



Clean Energy

LABOR MARKET ANALYSIS
SAN DIEGO COUNTY

October 2014





Foreword: Vision for San Diego

I am pleased to share with you the Clean Energy: Labor Market Analysis report. The report is one in a series of five published this year. We identified five regional high-priority sectors for an in-depth assessment of employer needs: Advanced Manufacturing, Life Sciences, Information and Communication Technologies, Clean Energy and Health Care.

The Clean Energy sector has been the topic of considerable excitement for a number of years. Two subsectors in Clean Energy have seen particular growth in San Diego—Renewable Energy and Energy Efficiency—which are the focus of this report. San Diego boasts more than 3,100 companies in these two subsectors, employing more than 28,000 individuals. One-third of these employers expect to add workers over the next 12 months. Its projected rapid employment growth and opportunities for on-the-job training, combined with reported current and future skills shortage, placed this sector on our list of San Diego's top five priority sectors.

Our findings are a result of a collaboration with the San Diego and Imperial Counties Community Colleges Association (SDICCCA). These reports represent the first step in cooperative, sector-based strategies for workforce development in our region. Together, the San Diego Workforce Partnership (SDWP) and SDICCCA conducted online surveys, in-person interviews and focus groups of regional employers from the Renewable Energy and Energy Efficiency subsectors. We delved deep, asking questions that would give us insight into the jobs that can be filled with an associate degree or short-term training. Our findings and recommendations paint a picture of where we are and where we should be headed in our workforce planning.

With nearly 1.6 million people in the regional workforce, it is important for us to continuously review the state of our industries and identify job potential for our burgeoning workforce. We need to inform the unemployed, the underemployed and the yet-to-be-employed of which careers will provide an upward trajectory and meet the needs of our regional employers. SDWP is committed to funding research and job training programs that will ensure every business in our region has access to a skilled workforce and every job seeker has access to meaningful employment.

Together we will build our region's skilled and prosperous workforce.



A handwritten signature in black ink, appearing to read 'Peter Callstrom', written in a cursive style.

Peter Callstrom, President and CEO
San Diego Workforce Partnership



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EXECUTIVE SUMMARY

For San Diego County's Clean Energy sector, technology and innovation has transformed previously mature industries such as construction, ushering in new employment opportunities for the region. Building upon available labor market data and survey responses from 290 Clean Energy firms and executive interviews with employers, this report analyzes occupational growth, employer expectations of workers regarding education and work experience, employer difficulties in finding qualified workers, the supply of and demand for workers, as well as resulting training gaps in the region.

This report explores the opportunities in Clean Energy and recommends specific actions for the workforce development system. Nine occupations were selected for detailed analyses of job gaps, in-demand skills and training priorities:

- Construction or project managers
- Energy auditors
- Photovoltaic designers
- Sales representatives
- Electricians
- Plumbers
- Solar photovoltaic installers
- Weatherization specialists
- Heating, ventilating, and air conditioning (HVAC) technicians

The study confirms that Clean Energy is a robust and continually growing sector in San Diego County. This sector is estimated to have over 28,000 workers in 2013 and is expected to grow at a rate of 11.5 percent to over 32,000 jobs in the next 12 months. Despite media attention directed toward the renewable energy subsector (promoting the installation of solar panels and alternative electrical sources in the county), more than two-thirds of companies surveyed focus instead on energy efficiency products and services. Therefore, workers with knowledge of the materials and technologies available to reduce energy consumption are in demand.

Occupational growth is also significant in the county. On average, employers surveyed projected all 11 occupations of study to grow from 2014 to 2015 with the exception of electricians. The most openings expected were for construction or project managers, sales representatives, HVAC technicians and solar photovoltaic installers. In general, Clean Energy employers do not have difficulty finding qualified workers, though they did report difficulty in hiring for specific occupations, specifically solar water heater installers, solar photovoltaic installers and photovoltaic designers.

The study also explores skills and work experience employers require across 11 occupations. The Clean Energy sector-specific skills employers look for in job applicants center on awareness of industry-specific policies and programs and the ability to discuss them with clients. As a result, sales occupations are increasingly in demand and often difficult to fill. Employers reported difficulty in finding applicants with soft skills, particularly problem-solving skills and critical thinking. While employer preferences of previous work experience vary by occupation, most employers of traditional trade occupations such as electricians and plumbers expect applicants to have prior work experience.

Analysis of the supply and demand for a trained workforce reveals a possible under-supply of construction and project managers, solar photovoltaic installers, sales representatives and energy auditors. This presents an opportunity for expanded program offerings at two-year and four-year institutions to train for these occupations. The study recommends that education and training providers include adaptable skills in curriculum, and invest in technology to train the workforce, while workforce development stakeholders should encourage apprenticeships that allow jobseekers to gain requisite experience.

INTRODUCTION

Employment in the Clean Energy sector has grown dramatically in the past decade, fueled by exponential growth in the installation of renewable energy technologies and energy efficiency retrofits. California leads the nation with proactive legislation that supports the Clean Energy sector: Firms must meet new energy building codes, conduct energy efficiency retrofits and have 33 percent of renewable energy resources by 2020. These policy initiatives helped fledgling companies become major job generators in regions throughout California, particularly in San Diego County.

In the solar industry alone, there were 47,223 jobs in California in 2013, with 3,566 of them in San Diego County.¹ Solar employers expect to add 10,500 jobs in California by the end of 2014.² Similar growth in San Diego County suggests that 550 new solar workers will be hired by the end of the year, representing a 15 percent growth in a one-year period. The City of San Diego alone is home to 107 megawatts (MW) of solar photovoltaic (PV)³ power (as of the end of 2013), second in the nation behind Los Angeles.⁴ At the same time, utility ratepayer programs and federal and state tax incentives have spurred a building efficiency movement, requiring firms to meet new energy efficiency standards and produce jobs to complete those requirements.

In order to better understand the labor market landscape and workforce needs of San Diego’s Clean Energy employers, the San Diego Workforce Partnership (SDWP) collaborated with the California Community Colleges Center of Excellence for Labor Market Research, San Diego-Imperial Region (COE) and the San Diego & Imperial Counties Community Colleges Association (SDICCCA) to conduct this study. Clean Energy was chosen for in-depth research as one of the five priority sectors that SDWP and SDICCCA share. The research will be used for sector-based workforce development strategies and allocation of resources. This report was commissioned by SDWP, and BW Research Partnership, Inc. collected data from surveys and interviews with 290 employers.

Study Scope and Methodology

¹ The Solar Foundation, “California Solar Jobs Census 2013: Analysis of the California Solar Workforce.” Available at: thesolarfoundation.org/sites/thesolarfoundation.org/files/California%20Solar%20Jobs%20Census%202013_Web.pdf.

² Respondents were surveyed in November of 2013 and asked about expected 12-month growth.

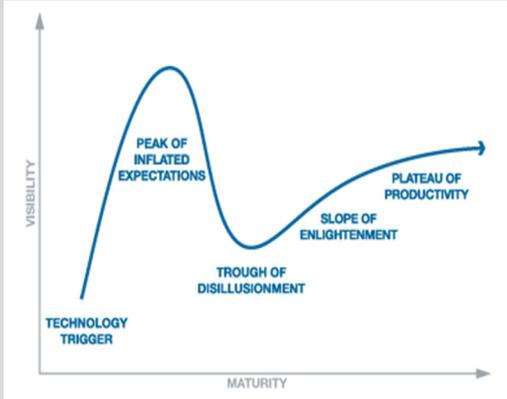
³ Photovoltaic power refers to the production of electric current or voltage through electromagnetic radiation, usually visible light.

⁴ Environment California, “Shining Cities.” Available at environmentcalifornia.org/reports/cae/shining-cities: The national average for number of homes that can be powered by 1 MW of solar energy is 164. Because of state by state variance, taking California’s average system performance and dividing this by the state’s average annual electricity consumption per household, the number comes out slightly higher to about 216 homes powered with just 1 MW of solar power. In fact, this is the highest compared to any other state.

The Hype Cycle

As the Clean Energy market picked up steam in the past decade, policymakers, politicians and economic developers looked to the sector as a source of significant job growth, expecting Clean Energy to create millions of jobs in the nation and save the economy from the Great Recession (2007–2009). This optimism is reflected across all levels of government, through large federal investments for “green” workforce training in the American Recovery and Reinvestment Act (ARRA), as well as in state- and local-level policies to create jobs and train the next generation of green workers.

Gartner’s “Technology Hype Cycle” provides a helpful illustration for how green jobs rose to a “peak of inflated expectations,” followed by the ultimate “trough of disillusionment” as the public and legislators realized that green jobs could not single-handedly fill the employment gap.



While green jobs did not produce the millions of jobs expected, it is clear that the sector has grown rapidly in the past several years and remains an important vehicle for continued economic and employment growth.

The Clean Energy sector represents a broad set of activities from electricity generation to greenhouse gas emissions accounting. These activities include research and development, sales, manufacturing, installation and maintenance. Despite the incredible growth and potential for Clean Energy in the nation, there is no single standard definition for the “green industries” that make up the Clean Energy sector. In recent years; however, Clean Energy has come to represent four major subsectors: 1) renewable energy, which includes solar energy, wind power, geothermal, biofuels and hydroelectric power; 2) energy efficiency, which includes lighting, retrofitting, weatherization and heating, ventilation and air condition (HVAC); 3) alternative transportation, which includes electric vehicles and hydrogen buses; and 4) greenhouse gas emissions accounting and management, which includes auditing and carbon sequestration.⁵

The majority of the 290 employers surveyed for this study are involved in the energy efficiency and renewable energy subsectors; consequently, these two subsectors with the most Clean Energy employment in San Diego County are the main focus of this report. Additionally, 11 occupations with the greatest employment growth potential were selected for further study:

- Construction or project managers
- Energy auditors
- Photovoltaic designers
- Sales representatives
- Electricians
- Plumbers
- Solar photovoltaic installers
- Weatherization specialists
- Heating, ventilation, and air condition (HVAC) technicians

Further details and profiles for each occupation can be found in Appendix A. The Standard Occupational Classification (SOC) codes that most closely correspond to these 11 occupations and the North American Industry Classification System (NAICS) codes used in this study to define the Clean Energy sector are listed in Appendix B.⁶ Four additional occupations (battery installation specialists, wind turbine technicians, wind blade installers, and construction equipment operators) were originally selected for this study, but were found to have no significant employment in San Diego County based on employer survey responses and were thus omitted.

A survey was administered online and by telephone to a list of businesses known to conduct work in the Clean Energy sector, as well as to a random sampling of construction-related businesses. From February to May 2014, 290 employers provided survey responses. (The survey instrument can be found in Appendix F.) Additionally, a facilitated employer discussion and follow-up interviews with employers were conducted to collect details of employer experiences with San Diego’s Clean Energy job applicants. Training providers in San Diego County were also surveyed to identify any available workforce programs that meet Clean Energy employer needs. The following report is a summary of the findings from this research. For more information on the report methodology, please see Appendix E.⁷

⁵ Many existing Clean Energy studies as well as several state legislatures use iterations of these four categories as their definitions of Clean Energy.

⁶ North American Industry Classification System (NAICS) is a coding standard used by federal agencies to collect and disseminate data related to a region’s economy and employment.

⁷ Economic Modeling Specialists, International’s (EMSI) “Inverse Staffing Pattern” tool determined the industries that employed the greatest number of the workers listed above. This provided a list of industry codes from NAICS to be used in this study, which was supplemented by the Green Goods and Services initiative definition from the U.S. Bureau of Labor Statistics. These strategies allowed for a robust definition of the Clean Energy sector, and informed the sampling plan for the survey.

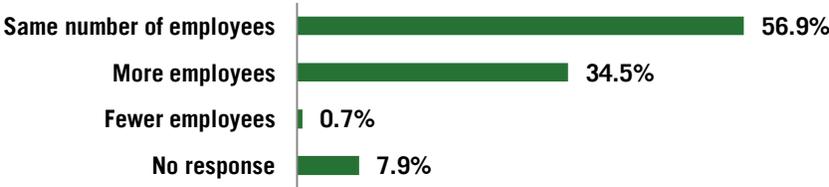
INDUSTRY OVERVIEW

Employment growth in the Clean Energy sector is robust and continuous. The Clean Energy sector includes 3,181 establishments and employs 28,597 workers, nearly half of which employ less than five employees. (A breakdown of establishments and jobs by industry can be found in Appendix C.) These Clean Energy firms expect to add 3,285 jobs (or 11.5 percent) over the next 12 months (Figure 1), while over one-third expect to add workers during this period (Figure 2).

Figure 1: Employer-Expected Employment Growth, 2014–2015



Figure 2: Percentage of Employers Expecting to Grow in Employment



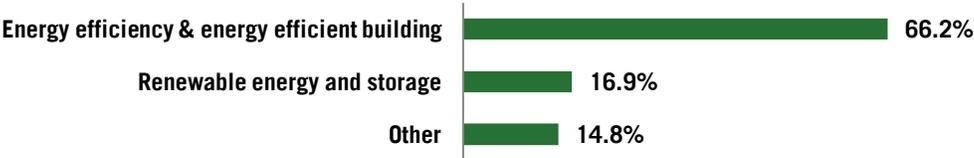
In addition to new jobs, a significant number of replacement jobs⁸ will open up between 2014 and 2015, generating a total of more than 6,000 jobs in the San Diego region (Figure 3).

Figure 3: 2014–2015 Projected Job Openings Due to New and Replacement Jobs



Despite media attention directed toward the renewable energy subsector (promoting the installation of solar panels and alternative electrical sources throughout San Diego County), more than 66 percent of companies surveyed focus in the energy efficiency subsector (Figure 4). As a result, there are significantly more employment opportunities for individuals in this subsector than in the renewable energy sector.

Figure 4: Subsector Makeup of Clean Energy Firms in San Diego



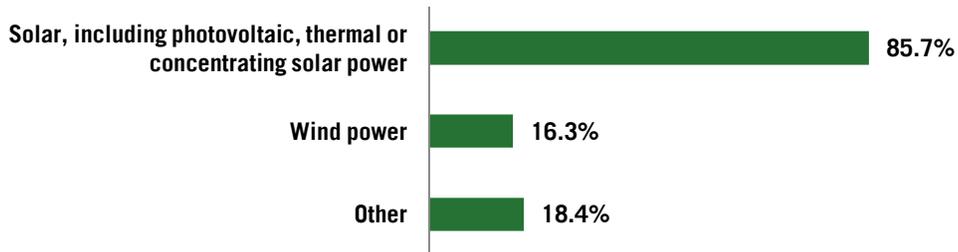
**Other” work includes alternative transportation, greenhouse gas emissions accounting and more.

While San Diego has a growing wind energy subsector, there are very few positions for wind turbine or blade repair technicians. Of the 290 employers surveyed, only two reported employing wind turbine or blade technicians. More than four-fifths (85.7 percent) of employers reported using solar or concentrating solar power (CSP)⁹ as their firm’s primary clean technology (Figure 5).

⁸ Replacement jobs are due to worker retirements or other employee turnovers.

⁹ Defined as the generation of energy by concentrating a large area of sunlight onto a small area, typically for steam generation.

Figure 5: Renewable Energy Technologies that Firms were Most Closely Connected to

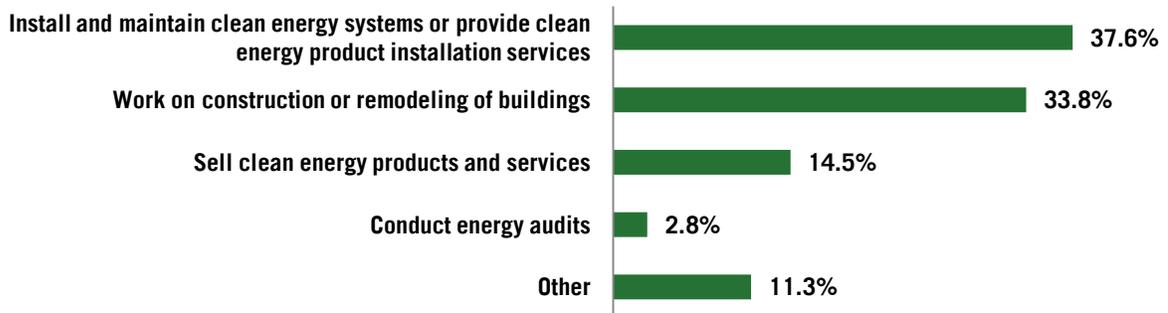


Note: Survey respondents were allowed to indicate more than one primary activity; hence the percentages add up to more than 100.

The small percentage of firms associated with wind power technology is largely reflective of the relatively low-installed capacity and estimated wind resource potential for San Diego County. Based on this data, it is unlikely that wind technician jobs will be a major source of employment in San Diego.

Of the companies involved in renewable energy and storage (or the renewable energy subsector), installation firms make up the largest segment of respondents (37.6 percent), followed closely by construction companies (33.8 percent) and sales firms (14.5 percent) (Figure 6).

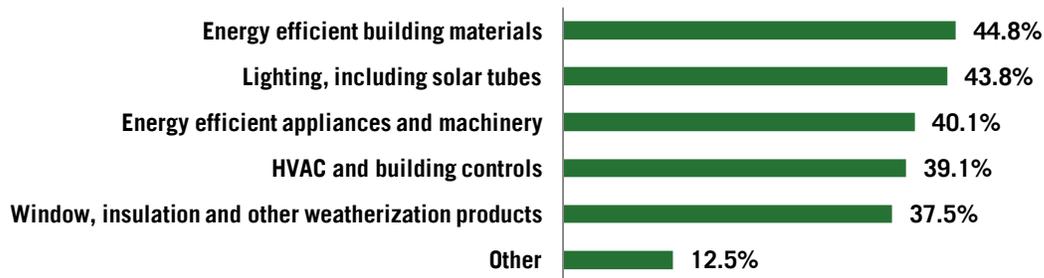
Figure 6: Business Focus that Renewable Energy Firms Most Identified With



Determining a firm’s business focus is important for San Diego workers seeking a Clean Energy career. Generally, renewable energy firms that install and maintain clean energy products have traditionally trade-related jobs—construction workers, plumbers and electricians—that have been repurposed to account for current technologies and trends in the Clean Energy market. For example, electricians can install traditional incandescent lights as well as energy efficient, recessed light emitting diode (LED) lights. Similarly, installing high-efficiency ductless mini-split air conditioners requires approximately the same skill set as installing conventional central air systems. On average, one-third of electricians and one-third of plumbers work on renewable energy or energy efficiency projects. These are the types of adaptable skill sets that employers demand from the workforce.

In addition to understanding activities that are prominent in renewable energy firms, workers must also be familiar with the types of materials and technologies that they work with. For firms in the energy efficiency subsector, knowledge of the materials and technologies available to reduce energy consumption is highly valued in workers (Figure 7).

Figure 7: Materials and Technologies that Firms in the Energy Efficiency Subsector Most Identified With



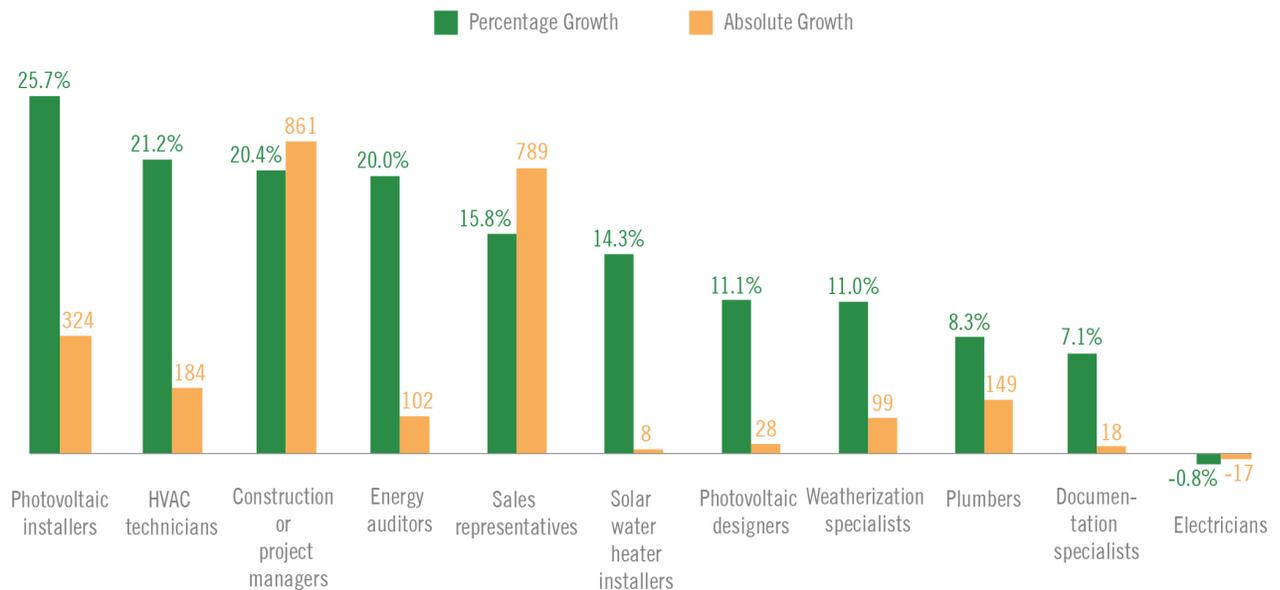
Note: Survey respondents were allowed to indicate more than one primary activity; hence the percentages add up to more than 100.

In addition to these activities, materials and technologies, employers noted that the Clean Energy sector-specific skills they look for in job applicants are awareness and knowledge of industry-specific policies and programs. Workers who can explain rebate programs, discuss and calculate potential energy savings, and generally describe why the technology is not risky for consumers are highly valued because they can often generate more business for the employer. As a result, sales occupations are increasingly in demand and often difficult to fill, which places them on this report as an occupation to study.

OCCUPATIONAL OVERVIEW

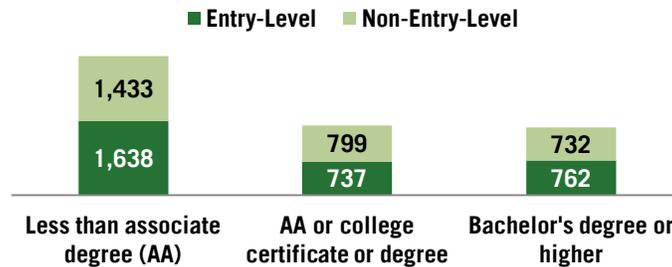
Based on survey and interview responses, employers expected all 11 occupations in this study to grow from 2014 to 2015 with the exception of electricians (Figure 8). The decline in electrician positions may be a result of seasonal changes or continued post-recession effects on the construction trade. However, based on historical data and industry trends, all 11 occupations are projected to grow in the long-term.

Figure 8: Employer Expectations of 12-Month Employment Growth, 2014–2015



Employers expect to have similar demand for the number of entry-level and non-entry-level jobs, but the most job openings¹⁰ by the end of 2015 will come from positions requiring less than an associate degree (Figure 9).

Figure 9: Overall 2014–2015 Projected Job Openings by Educational Attainment and Experience



More specifically for the 11 occupations, the most openings in the short-term (2014–2015) are construction or project managers, sales representatives, HVAC technicians and solar photovoltaic installers (Table 1).

Table 1: Projected New and Replacement Jobs, 2014–2015

Occupation	Total New & Replacement Jobs ¹¹			New & Replacement Jobs Requiring Bachelor's Degree or Higher			New & Replacement Jobs Requiring AA or College Certificate or Degree		
	Entry-Level	Experienced	Total	Entry-Level	Experienced	Total	Entry-Level	Experienced	Total
Construction or project managers	889	1,178	2,067	465	294	759	169	210	379
Sales representatives	913	981	1,894	211	372	583	140	271	411
HVAC technicians	235	207	442	0	14	14	110	83	193
Photovoltaic installers	275	113	388	39	0	39	156	117	273
Plumbers	125	232	357	0	9	9	45	45	90
Energy auditors	144	101	245	29	29	58	72	43	115
Weatherization specialists	164	73	237	0	0	0	19	0	19
Photovoltaic designers	27	40	67	11	13	24	11	18	29
Documentation specialists	32	11	43	6	0	6	6	5	11
Electricians	10	24	34	1	1	2	1	7	8
Solar water heater installers	15	4	19	0	0	0	8	0	8
Total	3,137	3,045	6,182	762	732	1,494	737	799	1,536

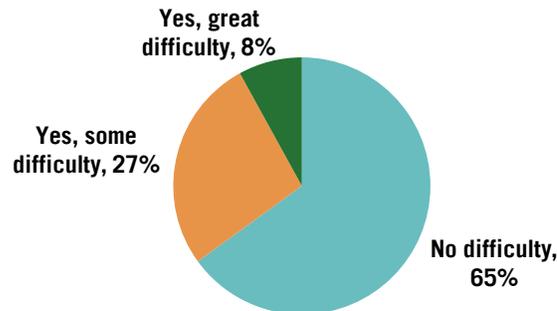
While strong employment growth is expected from 2014 to 2015, employers face little difficulty in finding qualified workers to fill job openings (Figure 10), creating an employers' market and allowing employers to

¹⁰ As mentioned in Figure 3, San Diego County will have 6,182 job openings between 2014 and 2015, which include both new and replacement jobs. This chart only displays the number of job openings based on educational attainment (a total of 6,101) and omits the 81 jobs that do not have these specific educational requirements.

¹¹ New and replacement jobs were generated using average estimates from the Employment Development Department and EMSI for the selected occupations, with the exception of solar installers (PV installers and solar water heater installers), which were generated from employer interviews.

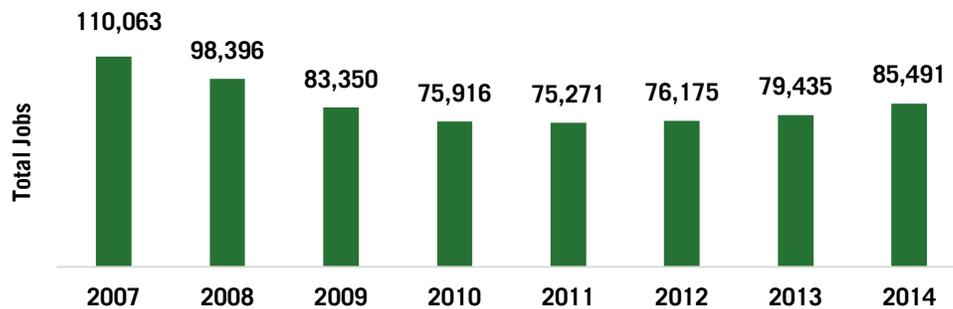
be particular with their employee selection. Sixty-five percent of San Diego Clean Energy firms report no difficulty in hiring qualified job candidates—a far larger percentage compared with 30 to 40 percent of firms in other industries that typically report difficulty in finding qualified applicants. This suggests that presently there is an ample supply of well-trained workers in San Diego County to fulfill growing employer demand.

Figure 10: Percent of Employers with Difficulty in Finding Qualified Job Applicants



Because a significant portion of Clean Energy jobs are traditionally trade-related professions, the severe decline in construction employment as a result of the Great Recession (2007–2009) helps explain the high percentage of employers with no difficulty in hiring qualified candidates. The construction industry in San Diego lost nearly 35,000 jobs between 2007 and 2011. Despite rebounding over the past several years, construction employment is still down approximately 24,500 jobs or 22.3 percent since before the recession (Figure 11).¹²

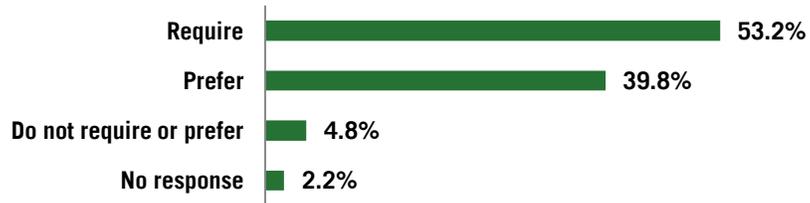
Figure 11: Construction Employment in San Diego County, 2007–2014



This suggests that there are still tens of thousands of unemployed individuals already trained and experienced with similar skills needed in the Clean Energy sector, thereby contributing to the employers’ market and selectivity of new employees. This raises the issue of newly-trained workers in the construction trades having to compete with experienced workers who lost their jobs during the recession. Given the competition in the marketplace, training providers need to train beyond the minimum requirements of these occupations and ensure that their trainees have sufficient “differentiators” in their skill sets to increase their chances of securing a job when training is complete. Employers reported that demonstrated technical ability was a key differentiator in job applicants. To demonstrate their technical abilities, job seekers need some prior work experience directly in the field. Approximately 53 percent of employers require previous job experience for the 11 occupations studied in this report and nearly 39.8 percent prefer it (Figure 12).

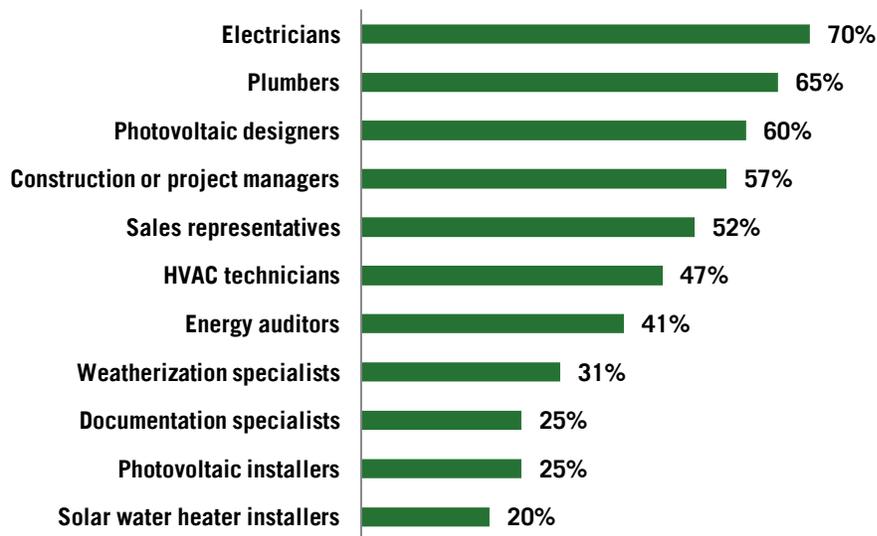
¹² EMSI. Name of dataset: Class of Worker 2014.2. 2014 numbers are projected based on historical industry trends.

Figure 12: Percent of Employers that Require or Prefer Previous Job Experience for All Occupations



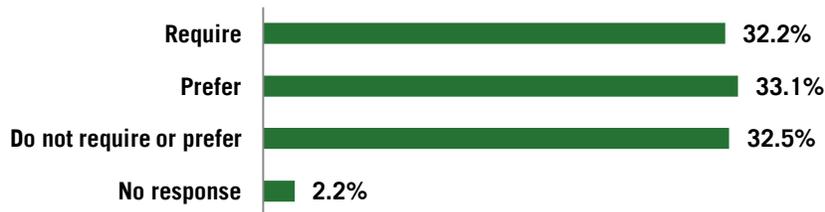
For each of the 11 occupations in this study, the percent of employers that require previous experience vary by occupation; however, most employers expect job applicants for traditional trade occupations such as electricians and plumbers to have prior work experience (Figure 13).

Figure 13: Percent of Employers that Require Previous Job Experience by Occupations



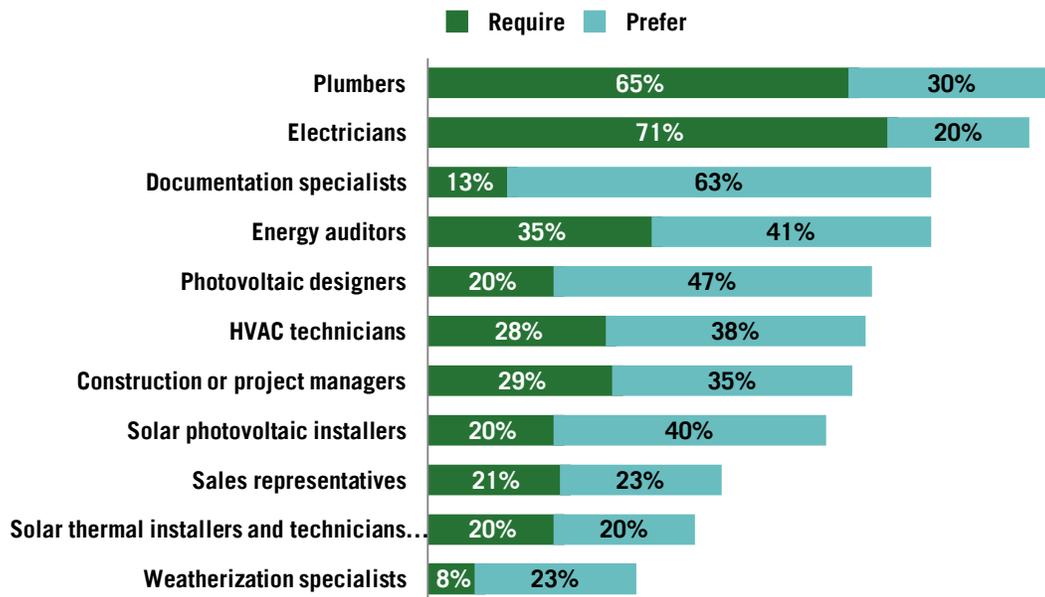
Another way to demonstrate technical proficiency is by obtaining a professional license or certification. While the type of licensure or certification is specific to each occupation, 32.2 percent of employers reported, overall, that they were required for the 11 occupations and 33.1 percent of employers reported that they were preferred (Figure 14).

Figure 14: Percent of Employers that Require or Prefer Licenses or Certifications for All Occupations



For specific occupations, the largest percent of respondents that require or prefer licensure were those who employed plumbers. However, most employers do require a license for electricians (Figure 15).

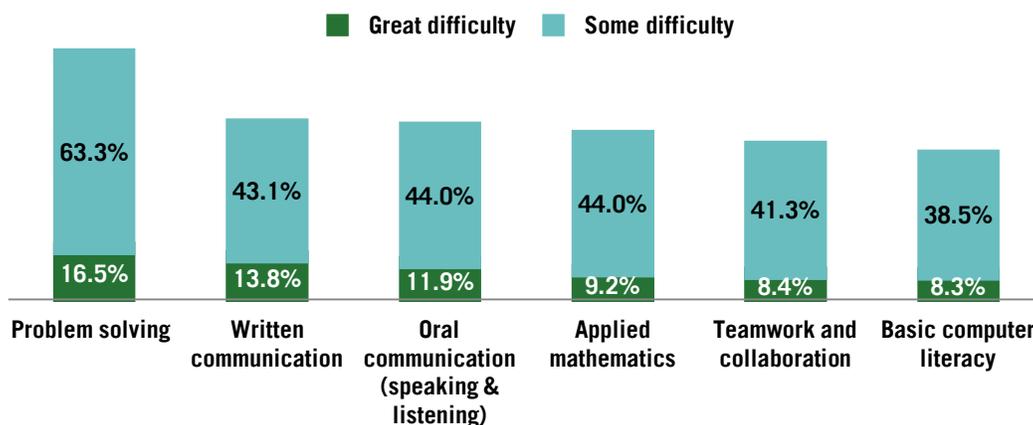
Figure 15: Percent of Employers that Require or Prefer Licenses or Certifications by Occupation



In short, while 70 percent of employers require electricians to have previous job experience and 71 percent require licensure, employers still have very little difficulty in filling that position. In other words, a job seeker vying for these positions should be aware of not only the rigorous requirements that employers have in filling these positions, but also that the labor market is very competitive with employers.

In addition to required experience, technical skills and licensures, candidates for Clean Energy jobs can differentiate themselves in the competitive labor market by demonstrating possession of non-technical or soft skills that employers find valuable. While most employers did not have difficulty in finding technically-skilled job applicants, they did report difficulty in finding applicants with soft skills, particularly problem-solving and critical thinking skills (Figure 16).

Figure 16: Percent of Employers with Difficulty in Finding Qualified Applicants with Soft Skills



The importance of soft or non-technical skills must be emphasized for job seekers in the Clean Energy sector. In executive interviews, employers reported less need for skills specific to the position and placed greater importance on flexibility across job types, ability to transfer skills to different jobs and aptitude to learn new skills quickly.

TRAINING, EDUCATION AND GAP ANALYSIS

In addition to reviewing employer demand, this study provides an analysis of the region's training programs and their supply of trainees to fill Clean Energy job openings. Analyzing employer demand and trained worker supply identifies potential job gaps within the sector. A gap is created when the number of qualified, trained workers produced by the region's educational institutions does not match the number of available job openings. These are potential gaps that can be filled with workforce development programs.

In order to determine Clean Energy worker supply in San Diego, this report includes data from IPEDS, California Community College Chancellor's Office Data Mart, local course catalogs, online searches and a training provider survey. Table 2 demonstrates the number of programs, institutions and program completions based on these data sets. The supply of qualified workers per occupation is based on the number of people who successfully complete programs related to the occupation. Analyzing training program data helps determine the number of potential qualified workers; however, these programs are not developed specifically for the 11 occupations. For instance, some electrical programs include solar photovoltaic installation modules while others do not. As a result, the supply data may be overestimated and should be used as a guide rather than the final determination of supply gaps in the San Diego region. For more details on the list of training providers and research methodology, please see Appendix D and Appendix E, respectively.

Table 2: Number of Educational and Training Programs by Institutions, Program Completions and Occupations

Occupation	# of Programs	# of Institutions	# of Program Completions
Construction or project managers	15	9	42
HVAC technicians	13	6	381
Electricians	13	3	456
Photovoltaic installers	9	5	63
Sales representatives	9	5	53
Plumbers	9	3	360
Energy auditors	5	3	0
Photovoltaic designers	4	2	63
Solar water heater installers	0	0	0
Documentation specialists	0	0	0
Weatherization specialists	0	0	0

In comparing the number of job openings for positions requiring a bachelor's degree or higher with the number of completions, there is a significant number of occupations that do not have enough worker supply to meet employer demand (Table 3). Job gaps, indicated in red in the table, imply that there is a shortage of workers for jobs that employers typically require a bachelor's degree for. This stresses the importance of continuing education for job seekers to obtain new and replacement jobs.

Table 3: Demand, Supply and Gaps for Occupations Requiring Bachelor's Degrees

Occupation	Demand ¹³	Supply ¹⁴	Oversupply/ Undersupply
Sales representatives	583	0	-583
Construction or project managers	759	42	-717
Energy auditors	43	20	-23
Photovoltaic installers	39	0	-39
Photovoltaic designers	24	0	-24
HVAC technicians	14	0	-14
Plumbers	9	0	-9
Documentation specialists	6	0	-6
Electricians	2	0	-2
Solar water heater installers	0	0	0
Weatherization specialists	0	0	0
Total Demand, Supply and Gaps	1479	62	-1417

For employers that require a minimum of an associate degree for these positions, all occupations except photovoltaic designers, HVAC technicians, plumbers and electricians have a supply gap (Table 4). Despite this, employer demand for workers with at least an associate degree is greater across all occupations than demand for bachelor's degrees or higher. This indicates that there are significant work opportunities in all occupations for trainees who obtain certificates or two-year degrees.

Table 4: Demand, Supply and Gaps for Occupations Requiring Associate Degrees or Less

Occupation	Demand ¹⁵	Supply ¹⁶	Oversupply/ Undersupply
Construction or project managers	379	0	-379
Sales representatives	411	53	-358
Photovoltaic installers	273	63	-210
Energy auditors	115	20	-95
Weatherization specialists	19	0	-19
Documentation specialists	11	0	-11
Solar water heater installers	8	0	-8
Photovoltaic designers	29	63	34
HVAC technicians	193	381	188
Plumbers	90	360	270
Electricians	8	456	448
Total Demand, Supply and Gaps	1536	1396	-140

Given that there are supply gaps for construction and project managers, solar photovoltaic installers, sales representatives and energy auditors, there is opportunity for expanded program offerings at two-year and four-year institutions.

¹³ Demand is based on the number of job openings (new and replacement) that employers requiring at least a bachelor's degree expect to be available between 2014 and 2015.

¹⁴ Supply is based on the number of people who successfully complete bachelor degree programs related to the occupation.

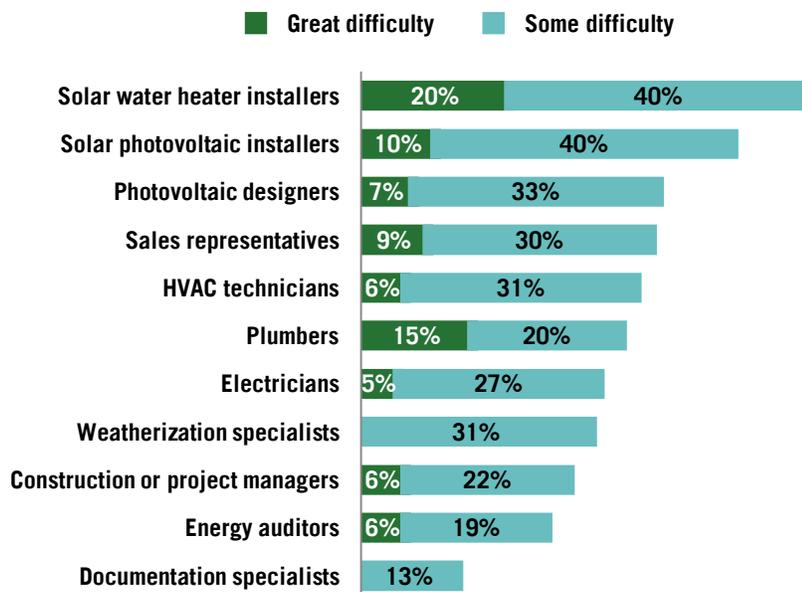
¹⁵ Demand is based on the number of job openings (new and replacement) that employers requiring an associate degree or less expect to be available between 2014 and 2015.

¹⁶ Supply is based on the number of people who successfully complete associate degree programs related to the occupation.

In addition to identifying job gaps, analyzing employer difficulty in hiring for specific occupations helps determine potential skill gaps that need to be addressed by workforce training programs. If the region produces a surplus of candidates for a certain occupation, but employers still have difficulty filling those positions, then there is a potential skills gap in the programs. This issue needs to be addressed by updating educational and training program curriculum to meet employers' technical needs.

As previously reported, Clean Energy employers generally do not have difficulty finding qualified workers; however, employers did report difficulty in hiring for specific occupations (Figure 17). Employers have the greatest difficulty finding qualified applicants for occupations most related to the renewable energy subsector: solar water heater installers, solar photovoltaic installers and photovoltaic designers. These are occupations that have developed out of high demand for Clean Energy services and products.

Figure 17: Percent of Employers with Difficulty in Finding Qualified Applicants by Occupation



Based on supply gaps and difficulty hiring, solar photovoltaic installers appear to be an appropriate occupation for the workforce development system to focus training on. Not only is it one of the top five occupations with supply gaps, but 50 percent of employers also reported having difficulty filling this position. Another occupation to note is solar water heater installers. Although demand appears low, solar water heater installers have the highest percentage of employers (60 percent) reporting at least some difficulty in filling this position. This implies that solar water heater installers are highly-specialized positions and require skill sets that employers find difficult to obtain.

CONCLUSIONS AND RECOMMENDATIONS

The Clean Energy sector is a unique and emerging sector in San Diego County. To ensure that the needs of employers are met, educators, trainers and workforce development systems must work together to ensure a strong future workforce. Job seekers can also take matters into their own hands by acquiring skill sets and certifications that will make them competitive in the job market.

Job Seekers

With significant opportunities available for workers in the Clean Energy sector, job seekers should take advantage of the high demand but differentiate themselves from the crowd with skills and certifications.

Soft Skills

Employers across all sectors look for job candidates who possess strong soft skills. Specifically for the Clean Energy sector, employers are experiencing difficulties finding workers skilled in problem-solving, written and oral communication, applied mathematics, teamwork and collaboration, and basic computer literacy. Job seekers should focus on obtaining and improving these skills in order to be competitive in the workforce.

Experience

For Clean Energy trainees or job seekers, training should include experiential learning, apprenticeship, internship or other on-the-job training. Employers reported requiring electricians to have experience, licensure and appropriate related training. However, while electricians are one of the most difficult occupations for job seekers to become qualified for, employers do not appear to have significant difficulty finding qualified applicants. For competitive occupations such as electricians, job seekers can differentiate themselves by having extensive hands-on experience.

Professional Licensure

For job seekers to become more competitive in the Clean Energy sector, they should obtain professional licensure to show employers the skills that they possess. There are a variety of resources available to job seekers for obtaining professional licensure:

- Energy auditors may obtain professional certification in areas such as building performance (building analysis, envelope professional, as well as heating, ventilation, and air conditioning installation, operation, and maintenance) and advanced home energy (energy auditing, retrofit installation, quality control inspection) through Building Performance Institute, Inc. (BPI).¹⁷
- Solar employees can obtain professional licensure in photovoltaic and solar water heating sales or installation through the North American Board of Certified Energy Practitioners (NABCEP).¹⁸ NABCEP also offers certifications for small wind installation.
- California's Department of Industrial Relations offers professional certification programs for electricians, which is required by the state for any employee working as an electrician.
- While plumbing licensure is less important to employers than electrical licensure, the California Apprenticeship Coordinators Association offers a five-year apprenticeship program, providing 9,000 hours of on-the-job training and 1,080 class hours. Additionally, the Contractors State License Board offers a licensing program for anyone in the construction industry, including plumbing.

Education Providers and Workforce Development

The size and expected growth of San Diego County's Clean Energy sector makes it an area worth examining. However with limited time and resources, the workforce development system should focus on the Energy Efficiency subsector, specifically on installation positions in San Diego County. While the sector as a whole has little difficulty finding qualified workers, specific occupations struggle to find acceptable job candidates.

Differentiation

With many construction workers still unemployed since the Great Recession, the labor market for Clean Energy occupations, particularly those that are trade-related, is very competitive. Training providers need to train beyond the minimum requirements of these occupations and ensure that their trainees have

¹⁷ BPI develops energy efficiency standards as well as professional certifications for individuals and companies

¹⁸ NABCEP is a North American certification organization for individuals seeking professional certification in a variety of solar industry professions.

sufficient “differentiators” in their skill sets to increase their chances of securing a job when training is complete. While employers may specify particular skill sets or certifications as “preferred” rather than “required,” job applicants with preferred skills will be more marketable to employers than applicants without them.

Adaptable/Transferable Skills

Educators should focus instruction on skills that are easily transferable among Clean Energy occupations. Being adaptable in the work environment makes job candidates more appealing to employers. This can include knowledge of materials used in Clean Energy installation and construction, as well as knowledge of policies and regulations in the sector. The latter is especially important for sales representatives who should be well versed in tax credits and governmental regulations on energy resources. Employers look for candidates with strong occupation-specific skills, who can also transfer that knowledge to other projects.

Long-term unemployed workers have the requisite work experience, but may lack new Clean Energy-specific skills and employer expectations. Upgrading these workers’ skills will help increase their chances of getting hired.

Soft Skills

While technical skills may be paramount to employers, non-technical skills such as communication and problem solving can be important in distinguishing candidates in a competitive environment. Focusing on these skills earlier in the education pathway (starting in the K-12 system) can help mitigate the lack of non-technical or soft skills in job applicants.

Non-technical skills are important to employers and can be developed through training. One method for improving communication and problem solving skills in the classroom is through role-play. Simulating different scenarios can help students hone their job skills, give them important talking points during job interviews, and make them more effective employees.

Given the low levels of reported hiring difficulties, these programs must ensure they offer trainees demonstrably superior skills to increase their employment chances. Therefore, while program expansion may not currently be warranted, there is a clear need for programs to provide training that reflects changing technologies and associated skill sets. Due to the limited need for programmatic expansion, educators should consider this a prime time to collaborate with institutions across the region to provide clear and consistent career pathways for students to effectively enter the workforce.

“Good Fit” Component

Nearly half of the employers in this sector have fewer than five employees. For job seekers, this means that “fit” will matter a great deal to employers. Because they make up a large portion of the overall workforce at a small business, each new worker can change the work environment and culture dramatically. As a result, decision-makers will want to ensure that personalities mix well. Poor hiring decisions may severely impact a small company as it becomes impossible to overlook inadequate or unsatisfactory employees in smaller firms.

Employers also noted the importance of workers who demonstrate hard work, good communication, and excellent teamwork skills. These microbusinesses need to be able to react to markets quickly to stay alive, and expect that their workers will try new tasks and be willing to learn new things.

Apprenticeships

On-the-job training and apprenticeship programs are important vehicles for providing the necessary work experience required by employers. While apprenticeships are expensive, employers emphasize the importance of exposure to a work environment as an important precursor to attaining a job.

Knowing the importance of apprenticeships in today’s job market, President Obama has designated particular attention and legislative action to the creation of apprenticeships and training programs. The

President's American Apprenticeship Initiative amounts to a \$600 million investment in partnerships dedicated to developing relevant training programs for current industry needs. Jobs for the Future, a nonprofit organization, is currently working on their GreenWays Initiative, which trains adults in sectors of the green economy such as manufacturing, construction of energy efficient buildings, urban forestry, renewable technologies, and transportation. However, many firms and employers are unaware of such funding programs, making it imperative that the workforce development system highlights these prospects.

Job Placement

Placement is a significant challenge. Many training programs operate under the assumption that large firms will hire cohorts of workers and that connecting to a few local businesses is all that is required to successfully place candidates. In today's economy, small firms are less likely to hire such large cohorts of similarly-trained workers. These firms often want someone with a specific technical skill set to round out their teams. At the same time, they may only hire once every several years, which suggests that job developers and business service representatives should reach out to small businesses to build relationships in time for the next hiring phase.

The growth of small businesses in the subsector and the very specialized needs of employers, together with an abundant supply of experienced workers all contribute to placement challenges within training programs. Throughout the country, the most successful training programs in terms of placement are those that develop strong, ongoing relationships with employers in their region. This type of relationship management cannot be an afterthought and is not a part time job, which means that training providers and placement agencies need to allocate more time and resources to business development in order to improve the chances of their trainees obtaining jobs.

Investment in Technology

Rather than expanding existing programs, Clean Energy training programs should invest in technology to maintain the changing skill sets within this sector. With 65 percent of employers having no difficulty in hiring quality workers, the workforce development system will have to focus on technology to generate the technical skills that differentiate their trainees from the rest of the competition.

APPENDIX A: OCCUPATIONAL PROFILES

Sources: U.S. Bureau of Labor Statistics, Economic Modeling Specialists, International and O*NET OnLine.

Construction Managers

Standard Occupational Code: 11-9021

Other Job Title(s): Construction Manager, Project Manager, Construction Superintendent, General Contractor

Description: Plan, direct, or coordinate, usually through subordinate supervisory personnel, activities concerned with the construction and maintenance of structures, facilities and systems. Participate in the conceptual development of a construction project and oversee its organization, scheduling, budgeting and implementation. Includes managers in specialized construction fields, such as carpentry or plumbing.

Fast Facts			
Current Employment (2013)		3,907	
Projected Employment (2018)		4,012	
Growth Rate (2013-2018)		3%	
Average Annual Openings (2013-2018)		115	
Hourly Pay Range		\$28.82 Entry-level	\$33.49 Median
Typical Educational Attainment		Bachelor's degree	

Top Skills and Competencies

Technical	Non-Technical
Construction management	Project management
Scheduling	Communication
Contract management	Planning
Inspection	Microsoft Excel
Estimating	Leadership

Occupational Tasks

- Confer with supervisory personnel, owners, contractors or design professionals to discuss and resolve matters, such as work procedures, complaints or construction problems.
- Plan, schedule or coordinate construction project activities to meet deadlines.
- Prepare and submit budget estimates, progress reports or cost tracking reports.
- Inspect or review projects to monitor compliance with building and safety codes or other regulations.
- Inspect or review projects to monitor compliance with environmental regulations.
- Plan, organize or direct activities concerned with the construction or maintenance of structures, facilities or systems.
- Study job specifications to determine appropriate construction methods.
- Investigate damage, accidents or delays at construction sites to ensure that proper construction procedures are being followed.



Business Operations Specialists, All Other (Energy Auditors)

Standard Occupational Code: 13-1199 (O*NET OnLine Code: 13-1199.01)¹⁹

Other Job Title(s): Energy Auditor, Energy Rater, Energy Consultant, Home Performance Consultant, Building Performance Consultant, Home Energy Rater

Description: Conduct energy audits of buildings, building systems or process systems. May also conduct investment grade audits of buildings or systems.

Fast Facts			
Current Employment (2013)		12,631	
Projected Employment (2018)		13,417	
Growth Rate (2013-2018)		6%	
Average Annual Openings (2013-2018)		337	
Hourly Pay Range		\$25.06 Entry-level	\$33.70 Median
Typical Educational Attainment		High School diploma or equivalent	

Top Skills and Competencies

Technical	Non-Technical
Energy audits	Communication
Solar panels	Multi-tasking
Assessment data	Team work
Energy consulting	Detail-oriented
Sales	Customer service

Occupational Tasks

- Identify and prioritize energy saving measures.
- Prepare audit reports containing energy analysis results or recommendations for energy cost savings.
- Collect and analyze field data related to energy usage.
- Inspect or evaluate building envelopes, mechanical systems, electrical systems or process systems to determine the energy consumption of each system.
- Perform tests such as blower-door tests to locate air leaks.
- Educate customers on energy efficiency or answer questions on topics such as the costs of running household appliances or the selection of energy efficient appliances.
- Calculate potential for energy savings.
- Prepare job specification sheets for home energy improvements, such as attic insulation, window retrofits or heating system upgrades.
- Recommend energy efficient technologies or alternate energy sources.
- Quantify energy consumption to establish baselines for energy use or need.

¹⁹ Some Standard Occupational Codes (SOC) do not exactly match the general occupational titles if the jobs are emerging or relative new. O*NET OnLine may have a more detailed code than the SOC code to identify new skills and responsibilities for the emerging occupation. For energy auditors, the O*NET OnLine code is 13-1199.01.

Engineers, All Other (Photovoltaic Designers)

Standard Occupational Code: 17-2199 (O*NET OnLine Code: 17-2199.11 – Solar Energy Systems Engineer)

Other Job Title(s): Photovoltaic Designer, Documentation Specialist

Description: Responsible for designing code-compliant solar photovoltaic systems for residential clients. The position relies heavily on structural, mechanical, and electrical engineering concepts and calculations, with a focus on efficiency and automation. The ideal candidate will be able to manage a large volume of projects while demonstrating excellent communication.

Fast Facts ²⁰			
Current Employment (2013)		3,042	
Projected Employment (2018)		3,276	
Growth Rate (2013-2018)		7.7%	
Average Annual Openings (2013-2018)		119	
Hourly Pay Range		\$31.55 Entry-level	\$46.36 Median
Typical Educational Attainment		Bachelor's degree	

Top Skills and Competencies

Technical	Non-Technical
Solar advisor model	Communication
Computer-aided design (CAD) software	Writing
PV optics	Quality Assurance and Control
Simple Model of the Atmospheric Radiative Transfer of Sunshine SMARTS	Organization
Data base user interface and query software	Planning

Occupational Tasks

- Conduct engineering site audits to collect structural, electrical and related site information for use in the design of residential or commercial solar power systems
- Design or coordinate design of photovoltaic (PV) or solar thermal systems, including system components, for residential and commercial buildings.
- Create checklists for review or inspection of completed solar installation projects.
- Create electrical single-line diagrams, panel schedules or connection diagrams for solar electric systems, using CAD software.
- Create plans for solar energy system development, monitoring and evaluation activities.
- Develop design specifications and functional requirements for residential, commercial or industrial solar energy systems or components.
- Perform computer simulation of solar photovoltaic (PV) generation system performance or energy production to optimize efficiency.

²⁰ Numbers based on SOC code 17-2199, which encompasses all other engineers, including solar energy systems engineers, which is similar to the occupational title, photovoltaic designer.



Sales Representatives, Wholesale and Manufacturing

Standard Occupational Code: 41-4010

Other Job Title(s): Sales Representative, Account Manager, Sales Specialist, Sales Executive, Inside Sales Representative, Outside Sales Representative

Description: Sell goods for wholesalers or manufacturers where technical or scientific knowledge is required in such areas as biology, engineering, chemistry and electronics, normally obtained from at least 2 years of post-secondary education.

Fast Facts			
Current Employment (2013)		13,477	
Projected Employment (2018)		14,789	
Growth Rate (2013-2018)		10%	
Average Annual Openings (2013-2018)		593	
Hourly Pay Range		\$19.85 Entry-level	\$27.21 Median \$38.09 Experienced
Typical Educational Attainment		High School diploma or equivalent	

Top Skills and Competencies

Technical	Non-Technical
Sales	Communication
Outside Sales	Organization
Business Development	Customer Service
Inside Sales	Microsoft Office
Sales Management	Writing

Occupational Tasks

- 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, availability or credit terms.
- Quote prices, credit terms or other bid specifications.
- Emphasize product features based on analyses of customers' needs and on technical knowledge of product capabilities and limitations.
- Negotiate prices or terms of sales or 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 or marketing information.

Electricians

Standard Occupational Code: 47-2111

Other Job Title(s): Electrician, Journeyman Electrician, Solar Electrician, Commercial Electrician

Description: Install, maintain and repair electrical wiring, equipment, and fixtures. Ensure that work is in accordance with relevant codes. May install or service street lights, intercom systems or electrical control systems.

Fast Facts			
Current Employment (2013)		5,531	
Projected Employment (2018)		6,337	
Growth Rate (2013-2018)		15%	
Average Annual Openings (2013-2018)		276	
Hourly Pay Range		\$19.72 Entry-level	\$24.08 Median
Typical Educational Attainment		High School diploma or equivalent	

Top Skills and Competencies

Technical	Non-Technical
Electrical Work	Troubleshooting
Repair	Communication
Hand Tools	Organization
Electrical Systems	Preventative Maintenance
Wiring	Leadership

Occupational Tasks

- Plan layout and installation of electrical wiring, equipment or fixtures, based on job specifications and local codes.
- Connect wires to circuit breakers, transformers or other components.
- Test electrical systems or continuity of circuits in electrical wiring, equipment or fixtures, using testing devices, such as ohmmeters, voltmeters or oscilloscopes, to ensure compatibility and safety of system.
- Use a variety of tools or equipment, such as power construction equipment, measuring devices, power tools and testing equipment, such as oscilloscopes, ammeters or test lamps.
- Inspect electrical systems, equipment, or components to identify hazards, defects or the need for adjustment or repair and to ensure compliance with codes.
- Prepare sketches or follow blueprints to determine the location of wiring or equipment and to ensure conformance to building and safety codes.
- Diagnose malfunctioning systems, apparatus or components, using test equipment and hand tools to locate the cause of a breakdown and correct the problem.
- Work from ladders, scaffolds, or roofs to install, maintain or repair electrical wiring, equipment or fixtures.
- Advise management on whether continued operation of equipment could be hazardous.
- Maintain current electrician's license or identification card to meet governmental regulations.



Plumbers, Pipefitters and Steamfitters

Standard Occupational Code: 47-2152

Other Job Title(s): Plumber, Pipefitter

Description: Lay out, assemble, install or maintain pipe systems, pipe supports, or related hydraulic or pneumatic equipment for steam, hot water, heating, cooling, lubricating, sprinkling or industrial production or processing systems.

Fast Facts			
Current Employment (2013)		4,577	
Projected Employment (2018)		5,035	
Growth Rate (2013-2018)		10%	
Average Annual Openings (2013-2018)		153	
Hourly Pay Range		\$18.40 Entry-level	\$24.39 Median
Typical Educational Attainment		High School diploma or equivalent	

Top Skills and Competencies

Technical	Non-Technical
Plumbing	Customer Service
Repair	Troubleshooting
Pipe Fitting	English
Blueprints	Communication
Hand Tools	Detail-oriented

Occupational Tasks

- Assemble pipe sections, tubing or fittings using couplings, clamps, screws, bolts, cement, plastic solvent, caulking or soldering, brazing or welding equipment.
- Install pipe assemblies, fittings, valves, appliances such as dishwashers or water heaters or fixtures such as sinks or toilets, using hand or power tools.
- Keep records of work assignments.
- Fill pipes or plumbing fixtures with water or air and observe pressure gauges to detect and locate leaks.
- Direct helpers engaged in pipe cutting, preassembly or installation of plumbing systems or components.
- Maintain or repair plumbing by replacing defective washers, replacing or mending broken pipes or opening clogged drains.
- Locate and mark the position of pipe installations, connections, passage holes or fixtures in structures, using measuring instruments such as rulers or levels.
- Measure, cut, thread, or bend pipe to required angle, using hand or power tools or machines such as pipe cutters, pipe-threading machines or pipe-bending machines.
- Review blueprints, building codes, or specifications to determine work details or procedures.
- Anchor steel supports from ceiling joists to hold pipes in place.

Solar Photovoltaic Installers

Standard Occupational Code: 47-2231

Other Job Title(s): Solar and Thermal Installer, Solar and Thermal Technician, Solar Photovoltaic Installer, Solar Installer, Solar Installer Technician

Description: Assemble, install or maintain solar photovoltaic (PV) systems on roofs or other structures in compliance with site assessment and schematics. May include measuring, cutting, assembling, and bolting structural framing and solar modules. May perform minor electrical work such as current checks.

Fast Facts			
Current Employment (2013)		169	
Projected Employment (2018)		193	
Growth Rate (2013-2018)		14%	
Average Annual Openings (2013-2018)		8	
Hourly Pay Range		\$16.19 Entry-level	\$19.48 Median \$25.56 Experienced
Typical Educational Attainment		High School diploma or equivalent	

Top Skills and Competencies

Technical	Non-Technical
Solar Installation	Communication
Photovoltaic (PV) Systems	Customer Service
Roofing	Writing
Solar Panels	Positive Disposition
Inverters	Organization

Occupational Tasks

- Install photovoltaic (PV) systems in accordance with codes and standards using drawings, schematics and instructions.
- Assemble solar modules, panels or support structures, as specified.
- Apply weather sealing to array, building or support mechanisms.
- Determine appropriate sizes, ratings, and locations for all system overcurrent devices, disconnect devices, grounding equipment and surge suppression equipment.
- Install module array interconnect wiring, implementing measures to disable arrays during installation.
- Identify methods for laying out, orienting, and mounting modules or arrays to ensure efficient installation, electrical configuration or system maintenance.
- Identify electrical, environmental, and safety hazards associated with photovoltaic (PV) installations.
- Examine designs to determine current requirements for all parts of the photovoltaic (PV) system electrical circuit.
- Check electrical installation for proper wiring, polarity, grounding or integrity of terminations.
- Test operating voltages to ensure operation within acceptable limits for power conditioning equipment, such as inverters and controllers.



Construction and Related Workers (Weatherization Specialists)

Standard Occupational Code: 47-4099

Other Job Title(s): Weatherization Specialist (O*NET OnLine Code: Weatherization Installers and Technicians)

Description: Perform a variety of activities to weatherize homes and make them more energy efficient. Duties include repairing windows, insulating ducts and performing heating, ventilating and air-conditioning (HVAC) work. May perform energy audits and advise clients on energy conservation measures.

Fast Facts			
Current Employment (2013)		299	
Projected Employment (2018)		318	
Growth Rate (2013-2018)		6%	
Average Annual Openings (2013-2018)		10	
Hourly Pay Range		\$12.60 Entry-level	\$15.56 Median \$18.90 Experienced
Typical Educational Attainment		High School diploma or equivalent	

Top Skills and Competencies

Technical	Non-Technical
Weatherization	Microsoft Windows
Insulation	Communication
Switches	Writing
Interior Design	Organization
Extensible Markup Language (XML)	Multi-tasking

Occupational Tasks

- Test and diagnose airflow systems, using furnace efficiency analysis equipment.
- Inspect buildings to identify required weatherization measures, including repair work, modification or replacement.
- Maintain activity logs, financial transaction logs or other records of weatherization work performed.
- Apply insulation materials such as loose, blanket, board and foam insulation to attics, crawl spaces, basements or walls.
- Prepare or assist in the preparation of bids, contracts or written reports related to weatherization work.
- Install and seal air ducts, combustion air openings or ventilation openings to improve heating and cooling efficiency.
- Recommend weatherization techniques to clients in accordance with needs and applicable energy regulations, codes, policies or statutes.
- Explain energy conservation measures, such as the use of low flow showerheads and energy efficient lighting.
- Explain recommendations, policies, procedures, requirements or other related information to residents or building owners.
- Clean and maintain tools and equipment.

Heating, Air Conditioning, and Refrigeration Mechanics and Installers

Standard Occupational Code: 49-9021

Other Job Title(s): HVAC Technician, HVAC Service Technician, HVAC Installer, HVAC Mechanic

Description: Install or repair heating, central air conditioning or refrigeration systems, including oil burners, hot-air furnaces and heating stoves.

Fast Facts			
Current Employment (2013)		1,924	
Projected Employment (2018)		2,212	
Growth Rate (2013-2018)		15%	
Average Annual Openings (2013-2018)		112	
Hourly Pay Range		\$19.26 Entry-level	\$23.00 Median
Typical Educational Attainment		Postsecondary non-degree award (Certificate)	
		\$25.95 Experienced	

Top Skills and Competencies

Technical	Non-Technical
HVAC	Troubleshooting
Repair	Preventative maintenance
Blueprints	Writing
Power tools	Customer service
Hand tools	Communication

Occupational Tasks

- Test electrical circuits or components for continuity, using electrical test equipment.
- Test pipe or tubing joints or connections for leaks, using pressure gauge or soap-and-water solution.
- Join pipes or tubing to equipment and to fuel, water or refrigerant source, to form complete circuit.
- Reassemble and test equipment following repairs.
- Repair or replace defective equipment, components or wiring.
- Lay out and connect electrical wiring between controls and equipment, according to wiring diagrams, using electrician's hand tools.
- Obtain and maintain required certifications.
- Install, connect and adjust thermostats, humidistats and timers, using hand tools.
- Comply with all applicable standards, policies and procedures, including safety procedures and the maintenance of a clean work area.
- Inspect and test systems to verify system compliance with plans and specifications or to detect and locate malfunctions.

APPENDIX B: DEFINITIONS

Clean Energy North American Industry Classification System (NAICS) Codes

NAICS Code	Industry Description
221118	Other Electric Power Generation
236115	New Single-Family Housing Construction (except Operative Builders)
236117	New Housing Operative Builders
236118	Residential Remodelers
236210	Industrial Building Construction
236220	Commercial and Institutional Building Construction
237130	Power and Communication Line and Related Structures Construction
237210	Land Subdivision
237990	Other Heavy and Civil Engineering Construction
238150	Glass and Glazing Contractors
238160	Roofing Contractors
238170	Sliding Contractors
238190	Other Foundation, Structure, and Building Exterior Contractors
238210	Electrical Contractors and Other Wiring Installation Contractors
238220	Plumbing, Heating and Air Conditioning Contractors
238290	Other Building Equipment Contractors
238310	Drywall and Insulation Contractors
238990	All Other Specialty Trade Contractors
423720	Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers
423730	Warm Air Heating and Air-Conditioning Equipment and Supplies Merchant Wholesalers
444190	Other Building Materials Dealers
531311	Residential Property Managers
531312	Nonresidential Property Managers
541310	Architectural Services
541320	Landscape Architectural Services
541330	Engineering Services
541370	Surveying and Mapping (except Geophysical) Services
541410	Interior Design Services
541420	Industrial Design Services
541614	Process, Physical Distribution and Logistics Consulting Services
541690	Other Scientific and Technical Consulting Services
541711	Research and Development in Biotechnology

Clean Energy Standard Occupational Classification (SOC) Codes

SOC	Description
11-9021	Construction Managers
13-1199	Business Operations Specialists, All Other (Energy Auditors)
17-2199	Engineers, All Other (Photovoltaic designers)
41-4010	Sales Representatives
47-2111	Electricians
47-2152	Plumbers, Pipefitters and Steamfitters
47-2231	Solar Photovoltaic Installers
47-4099	Construction and Related Workers, All Other (Weatherization Specialists)
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers

APPENDIX C: ESTABLISHMENTS AND EMPLOYMENT BY INDUSTRY

Industry Description	Number of Establishments (2013)	Number of Jobs (2013)
Other Electric Power Generation	14	156
New Single-Family Housing Construction (except Operative Builders)	728	4,435
New Housing Operative Builders	7	246
Residential Remodelers	690	7,221
Industrial Building Construction	18	476
Commercial and Institutional Building Construction	347	6,838
Power and Communication Line and Related Structures Construction	34	1,030
Land Subdivision	113	773
Other Heavy and Civil Engineering Construction	47	923
Glass and Glazing Contractors	72	1,061
Roofing Contractors	189	2,061
Sliding Contractors	21	198
Other Foundation, Structure, and Building Exterior Contractors	44	538
Electrical Contractors and Other Wiring Installation Contractors	632	9,663
Plumbing, Heating and Air Conditioning Contractors	685	9,446
Other Building Equipment Contractors	44	682
Drywall and Insulation Contractors	217	4,334
All Other Specialty Trade Contractors	323	5,932
Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers	52	1,313
Warm Air Heating and Air-Conditioning Equipment and Supplies Merchant Wholesalers	38	294
Other Building Materials Dealers	214	2,041
Residential Property Managers	840	7,431
Nonresidential Property Managers	271	2,303
Architectural Services	289	2,249
Engineering Services	829	14,046
Surveying and Mapping (except Geophysical) Services	37	234
Interior Design Services	151	1,455
Industrial Design Services	33	383
Process, Physical Distribution and Logistics Consulting Services	95	1,015
Other Scientific and Technical Consulting Services	2,036	11,404
Research and Development in Biotechnology	275	9,784
Landscaping Services	769	15,759
Total	10,151	125,724

APPENDIX D: SAN DIEGO EDUCATION AND TRAINING PROVIDERS

Training Provider/Institution	Degree Description	Type of Program	Annual Awards (2012-13)
Sales Representative			
CleanEdison	Solar Sales Mastery Course	Training Course	
CleanEdison	Solar PV Design & Sales	Training Course	
Contractors State License Schools	Solar PV Technical Course (Designed for sales professionals, technicians and managers)	Training Course	
Everblue	Solar Contractor Series	Training Course	
Grossmont	Marketing and Distribution	Certificate Award, Associate Award	1
MCCAIE Alternative Energy	Solar Business Strategies and Opportunities	Training Course	
MiraCosta	Marketing and Distribution	Certificate Award, Associate Award	6
Palomar	Sales and Salesmanship	Certificate Award	0
San Diego Mesa	Marketing and Distribution	Certificate Award, Associate Award	0
Solar Training Institute	Solar Sales and Estimation	Training Course	
Southwestern	Marketing and Distribution	Associate Award	3
SunMaxx Solar	Solar Thermal Education & Training	Training Course	
Photovoltaic Designer			
Cuyamaca College	Solar Photovoltaic Installation	Non-Credit (80 Hour) Class	
Cuyamaca College	Solar Thermal Systems	Non-Credit (80 Hour) Class	
Imperial	Electronics and Electric Technology	Certificate Award, Associate Award	21
MiraCosta	Green Building Pre-Apprenticeship and Retrofit Training Program	Non-Credit (120 Hour) Class	
MiraCosta	Solar PV Training	Non-Credit (50 Hour) Class	
San Diego City	Electronics and Electric Technology	Certificate Award	8
Solar Training Institute	PV Design and Installation	5-Day Accelerated Hands-On Course	

Solar Training Institute	Advanced PV Solar Design	3-Day Training Course	
Photovoltaic Installer			
8minuteenergy Renewables LCC	Solar Vocational and Internship Program	Vocational and Internship Program	
CET	Green Building Construction Skills	Training Course	
CleanEdison	Entry Level Solar PV Training	Training Course	
CleanEdison	Solar PV Mastery Training	Training Course	
Cuyamaca College	Solar Photovoltaic Installation	Non-Credit (80 Hour) Class	
Cuyamaca College	Solar Thermal Systems	Non-Credit (80 Hour) Class	
Everblue	Solar PV Installer	Advanced 40-Hour Hands-On Course	
Imperial	Electronics and Electric Technology	Certificate Award, Associate Award	21
MCCAIE Alternative Energy	Entry Level Solar PV Training	One Week 40 Hour Course	
MiraCosta	Green Building Pre-Apprenticeship and Retrofit Training Program	Non-Credit (120 Hour) Class	
MiraCosta	Solar PV Training	Non-Credit (50 Hour) Class	
ReneSola	Installer Training	Training Course	
San Diego City	Electronics and Electric Technology	Certificate Award	8
San Diego City College	Training Program in Green Building Technology	5-Week Program	
Solar Training Institute	PV Design and Installation	5-Day Accelerated Hands-On Course	
Solar Training Institute	Advanced PV Solar Design	3-Day Training Course	
SunMaxx Solar	Solar Thermal Education & Training	Training Course	
Veterans Village of San Diego	Green Jobs Training	Vocational Program	
Battery Installation Specialist			
Imperial	Industrial Electronics	Certificate Award	3
Training Provider/Institution	Degree Description	Type of Program	Annual Awards

				(2012-13)
Plumber				
San Diego Adult	Plumbing, Pipefitting and Steamfitting	Noncredit Award	93	
San Diego City	Plumbing, Pipefitting and Steamfitting	Certificate Award, Associate Award	19	
San Diego Continuing Education	Plumbing Technology/Plumber	Certificate Award	0	
Construction Equipment Operator				
CET El Centro	Building Construction Technology	Certificate Award	54	
CET San Diego	Building Construction Technology	Certificate Award	79	
Imperial Valley College	Building Construction Technology	Certificate Award, Other	16	
HVAC Technician				
Associated Builders and Contractors	Heating, Ventilation and Air Conditioning	Apprenticeship		
Imperial	Environmental Control Technology	Certificate Award	8	
Kaplan College	Heating, Ventilation, Air Conditioning, and Refrigeration	Training Course		
San Diego & Imperial Counties Pipe Trades J.A.C.	Air Conditioning and Refrigeration Mechanic	Apprenticeship		
San Diego City	Environmental Control Technology	Certificate Award, Associate Award	40	
San Diego City College	Training Program in Green Building Technology	5-Week Program		
San Diego Continuing Education	Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technology/Technician	Associate Award	0	
SD ROP	Construction General Introduction	Training Course		
SD ROP	Construction, General	Training Course		
Southwestern	Sustainable Energy Studies	Certificate Award	0	
Tillman Learning, LCC	Air Conditioning & Refrigeration Training	Training Course		
UC San Diego Extension	HVAC Systems Design and Control	Certificate Award	0	
Veterans Village of San Diego	Green Jobs Training	Vocational Program		
Training Provider/Institution	Degree Description	Type of Program		Annual Awards (2012-13)

Construction or Project Manager			
ITT Technical Institute	Construction Management	Bachelor Award	1
Associated General Contractors of America San Diego Chapter, Inc.	Construction Project Management Certificate Course	26-Week Program	
CET EI Centro	Certification in Building / Property Maintenance and Management	Certificate Award	
Construction Management Association of America	San Diego Professional Construction Manager Course	Training Course	
Imperial Valley College	Project Management	Certificate Award, Associate Award	
ITT Technical Institute	Project Management and Administration, Construction Option and IT option (online program)	Bachelor Award	
ITT Technical Institute	Construction Technology (online program)	Associate Award	
National University	Construction Management	Bachelor Award	7
Newschool of Architecture and Design	Construction Management	Bachelor Award, Master Award	12
San Diego Mesa College	Building Construction Technology	Certificate Award, Associate Award	N
San Diego State University College of Extended Studies	Professional Certificate in Project Management	Certificate Award	
San Diego State University College of Extended Studies	Professional Certificate in Construction Supervisory Series (online)	Certificate Award	
San Diego State University College of Extended Studies	Professional Certificate in Green Energy Management Online	Certificate Award	
Southwestern	Construction Managers	Associate Award	
Turner Construction	The Turner School of Construction Management (Free course designed to help minority and women-owned enterprises)	Free Course	
UC San Diego Extension	Project Management	Certificate Award	
Electrician			
Palomar	Electrical	Certificate Award, Associate Award	95
San Diego City	Electrical	Certificate Award, Associate Award	10
Wind Turbine Technician			



Cal Apprenticeship	Solar Turbines Apprenticeship	Apprenticeship
Everblue	Basics of Wind	Training Course
MCCAIE Alternative Energy	Small Wind Generation Fundamentals	Training Course
San Diego Community College	Solar Turbines Course	4-Unit Course (300 Hours per Semester)
Construction Equipment Operators		
San Diego City College	Operating and Maintenance Engineers	4-Year Apprenticeship Program, Certificate Award, Associate Award
San Diego City College	Heavy Equipment Operator Apprenticeship	Apprenticeship
Weatherization Specialists		
Everblue	BPI Insulation and Air Sealing Technician (Weatherization Certification Course)	Training Course
Green Training USA	BPI RBE-ALCI Certification Advanced Whole-House Weatherization Installer Course & Exam	Training Course

APPENDIX E: METHODOLOGY

Employer Survey

The data in the report was derived from a comprehensive survey of business establishments in San Diego County. Surveys were administered online and over the phone to a list of known employers as well as a representative, clustered sample of companies from the North American Industry Classification System (NAICS) identified by the U.S. Bureau of Labor Statistics (BLS) and BW Research Partnership as being potentially related to the Clean Energy sector. The research methodology employed for this report has been used increasingly as a tool for measuring clean energy industry jobs and businesses in states such as Massachusetts, Illinois, Vermont, Missouri, and Iowa.

For this study, the research team placed 9,786 telephone calls and sent 307 emails to employers. The combined margin of error for the survey effort was approximately +/- 3.78 percent at a 95 percent confidence interval. The survey yielded 639 responses from employers in San Diego and Imperial Counties and averaged 12 minutes in length.

“Known Universe”

The “known universe” includes firms previously identified by researchers as clean energy companies. The combined database was developed from previous work and databases from BW Research Partnership. This list was also supplemented with industry lists that were publicly available or provided by research partners. After combining records and duplicate cleaning, the “known universe” of firms was estimated at 2,529 companies at the beginning of the research. Of the firms in the database, 90 completed the survey. The margin of error at a confidence level of 95 percent is approximately +/- 10.15 percent.

“Unknown Universe”

The “unknown universe” included firms not previously identified by researchers as clean energy companies. This database was drawn from BLS NAICS industries and InfoUSA businesses. 565 firms provided information as to whether they were involved in clean energy or not. The overall margin of error for the incidence rate analysis is estimated at approximately +/- 4.01 percent at a confidence level of 95 percent. Of the firms that provided information, 200 firms from the “unknown universe” identified as clean energy and completed the full survey.

Training Provider Survey

For the training provider portion of the survey, 77 emails were sent to contacts in San Diego County in order to determine clean energy programs offered in the region. From this, 13 contacts provided information on programs offered at their institution. This information was cross-referenced with and supplemented by program information pulled from Data Mart and the Integrated Postsecondary Education Data System (IPEDS).

Secondary Data Sources and Limitations

Secondary and literary research was conducted for the employer demand analysis or the projected employment growth of occupations and industries. Secondary data resources include BLS data through the Economic Modeling Specialists, International (EMSI) database program, Analyst.

Economic Modeling Specialists, International

EMSI industry data have various sources depending on the class of worker. (1) For Quarterly Census of Employment and Wages (QCEW) employees, EMSI primarily uses the QCEW, with supplemental estimates from County Business Patterns and Current Employment Statistics. (2) Non-QCEW employees data are

based on a number of sources including QCEW, Current Employment Statistics, County Business Patterns, Bureau of Economic Analysis (BEA) State and Local Personal Income reports, the National Industry-Occupation Employment Matrix (NIOEM), the American Community Survey, and Railroad Retirement Board statistics. (3) Self-Employed and Extended Proprietor classes of worker data are primarily based on the American Community Survey, Non-employer Statistics, and BEA State and Local Personal Income Reports. Projections for QCEW and Non-QCEW Employees are informed by NIOEM and long-term industry projections published by individual states.

APPENDIX F: EMPLOYER SURVEY

This instrument has been edited and cleaned to include only key questions from the survey.

Section 1

A. Does your firm have at least one location with employees in San Diego or Imperial Counties? (Please count yourself as an employee if you are an owner-operated business or sole proprietor).

1. Yes
2. No

For this survey, please only answer for your San Diego or Imperial County business locations. What is the zip code of your current location? _____

B. Is your company involved with an activity related to the sales, installation and maintenance of clean energy goods and services, including renewable energy and energy efficiency measures as well as new efficient building construction and existing building retrofitting?

1. Yes
2. No

Do you feel comfortable answering questions about the hiring and staffing needs of your San Diego or Imperial locations?

1. Yes
2. No – Please provide us with the email address of someone at your firm who is better able to answer questions about hiring and staffing.

C. Which of the following clean energy industries is your firm most closely connected to?

1. Renewable energy and storage
2. Energy efficiency and energy efficient building
3. Other (Specify: _____)
4. N/A

D. Which of the following technologies is your firm most closely connected to?

a. Renewable Energy

1. Solar, including PV or photovoltaic, thermal, or concentrating solar power (CSP)
2. Wind power
3. Other (Specify: _____)
4. N/A

b. Energy Efficiency/Building

1. Lighting, including solar tubes
2. HVAC and building controls
3. Energy efficient appliances and machinery
4. Window, insulation, and other weatherization products
5. Energy efficient building materials
6. Other (Specify: _____)
7. N/A

E. Which of the following industry descriptions best describes your organization's focus as it relates to the Clean Energy industry?

1. A firm that sells _____ products and services
2. A firm that installs and maintains [clean energy/ SD] systems or provides services for installation of _____ products

3. A firm that conducts energy audits
4. A firm that works on the construction or remodeling of buildings
5. Other (Specify: _____)
6. N/A

Section 2

1. How many full-time and part-time permanent workers support the _____ portion of your business in San Diego and Imperial Counties? Please note that your response should include administrative staff supporting the clean energy portion of your business. _____
2. If you currently have _____ full-time and part-time permanent employees in San Diego and Imperial Counties that support the _____ portion of your business, how many more or how many fewer permanent employees do you expect to have supporting the _____ portion of your business from your San Diego and Imperial County location(s) 12 months from now?
 1. More
 2. Fewer
 3. Same number
 4. Refused

Section 3

Please answer yes if you currently employ the following occupations in your San Diego or Imperial County location(s).

- Sales representative
 - Photovoltaic installer
 - Battery installation specialist
 - Solar water heater installer
 - Electrician, other than PV or battery installer
 - Plumber
 - Energy auditor
 - Photovoltaic designer
 - Documentation specialist
 - Wind turbine technician
 - Wind blade installation/repair
 - Electrician, other than turbine technician
 - Construction equipment operators
 - Carpenter
 - Weatherization specialist
 - HVAC technician
 - Construction or project manager
3. Does your firm require or prefer previous work experience related to the position for all new hires of _____?
 1. Require
 2. Prefer
 3. We do not require nor prefer experience
 4. DK/NA
 4. What is your firm's preferred level of education or training for new _____ workers with previous work experience?
 1. Bachelor's degree or higher
 2. Associate degree, but not a bachelor's degree or higher

3. Technical certification from a college but not a degree
 4. Technical certification from a high school but no college
 5. Non-technical high school diploma or GED
 6. Union apprenticeship training
 7. None of the above
 8. N/A
5. What is your firm's preferred level of education or training for new _____ workers without previous work experience in the position?
1. Bachelor's degree or beyond
 2. Associate degree, but not a bachelor's degree or beyond
 3. Technical certification from a college but not a degree
 4. Technical certification from a high school but no college
 5. Non-technical high school diploma or GED
 6. Union apprenticeship training
 7. None of the above
 8. N/A
6. Does your firm require or prefer professional certification or licensure for your _____ in San Diego and Imperial County location(s)?
1. Require
 2. Prefer
 3. We do not require nor prefer professional certification or licensure
 4. DK/NA
7. Does your firm face any difficulty when filling positions for _____ workers at your firm based on applicants' qualifications?
1. Yes, great difficulty
 2. Yes, some but not great difficulty
 3. No
8. Please tell me whether your firm has great, some, or no difficulty hiring employees who possess adequate proficiency in each skill area for _____ workers.
1. Problem solving skills
 2. Oral communication, such as speaking and listening
 3. Written communication
 4. Teamwork and collaboration
 5. Applied math
 6. Basic computer literacy
9. Next I am going to read a list of technical skills. Thinking of when you hire entry-level _____ at your San Diego and Imperial County location(s), please tell me whether the following skills are required, preferred but not required, or not important or applicable.
10. What are the two most important attributes a worker can demonstrate that would contribute to a promotion or pay raise?
1. Technical proficiency
 2. Work ethic/dependability
 3. Leadership abilities
 4. Other (specify)
 5. Other (specify)

APPENDIX G: FUNDING CHECKLIST RECOMMENDATION

This is a potential list of questions that can be asked before funding any Clean Energy programs:

Entry-Level or Initial Training Programs

- ✓ Does it cross-train workers in multiple technologies?
- ✓ Does it incorporate the clean energy skills AND prepare for the underlying occupation?
- ✓ Does it offer hands-on experience and role-play?
- ✓ Are there pre- and post-assessment tests for non-technical skills and behaviors?
- ✓ Are there pre- and post assessment tests for technical skills, or does the program culminate in a professional license or certification?
- ✓ Does the program include applied mathematics, including how to develop cost and return on investment (ROI) for customers?
- ✓ Is there a dedicated staff member focused on placement and employer engagement?
- ✓ Has the program staff identified companies that have made commitments to hire trainees?

Experienced Worker Retraining Programs

- ✓ Is it targeted on trainees with prior construction or sales experience?
- ✓ Does it cross-train workers in multiple technologies?
- ✓ Does it incorporate the clean energy skills AND prepare for the underlying occupation?
- ✓ Are there pre- and post-assessment tests for non-technical skills and behaviors?
- ✓ Are there pre- and post-assessment tests for technical skills, or does the program culminate in a professional license or certification?
- ✓ Does the program include applied mathematics, including how to develop cost and return on investment (ROI) for customers?
- ✓ Is there a dedicated staff member focused on placement and employer engagement?
- ✓ Has the program staff identified companies that have made commitments to hire trainees?
- ✓ Does it incorporate leadership and non-technical skill training?

Incumbent Worker Training Programs

- ✓ Is it targeted on trainees with prior construction or sales experience?
- ✓ Does it cross-train workers in multiple technologies?
- ✓ Does it incorporate leadership and non-technical skill training?
- ✓ Does it offer hands-on experience and role-play?
- ✓ Are there pre- and post-assessment tests for non-technical skills and behaviors?
- ✓ Are there pre- and post assessment tests for technical skills, or does the program culminate in a professional license or certification?
- ✓ Does the program include applied mathematics, including how to develop cost and return on investment (ROI) for customers?
- ✓ Can the program be easily tailored for firms' incumbent workers?

The checklist can be used as an evaluation or point-system for determining which programs should be funded, especially for special projects and grants. In this framework, programs that are most responsive in illustrating how they meet each of the checklist items would receive the highest ranking for funding.

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