

ENVIRONMENTAL SCAN

**GREEN ECONOMY
WORKFORCE STUDY**

CENTRAL VALLEY REGION

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CENTER OF EXCELLENCE,
CENTRAL VALLEY REGION

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REAL TIME DATA TO ADVANCE COMMUNITY COLLEGES

Table of Contents

Executive Summary.....	3
Introduction.....	4
Industry Overview	5
Occupational Overview	10
Career Pathways	11
Employer Needs and Challenges	12
College Programs and Response.....	13
Conclusion and Recommendations	14
References.....	16
Appendix A: Crosswalk of green industries, NAICS Codes and SOC Codes	17
Appendix B: Green Job Occupational Descriptions.....	29
Appendix C: Green degree/certificate programs, California Community Colleges	32
Appendix D: Model College Programs	35
Appendix E: How to Utilize this Report	39

Based on a 2008 survey of Central Valley businesses in energy, building and design services, engineering and environmental services, as well as government and public administration, over three-quarters (79%) of employers indicated that the green economy will be very or somewhat important in focusing the types of products or services that they will be involved with in the future. Source: BW Research Partnership

Executive Summary

Elected officials and policy makers from Central California to Washington, DC have heralded the coming of a new green economy. However, there is little agreement and sometimes a poor understanding of what the new green economy entails and how it will impact workforce and economic development at the regional level. The current environment for a new green economy is being driven by:

- Rising energy prices that are fueling demand for alternative energy
- New legislative requirements that require substantial reductions in GhG (Greenhouse Gas) emissions and more efficient use of natural resources
- Consumer demand for more environmentally sustainable products and services
- The reduced supply of fresh water and other natural resources that is focusing more attention on new technologies that increase resource usage efficiency

Research identified several occupations that are likely to grow in the Central Region as the green economy develops. These occupations include renewable energy technician or installer, sales representative or cost estimator, assembler or manufacturing technician, and resource conservation manager or planner. These occupations have opportunities in several of the green impacted industries including utilities and renewable energy, green building and design services, and engineering and environmental services.

Employer research of green impacted industries in the Central Region provided several key findings including:

- Just over 60% of employers identified themselves as green or somewhat green firms, indicating a high level of awareness of the importance of being perceived as green
- Almost two-thirds (63%) of employers stated the demand for lower energy costs was very important to the development of the green economy and their business, and
- Over 70 percent of employers indicated they had at least some difficulty (49%) if not great difficulty (22%) recruiting non entry-level employees with adequate skills and work experience.
- Employers indicated that an A.A. degree in a green subject area was not a priority for hiring employees. A short-term certificate is more desirable to employers hiring employees in the green economy.

To remain competitive in the global marketplace, businesses in California will require energy conservation training, green training, and technical education and energy credentials for employees that align with current and future energy workforce needs. -Developing a statewide energy education and technical training strategy, August 2008

The development of the green economy in the Central Region also faces some challenges. The recession is expected to play particular havoc in the building industry and the region is already seeing much less investment in clean technology than other regions in California. While obstacles do not spell the demise of the green economy, they do indicate some of the macroeconomic and regional challenges that California and the Central Region face in developing the green economy.

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. Increasing energy and commodity costs, legislative requirements and consumer demands for a more sustainable environment have all led to a substantial push for a greener economy. The Central Region is beginning to see the first indicators of the blossoming green economy in industries such as energy and utilities, building and design services, engineering and environmental services and in local government and public administration.

The green economy can have different definitions and areas of concentration, but fundamentally it consists of those businesses that are providing products and services that are developed and produced to lower greenhouse gas (GHG) emissions, improve air and water quality, provide more sustainable development alternatives, or provide cleaner and more efficient energy and water options.

The purpose of this report is to examine how a greener economy will impact the Central Region economy, identify which industries are most likely to be affected in the short-run and summarize changes in the workforce demand and training needs of the region. The findings of the study were based on secondary research of the green economy and the Central Region, executive interviews of green economy pundits and regional experts as well as a survey of employers in industries most likely to be impacted by the new green economy.



In June of 2008, the Central Region Center of Excellence (COE) launched and completed a survey of 59 businesses in the region. The survey was conducted among regional employers that had at least five employees and were in one of the five industries considered to be most impacted by the green economy, including:

- Engineering and environmental services
- Energy and utility firms
- Local government and public administration
- Building and design services
- Agriculture firms or firms directly servicing agricultural firms¹

The Green Economy Workforce Study was focused on understanding and beginning to quantify how the region will be impacted by the greening of the economy and how these changes will translate into new demands on the regional workforce. Specifically, the research study identified:

- Industries that are expected to be most impacted by the developing green economy
- Key “green” workforce needs and occupations that are most relevant to the industries and community colleges
- Employer challenges in recruiting, hiring and retaining workers

The research findings provide colleges with timely and credible information for the development or redesign of training and education programs dedicated to those industries most affected by the greening of the economy.

¹ It should be noted that we were unable to complete interviews with firms in the agricultural industry, but they were examined in the labor market data evaluated as part of the research for this study.

Industry Overview

In the Central Region, the most immediate and significant workforce opportunities in the green economy can be found in the following industry clusters.

Energy Technology and Power Production: These are typically public and private institutions that produce energy from wind, solar and bio-mass. These include firms that are developing new sources of energy (see Bioenergy Solutions below), those firms that are expanding use or installing wind and solar energy, as well as firms that are engaged in researching the next alternative energy sources. Examples of these employers include firms in the wind industry such as **International Turbine Research** in Los Banos and firms in the solar industry such as **Acro Electric** in Oakdale. One particularly interesting employer with an innovative approach to energy production is profiled below.

Energy Technology Employer – Bioenergy Solutions in Bakersfield provides a new energy option for firms in the dairy or greater agricultural industry. They provide the infrastructure necessary to create renewable natural gas from animal waste then share revenues from the sale of gas and carbon credits with the farmers or food processors. This provides revenue for the farmers and cleaner energy to the region and California. For more information about Bioenergy Solutions go to <http://www.allbioenergy.com/>

Green Building: These included green building, or green construction, can be defined as an organized effort to design, construct and maintain buildings and facilities using a process and materials which promote environmental sustainability. Green building firms are found in all sectors of construction, including commercial and industrial facilities, residential buildings, and among specialty trade contractors. The workforce impact will not only be felt in the construction industry, but also among those firms that are involved in green design (i.e., architects and planners) as well as firms that develop and produce green building materials.

Water Usage and Utilities: Typically public with some private institutions that provide energy, water, and wastewater services for residents and businesses in the Central Region. Utilities are expanding their renewable energy portfolios and are focused on how to increase water and energy efficiency objectives. Technicians, engineers and planners will be needed to design, install, operate, and maintain new energy facilities and water efficiency programs.

Other industries, such as **agriculture** and **advanced manufacturing** offer additional opportunities for green employment. To date, the Central Region has not been a large recipient of clean technology venture capital investments. The leading region in California and the country has been Silicon Valley, followed by the greater Los Angeles region and the rest of the Bay Area without Silicon Valley². However, the Central Region's geographic proximity to the Bay Area and to Silicon Valley provide opportunities for new production and manufacturing opportunities as Bay Area firms moving from research and development to production and manufacturing look to "rural outsourcing" as a way of reducing production costs while maintaining access to a skilled and able workforce. In agriculture as firms look to develop new bio-mass alternatives, the region provides a natural fit for exploring and developing new crops that could be used as fuel for bio-mass energy production.

² For a more detailed assessment of clean technology venture capital investments in California, see Next 10's Green Innovation Index <http://www.next10.org/environment/greeninnovation.html>

Industry Trends

Unlike a more traditional industry cluster, the green economy is not defined by closely aligned products and services or shared supply chains. Instead, it is delineated by those firms that share a set of objectives to provide cleaner energy, reduce greenhouse gas emissions, improve or lessen the impact on water and air quality, and/or provide more sustainable development alternatives. From an occupational perspective, green jobs are found throughout the economy, from energy and public administration to engineering and construction.

The growth and opportunity in the green economy has only strengthened in the last 12 months, as energy prices climb and consumers place a higher priority on environmental amenities and reducing greenhouse gas emissions. The growth and significance of the green economy can be attributed to several changes in the economic and legislative environment. Drivers of the green economy include the following:

- **Strong price signals** from energy and natural resources, including fossil fuels and water, have created stronger financial incentives to find clean energy alternatives and new ways of treating and reusing water.
- **Consumer demand** is changing, as households respond to concerns about global warming and environmental degradation and are increasing the demand for products and services that offer reduced impacts upon the environment.
- **Legislation** at the state and local level has committed California and the Central Region to a leadership role in the green economy. The legislation has created both incentives and requirements for the creation and/or development of infrastructure that would serve the green economy and the products and services provided by the industries that were surveyed.



As the price of oil continues to fluctuate, as demand for cleaner, less polluting energy alternatives grows and as new legislative measures continue to push these opportunities forward, the fundamental drivers of the green economy will continue to grow in strength. Although the current economic downturn could test the legislative commitment to green development, the overall price signals from fossil fuels and commodities are likely to remain a strong financial incentive for continued development and innovation in the green economy.

Green Economy Profile in the Central Region

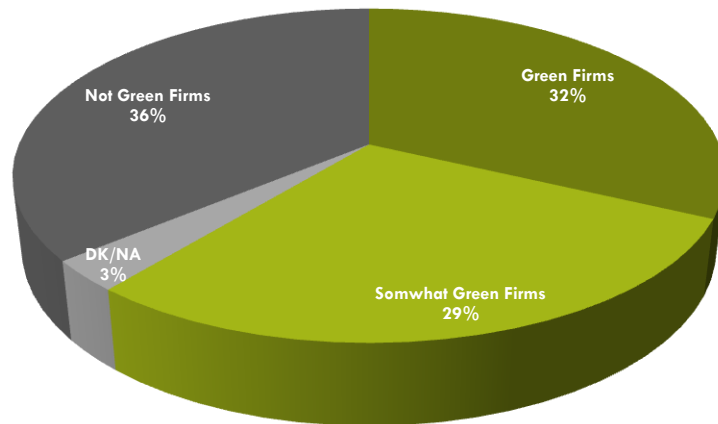
For the 15 county Central Region, there are an estimated 10,980³ firms that fall into the industries most likely to be connected to the green economy. Figure 1 illustrates that firms in green-impacted industries⁴ in the Central Region are somewhat evenly split between identifying themselves as a green firm (32%), a somewhat green firm (29%) or not a green firm (36%). A comprehensive listing of green impacted industries can be found in Appendix A.

Green firms in the research were defined as “businesses that are making money off of providing products or services that use resources more efficiently, provide alternative sources of energy or lower or minimize greenhouse gas emissions⁵.”

³ This estimate is taken from InfoUSA's database of employers in the 15 county Central Valley region in the five industries surveyed for the study.

⁴ A complete listing of NAICS codes used to identify green-impacted industries is located in Appendix A

⁵ Definition derived from BW research and Cleantech

Figure 1: Employers Self Classified as a “Green Firm”

Industry projections

Using primary data collected from Central Region employers, some assumptions can be made regarding the current number of green jobs in the valley. Among survey respondents, 32% of employers in green-impacted industries identify themselves as a green firm, meaning they are hiring employees specifically to support the green economy. Assuming the same distribution across all employers, Table 1 demonstrates the number of green jobs in the Central Region.

Table 1: Central Region green jobs by industry, 2007⁶

Green Economy Industry	Total Number of Firms in 2007	Number of Green Firms ⁷ in 2007	Total Number of Jobs in 2007	Total Number of Green Jobs ⁶ in 2007
Engineering and Environmental Services	1,451	464	13,795	4,640
Building and Design Services	8,757	2,802	62,775	19,614
Local Government and Public Administration	212	68	3,876	1,224
Agriculture	326	104	6,501	2,080
Energy and Utility Services	234	75	2,682	825
Total	10,980	3,513	89,629	28,383

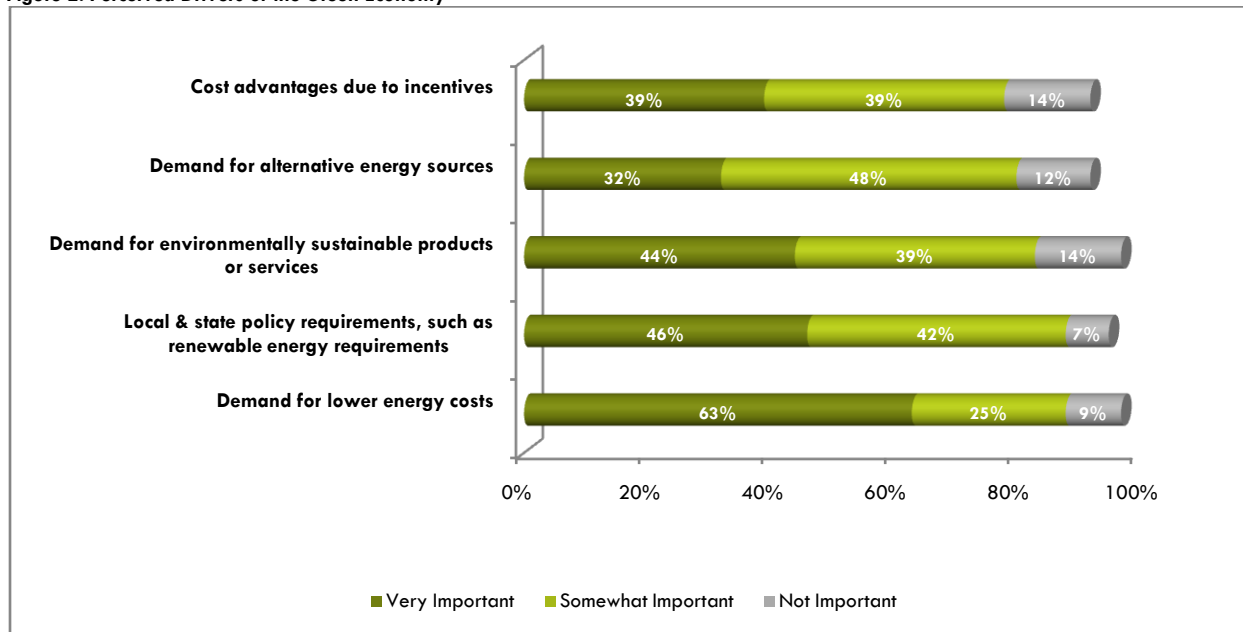
⁶ Source: Info USA, 2008

⁷ Green Firms and Green Jobs are estimates using BW Research data and Info USA data

Based on the estimates in Table 1 above, there are currently nearly 30,000 green jobs in the Central Region. These are jobs which already exist within the valley; many of the jobs require new skills for the existing workforce. Additionally, many of the employers within these industries will be heavily impacted by retirements in the next few years. In the utility sector alone, 45% of the workforce will be eligible for retirement in the next five years⁸

Central Region employers were also asked to gauge how important different factors may be in driving the growth of their business. Of the five issues that were considered, employers placed the highest importance on the demand for lower energy costs, with over six out of 10 employers indicating that it was very important for their business and almost 9 out of 10 employers indicating it was at least somewhat important for their business. Of the other issues tested, over three-quarters of employers indicated that each issue was at least somewhat important for their business. Issues tested included local and state policy requirements (such as renewable energy requirements), demand for environmentally sustainable products or services, demand for alternative energy sources, and cost advantages due to incentives. Figure 2 below illustrates employers' perceived drivers of the green economy in the Central Region.

Figure 2: Perceived Drivers of the Green Economy



Green Economy Challenges in the Region

While the development of the green economy in the Central Region provides great promise for the regional economy and specifically for developing new quality job opportunities, there are potential obstacles that could slow or hinder that development. They include:

1. **Economic Slowdown** - A recent economic outlook report⁹ produced by the Milken Institute paints a relatively dour forecast for the national economy and even less appealing expectations for the California economy. The recession that California is expected to experience will reduce consumer spending, reduce consumer investment and diminish the state's budget and its ability to invest in new infrastructure and new energy efficiency programs.
2. **Building Industry Blues** - The same Milken report pointed out the impact that the housing market is having on the state and how it "will disproportionately affect the Central Valley." The report compares the

⁸ Source: California Public Utilities Commission, *The Energy Action Plan*.

⁹ Source: The Economic Outlook for the United States and California: Slow Growth or Recession. May 2008. By DeVol with Bedrossian.

high-tech bubble burst in 2001 to what will happen in the building and real estate industry in places like the Central Region and parts of Southern California.

3. Lack of Clean Technology Investments in the Region – While California as a whole, and Silicon Valley in particular, have received hundreds of millions of dollars in venture capital for clean technology and firms looking to innovate within the green economy, the Central Region has received very little green venture capital investment.

These issues all pose potential obstacles to the development of the green economy. However, employers indicated that the demand for lower energy costs was the most important of the issues evaluated and there is little to no evidence that energy prices will go down. Hence, the importance of fuel costs for energy production will remain a key factor in the development of the green economy.

Public Policy and Legislation Impacting the Green Economy

The departing administration has not taken a leadership role on the country's and planet's environmental quandaries at the national level, unlike California which has taken a legislative lead on environmental issues such as global warming and deteriorating air quality. In the last few years, Sacramento has passed multiple pieces of legislation committed to improving the environment, combating global warming, and changing business as usual in the state's economy. Some of the more important pieces of legislation include:

- **AB 32: The Global Warming Solutions Act of 2006** – This legislation mandates the State of California to reduce its greenhouse gas emissions back below 1990 levels by 2020. This is considered by many to be the hallmark legislation that provides clear goals and requirements for lowering greenhouse gas emissions and changing business practices in the world's eighth largest economy.
- **SB 1: The Million Solar Roofs Bill** – Provides funding, incentives, and mandates to increase solar panels throughout the state and complement the million solar roofs plan. 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."¹⁰
- **AB 118: Low Carbon Transportation and Energy Efficiency** – This measure will generate more than \$100 million in funding for new technologies, vehicles, and fuels that reduce greenhouse gas emissions. Approximately half the funding for AB 118 would go toward incentives for putting significantly lower carbon fuels and vehicles on the road. The other half would be allocated for the development of the next generation of clean and energy efficient transportation technologies such as renewable and low carbon fuels, electronic, hybrid, and fuel cell technology.
- **AB 2021: Public Utilities and Energy Efficiency** – This measure requires the Energy Commission to develop a statewide estimate of all potentially achievable cost-effective electricity and natural gas efficiency savings and to establish targets for statewide annual energy efficiency savings and demand reduction for the next 10-year period. The measure also requires all publicly owned



¹⁰ Most of this Assessment of SB1 was identified by Sue Kateley, Executive Director of the California Solar Energy Industries Association (CALSEIA) and the Authors of the Solar Industry Scan, John Carrese and Jennifer Oliver.

utilities to identify all potentially achievable cost-effective electricity efficiency savings and to establish annual targets for energy efficiency savings and demand reduction for the next 10-year period. Within 60 days of adopting annual targets, each local POU shall report those targets and the basis for establishing those targets to the Energy Commission.¹¹

The incoming administration's preliminary proposals to support the green economy include emphasis on infrastructure development and construction, renewable energy, and global climate change. As the new administration transitions into office, funding opportunities surrounding these areas of emphasis may become available to community colleges.

Regional Response

In the Central Region, like other regions in California, the opportunities presented by the green economy have spawned a new commitment to economic development strategies to support it. In 2006, some of the leading workforce and economic development organizations in the Central Region developed "A Clean Energy Roadmap for the Greater Fresno Area".¹² This document chose four priority opportunity areas, including:

1. **The built environment**, which concentrates on green building policies, projects and facilities,
2. **Power production**, which focuses on new opportunities to develop energy, including biomass-to-energy, wind power, and solar installations along with supporting policies that encourage clean energy,
3. **Water use**, which concentrates on programs that conserve water or promote water efficiency, including increasing the use of solar power for water pumping and treatment, and
4. **Workforce development**, which is focused on preparing a highly skilled workforce that will support the burgeoning green economy and provide quality employment for regional residents.

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The vast majority of green jobs are in the same areas of employment that people already work in today, in every region and state of the country. For example, constructing wind farms creates work for sheet metal workers, machinists and truck drivers, among many others. Increasing the energy efficiency of buildings through retrofitting relies, among others, on roofers, insulators and building inspectors. Expanding mass transit systems employs civil engineers, electricians, and dispatchers. So green jobs don't just mean new jobs- they can also mean greater job security for people who already work in these fields. Source: "Job Opportunities for the Green Economy", Political Economy Research Institute

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This document connects the current high levels of unemployment in cities like Visalia, Merced and Fresno with the opportunity that clean energy and the green economy could provide. The document sets a goal of having a skilled and able workforce that is in demand by regional employers by 2015. The roadmap also indicates the community college system, along with the Fresno County WIB and the California State University and University of California systems, as key champions in the workforce development priority area.

Occupational Overview

The secondary and primary research component of this study focused on several demand occupations within the green economy. To be selected for inclusion in this report, the occupations had to meet at least one of the following criteria: high employment in at least one of the industries that we considered as part of the green economy above average growth, or easily served by community college-level education and

¹¹ Source: Notice on AB 2021 from the California Energy Commission. http://www.energy.ca.gov/2007_energy_policy/notices/2007-04-20_committee_workshop.html

¹² For more information on "A Clean Energy Roadmap for the Greater Fresno Area" go to www.cleanenergyroadmap.com

training programs. The following four occupations were identified through secondary research as the key jobs needed within the green economies that are accessible to community college students:

- Renewable Energy Technician or Installer
- Sales Representative or Cost Estimator
- Assembler or Manufacturing Technician
- Resource Conservation Manager or Planner

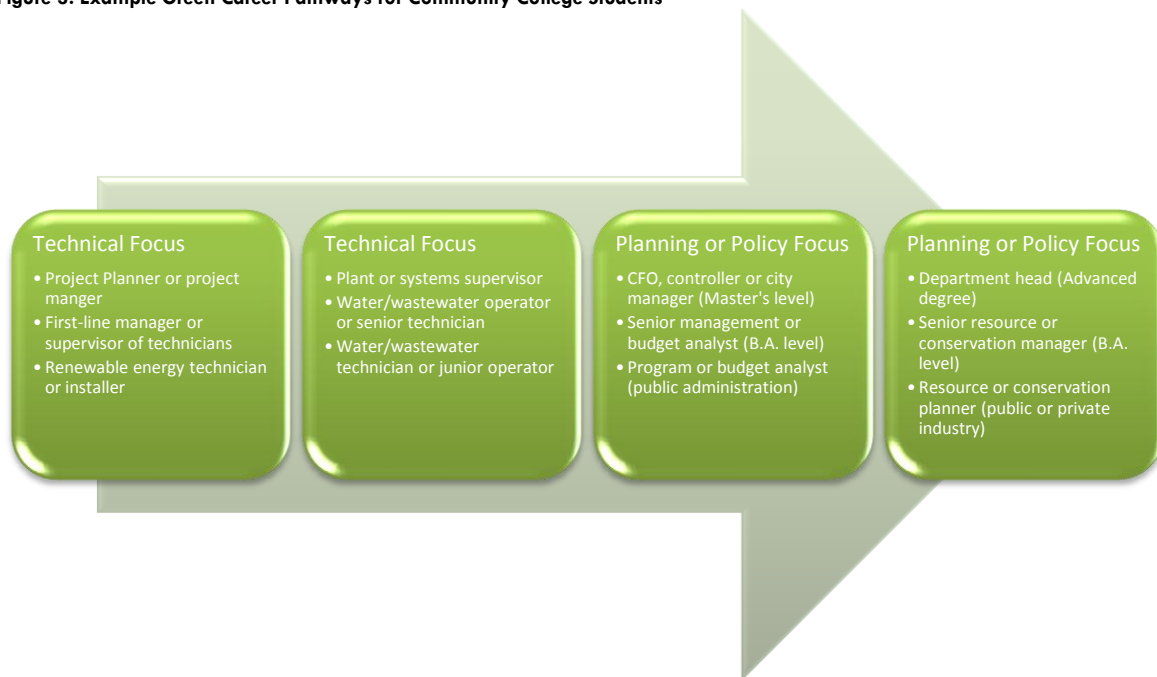
The occupational profiles are largely based on publicly available labor market information. These occupations were included in the employer survey¹³. A complete description of each occupation is located in Appendix B.

Career Pathways

The green jobs profiled do not exist in a single industry or occupation, but can be found throughout the economy. The figure below provides some examples of career pathways in different industries and occupations for Central Region community college students. The table differentiates between those individuals that want to consider a planning or policy focused occupation versus one that is more hands-on and technically focused.

These four career pathways are in no way meant to be a comprehensive list of green career options. Other green collar occupational pathways can be found in building and construction, transportation, and environmental assessment and protection to name just a few.

Figure 3: Example Green Career Pathways for Community College Students



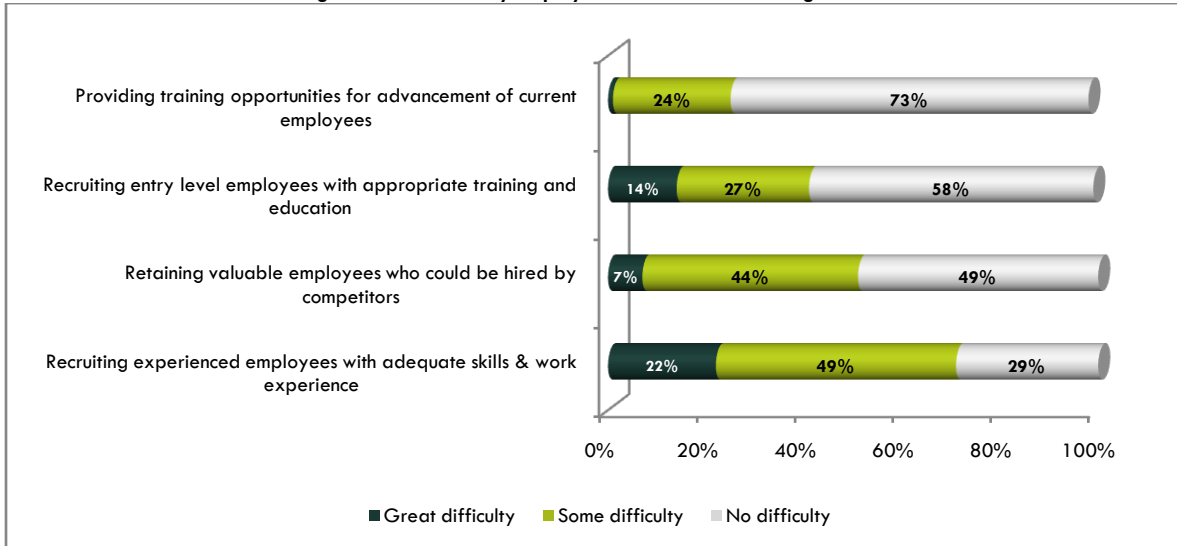
¹³ The sample size for each occupation was below 30 and not necessarily representative of regional employers.

Employer Needs and Challenges

Workforce Issues and Challenges

Figure 4 below reveals the difficulty that Central Region employers who are in an industry likely to be impacted by the green economy are experiencing with workforce issues. Survey results show that nearly three out of four employers (71 percent) have difficulty recruiting non-entry level employees with adequate skills and work experience, and just over half of employers (51 percent) have difficulty retaining valuable employees who could be hired by competitors. In addition, more than 40 percent of the employers surveyed report difficulty recruiting entry-level employees with appropriate training and education (41 percent).

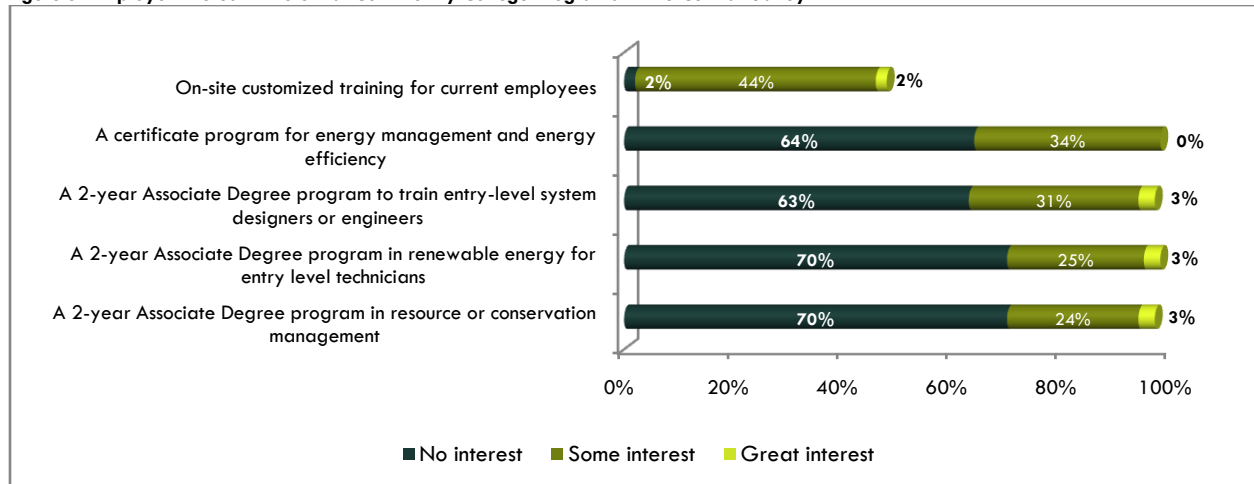
Figure 4: Workforce Issues and Challenges for Central Valley Employers in Industries Becoming Green



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 green workforce, an average of 34 percent of Central Valley employers surveyed expressed “great” or “some” interest in the options presented, with 46 percent expressing interest in on-site customized training for current employees. While the aggregate interest numbers are not as high as other industry surveys that BW Research has completed, that is expected given the broad range of industries that were included in this sample universe.

Figure 5: Employer Interest in Potential Community College Programs in the Central Valley



Although there are many green employers in the Central Region, the impact of the green workforce training needs have been unclear to community colleges. Meaning, are there fundamental differences between jobs at green firms versus non-green firms? During executive interviews and validation for this report, three key points related to the green workforce emerged:

1. **It would be beneficial for colleges in the region to embed green curriculum throughout all courses.** The idea of green is much more of a value belief than a trade that is taught. The green workforce is a workforce made up of individuals that have selected to work towards improving the environment. If existing degree and certificate programs had a 'green thread' throughout the program, students would begin to understand and value the green economy.
2. **There are few specific new programs for green that need to be created.** Jobs that may require specific programs are the technician level jobs for specific trades (i.e., wind, solar, geothermal). A plumber trained in an existing program is sufficient to work in a green firm. However, employers do see a value in all employees having a base understanding of what green is and the value behind it.
3. **Safety is an issue.** Many of the jobs in the green economy require safety training beyond industry standards. This is particularly true in the renewable energy sector. Employers expressed a great need for additional safety training for new and existing employees.

College Programs and Response

To find colleges within the Central Region who offer certificate or degree programs in the green sector, a review of the California Community College's Taxonomy of Programs (TOPs) was conducted. The following table indicates programs in the Central Region to train workers for the green economy. A complete listing of programs statewide is located in Appendix C.

Table 2: Green Programs, Central Region¹⁴

Community College	Green Programs ¹⁵
Bakersfield	Environmental engineering, environmental science, environmental horticulture
Cerro Coso	Natural resources, industrial technology
Columbia	Environmental science, watershed restoration, GIS
Fresno City	HVAC and industrial electronics, environmental technology
Hartnell	Environmental technology
Merced	Agriculture science, horticulture, HVAC, natural resources
Modesto	Horticulture, environmental engineer, natural resources, industrial systems technician
Porterville	Agricultural production
Reedley	Metal working, horticulture, mechanized agriculture, agriculture technician, automotive technician
San Joaquin Delta	Building, welding, carpentry, horticulture, HVAC, wastewater engineering and operations, natural resources, automotive technician
College of the Sequoias	Construction, welding, carpentry, HVAC, agriculture power equipment, welding industrial maintenance
Taft	Automotive specialist
West Hills Coalinga	Precision agriculture

Gaps Identified

According to the primary research data collected for this report, the greatest needs for training programs for the green economy are:

- Renewable energy training programs
- Environmental policy (planners)

¹⁴ Source: Source: Green jobs guidebook and California Community Colleges Chancellor's Office, August 22, 2008

¹⁵ Green programs as of August 2008

- Green engineering programs/focus

Many colleges in the region are ready to begin training workers to support the green economy; however there has not been a clear sense of what the actual training needs are. Colleges in the region are hesitant to begin programs without an identifiable workforce need. Many colleges are unsure whether to implement a broad program (e.g., renewable energy) or specific programs (e.g., solar installer or LEED certification). In addition, little research has been conducted on the value of an Associate's degree versus a Certificate. Industry validation indicated employers preference towards a certificate for technician level jobs, and an Associate Degree (or higher) for supervisory or engineer jobs. There also does not appear to be a monetary benefit for completing a green program beyond standard wages. Meaning, an employee that receives training in a green occupation will not necessarily make more money because the job is considered green. Wages are based on technical expertise or merit, and vary by employer.

Some colleges are taking a focused approach to training a green workforce. One such example is the Center for Renewable Energy Systems Technology at Loughborough University, United Kingdom. Appendix D contains examples of various green programs.

Conclusion and Recommendations

The following recommendations are meant to help regional colleges respond to the workforce and economic development opportunities provided by the growth and development of the green economy.

Familiar occupations in the Green Economy

The new jobs created in the green economy in the Central Region will primarily be jobs that we are already quite familiar with. Whether it is electricians who are installing new solar panels, manufacturing technicians who are assembling new wind turbine components, or construction managers who are overseeing the development of a new LEED certified building, these are all jobs in the green economy in established occupations. A recent report by the Political Economy Research Institute¹⁶ confirms this assessment of the green economy:

But the vast majority of green jobs are in the same areas of employment that people already work in today... ...What makes these entirely familiar occupations "green jobs" is that the people working in them are contributing their everyday labors toward environmental solutions. Put simply, a green job is one that is contributing to fighting global warming and building a green economy.



The premise that most of the employment generated from the growth of the green economy in the Central Region will result, at least in the short-term, in jobs that we already are familiar with, has clear implications for strategies to develop job-training for the green economy. The green economy is an emerging area, but not a new emerging area. The jobs to support the green economy are going to be transformations of existing jobs in the form of industry adaptations. Job training strategies for the green economy should not be separated from current programs or curricula but should instead become imbedded into existing programs. For example, construction programs at the colleges should examine how green certifications (such as LEED) will change the training and educational requirements for construction managers. Training curricula for electricians could incorporate courses that educate students on the placement and installation of photo voltaic systems. Generally, each of the workforce programs and departments at the colleges should evaluate if the jobs

¹⁶ Job Opportunities for the Green Economy: A state by state picture of occupations that gain from Green Investments. Robert Pollin & Jeanette Wicks-Lim, June 2008

they are training individuals for are impacted by the greening of the economy and what impact that could have on their curriculum.

A Clean Energy Roadmap for the Greater Fresno Area

The green economy in the Central Region is relatively young in its development, but certain regional agencies have already begun planning how to develop and prepare for the region's greener economy. A Clean Energy Roadmap for the Greater Fresno Area was published in March 2006 by the Great Valley Center, the Regional Jobs Initiative and Strategic Energy Innovations. As stated earlier in the regional response, this document identifies workforce development as one of four "Priority Areas of Focus." The document also describes the current challenges in the region's workforce with high levels of unemployment and a relatively high proportion of unskilled workers and identifies the community colleges as one of five key champions in the workforce development priority area.

The agencies publishing the roadmap (Great Valley Center, Regional Jobs Initiative and Strategic Energy Innovations) provide a valuable opportunity for the colleges to collaborate in preparing for the workforce needs of the green economy. Collaboration with the Roadmap authors could provide the colleges with better understandings of which workforce development programs are needed and which are not, as well as keeping a pulse on the technologies and employers that are growing or moving into the region and the workforce needs that are changing because of it.

Next Steps for the Green Economy in the Central Region

Unlike industry clusters that are connected by supply chains or related industries that share similar products or services, the green economy is not defined by any set of traditional industry classifications. Future research on the green economy in the Central Region should evaluate the green economy within the classifications of specific industry clusters to better understand how industry workforce needs and skills are changing with the greening of the economy. As colleges begin to identify and address workforce needs in the green economy, they can focus their efforts to adapt curriculum to serve the green economy by considering impacts in the programs that serve these industries first. Further research could also include how the legislative requirements are impacting the industries and how they are supporting or hindering the greening of the cluster.



Given our focus on workforce and economic development opportunities in the Central Region, we can identify the industries that are most likely to be impacted by the developing green economy. For the Central Region, they include:

- **Agriculture**— Current examples in the region include crops being grown for new bio-fuels and animal waste being used to generate natural gas and methane.
- **Utilities & Power Generation**— Current examples in the region include power generated from wind, solar, and water.
- **Water and Wastewater**— Current examples in the region include new infrastructure and policies that are being implemented to use water more efficiently.
- **Construction & Design Services**— Current examples include all the firms that are designing new buildings and homes (architects) all the way down to the roofers who are installing new solar roofs.

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Appendix A: Crosswalk of green industries, NAICS Codes and SOC Codes

Green Economy area/sector	Sectors (2-digit NAICS codes)	Examples of industry sectors providing green collar jobs	Examples of entry-level green collar jobs (AA Degree or less)	Examples of higher-level green collar jobs (BA Degree or higher)	Jobs from Green Jobs Guidebook
Energy Generation & Storage and distribution: Renewable Energy	22 – Utilities 56 – Administrative & waste services 92 – Local government 23 - Construction 54 – Bus. Prof.	<ul style="list-style-type: none"> • Solar Power & PV Systems • Wind Power • Water & Hydro-Electric Power • Geothermal Power • Other (Hydrogen Energy Generation; Biogas & Biomethane Generated Power; Biomass Power) • Energy storage • Energy transmission/distribution • Energy services (ESCO) • Utility-scale renewable energy plants 	<ul style="list-style-type: none"> • Assemblers <ul style="list-style-type: none"> ○ Electrical and electronic equipment assemblers SOC 51-2022 ○ Engine and other machine assemblers SOC 51-2031 ○ Team assemblers SOC 51-2092 ○ Electromechanical equipment assemblers SOC 51-2023 • Installers <ul style="list-style-type: none"> ○ Control and valve installers and repairers, except mechanical door SOC 49-9012 ○ Electrical power-line installers and repairers SOC 49-9051 ○ Heating, air conditioning, and refrigeration mechanics and installers SOC 49-9021 • Energy Auditors SOC 13-2011.02 • Power Plant 	<ul style="list-style-type: none"> • Engineers (including civil and electrical engineers*) <ul style="list-style-type: none"> ○ Mechanical engineers SOC 17-2141 ○ Civil Engineers SOC 17-2051 ○ Environment engineers SOC 17-2081 ○ Materials engineers SOC 17-2131 • Designers <ul style="list-style-type: none"> ○ Commercial and industrial designers SOC 27-1021 	<p><u>Solar Thermal & PV:</u></p> <ul style="list-style-type: none"> • Solar Sales Marketing • Residential/Commercial Solar Sales Consultant • Solar Energy Systems Designer • Solar Thermoelectric Plant Manager • Solar Energy System Installer Helper • Solar Energy System Installer • Solar and PV Installation: Roofer • Solar Residential/Commercial Installation Electrician • Solar Commercial Installation Engineering Technician • Solar Residential/Commercial Installation Electrician Foreman • Solar Commercial Installation Engineer • Solar Operations Engineer • PV Solar Cell Designer • Solar Energy Engineer • PV Power Systems Engineer <p><u>Wind Energy:</u></p> <ul style="list-style-type: none"> • Wind Turbine Engineering Intern • Wind Farm Electrical Systems Designer • Wind Turbine Electrical Engineer • Wind Turbine Mechanical Engineer • Wind Field Technician • Wind Power Plant Project Engineer • Director of Wind Development <p><u>Hydro-electric Power:</u></p> <ul style="list-style-type: none"> • Hydro-Electric Operations Maintenance Worker • Hydro-Electric Plant Efficiency Operator • Hydro-Electric Plant Installation Technician

			<p>Operators SOC 51-8013</p> <ul style="list-style-type: none"> • Technicians/Electrical Technicians <ul style="list-style-type: none"> ○ Electronics engineering technicians SOC 17-3023.01 ○ Engineering technicians, except drafters, all others SOC 17-3029.99 ○ Mechanical engineering technicians 17-3027 ○ Electrical engineering technicians SOC 17-3023.03 ○ Electro-mechanical technicians SOC 17-3024 • Managers <ul style="list-style-type: none"> ○ General and operations managers SOC 11-1021 ○ Engineering managers 11-9041 • Maintenance workers <ul style="list-style-type: none"> ○ Maintenance and repair workers, general SOC 49-9042 ○ Maintenance workers, machinery SOC 		<ul style="list-style-type: none"> • Hydro-Electric Plant Electrical Operations Supervisor • Hydro-Electric Power Generation Engineer • Hydro-Electric Engineering Intern • Hydrogeologist • Marine and Fish Biologists • Hydro-Electric Mechanical Engineer • Hydro-Electric Electrical Engineer • Hydro-Electric Structural Engineer <p><u>Geothermal:</u></p> <ul style="list-style-type: none"> • Geothermal Engineering Intern • Geothermal Electrical Engineer • Geothermal Power Generation (Mechanical) Engineer • Geothermal Plant Installation Technician • Geothermal Plan Efficiency Operator • Geothermal Operations Engineer • Geothermal Engineering Intern • Geothermal Mechanical Engineer • Geothermal Electrical Engineer • Geothermal Power Plant Structural Engineer <p><u>Other (Hydrogen, Biomass, etc.):</u></p> <ul style="list-style-type: none"> • Hydrogen Power Plant Installation, Operations, Engineering and Management – General • Hydrogen Plant Operator and Operations Manager • Landfill Gas Collection System Operator • Landfill Gas System Technician • LGE (Landfill Gas to Energy) Plant Installation, Operations, Engineering & Management • Animal Waste Biomethane Gas Collection System Technician • Biomass Collection, Separation and Sorting • Biomass Plant Operations, Engineering, and Maintenance
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			<ul style="list-style-type: none"> 49-9043 <ul style="list-style-type: none"> ○ Helpers-installation, maintenance and repair workers SOC 49-9098 • Sales representatives <ul style="list-style-type: none"> ○ Sales representatives, wholesale and manufacturing, technical and scientific products SOC 41-4011 ○ Sales engineers SOC 41-9031 ○ Telemarketers SOC 41-9041 • Energy efficiency specialists <ul style="list-style-type: none"> ○ Electrical drafters SOC 17-3012 ○ Heating and air conditioning mechanics and installers SOC 49-9021 • Accountants (knowledge of tax incentives, rebates, etc) SOC 13-2100.01 • Meter readers <ul style="list-style-type: none"> ○ Meter readers, utilities SOC 43-5041 		<p><u>All Renewables:</u></p> <ul style="list-style-type: none"> • ICE Technician – (Instrumentation/Controls/Electrical Systems) • Junior Renewable Energy Technician • Hydrogeologist
<p>Water & Waste Management</p>		<ul style="list-style-type: none"> • Recycling • Waste treatment • Waste collection and remediation • Municipal Waste & Recycling Operations 	<ul style="list-style-type: none"> • Maintenance and repair workers <ul style="list-style-type: none"> ○ Maintenance and repair workers, general SOC 	<ul style="list-style-type: none"> • Energy efficiency specialist <ul style="list-style-type: none"> ○ Mechanical engineers SOC 17-2141 ○ Environment 	<ul style="list-style-type: none"> • Recycling Collections Driver • Recycling Center Operator • Hazardous Materials Removal Worker • Hazardous Waste Management Specialist • Solid Waste (Energy) Engineer

		<ul style="list-style-type: none"> • Water treatment • Water conservation <ul style="list-style-type: none"> • Water shed conservation and management • Wastewater treatment & Management 	<p>49-9042</p> <ul style="list-style-type: none"> ○ Helpers-installation, maintenance, and repair workers SOC 49-9098 ○ Maintenance workers, machinery SOC 49-9043 ○ Electric motor, power tool and related repairers SOC 49-2092 <ul style="list-style-type: none"> • Managers <ul style="list-style-type: none"> ○ General and operations managers SOC 11-1021 ○ Engineering managers SOC 11-9041 • Meter readers <ul style="list-style-type: none"> ○ Meter readers, utilities SOC 43-5041 • Soil and water conservation technicians <ul style="list-style-type: none"> ○ Forest and conservation technicians SOC 19-4093 • Water treatment plant operators <ul style="list-style-type: none"> ○ Water and liquid waste treatment plant and system operators SOC 51-8031 	<p>engineers SOC 17-2081</p> <ul style="list-style-type: none"> • Soil and water conservation specialists <ul style="list-style-type: none"> ○ Soil and water conservationists SOC 19-1031.01 ○ Conservation scientists SOC 19-1031 	<ul style="list-style-type: none"> • Nuclear Waste Management Engineer • Operations Maintenance Worker for Water Services • Associate Engineer-Wastewater Treatment • Wastewater Engineer in Refinery • Wastewater Plant Civil Engineer
Green Building/ Energy Efficiency	23 – Construction	<ul style="list-style-type: none"> • Lighting • Green building 	<ul style="list-style-type: none"> • Welders <ul style="list-style-type: none"> ○ Welders, 	<ul style="list-style-type: none"> • Engineers <ul style="list-style-type: none"> ○ Civil engineers 	<ul style="list-style-type: none"> • Wind Generating Installer • Electro-Mechanical Wind Turbine

	<p>54 – Professional and technical services</p> <p>42 – Wholesale services</p>	<p>practices for new structures</p> <ul style="list-style-type: none"> • Certifications (LEED) • Retrofitting of existing structures • Green space/landscaping • Wood working • Residential building • Building equipment contractors • Building finishing contractors • Green construction materials wholesaling • Deconstruction 	<p>cutters, Solderers, and brazers SOC 51-4121</p> <ul style="list-style-type: none"> • Crane operators <ul style="list-style-type: none"> ○ Crane and tower operators SOC 53-7021 • Concrete machine operators <ul style="list-style-type: none"> ○ Cement masons and concrete finishers SOC 47-2051 • Carpenters <ul style="list-style-type: none"> ○ Construction carpenters SOC 47-2031.01 ○ Helpers-Carpenters SOC 47-3012 • Construction laborers SOC 47-2061 • Maintenance and repair workers <ul style="list-style-type: none"> ○ Maintenance and repair workers, general SOC 49-9042 • Construction supervisors <ul style="list-style-type: none"> ○ First-line supervisors/managers of construction trades and extraction workers SOC 47-1011 • Electricians <ul style="list-style-type: none"> ○ Electricians SOC 47-2111 ○ Helpers-electricians SOC 	<p>SOC 17-2141</p> <ul style="list-style-type: none"> • Architects <ul style="list-style-type: none"> ○ Landscape architects SOC 17-1012 ○ Architects, except landscape and naval SOC 17-1011 ○ Architectural drafters SOC 17-3011.01 	<p>Technician</p> <ul style="list-style-type: none"> • Wind Field Operations Manager for Commercial • Wind Field Service Technician • Other RE Systems Installers & Engineers (solar) • Field Energy Consultant • Energy Conservation Representative • Energy Manager and Analyst • Energy Efficiency Finance Manager • Environmental Compliance Specialist • Engineering Intern • Water Systems Designer and Engineer • Site Supervising Technical Operator • Environmental Compliance Specialist • Refrigeration engineer • Lighting & HVAC Engineer • Civil Engineer • HVAC Engineer • Electrical Engineer • Residential Green Building and Retrofit Architect • Commercial Green Building and Retrofit Architect • Indoor & Outdoor Landscape Architect • Industrial Green Systems and Retrofit Designer • Senior HVAC Engineer • Environmental Construction Engineer • Energy Engineer • Structural Design Engineer • Home Improvement Retrofit Trainee • Residential Air Sealing Technician • Insulation Installer • HVAC Maintenance/Repair Trainee • Water Purification Systems Service Technician • Building Maintenance Engineer • Machinist • Welder • Carpenter

			<p>47-3013</p> <ul style="list-style-type: none"> • Plumbers <ul style="list-style-type: none"> ○ Plumbers SOC 47-2152.02 ○ Helpers-pipelayers, plumbers, pipefitters, and steamfitters SOC 47-3015 ○ Plumbers, pipefitters, and steamfitters SOC 47-2152 • HVAC <ul style="list-style-type: none"> ○ Heating and air conditioning mechanics and installers SOC 49-9021.01 ○ Refrigeration mechanics and installers SOC 49-9021.02 • Inspectors <ul style="list-style-type: none"> • Construction and building inspectors SOC 47-4011 • Interior designers SOC 27-1025 • Sales <ul style="list-style-type: none"> • Sales engineers SOC 41-9031 • Sales representatives, wholesale and manufacturing, technical and scientific products SOC 41-4011 • Landscaping 		<ul style="list-style-type: none"> • Electrical System Installer • Field Technician • Green Plumber and Pipefitter • HVAC Service Technician • Roofing and Skylight Installer • Weatherization Operations Manager • Residential Energy Field Auditor* • Commercial Energy Field Auditor* • Industrial Energy Field Auditor* • Auditing Services Sales Consultant* • Renewable Energy Consultant*
Manufacturing	31-33 -	• Advanced	• Machinists SOC 51-	• Industrial engineers	<u>Renewable Energy Systems Mfg:</u>

	Manufacturing	<p>manufacturing (renewable energy systems; semiconductor processors)</p> <ul style="list-style-type: none"> • Monitoring and control • Smart production • HVAC/R equipment mfg • Building materials mfg • Fuel efficient vehicle manufacturing • Component manufacturing (components for assembling RE systems) • Energy Storage Equipment • Food packaging • Food processing • Lighting 	<p>4041</p> <ul style="list-style-type: none"> • Fabricators <ul style="list-style-type: none"> ○ Structural metal fabricators and fitters SOC 51-2041 • Welders <ul style="list-style-type: none"> ○ Welders, cutters, Solderers and brazers SOC 51-4121 ○ Welding, soldering, and brazing machine setters, operators and tenders SOC 51-4122 • Inspectors <ul style="list-style-type: none"> ○ Inspectors, testers, sorters, samplers, and weighers SOC 53-9061 • Woodworkers <ul style="list-style-type: none"> ○ Woodworking machine setters, operators, and tenders, except sawing SOC 51-7042 • Assemblers <ul style="list-style-type: none"> ○ Engine and other machine assemblers SOC 51-2031 ○ Team assemblers SOC 51-2092 • Technicians <ul style="list-style-type: none"> ○ Electronics engineering technicians SOC 17-3023.01 	<p>SOC 17-2112</p> <ul style="list-style-type: none"> • Engineering managers SOC 11-9041 • Designers <ul style="list-style-type: none"> ○ Commercial and industrial designers SOC 27-1021 	<ul style="list-style-type: none"> • PV Solar Cell Designer • Solar Energy Engineer • PV Power Systems Engineer • Solar Fabrication Technician • Solar Lab Technician • Solar Hot Water Heater Manufacturing Technician • PV Fabrication and Testing Technician • Wind Turbine Machinist • Wind Turbine Sheet Metal Worker • Hydro-electric Component Machinist • Hydro-electric Construction Sheet Metal Worker? • Geothermal Heat Pump Machinist • Geothermal Sheet Metal Worker <u>Energy Storage Systems Mfg:</u> <ul style="list-style-type: none"> • Energy Storage • Battery Design Engineer • Battery Testing Technician • Battery Manufacturing Technician
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			<ul style="list-style-type: none"> ○ Mechanical engineering technicians SOC 17-3027 ○ Environmental engineering technicians SOC 17-3025 ○ Electrical engineering technicians SOC 17-3023.03 ● Sheet metal worker SOC 47-2211 ● Maintenance mechanics SOC 49-9042 ● Consultants 		
<p>Biofuels/Farming</p>	<p>11 – Agriculture, forestry, fishing and hunting</p>	<ul style="list-style-type: none"> ● Natural pesticides ● Biofuels ● Biomethane production ● Land management ● Organic Farming ● Agriculture ● Horticulture ● Aquaculture ● Warehousing/storage 	<ul style="list-style-type: none"> ● Park naturalists SOC 19-1031.03 ● Managers <ul style="list-style-type: none"> ○ First-line supervisors/managers of agricultural crop and horticulture workers ○ Crop and livestock managers SOC 11-9011.02 ○ Farm, ranch and other agricultural managers SOC 11-9011 ● Agricultural inspectors SOC 45-2011 ● Agriculture technicians SOC 19-4011.01 ● Farmers and ranchers SOC 11-9012 ● Farm workers <ul style="list-style-type: none"> ○ Farmworkers, 	<ul style="list-style-type: none"> ● Fish and game wardens SOC 33-3031 ● Agriculture science professors <ul style="list-style-type: none"> ○ Agricultural sciences teachers, postsecondary SOC 25-1041 ● Agricultural engineers SOC 17-2021 	<ul style="list-style-type: none"> ● Fisheries Biologist ● Biofuel Plant Field and Operations Engineer ● Biofuel Plant Field Technician ● Biodiesel/Biofuel Technology & Product Development Manager ● Alternative Fuels Policy Analyst and Business Sales ● Civil Engineer – Agriculture/Irrigation/Water Supply ● Agricultural/ Farm Worker

			<p>farm and ranch animals SOC 45-2093</p> <ul style="list-style-type: none"> ○ Farmworkers and laborers, crop SOC 45-2092.02 ● Landscaping and grounds keeping workers SOC 37-3011 ● Landscape designers and architects <ul style="list-style-type: none"> ○ Landscape architects SOC 17-1012 		
<p>Transportation/Alternative Fuel</p>	<p>48-49 – Transportation and warehousing</p> <p>21 – Mining</p> <p>54 – Professional and technical services</p>	<ul style="list-style-type: none"> ● Transportation Vehicles ● Logistics ● Structures ● Transportation Fuels (biogas, hydrogen, electricity, natural gas, biofuel, biodiesel) ● Transportation Systems ● Warehousing ● Green infrastructure (ports, airports, etc) ● Hybrid system 	<ul style="list-style-type: none"> ● Truck drivers <ul style="list-style-type: none"> ○ Truck drivers, heavy and tractor-trailer SOC 53-3032 ○ Truck drivers, light or delivery services SOC 53-3033 ○ Industrial truck and tractor operators SOC 53-7051 ● Bus drivers <ul style="list-style-type: none"> ○ Bus drivers, transit and intercity SOC 53-3021 ○ Bus drivers, school SOC 53-3022 ● Mechanics (liquefied natural gas –LNG and liquefied petroleum gas –PNG) <ul style="list-style-type: none"> ○ Bus and truck mechanics and diesel engine specialists SOC 		<ul style="list-style-type: none"> ● Automotive Plant Assembly ● Diesel Retrofit Installer ● Diesel Retrofit Manufacturer Plant Labor??? ● Electric Vehicle Electrician ● Hybrid Powertrain Development Engineer ● Powertrain Control Systems & Software Engineer ● Air Pollution Specialist ● Senior Automotive Power Electronics Engineer ● Diesel Retrofit Designer ● Biodiesel/Biofuel Technology & Product Development Manager ● Bus System Operator ● Train System Operator ● Electric Shipyard Operator ● Fueling Station Designer & Project Engineer ● Fuel Transporter – Trucker ● Alternative Fueling Station Operations ● Hydrogen Pipeline Construction ● Program Manager, Environmental Construction ● Urban Planner ● Environmental Engineering Manager

			<ul style="list-style-type: none"> 49-3031 <ul style="list-style-type: none"> ○ Automotive master mechanics SOC 49-3023.01 • Shipping & receiving <ul style="list-style-type: none"> ○ Shipping, receiving and traffic clerks SOC 43-5071 ○ Tank, car, truck and ship loaders SOC 53-7121 ○ Storage and distribution managers SOC 11-3071.02 • Railroad technicians & workers <ul style="list-style-type: none"> ○ Railroad brake, signal and switch operators SOC 53-4021 ○ Transit and railroad police SOC 33-3052 ○ Railroad conductors and yardmasters SOC 53-4031 ○ Signal and track switch repairers SOC 49-9097 ○ Locomotive engineers SOC 53-4011 ○ Locomotive firers SOC 53-4012 		<ul style="list-style-type: none"> • Environmental Planner • Energy Infrastructure Engineer • Environmental Engineer
Environmental compliance/ Public Policy/ Government	90 – Government 81 – Other services, except public	<ul style="list-style-type: none"> • Air and environment • Conservation and Pollution Prevention • Pollution Prevention, Rule Development 	<ul style="list-style-type: none"> • Environmental Auditors SOC 13-2011.02 • Environmental health & safety engineers 	<ul style="list-style-type: none"> • Sustainability planners • Environmental engineers • Urban and regional 	<ul style="list-style-type: none"> • Environmental Sampling Technician • Climatologist • Environmental Scientist • Environmental Engineer/Scientist Intern • Biologist – Marine/Fisheries

	<p>administration Non-Profit Sector Climate Change Adaptation (Climate Studies)</p>	<p>and Enforcement</p> <ul style="list-style-type: none"> • Cleanup/safety • Emissions control • Monitoring and compliance • Transportation systems 	<p>and technicians</p> <ul style="list-style-type: none"> ○ Environmental science and protection technicians, including health SOC 19-4091 ○ Industrial safety and health engineers SOC 17-2111.01 ○ Occupational health and safety specialists SOC 29-9011 ○ Environmental engineers SOC 17-2081 ○ Environmental scientists and specialists, including health SOC 19-2041 ○ Occupational health and safety technicians SOC 29-9012 ○ Mining and geological engineers, including mining safety engineers SOC 17-2151 ○ Environmental engineering technicians SOC 17-3025 • Urban and regional planning aides and technicians (including transportation planning aides) <ul style="list-style-type: none"> ○ City and 	<p>planners (including transportation planners*)</p> <ul style="list-style-type: none"> ○ Urban and regional planners SOC 19-3051 • Economists SOC 19-3011 <ul style="list-style-type: none"> ○ Statisticians SOC 15-2041 • Scientists <ul style="list-style-type: none"> ○ Soil and plant scientists SOC 19-1013 ○ Environmental scientists and specialists SOC 19-2041 ○ Biological scientists, all other SOC 19-1029.99 ○ Life scientists, all other SOC 19-1099.99 ○ Physical scientists, all other SOC 19-2099.99 ○ Food scientists and technologists SOC 19-1012 ○ Materials scientists 19-2032 ○ 	<ul style="list-style-type: none"> • Water Resource Engineer • Environmental Research Manager • GIS Specialist • Engineering Geologist • Urban Planner • Urban Renewal Planner • Conservation of Resources Commissioner • Power Systems Operator and Instructor • Air Quality Specialist and Enforcement Officer • Air Emissions Permitting Engineer • Chemist • Economist • Conservation Policy Analyst & Advocate • Climate change & Energy Policy Specialist Advocate • Water Resource Policy Specialist & Advocate
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			regional planning aides SOC 19-4061.01 <ul style="list-style-type: none"> ○ Environmental science and protection technicians, including health SOC 19-4091 ○ Soil and water conservationists SOC 19-1031.01 ○ Transportation managers SOC 11-3071.01 ○ Traffic technicians SOC 53-6041 		
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Green collar jobs – an analysis of the capacity of Green businesses to provide high quality jobs to men and women with barriers to employment, <http://bss.sfsu.edu/raquelrp/documents/v13FullReport.pdf>

Green Jobs Guidebook: Employment Opportunities in the New Clean Economy. www.edf.org/cagreenjobs

Greener pathways: Jobs and workforce development in the clean energy economy, <http://www.cows.org/pdf/rp-greenerpathways.pdf>

Jobs in LA’s green technology sector, http://www.economicrt.org/summaries/Green_Tech_synopsis.html

Green Careers Resource Guide, <http://www.cassio.com/GreenCareersResourceGuide.pdf>

Appendix B: Green Job Occupational Descriptions

Renewable Energy Technician or Installer

Similar standardized occupations (SOC Code): Environmental Science and Protection Technician (19-4091) and Electricians (47-2111).

The work of renewable energy technicians and installers is focused on installing, maintaining and repairing solar cells, wind turbines and other renewable energy applications. This position can include an emphasis on photovoltaic installation and design, solar hot water, and/or wind power installation and maintenance.

Individuals in this occupation typically need to have the skills of a construction worker combined with an in-depth understanding of renewable energy systems including solar, wind and hydro power. Individuals in this occupation often work outside and must be willing to work on top of roofs and other high places. This position also requires some applied mathematics, written and spoken communication skills, the ability to receive and follow directions as well as the ability to work as part of a team.

Education:

This occupation typically requires training in vocational schools, related on-the-job experience, or an associate's degree. Some may require a bachelor's degree.

Industry and Occupational Focus:

- The renewable energy technician or installer is typically found in energy production, the utilities industry, or in the construction industry installing or repairing solar panels or small-scale wind turbines.
- This occupation is considered for employment in the future by firms of all sizes, both large and small.
- This occupation is more likely to be considered by firms that are planning to engage in manufacturing, but are not currently.
- Clean technology sectors that are more likely to hire renewable energy technicians include those firms that are involved in energy generation, recycling and waste, and advanced manufacturing.

Sales Representative or Cost Estimator

Similar standardized occupations (SOC Code): Sales Engineer (41-9031) or Sales Representative (41-4011), and Cost Estimator (13-1051)

The work of sales representative and cost estimators is focused on understanding what customers or potential customers may need in terms of products or services and then developing a sales plan with the appropriate costs. These individuals often must understand the needs of the customer; have a comprehensive understanding of the products or services they are selling, and an ability to communicate effectively.

The critical skill sets include strong written and verbal communication, cost accounting skills as well as scientific aptitude using high technology tools and competency in mathematics and environmental sciences, and strong familiarity with computers. The level of scientific aptitude is largely dependent on the industry.

Education:

Sales representatives typically require a Bachelor's degree with additional education in the industry or product they are involved with. Cost estimators typically have lower educational requirements and can move up to sales representatives as they develop their experience and expand their educational base.

Industry and Occupational Focus:

- This occupation is considered for employment in the future by firms of all sizes, both large and small.
- This occupation is more likely to be considered by firms that are currently or planning to engage in manufacturing, and less likely to be hired by those firms that are focused on research, design, and consulting.
- The green economy sectors that are more likely to hire sales representative or cost estimators include those private firms that are involved in energy generation, transportation, and advanced manufacturing.

Assembler or Manufacturing Technician

Similar standardized occupations (SOC Code): Industrial Engineering Technician (17-3026) or Electrical and Electronic Equipment Assemblers (51-2022).

The work of assembler and/or manufacturing technicians is focused on assembling and fabricating finished products and the pieces that go into them. The products they assemble using tools, machines, and their hands range from entire airplanes to intricate timing devices. They fabricate and assemble household appliances, automobiles and automobile engines and parts, computers, electronic devices, and more.

The job of an assembler or manufacturing technician ranges from very easy to very complicated, requiring a range of knowledge and skills. Skilled assemblers or technicians putting together complex machines, for example, begin by reading detailed schematics or blueprints that show how to assemble the machine. After determining how parts should connect, they use hand or power tools to trim, shim, cut, and make other adjustments to fit components together and align properly. Once the parts are properly aligned, they connect them with bolts and screws or by welding or soldering pieces together.

Education:

These occupations usually require a high school diploma and may require some vocational training or job-related course work. In some cases, an Associate's or Bachelor's degree could be needed.

Industry and Occupational Focus:

- This occupation is considered for employment in the future by firms of all sizes, both large and small.
- This occupation is more likely to be considered by firms that are currently or planning to engage in manufacturing, and less likely to be hired by those firms that are focused on research, design, and consulting.
- The Green economy sectors that are more likely to hire manufacturing technicians include those firms that are involved in energy generation, transportation, water and wastewater, and advanced manufacturing.

Resource or Conservation Planner

Similar standardized occupations (SOC Code): Conservation Scientist (19-1031), Business Operation Specialists, All Other (13-1199.99) and Urban and Regional Planner (19-3051).

The work of resource and conservation planners is focused on assessing the energy or resource usage of facilities and companies and developing strategies to reduce usage or increase efficiency.

The critical skill sets include scientific aptitude using high technology tools and competency in mathematics, biology, chemistry, and environmental sciences, and strong familiarity with computers.

Education:

Most resource and conservation planners require a Bachelor's degree or Associate's degree with additional education in energy or conservation management.

Industry and Occupational Focus:

- This occupation is considered for employment in the future by larger firms or smaller firms that are sensitive to energy and commodity costs.
- This occupation is more likely to be considered by firms that are currently resource intensive and using larger quantities of energy in the production and manufacturing process
- This position is often found among manufacturers and government agencies but is starting to be found all across the economy, from information technology firms to agricultural firms.

Appendix C: Green degree/certificate programs, California Community Colleges¹⁷

Community College	Green Programs
Alameda	Automotive technology, diesel and truck mechanics
Allan Hancock	Civil engineering, natural science, environmental technology
American River	Ecology, natural resources, green diesel technology, geographic information systems (GIS), environmental design
Antelope Valley	HVAC, GIS, environmental horticulture
Bakersfield	Environmental engineering, environmental science, environmental horticulture
Barstow	Natural resources
Berkeley City College	Biotech program focus in physical sciences
Butte	Civil engineering, ecology, environmental science, hydrological sciences, natural resources, environmental horticulture
Cabrillo	Construction and energy management
College of the Canyons	Natural resources
Cerritos	Natural resources
Cerro Coso	Natural resources, industrial technology
Chabot	HVAC
Chaffey	Earth sciences
Citrus	HVAC, wastewater engineering and operations
Columbia	Environmental science, watershed restoration, GIS
Contra Costa	Earth sciences
Copper Mountain	Environmental sciences
Cosumnes River	Civil engineering, environmental engineering, GIS
Crafton Hills	Environmental sciences
Cuesta	Environmental science, natural resources, environmental horticulture, environmental biology
Cuyamaca	Civil engineering, environmental engineering, environmental science, wastewater, environmental management, environmental technician
Cypress	HVAC, GIS
De Anza	Ecology, pollution prevention, environmental stewardship, energy management and climate policy
College of the Desert	Ecology, HVAC, environmental science, environmental horticulture, alternative fuels technician, interdepartmental environmental studies
Diablo Valley	GIS, alternate energy technology program
El Camino	Horticulture, HVAC, environmental sciences, environmental technology
Evergreen Valley	Civil engineering, fuel and electrical technology
Feather River	Environmental sciences, natural resources
Foothill	Horticulture, environmental sciences, GIS
Fresno City	HVAC and industrial electronics, environmental technology
Fullerton	Environmental technology, environmental science
Golden West	Environmental technology, environmental studies- solar energy
Grossmont	Hydrology
Hartnell	Environmental technology
Imperial Valley	Industrial electronics, wastewater engineering and operations, environmental technology
Laney	Architectural & engineering technology, HVAC & refrigeration (environmental control technician), construction management, carpentry, welding, machine technology, physical sciences, electricity & electronics
Las Positas	Occupational health and safety
Long Beach City	Alternative fuels, HVAC
Los Angeles Pierce	Nursery technician, horticulture, natural resources, environmental science
Los Angeles Trade-Tech	Diesel technology, solid waste operations, HVAC, wastewater engineering and operations, GIS
Los Angeles Valley	Industrial operations and manufacturing, earth sciences

¹⁷ Source: Green jobs guidebook, California community colleges chancellor's office, August 22, 2007

Los Angeles Medanos	Appliance repair, environmental science, welding technology, physical sciences
Los Medanos College	Electronic technology, environmental science, welding technology, physical sciences
College of Marin	Civil engineering, environmental landscaping, natural resources, environmental science
Mendocino	Horticulture, HVAC, natural resources, computer and information applications- office environment
Merced	Agriculture science, horticulture, HVAC, natural resources
Merritt	Green building, urban farming ecology, horticulture, environmental restoration, environmental design & energy technology, human ecology, environmental hazardous materials technology
Mira Costa	Radiation
Mission	Environmental engineering, environmental technology
Modesto Junior	Horticulture, environmental engineer, natural resources, industrial systems technician
Moorpark	Civil engineering, environmental engineer, environmental science, environmental studies
Mt. San Antonio	Industrial electronics, HVAC, water distribution, agriculture power equipment
Mt. San Jacinto	Environmental sciences, wastewater engineering and operations, GIS, alternative fuels
Napa Valley	Natural resources
Ohlone	Natural resources, environmental studies, solar photovoltaic design and installation
Orange Coast	Civil engineering, HVAC, natural resources, machinist
Oxnard	HVAC, environmental science
Palo Verde	Welding, environmental engineer, automotive technician
Palomar	Building, welding, carpentry, wastewater engineering and operations, automotive technician, sheet metal
Pasadena City	Building, welding, carpentry, automotive technician
Porterville	Agricultural production
College of the Redwoods	Metal working, diesel fuel injection
Reedley	Metal working, horticulture, mechanized agriculture, agriculture technician, automotive technician
Rio Hondo	Building, welding, carpentry, heavy equipment, environmental technology, automotive technician
Riverside City	Building, welding, HVAC, automated systems engineering
Sacramento City	Civil engineering, ecology, HVAC, wastewater engineering and operation, railroad operations
Saddleback	Horticulture, ecology, automotive technician, construction inspection, geographic information system, environmental studies
San Bernadino	Metal working & welding, HVAC, wastewater engineering & operations, automotive technician
San Diego City	Building, welding, carpentry, plumbing, HVAC, pipefitting solar turbines
San Diego Mesa	Construction, GIS
San Diego Miramar	Heavy equipment operations, diesel technology
San Francisco City	Construction management, mechanical engineering, electrical engineering, environmental horticulture
San Joaquin Delta	Building, welding, carpentry, horticulture, HVAC, wastewater engineering and operations, natural resources, automotive technician
San Jose City	Building, welding, carpentry, horticulture, HVAC, machinist
San Mateo	Building, welding, carpentry, plumbing, HVAC, construction, metalworking
Santa Ana	Welding, automotive technician
Santa Barbara City	Ecosystem restoration, horticulture, environmental studies
Santa Rosa Junior	Sustainable agriculture, welding diesel technology, GIS, environmental horticulture, landscape design, garden design, environmental conservation (natural resources, watershed management)
Santiago Canyon	Public works, carpentry, wastewater engineering and operations
College of the Sequoias	Construction, welding, carpentry, HVAC, agriculture power equipment, welding industrial maintenance
Shasta	Civil engineering, horticulture, forestry, automotive technician, wastewater engineering and operations, natural resources, agricultural power equipment, welding, industrial operations
Sierra	Horticulture, watershed ecology, construction, metalworking, GIS, CAD environmental

	management skills
College of the Siskiyous	Welding
Solano CC	Horticulture, hazardous waste, wastewater engineering and operations, industrial systems, welding and metalworking, automotive specialist
Southwestern	Building and construction trades, environmental management, environmental technology
Taft	Automotive specialist
Ventura	Building and construction trades, horticulture, wastewater engineering and operations, natural resources, environmental studies
Victor Valley	Building and construction trades, horticulture
West Hills Coalinga	Precision agriculture
West Los Angeles	Power plant management and operations
West Valley	GIS
Yuba	Welding, horticulture, agriculture, industrial electricity, hazardous materials management

Appendix D: Model College Programs¹⁸

This addendum is meant to provide an introduction to some of the training and education programs that have effectively prepared students for positions in the green economy. The description of each college program will include a discussion of the overall goals of the education provided, a description of the curriculum provided, and an assessment of how the program will fit the employment needs of the clean technology industry, which is part of the larger green economy.

The three programs that are highlighted come from different geographic regions (West Coast of the United States, East Coast of the United States, and in the United Kingdom), focus on different academic degrees, and include programs in both community colleges and a university. While these programs are different in many ways, they share some important similarities; they are typically inter-disciplinary in nature and the curriculum includes applied coursework or internships as well as more traditional academic courses to anchor the programs.

Energy Management and Sustainability at Lane Community College, Eugene Oregon

Lane Community College has been a leader in training individuals for work in energy efficiency occupations, which is considered by many to be an important foundation for today's green economy. The director of the program, Roger Ebbage, who is also director of the Northwest Energy Education Institute (NEEI), is committed to teaching energy efficiency as the basis for not only the energy efficiency program, but also as the foundation for other programs taught under the energy management department at Lane.

Lane Community College offered one of the first associate's degree programs in energy efficiency, initially introduced at the community college in 1980. In 2003 the College introduced a program in renewable energy. Currently the College offers a two-year associate's degree of applied science in energy management (focused on energy efficiency) and a renewable energy technician degree. In the near future the energy management department will begin offering other associate's degree programs, including water conservation and collection as well as a degree in sustainability focused on resource conservation management.

Currently, the College accepts 30 new students annually for the energy management program and this program is typically at capacity with a waiting list of individuals who would like to enroll. According to Mr. Ebbage, 75 percent of those students that enter the energy management program at Lane have already received a four-year college degree and are coming back to get there associate's degree. The students are typically highly motivated and are looking to make a career change.

Curriculum

The two-year associate's of applied science degree in energy management includes courses in mathematics, physics, building and design, and English as well as the courses in energy and electrical engineering.

The more traditional academic courses include:

- Intermediate Algebra
- Fundamentals of Physics
- English Composition: Exposition and Introduction to Argument
- Technical Writing (English).

Some of the energy management courses include:

¹⁸ This information has been adapted but was originally written by BW Research in the Workforce Challenges and Opportunities report presented to the Los Angeles/Orange County Regional Consortium & the Los Angeles Trade-Technical College, February 2008

- Introduction to Sustainability
- Residential/Light Commercial Energy Analysis
- Air Conditioning Systems Analysis
- Energy Investment Analysis
- Energy Accounting.

The renewable energy technician degree program has many of the same requirements as the energy management degree, with a larger focus on building skills and a greater understanding of electrical theory.

Employment in Clean Technology

Graduates from Lane's energy management programs find opportunities in energy consulting positions or in the renewable energy field.

Some of the positions include:

- Renewable Energy Technician
- Operations and Maintenance Technician or Engineer (Energy and/or Utilities)
- Energy Auditor or Consultant.

The associate's degree also requires cooperative education and/or some type of internship. The cooperative education agreements are often made with regional utilities or other potential employers in the region.

Environmental Technology at Cape Cod Community College, West Barnstable Massachusetts

Cape Cod Community College's environmental technology program is viewed as one of the leading programs for the green economy offered in the community college system. The program offers an interdisciplinary approach to preparing students for employment as a technician in the environmental protection arena or a consultant in the field of sustainability.

The environmental technology program at Cape Cod was developed out of the environmental challenges facing the region in the early 1990's. In 1994, The Massachusetts legislature funded an education and training program that would supply a workforce to deal with these issues. Three higher education institutions: Cape Cod Community College, Massachusetts Maritime Academy and the University of Massachusetts at Dartmouth have collaborated, drawing upon the strengths of the three geographically connected institutions, to develop an education and training ladder that will prepare students for jobs in the environmental industry¹⁹.

Curriculum

The two-year associate's in science degree in environmental technology includes courses in chemistry, communications, engineering, earth science, and English as well as the courses in environmental technology.

The more traditional academic courses include:

- Survey in Chemistry
- Oral Composition (Communications)
- Introduction to Earth Science
- English Composition (I and II).

¹⁹ History taken from <http://www.capecod.edu/web/academics/depts/natsci/env>

Some of the environmental technology courses include:

- Environmental Instrumentation
- Environmental Chemistry
- Occupational Health & Safety through Hazardous Waste Management
- Coastal Ecology
- Quantitative Methods for Environmental Analysis.

The environmental technology program includes a number of course electives that focus on specialties including; industrial wastewater treatment, oceanography, geographic information systems, botany, air pollution, and renewable energy.

Besides the associate's degree program, the Community College, in collaboration with the Massachusetts Maritime Academy and the University of Massachusetts at Dartmouth, also offers environmental technology certificates. These certificates are designed to provide students with up-to-date knowledge of the principles and practices that are found in the environmental technology field.

These certificates include:

- Environmental Site Assessment
- Coastal Zone Management
- Geographic Information Systems
- Wastewater Management
- Water Supply.

Employment in Clean Technology

Graduates from Cape Cod's environmental technology programs find opportunities in environmental consulting positions or in the hazardous waste or environmental compliance field.

Some of the positions include:

- Research & Development Assistant or Technician
- Quality Control Technician
- Environmental Compliance Technician or Consultant.

Center for Renewable Energy Systems Technology at Loughborough University, Leicestershire United Kingdom

CREST (Center for Renewable Energy Systems Technology) is established within the Department of Electronic & Electrical Engineering at Loughborough University in the United Kingdom. The center is one of the leading international groups working in the field of renewable energy.

The CREST program is focused on renewable energy research, supporting the development and implementation of renewable energy projects, and providing training and education in both theoretical and practical aspects of renewable energy systems technology. CREST is a leading participant in the UK Energy Research Centre and has committed a significant portion of its resources to research on photovoltaics and wind power. CREST also owns and operates, as part of its training and educational resources, a broad range of renewable energy systems including, wind turbines, generators and photovoltaic equipment and cells, just to name a few.

Curriculum

CREST offers a traditional full-time, as well as a distance learning (on-line), master's of science in renewable energy systems technology. This is a post-graduate degree program with some requirements in mathematics and engineering.

The academic foundation of the coursework is grounded in:

- Electricity – An understanding of the ways in which electrical energy is generated and transported.
- Mechanics – A complete understanding of work, power, energy, and conversion efficiency.
- Fluid Mechanics – An understanding of how wind and water turbines convert energy in a fluid into mechanical energy.
- Mathematics – Use of mathematics to understand the technical basis for evaluation particularly used in the wind and solar modules.

The core courses in the program include:

- Sustainability, Policy and Energy Management
- Solar Power (I & II)
- Wind Power (I & II)
- Biomass (I & II)
- Water Power
- Integration of Renewables.

Besides the master's degree, CREST also provides short courses including a five-day wind power course.

Employment in Clean Technology

Graduates from CREST's renewable energy systems technology post-graduate program find opportunities in the renewable energy industry.

Some of the positions include:

- Research & Development Engineer
- Solar Energy Program Manager
- Wind Power Program Manager
- Energy Auditor or Consultant
- Clean Technology Teacher.

Appendix E: How to Utilize this Report

About Us - Description of EWD

The Economic and Workforce Development (EWD) 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 EWD 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 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 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.