
Oakland
San Francisco
Daly City
Santa Rosa
Legend
Solar Related Businesses (n=257)
10-County Bay Region
0
15
30
60 Miles
N
E
S
W

Appendix D: Occupational Profiles

The following Occupational Profiles synthesize all the secondary research and employer survey data for each of the five solar occupations studied for this report.

Solar Energy System Installers and Technicians

In most sources, the occupational title "Solar Energy System Installers and Technicians" is used to identify both Solar Thermal Installers or Technicians and Solar Photovoltaic (PV) Installers or Technicians. Both types of installers are responsible for the installation, commissioning, and servicing of solar electric or photovoltaic and solar thermal systems. Working under the supervision of lead installers or project managers, installers and technicians mount pre-assembled solar panels or systems and install storage tanks, pumps, valves, pipes, and ducts. They set up and adjust electrical or electronic controls and sometimes do routine maintenance. In new construction, they follow blueprints to connect piping, ducting, controls and wiring.

Solar Photovoltaic (PV) Installers or Technicians install the systems that generate solar electricity to heat and cool entire homes and buildings.

Solar Thermal Installers install and repair solar-energy systems designed to collect, store, and circulate solar-heated water or other medium for residential, commercial, or industrial use—such as those in swimming pool heating systems.

Occupational Growth: Among all solar related occupations, the Solar Technician or Installer is and will be the fastest growing and most in demand in the Bay Area. Industry experts claim that since the energy crises of the 1970s, there has been an increasing need for solar energy technicians who can install, maintain, operate and test solar energy systems.

- In a recent solar industry survey, Bay Area employers indicated 45.7 percent growth in employment over the next 12 months for Solar Thermal Installers or Technicians.
- Surveyed employers indicated 55.8 percent growth in employment over the next 12 months for Solar Photovoltaic (PV) Installers or Technicians.
- In the Bay Area, 77.8 percent of employers indicated some or more difficulty finding qualified applicants for Solar Thermal Installers or Technicians and 76 percent of employers reported some or more difficulty finding qualified applicants for Solar Photovoltaic (PV) Installers or Technicians.

Occupational Qualifications: This is an entry-level position, with most occupations in this category requiring related on-the-job training or training in a vocational program.

- 89.8 percent of employers surveyed considered customer service skills very or somewhat important in a Technician or Installer employee.
- 94.9 percent of employers surveyed rated general construction experience as a very or somewhat important knowledge and skill set for Technicians or Installers.
- In the Bay Area, 50 percent of the employers surveyed had great interest in an Associate Degree program in renewable energy for entry level technicians.
- In addition, 85.7 percent of employers indicated interest in a certificate program for entry level entry level Solar Photovoltaic (PV) Installers and technicians. 57.2 percent responded with interest in a certificate program for entry level Solar Thermal Installers and Technicians.

Occupational Wages: In the Bay Region, the annual wages (based on survey responses) for Installers or Technicians are:

	Entry Level Median Annual Wage	Experienced Level Median Annual Wage
Solar Thermal Installers or Technicians	$31,200	$60,000
Solar Photovoltaic (PV) Installers or Technicians	$31,200	$52,000

Entry level is loosely defined as new hires up to one-year on-the-job, while experienced level is more typically defined as those workers with more than three years on-the-job.

Since Solar Thermal and Solar PV Installers and Technicians are frequently compared to the broader occupation Heating, Air Conditioning, and Refrigeration (HVAC) Mechanic, the wages for HVAC Mechanic are included here for comparison:

	25th Percentile Wage	Median Annual Wage	75th Percentile Annual Wage
Heating, Air Conditioning, and Refrigeration (HVAC) Mechanics	$33,794	$45,246	$57,055
Wage data is from the OES Wage Survey 1st Quarter, 2007; California EDD/LMID and reflects California level data.			

Solar Energy System Installers and Technicians Tasks
The following list describes in more detail some of the tasks that may be required of Solar Energy System Installers and Technicians:[25]

- Locate and mark position of collectors, holding tank, and distribution system on structure, according to specifications and blueprints.
- Cut holes in roofs, walls, and ceilings, to install equipment and plumbing, using power saws and drills.
- Install supports and brackets to anchor solar collectors and holding tank, using carpenter's hand tools.
- Cut, thread, and fit plumbing according to specifications for connecting circulation system, using plumber's hand tools.
- Lay out and connect electrical wiring between controls and pumps according to wiring diagram and knowledge of standard industry practice, using hand tools.
- Test electrical circuits and components for continuity, using electrical test equipment.
- Test plumbing for leaks, using pressure gauge. Operate control buttons to activate pumps and observe system to detect malfunctions.
- Repair or replace defective equipment.

Solar Energy System Installers and Technicians are most often compared to the broader occupation "Heating and Air Conditioning Mechanics and Installers" or "HVAC Installers," due to the similar knowledge, skills, and abilities required to perform the work.[26]

[25] Task detail is taken from the Dictionary of Occupational Title description for Solar-Energy-System-Installer, http://www.occupationalinfo.org/63/637261030.html

Critical Knowledge:

Mechanical — Knowledge of machines and tools, including their designs, uses, repair, and maintenance.

Customer and Personal Service — Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.

Engineering and Technology — Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.

Design — Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.

English Language — Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.

Building and Construction — Knowledge of materials, methods, and the tools involved in the construction or repair of houses, buildings, or other structures such as highways and roads.

Mathematics — Knowledge of arithmetic and its applications.

Sales and Marketing — Knowledge of principles and methods for showing, promoting, and selling products or services. This includes marketing strategy and tactics, product demonstration, sales techniques, and sales control systems.

Computers and Electronics — Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

Critical Skills:

Troubleshooting — Determining causes of operating errors and deciding what to do about it.

Repairing — Repairing machines or systems using the needed tools.

Active Listening — Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

Equipment Maintenance — Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.

Critical Thinking — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Installation — Installing equipment, machines, wiring, or programs to meet specifications.

Active Learning — Understanding the implications of new information for both current and future problem-solving and decision-making.

Reading Comprehension — Understanding written sentences and paragraphs in work related documents.

Critical Abilities:

Extent Flexibility — The ability to bend, stretch, twist, or reach with your body, arms, and/or legs.

Finger Dexterity — The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.

Manual Dexterity — The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.

[26] Knowledge, skills, and abilities listed are adapted from O*NET's Summary Report for Heating and Air Conditioning Mechanics and Installers, http://online.onetcenter.org/ .

Problem Sensitivity — The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

Arm-Hand Steadiness — The ability to keep your hand and arm steady while moving your arm or while holding your arm and hand in one position.

Inductive Reasoning — The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).

Trunk Strength — The ability to use your abdominal and lower back muscles to support part of the body repeatedly or continuously over time without 'giving out' or fatiguing.

Control Precision — The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.

Deductive Reasoning — The ability to apply general rules to specific problems to produce answers that make sense.

Information Ordering — The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

Sales Representatives or Estimators

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 executive interviews with industry representatives, employers indicated that solar sales representatives were expected to have some knowledge or experience in construction, accounting, and electrical systems. In addition the following background is desired:

- General business skills and customer service skills were also considered important assets for this position.
- Energy system cost estimation and site analysis may require additional training on-the-job or previous work experience.
- 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.

Occupational Growth: Solar industry Sales Representatives or Estimators are expected to experience significant growth in the immediate future.

- In the Bay Region, employment in this occupation is projected to increase 50.5 percent over the next 12 months; statewide, the occupation is projected to increase by 55.4 percent (based on employer responses to a recent survey).
- In addition to increased demand for Sales Representatives or Estimators, 75 percent of employers experience difficulty finding qualified applicants for these positions, with 23 percent of employers responding “great” difficulty.

Occupational Qualifications: This position generally requires a business-related Associate’s or Bachelor’s degree, depending on individual employer requirements.

- 25 percent of employers surveyed preferred Sales Representatives or Estimators with a Bachelor’s degree, while 33 percent indicated potential employees would need a related Associate’s degree.
- Bay Region employers rated customer service skills and knowledge of solar power as important qualities and qualifications for solar energy systems-related occupations.

- In the Bay Region, 36 percent of the employers had great interest and 40 percent of the employers indicated some interest in on-site customized training for current solar employees.

Occupational Wages: In the Bay Region, the annual wages (based on survey responses) for Sales Representatives or Estimators are:

	Entry Level Median Annual Wage	Experienced Level Median Annual Wage
Sales Representatives or Estimators	$41,600	$62,400

Entry level is loosely defined as new hires up to one-year experience on-the-job, while experienced level is more typically defined as those workers with more than three years experience on-the-job.

Since Sales Representatives or Estimators may be considered somewhat similar to the broader occupation, "Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products" the wages for that occupation is included here for comparison:

	25tn Percentile Wage	Median Annual Wage	75th Percentile Annual Wage
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	$50,903	$70,164	$96,133
Wage data is from the OES Wage Survey 1st Quarter, 2007; California EDD/LMID.			

Sales Representative or Estimator Tasks
Typical sales tasks might 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 customers' 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.
- Negotiate prices and terms of sales and service agreements.
- Maintain customer records, using automated systems.
- Identify prospective customers by using business directories, following leads from existing clients, participating in organizations and clubs, and attending trade shows and conferences.
- Prepare sales contracts for orders obtained, and submit orders for processing.
- Select the correct products or assist customers in making product selections, based on customers' needs, product specifications, and applicable regulations.
- Collaborate with colleagues to exchange information such as selling strategies and marketing information.

- Sales Representatives or Estimators may also incorporate knowledge, skills, and abilities similar to those assigned to the broader occupation "Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products." [27]

Critical Knowledge:

Sales and Marketing — Knowledge of principles and methods for showing, promoting, and selling products or services. This includes marketing strategy and tactics, product demonstration, sales techniques, and sales control systems.

Customer and Personal Service — Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.

English Language — Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.

Computers and Electronics — Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

Production and Processing — Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.

Critical Skills:

Speaking — Talking to others to convey information effectively.

Persuasion — Persuading others to change their minds or behavior.

Active Listening — Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

Time Management — Managing one's own time and the time of others.

Negotiation — Bringing others together and trying to reconcile differences.

Service Orientation — Actively looking for ways to help people.

Social Perceptiveness — Being aware of others' reactions and understanding why they react as they do.

Reading Comprehension — Understanding written sentences and paragraphs in work related documents.

Critical Thinking — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Active Learning — Understanding the implications of new information for both current and future problem-solving and decision-making.

Critical Abilities:

Oral Expression — The ability to communicate information and ideas in speaking so others will understand.

Oral Comprehension — The ability to listen to and understand information and ideas presented through spoken words and sentences.

Speech Clarity — The ability to speak clearly so others can understand you.

Speech Recognition — The ability to identify and understand the speech of another person.

[27] Knowledge, skills, and abilities listed are adapted from O*NET's Summary Report for Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products, http://online.onetcenter.org/ .

Written Comprehension — The ability to read and understand information and ideas presented in writing.

Written Expression — The ability to communicate information and ideas in writing so others will understand.

Deductive Reasoning — The ability to apply general rules to specific problems to produce answers that make sense.

Near Vision — The ability to see details at close range (within a few feet of the observer).

Problem Sensitivity — The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

Inductive Reasoning — The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).

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.

Occupational Growth: Solar Designer or Engineer occupations are expected to experience significant growth in the immediate future.

- In the Bay Region, employment in this occupation is projected to increase 44 percent over the next 12 months; statewide, the occupation is projected to increase by more than 40 percent (based on employer responses to a recent survey).
- In addition to increased demand for Solar Designers or Engineers, more than 80 percent of employers experience difficulty finding qualified applicants for these positions, with 40 percent of employers responding “great” difficulty.

Occupational Qualifications: This position generally requires a related Associate’s degree or completion of a related vocational program.

- 50 percent of employers surveyed preferred solar designers or engineers with a Bachelor’s degree, while 30 percent indicated designers or engineers would need a Related Associate’s degree.
- Bay Region employers also rated customer service skills, general construction experience, knowledge of solar power, and the ability to work on a roof as important qualities and qualifications for solar energy systems-related occupations.
- In the Bay Region, 57 percent of the employers had great interest and 32 percent of the employers indicated some interest in an Associate Degree program to train entry-level system designers or engineers in the renewable energy industry.

Occupational Wages: In the Bay Region, the annual wages (based on survey responses) for Solar Designers or Engineers are:

	Entry Level Median Annual Wage	Experienced Level Median Annual Wage
Solar Designers or Engineers	$50,000	$83,200

Entry level is loosely defined as new hires up to one-year experience on-the-job, while experienced level is more typically defined as those workers with more than three years experience on-the-job.

Since Solar Designers and Engineers are frequently compared to the broader occupations "Electrical Drafters" and "Mechanical Engineers," the wages for Mechanical Engineers are included here for comparison:

	25th Percentile Wage	Median Annual Wage	75th Percentile Annual Wage
Electrical and Electronics Drafters	$39,655	$51,167	$66,291
Mechanical Engineers	$65,218	$82,242	$101,869
Wage data is from the OES Wage Survey 1st Quarter, 2007; California EDD/LMID.			

Solar Designers or Engineers Tasks
The following list describes in more detail tasks that may be required of Solar Designers or Engineers:[28]

- 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.
- Arranges location of solar system components, such as panel, pumps, and storage tanks, to minimize length and number of direction changes in pipes and reconstruction of existing structures.
- Studies engineering tables to determine size of pipes and pumps required to maintain specified flow rate through solar panels.
- Specifies types of electrical controls, such as differential thermostat, temperature sensors, and solenoid valves, compatible with other system components, using knowledge of control systems.
- Completes parts list, specifying components of system.
- Draws wiring, piping, and other diagrams, using drafting tools.
- May inspect structures to compile data used in solar system design, such as structure's angle of alignment with sun and temperature of incoming cold water.
- May inspect construction of system to ensure adherence to design specifications.

Solar Designers and Engineers are most often compared to the broader occupations "Electrical Drafters" and "Mechanical Engineers," due to the similar knowledge, skills, and abilities required to perform the work. Although it should be noted that a Bachelor's degree is required for Mechanical Engineers but is not always required for Solar Designers or Engineers or Electrical Drafters. [29]

[28] Task detail is taken from the Dictionary of Occupational Title description for Solar-Energy-Systems Designer, http://www.occupationalinfo.org/00/007161038.html
[29] Knowledge, skills, and abilities listed are adapted from O*NET's Summary Reports for Electrical Drafters and Mechanical Engineers, http://online.onetcenter.org/ .

Critical Knowledge:

Engineering and Technology — Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.

Mechanical — Knowledge of machines and tools, including their designs, uses, repair, and maintenance.

Design — Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.

Production and Processing — Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.

Mathematics — Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.

Administration and Management — Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.

English Language — Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.

Computers and Electronics — Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

Physics — Knowledge and prediction of physical principles, laws, their interrelationships, and applications to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and sub- atomic structures and processes..

Critical Skills:

Mathematics — Using mathematics to solve problems.

Active Learning — Understanding the implications of new information for both current and future problem-solving and decision-making.

Complex Problem Solving — Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

Critical Thinking — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Reading Comprehension — Understanding written sentences and paragraphs in work related documents.

Science — Using scientific rules and methods to solve problems.

Active Listening — Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

Judgment and Decision Making — Considering the relative costs and benefits of potential actions to choose the most appropriate one.

Time Management — Managing one's own time and the time of others.

Writing — Communicating effectively in writing as appropriate for the needs of the audience.

Speaking — Talking to others to convey information effectively.

Critical Abilities:

Oral Comprehension — The ability to listen to and understand information and ideas presented through spoken words and sentences.

Problem Sensitivity — The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

Written Comprehension — The ability to read and understand information and ideas presented in writing.

Deductive Reasoning — The ability to apply general rules to specific problems to produce answers that make sense.

Inductive Reasoning — The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).

Information Ordering — The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

Near Vision — The ability to see details at close range (within a few feet of the observer).

Oral Expression — The ability to communicate information and ideas in speaking so others will understand.

Written Expression — The ability to communicate information and ideas in writing so others will understand.

Speech Clarity — The ability to speak clearly so others can understand you.

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.[30]

Occupational Growth: Solar Installation Managers or Project Foremen are expected to experience significant growth in the immediate future.

- In the Bay Region, employment in this occupation is projected to increase 36.5 percent over the next 12 months; statewide, the occupation is projected to increase by 47.6 percent (based on employer responses to a recent survey).
- In addition to increased demand for Solar Installation Managers or Project Foremen, 75 percent of employers experience difficulty finding qualified applicants for these positions, with 36 percent of employers responding "great" difficulty.

Occupational Qualifications: Most Solar Installation Managers or Project Foremen are required to have training in vocational schools, related on-the-job experience, or an associate's degree. Some positions may require a bachelor's degree.

[30] Knowledge, skills, and abilities listed are adapted from O*NET's First-Line Supervisors/Managers of Construction Trades and Extraction Workers, http://online.onetcenter.org/ .

- Only 13 percent of Bay Region employers surveyed preferred Solar Installation Managers or Project Foremen with a Bachelor's degree, while 25 percent indicated potential employees would need a related Associate's degree and 35 percent did not require any degree experience.
- Bay Region employers rated customer service skills, general construction experience, the ability to work on a roof and knowledge of solar power as important qualities and qualifications for solar energy systems-related occupations.
- In the Bay Region, 36 percent of the employers had great interest and 40 percent of the employers indicated some interest in on-site customized training for current solar employees.

Occupational Wages: In the Bay Region, the annual wages (based on survey responses) for Solar Installation Managers or Project Foremen are:

	Entry Level Median Annual Wage	Experienced Level Median Annual Wage
Solar Installation Managers or Project Foremen	$52,000	$77,500

Entry level is loosely defined as new hires up to one-year experience on-the-job, while experienced level is more typically defined as those workers with more than three years experience on-the-job.

Since Solar Installation Managers or Project Foremen may be considered somewhat similar to the broader occupation, "First-Line Supervisors/Managers of Construction Trades and Extraction Workers" the wages for that occupation are included here for comparison:

	25th Percentile Wage	Median Annual Wage	75th Percentile Annual Wage
First-Line Supervisors/Managers of Construction Trades and Extraction Workers	$53,623	$65,951	$81,184
Wage data is from the OES Wage Survey 1st Quarter, 2007; California EDD/LMID and reflects California level data.			

Solar Installation Managers or Project Foremen Tasks
A Solar Energy Foreman leads work crews installing residential and commercial photovoltaic (PV) or thermal systems.

- 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.
- Both Installers and Foremen can be specialists either in solar electric or solar thermal equipment.
- The main professional advancement for all three groups is to move to a Solar Installation Manager position.

Other tasks might include:

- 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.
- Confer with managerial and technical personnel, other departments, and contractors in order to resolve problems and to coordinate activities.
- Coordinate work activities with other construction project activities.
- Order or requisition materials and supplies.
- Locate, measure, and mark site locations and placement of structures and equipment, using measuring and marking equipment.
- Record information such as personnel, production, and operational data on specified forms and reports.
- Assign work to employees, based on material and worker requirements of specific jobs.
- Provide on-site system operation information to the customer.

Critical Knowledge:

Building and Construction — Knowledge of materials, methods, and the tools involved in the construction or repair of houses, buildings, or other structures such as highways and roads.

Administration and Management — Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.

Mathematics — Knowledge of arithmetic, algebra, geometry, and their applications.

Customer and Personal Service — Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.

Mechanical — Knowledge of machines and tools, including their designs, uses, repair, and maintenance.

Public Safety and Security — Knowledge of relevant equipment, policies, procedures, and strategies to promote effective local, state, or national security operations for the protection of people, data, property, and institutions.

Design — Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.

Production and Processing — Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.

Engineering and Technology — Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.

Personnel and Human Resources — Knowledge of principles and procedures for personnel recruitment, selection, training, compensation and benefits, labor relations and negotiation, and personnel information systems.

Critical Skills:

Time Management — Managing one's own time and the time of others.

Coordination — Adjusting actions in relation to others' actions.

Supervision --- Giving attention to safe practices and handling unexpected situations.

Instructing — Teaching others how to do something.

Judgment and Decision Making — Considering the relative costs and benefits of potential actions to choose the most appropriate one.

Speaking — Talking to others to convey information effectively.

Active Listening — Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

Critical Thinking — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Equipment Selection — Determining the kind of tools and equipment needed to do a job.

Reading Comprehension — Understanding written sentences and paragraphs in work related documents.

Mathematics — Using mathematics to solve problems.

Critical Abilities:

Oral Comprehension — The ability to listen to and understand information and ideas presented through spoken words and sentences.

Oral Expression — The ability to communicate information and ideas in speaking so others will understand.

Problem Sensitivity — The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

Deductive Reasoning — The ability to apply general rules to specific problems to produce answers that make sense.

Inductive Reasoning — The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).

Near Vision — The ability to see details at close range (within a few feet of the observer).

Information Ordering — The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

Written Expression — The ability to communicate information and ideas in writing so others will understand.

Selective Attention — The ability to concentrate on a task over a period of time without being distracted.

Speech Clarity — The ability to speak clearly so others can understand you.

Appendix E: College Resources

New Energy Workforce (NEW) Regional Planning Initiative: The New Energy Workforce (NEW) Regional Planning Initiative was formed in 2007 to facilitate communication among the 26 Bay Area Colleges about their current and projected responses to new energy industry needs. A listserv has been created at www.newenergyworkforce.org for members of the Bay Area Colleges interested in discussing how to respond to workforce needs in emerging energy-related fields. The listserv contains messages and posts, plus a repository of reports and files. Communication has resulted in more coordination of efforts and less confusion among industry partners who assume colleges work together. The NEW Initiative is open to any Bay Area College.

To join, contact: kitodoherty@gmail.com.

Silicon Valley Solar Industry-Driven Regional Collaborative (IDRC): An IDRC grant held by DeAnza College is a strategic regional response to meet the need for a skilled workforce in photovoltaic solar system design and installation. This two-year grant includes the following partners: Silicon Valley Leadership Group, SolarTech, NOVA Workforce Investment Board, Mission College, San Jose City College, Cabrillo College, West Valley College, and Ohlone College. Cabrillo, San Jose City College and Ohlone College are offering courses as part of the grant.

(Contact: Rick Kuhn, kuhnrick@fhda.edu ,(408) 864-8302.)

Solar PV Installer DACUM – Developing A Curriculum: A training assessment (DACUM –Developing a Curriculum) for solar PV installers was conducted by West Valley College's Advanced Transportation Technology and Energy Initiative (ATTE) Center as part of the Industry-Driven Regional Collaborative grant held by DeAnza College described above. The DACUM is being used to develop the curriculum for industry-certified training by the IDRC partner colleges. The DACUM report can be found at the following link: http://groups.yahoo.com/group/NewEnergyWorkforce/file.

(Contact: David Esmaili, david_esmaili@wvm.edu, (408) 741-4693.)

College Faculty Certification Training: Diablo Valley College is planning to offer Train-the-Trainer courses to interested regional college faculty in a variety of solar and energy-certified areas through a recently-awarded Industry-Driven Regional Collaborative (IDRC) Grant. Future offerings may include the following:

- Photovoltaic Installer - NABCEP Certified
- Solar Thermal Installer – NABCEP Certified
- Architecture/Construction – LEED Certification
- Energy Analyst (a software course)
- Home Efficiency Raters (HERS) – (Energy Auditor)

(Contact: Tom Chatagnier, tchatagnier@dvc.edu , (925) 685-1230 ext. 2522.)

Cleantech Job Skills Inventory: An inventory has been compiled which examines 10 emerging industry sectors within cleantech, employing 50 job types in the Silicon Valley. Funded through a Bay Region Community College Consortium (BACCC) mini-grant, and created by Robert Cormia at Foothill College (rdcormia@earthlink.net), the inventory can be accessed at: www.newenergyworkforce.org.

Solar Panel Workshops for Homeowners: Solar workshops for homeowners led by San Francisco City College electrical program instructors will be offered on weekends (6 hours) starting in Fall 2008. A training aid has been built with four solar panels (320 W/48 volts) and inverters on a portable roof module.

(Contact: Gerald Bernstein, gbernste@ccsf.edu, (415) 550-4437.)

Silicon Valley Workforce Development Coalition (SV Works): A symposium was held on February 23, 2007 that brought together energy industry executives and the Bay Region Community Colleges to discuss the rapidly growing energy industry and its workforce needs. The event was convened by the Silicon Valley Workforce Development Coalition (SV Works) in collaboration with the Silicon Valley Leadership Group (SVLG). Employers at this event asked the education community to respond to their hiring and training needs, especially in the area of solar. To develop a unified response to industry, the NEW Regional Planning Initiative, (previously described) was developed.

(Contact: Bruce Whistler, bruce_whistler@wvm.edu, (408) 855-5204 or Rick Kuhn, kuhnrick@fhda.edu, (408) 864-8302.)

Appendix F: Contacts for Bay Region Colleges Offering Solar Courses

Cabrillo College

Rock Pfotenhauer
Dean, Instruction, Career Education and Economic Development
rock@cabrillo.edu
(831) 479-6482

Chabot College

Tom Clark
Dean, Applied Technology & Business
TClark@chabotcollege.edu
(510) 723-6652

DeAnza College

Julie Phillips
Chair, Environmental Studies
phillipsjulie@fhda.edu
(408) 864-8655

Diablo Valley College

Tom Chatagnier
Faculty, Physical Sciences & Engineering Division
tchatagnier@dvc.edu
(925) 685-1230 ext. 2522

Napa Valley College

Rich Della Valle
Statewide Director, Northern California Environment, Health, Safety, and Homeland Security (EHS2) Centers
rdellavalle@cccewd.net
(925) 672-2209

Ohlone College

George Rodgers
Departments of Anthropology, Geography, Sustainability
grodgers@ohlone.edu
(510) 659-6257

San Jose City College

Kathy Werle
Dean, Applied Science, Technology & PE
Kathy.Werle@sjcc.edu
(408) 288-3782

Skyline College

Mike Williamson
Dean, Science, Math & Technology
williamsonm@smccd.edu
(650) 738-4221

Appendix G: Survey Methodology and Script

Methodology

The table below briefly outlines the methodology for the Bay Region Solar Industry Workforce Study. Two phases of primary research were conducted - qualitative executive interviews with managers and directors within the solar industry and a quantitative internet/telephone survey of 77 solar industry employers across the ten-county Bay Region.

Internet/Telephone Survey Methodology

Technique	Internet and Telephone Survey of Solar Industry Employers
Universe	Firms with at Least Five Employees: 257
Number of Respondents	77
Field Dates	December 2007 to January 2008

Questionnaire Design

Through an iterative process, BW Research Partnership worked closely with the Centers of Excellence and Advanced Transportation Technology and Energy Centers to develop the questionnaire for the study.

To avoid the problem of systematic position bias - where the order in which a series of questions is asked systematically influences the answers to some of the questions - several of the questions in this survey were randomized such that respondents were not consistently asked the questions in the same order. (The series of items relating to industry workforce issues, employee development practices, important skills for technicians, and interest in training and education programs (Question 3, 4, 12, and 13) were randomized to avoid the systematic position bias.)

Survey Script

[bw] RESEARCH PARTNERSHIP

Centers of Excellence
Advanced Transportation Technology
& Energy Centers

Solar Energy Employer Survey
Bay Region (n= 77)
December 2007

Introduction:

Hello, my name is _____. May I please speak to a Human Resources Manager or person responsible for staffing at [organization]?

Hello, my name is _____ and I'm calling on behalf of **California Solar Energy Industry Association (CALSEIA) and the California Community Colleges**, who would value your participation in a brief survey that will help address your future organization needs for trained and educated employees in the solar industry

As a thank you for participating in the survey, we will enter you in a drawing for an IPOD as well as sending you the report based on the findings of this survey.

(If needed): The survey should take approximately ten minutes of your time. By answering this survey, you can help the California Community College system develop the appropriate type of training that will prepare the employees you will be looking for in the future.

(If needed): This survey has been commissioned by the California Community Colleges, which are committed to developing the regional workforce. The survey is being conducted by BW Research, an independent research organization.

(If needed): Your individual responses will **not** be published, only aggregate information will be used in the reporting of the survey results.

Screener Question

A. Does your firm work in the solar industry in California?

1 Yes [CONTINUE
2 No [TERMINATE]
3 Not sure [TERMINATE]

B. Is your firm primarily in the solar industry as a manufacturer?

1 Yes [SECOND OCCUPATION SET]
2 No [FIRST OCCUPATION SET]

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**Organization-Related Questions**

I'd like to begin by asking you a few general questions about your organization,

1. Including all full-time and part-time employees, how many **permanent** employees work at your business location?

Record # of employees _____

2. If you currently have [TAKE Q1 #] full-time and part-time **permanent** employees at your agency location, how many more or less permanent employees do you expect to have at your location 12 months from now?

1 More [record #_____]
2 Less [record #_____]
3 (DO'NT READ) Same number of permanent employees

[If amount differs by 10% or more in either direction, ask: ]
Just to confirm, you currently have ____ permanent employees and you expect to have _____ (more/less) employees, for a total of ____ permanent employees 12 months from now.

3. Now, I'm going to read a list of issues facing solar industry employers in the coming years. Please tell me how much difficulty your organization faces in addressing each workforce need.

Here's the (first/next) one _____ (READ ITEM): Please tell me whether your organization has no difficulty, some difficulty, or great difficulty in dealing with this issue.

**RANDOMIZE**

| | No difficulty | Some difficulty | Great difficulty | (DON'T READ DK/NA |
|---|---|---|---|---|
| A. Providing training opportunities so current employees are able to advance within the organization | 1 | 2 | 3 | 4 |
| B. Recruiting entry-level employees with appropriate training and education | 1 | 2 | 3 | 4 |
| C. Recruiting non-entry level employees with adequate skills and work experience | 1 | 2 | 3 | 4 |
| D. Retaining valuable employees who could be hired by competitors | 1 | 2 | 3 | 4 |

4. Next, I'd like to ask you about employee development practices at your business location. As I read each of the following employee development practices, please indicate whether your business uses each practice.

**RANDOMIZE**

| | Yes | No | (DON'T READ DK/NA |
|---|---|---|---|
| E. Internships | 1 | 2 | 3 |
| F. Apprenticeships | 1 | 2 | 3 |
| G. Career advancement and promotion planning | | | |
`````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````

for current employees (a carrer ladder) 1	2	3
H. Employer paid outside training 1	2	3
I. Tuituion assistance or reimbursement at a college or university 1	2	3

Occupation-Related Questions

[NOTE PLEASE COMMUNICATE TO RESPONDENT THAT WE WILL BE USING GENERAL OCCUPATIONAL TITLES RATHER THAN SPECIFIC JOB TITLES THAT MAY BE USED WITHIN EACH ORGANIZATION]

5. Now, I'm going to ask you about specific occupations within your organization related to your solar business. The occupational titles we are using may differ from the specific position titles used in your organization. For these questions, I would like you to try to equate your organization's specific position titles with the more general ones we will use here. Please tell me if your organization employs, at your location, individuals in positions matching the following general occupational titles:

   Here's the (first/next) one: _____ (READ ITEM, THEN ASK): Do you have employees who fit this occupational description at your agency location?
   (1 = Yes, 2 = No, 3 =DK/NA)

   Occupational List (Read brief definition of occupation only if needed by respondent)

Non manufacturing occupations

Occupation 1: Solar thermal installers or technicians

Occupation 2: Solar photovoltaic installers or technicians

Occupation 3: Sales representative or Estimator

Occupation 4: Solar designer or engineer

Occupation 5: Solar installation managers or project foremen

Manufacturing occupations

Occupation 1: Solar thermal installers or technicians

Occupation 2: Solar photovoltaic installers or technicians

Occupation 3: Sales representative or Estimator

Occupation 4: Solar designer or engineer

Occupation 6: Assemblers or Electrical Assemblers

Occupation 7: Quality control technicians

(SELECT UP TO 4 OF THE OCCUPATIONS THAT THE RESPONDENT INDICATED ARE REPRESENTED AT THEIR AGENCY'S LOCATION IN Q9 – TO BE ASKED THE FOLLOWING OCCUPATIONAL QUESTIONS)

[NOTE: FOR DATA COLLECTION, EACH OCCUPATION SHOULD HAVE ITS OWN NUMBER AND THAT NEEDS TO BE USED FOR ENTIRE DATA COLLECTION – FOR EXAMPLE, OCCUPATION 6 SHOULD ALWAYS BE OCCUPATION 6 – RESPONSES TO Q6 FOR OCCUPATION 6 SHOULD BE FOUND UNDER Q6.6]

(READ THE OCCUPATIONS IN THE SAME ORDER FOR EACH OF THE OCCUPATION-SPECIFIC QUESTIONS: Q10 – Q10)

Next I'm going to ask you a few questions about some of the occupations you mentioned, including _____ (READ LIST OF OCCUPATIONS TO BE USED)

6. As I read each of the following occupations, please tell me how many individuals you have at your business location that are currently employed either full-time or part-time in this occupation.

A	Occupation 1	### (3 digit number)
B	Occupation 2	### (3 digit number)
C	Occupation 3	### (3 digit number)
D	Occupation 4	### (3 digit number)

7. As I read each of the occupations again, please tell me how many more or less employees you estimate will be employed in each of the occupations 12 months from now.

[Use the following format for each one:]

If you currently have [TAKE Q11 #] [INSERT OCCUPATION TITLE] _____ at your agency location, how many more or less [INSERT OCCUPATION TITLE] do you expect to have at your location 12 months from now?

A Occupation 1
- 1 More [record #_____]
- 2 Less [record #_____]
- 3 (DO NOT READ) Same number of Occupation 1

B Occupation 2
- 1 More [record #_____]
- 2 Less [record #_____]
- 3 (DO NOT READ) Same number of Occupation 2

C Occupation 3
- 1 More [record #_____]
- 2 Less [record #_____]
- 3 (DO NOT READ) Same number of Occupation 3

D Occupation 4
- 1 More [record #_____]
- 2 Less [record #_____]
- 3 (DO NOT READ) Same number of Occupation 4

[If amount differs by 10% or more in either direction, ask:]
Just to confirm, you currently have ____ (insert occupation title) and you expect to have _____ (more/less), for a total of ____ (insert occupation title) 12 months from now.

8. For the same list of occupations, I'm interested in the level of difficulty your organization has in finding applicants who meet the organization's hiring standards. As I read each occupation, please tell me whether your organization has no difficulty, some difficulty or great difficulty finding applicants. (PRESENT IN ORDER THEY WERE PREVIOUSLY PRESENTED)

		No difficulty	Some difficulty	Great difficulty	(DON'T READ DK/NA
J.	Occupation 1	1	2	3	4
K.	Occupation 2	1	2	3	4
L.	Occupation 3	1	2	3	4
M.	Occupation 4	1	2	3	4

9. For my next occupation-specific question, I'm going to present you with three applicants with different educational backgrounds.

   For _____ (INSERT OCCUPATION), would you prefer:

   (Rotate order of the three applicant types)

   - An applicant with a Bachelor's Degree in a related field, but not specific to the occupation

   or

   - An applicant with a two year Associate Degree specific to the position?

   or

   - An applicant with no post high school degree but more hands on industry experience?

		General Bachelors	Specific Associates	No Degree Experience	(DON'T READ) It Depends	(DON'T READ) DK/NA
N.	Occupation 1	1	2	3	4	5
O.	Occupation 2	1	2	3	4	5
P.	Occupation 3	1	2	3	4	5
Q.	Occupation 4	1	2	3	4	5

10. For my last occupation-specific question, which occupations do current _____ (READ OCCUPATION) usually promote to after working successfully as a _____ (READ OCCUPATION) within your organization? (RECORD TOP 1 OR 2 FOR EACH OCC).

Occupation 1:

Record Top Occupations Promote to:_____
98 (DON'T READ) Don't know/ Not sure
99 (DON'T READ) Refused

Occupation 2:

Record Top Occupations Promote to:_____
98 (DON'T READ) Don't know/ Not sure
99 (DON'T READ) Refused

Occupation 3:

Record	Top Occupations Promote to:_____
98	(DON'T READ) Don't know/ Not sure
99	(DON'T READ) Refused

Occupation 4:

Record	Top Occupations Promote to:_____
98	(DON'T READ) Don't know/ Not sure
99	(DON'T READ) Refused

11. What is the typical pay range for each occupation, from entry level to most experienced employees in that occupation? [After each response to the pay range, please clarify whether the intended response was for hourly[1], monthly[2], or annual salary[3]] [IF NEEDED: CLARIFY THIS IS WAGES ONLY NOT BENEFITS]

		Entry	Experienced	Hour, Month Annual	(DON'T READ DK/NA
R.	Occupation 1	___	___	1,2,3	4
S.	Occupation 2	___	___	1,2,3	4
T.	Occupation 3	___	___	1,2,3	4
U.	Occupation 4	___	___	1,2,3	4

We have completed all of the questions about specific occupations. Before we finish, I'd like to ask you some general questions and verify your contact information.

12. Thinking about the different types of technicians, installers, and engineers that work at your location, do any of your technicians require the following skills sets or educational certifications, and if so are they somewhat important or very important?

    As I read each skill or area of knowledge, please indicate whether you have technicians which require this skill or area of knowledge and if so is it somewhat important or very important.

RANDOMIZE

		No this Is not needed	Somewhat Important	Very Imporant	(DON'T READ) DK/NA
V.	Ability to develop CAD (computer assisted design) drawings	1	2	3	4
W.	NABCEP (North American Board of Certified Energy Practioners) certification	1	2	3	4
X.	Customer service skills that simplify the Solar installation process	1	2	3	4
Y.	General construction experience	1	2	3	4
Z.	Ability to work on a roof	1	2	3	4
AA.	General understanding of the mechanics and engineering of Solar power	1	2	3	4

BB. A Certified electrian 1 2 3 4
CC. Ability to solder and assemble electronic components 1 2 3 4

13. What is your organization's level of interest in the following training and education programs that could be developed by the California Community Colleges for the solar industry workforce?

As I read each possible program, please tell me whether your organization would have no interest, some interest, or great interest in the following workforce development programs.

RANDOMIZE

	No Interest	**Some Interest**	**Great Interest**	**(DON'T READ) DK/NA**
DD. A two-year Associate Degree program that would train entry-level system designers or engineers in the renewable energy industry	1	2	3	4
EE. On-site customized training for your current solar employees	1	2	3	4
FF. A certificate program for entry-level solar thermal Installers and technicians	1	2	3	4
GG. A two-year Associate Degree program in renewable energy for Entry-level technicians	1	2	3	4
HH. A certificate program for entry-level solar photovoltaic (PV) Installers and technicians	1	2	3	4

Thank you for you completion of the survey, we would like to enter you in a drawing for IPOD what is your contact information so we can contact you if you win.

A. First and Last Name of Respondent_____

B. Position of Respondent_____

C. Phone of Respondent_____

D. Email of Respondent_____

E. Name of Business_____

F. County you are located in _____

Those are all the questions I have.
Thank you very much for your time.

G. Date of Interview _____

H. Time of Interview_____

I. Name of Interviewer_____

J. Employer Type _____

K. County _____

Primary SIC_____