



# Building a Clean Energy Workforce

Preparing Californians for New Opportunities  
in the State's Green Economy

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# Executive Summary

California's ground-breaking clean energy and environmental policies are creating new economic and job opportunities.

To deal with the challenging problems of air pollution, fossil fuel dependence and greenhouse gas emissions, the state has established a suite of policies that promote energy efficiency and clean sources of energy such as wind and solar. The implementation of these policies has already created new opportunities for trained workers, but in order to make California's clean energy economy a long-term reality, California must continue to expand the market for clean energy as well as create a permanent workforce trained in green technologies and practices. Job training programs are a critical engine for developing such a workforce to achieve the state's environmental and economic goals.

California is already making great strides, with hundreds of programs around the state training thousands of workers with the skills they will need to meet the demands of this new economy, from installing solar panels to improving building efficiency to servicing electric vehicles.

**There are at least 298 green job training programs in California, offered by 130 institutions.** These programs include multi-year apprenticeships, community college programs for career entry, and short-term certification-preparation courses for unemployed or underemployed workers. They include programs focused on energy efficiency, renewable energy construction and maintenance, alternative transportation fuels, and electric vehicle-related design and maintenance jobs. However, this total excludes many other programs—such as programs in architecture or engineering—that are relevant to the clean energy economy, but that train workers for non-energy related work.

**Through our outreach efforts, we received enrollment information concerning 111 of these programs, in which 12,600 to 15,100 students are enrolled annually.**

- Of the 64 institutions who responded to our query, 19 offer college credit or some sort of completion certificate, 10 offer associate's or bachelor's degrees, and 32 institutions offer programs

that either result in an industry-recognized certification or qualify students to sit for a certification exam.

- Community and technical college programs tend to focus primarily on energy efficiency, green building, and solar energy. Clean vehicle and other renewable energy programs are also common, while wind energy represents a much smaller portion of community and technical college programs.

**Five case studies in this report highlight how each type of training program has a unique role in preparing workers to make the state’s clean energy goals a reality. For example:**

- Putting people back to work: Underemployed construction workers can gain new skills and knowledge through short-term training programs to obtain certification in green energy practices, such as heating, ventilation, and cooling (HVAC) retrofits or green plumbing. CleanEdison, one of the nation’s largest green job training firms, enrolls more than 1,200 California students in clean energy programs per year.
- Model partnerships: Laney College in Oakland provides training through a partnership with non-profit organizations, workforce investment boards, and job placement agencies. Laney is able to tailor its trainings to supplement the skills that students already have. This four-pronged partnership has become the model for the new, statewide California Green Job Corps Program.
- Pathways for all: technical colleges, such as Los Angeles Trade-Technical College, attract new students of all

backgrounds and skill levels. Students receive hands-on training that gives them an entry point into the clean energy economy.

- Skill upgrades for union workers: Union training programs are integrating “green” skills into their existing apprenticeship programs.
- Teaching the teachers: There is a shortage of training programs for instructors of green technologies and techniques. In order to ensure consistency and quality among clean energy training programs, and to allow for the expansion of such programs, Hands On Solar, Inc., trains teachers through workshops and site visits.

**Job training programs in California are essential to successful implementation of the state’s policies, which are designed to spur investment in infrastructure for sustainable energy. Without adequately trained workers, California will not be able to meet the goals of its clean energy policies.**

- California has established ambitious goals to promote energy efficiency and the development of renewable energy sources.
  - o California’s renewable electricity standard requires that 33 percent of the electricity consumed in the state in 2020 come from renewable sources such as wind, solar, and geothermal.
  - o Reaching the goals of the Million Solar Roofs Initiative will require outfitting the equivalent of 1,000,000 rooftops in California with solar panels.

- o Policies to promote solar water heating call for installing 200,000 new solar water heaters by 2017.
- o The state's aggressive energy efficiency standards for new buildings will require improved construction techniques in millions of new structures.
- California's Clean Cars Program and the Low Carbon Fuel Standard will result in sweeping changes in vehicle and fuel technology.
  - o If the latest updates to the Clean Cars Program are adopted, up to 14 percent of new vehicles sold in California in 2025 could be electric vehicles and up to 68 percent could be hybrids.
  - o Because of the Low Carbon Fuel Standard, cleaner fuels will gradually replace gasoline. By 2020, up to 3.5 million cars could operate on 85 percent ethanol fuel, most of which would be cellulosic or advanced ethanol rather than the corn ethanol in use today.
- California's strong clean energy policies have already benefited the state's broader economy, energizing new growth in clean energy industries.
  - o Approximately 40 percent of global clean technology-oriented venture capital comes to California. Businesses and institutions in California have received \$11.6 billion worth of clean technology venture capital funding since 2006, supporting clean energy, energy efficiency, green transportation, energy infrastructure and storage, materials research, and other activities.
  - o From 2007 to 2008, even as unemployment increased during the early stages of the economic downturn, employment in the green sector increased by 5 percent.
  - o More than 500,000 employees currently work in "green jobs" in the state, and the energy efficiency sector is projected to employ two to four times as many workers in 2020 compared to 2008.
  - o 75,000 workers will have to be trained for energy efficiency jobs in the next decade to meet the demand for labor in 2020.

**To ensure continued growth of the clean energy economy and new job opportunities, California must maintain its commitment to policies that will help the state develop a clean energy future. Strong energy policies will help drive job growth, and solid training programs will help to create the workforce needed to implement those policies. Specifically, California should:**

- Ensure that the requirements outlined in clean energy, clean cars and global warming legislation are enforced, prompting governments and private companies to continue to invest in clean energy infrastructure and technology.
- Maintain California's momentum toward a clean energy economy after current goals are achieved: obtain a higher percentage of electricity from renewable sources, install solar panels on more rooftops, seek out additional energy efficiency savings, and continue to reduce emissions from vehicles.

- Continue to support policies that will lead to the creation of a self-sufficient market for clean energy technologies. Providing rebates or tax credits for energy efficiency or technologies like wind, solar, or solar hot water systems will foster the growth of these industries and keep demand for trained labor high.
- Support efforts to improve the quality and expand the reach of green job training programs.

# Introduction: Building a Better Way

In Humboldt County, moisture is a problem. The damp creeps into homes through cracks in windows and door-frames and gaps in insulation. If moisture is getting in, it's a pretty good bet that energy is getting out—and that's a problem, both for the environment and for homeowners' pocketbooks.

Contractor Isaac Lyons, owner of Humboldt Homes in Arcata, California, knows from experience that it takes skill to keep a home well-insulated. In his training to become a Building Performance Institute (BPI) certified Building Analyst and Building Envelope Specialist, Lyons learned how to make the energy systems in a home work together to maximize energy efficiency.

Although Lyons has always been self-employed, he struggled, like millions of other Californians, to find enough work after the 2008 economic downturn. In California, new home construction virtually ground to a halt. No new construction meant the loss of tens of thousands of jobs for carpenters, plumbers, masons, electricians, designers, site managers, and independent contractors like Lyons.

Though construction of conventionally built new homes has slowed dramatically,

opportunities abound in “green” construction. Supported by state policies encouraging better energy efficiency and increased use of renewable energy, home and building owners in California are seeking to invest in energy efficiency retrofits or renewable energy technologies, such as solar panels.

In order to take advantage of the promising new market for green construction and technologies, workers in California's construction trades will need to acquire additional skills and training in new, clean energy technologies and techniques. Responding to this need, public and private institutions have begun offering training programs—in energy efficiency, wind and solar technologies, and clean vehicles—all over California to fulfill the labor demands of the state's multi-billion dollar clean energy economy.

In 2009, for example, the Humboldt County Economic Development Division began re-training underemployed or displaced construction workers to become certified by BPI as well as Build It Green, a non-profit organization promoting green building in California. Lyons is a graduate of the county's Redwood Coast

Dislocated Worker Clean Energy Training Program.

“I’ve seen a wide-open market for green building,” Lyons said. “There aren’t enough people building in an appropriate manner by using green technologies.” Since he began focusing on building energy-efficient new homes and performing energy-efficient remodels, Lyons said work has been steady. Demand for workers trained in green construction outstrips the current supply of trained contractors in Humboldt County.

The supply of trained workers should increase in the coming years, according to Jacqueline Dyer, economic development specialist for the county. Green building is

way overdue in Humboldt, and the county’s program for dislocated workers is the first step toward training the workforce necessary to meet the area’s energy efficiency demands, she said.

This pattern is being replicated all over California, as thousands of people undergo training each year for clean energy jobs. Non-profits, community colleges, unions, and private companies are recruiting workers statewide to participate in training programs that will give them skills needed in California’s new economy. These skilled professionals will be essential to developing the clean energy economy that California has so ardently encouraged through its energy and environmental policies.



*In Humboldt County, a participant in the Redwood Coast Dislocated Worker Program, left, works with a young worker, right, from the county’s Youth Green Building Pre-Apprenticeship Program. They are retrofitting an old cookhouse that will eventually be a green hostel. Photo courtesy of Humboldt County Economic Development Division*

# The Importance of Green Job Training to California

California faces environmental and economic challenges resulting from its reliance on dirty fossil fuels. Fossil fuels generate much of the state's electricity and power its transportation sector; they are also the cause of California's notorious bad air quality and are a major source of global warming pollution. In addition, this dependence on fossil fuels leaves California residents and businesses at the mercy of volatile energy markets, hurts the economy, and sends millions of dollars out of the state to pay for imported fuel.

California has responded to these problems with a variety of policies designed to protect its environment, increase its use of renewable energy, and reduce the state's dependence on fossil fuels. However, the scale of the change envisioned for California will not be possible without a large, well-trained workforce.

## Energy Efficiency and Renewable Energy

California has adopted bold policies to cut global warming pollution, increase renewable electricity generation, and improve energy efficiency. These measures will have widespread effects on energy use and require the development of new job skills by workers in the construction and energy industries.

### Repowering California with Renewable Electricity

In the years to come, a growing percentage of electricity consumed in the state will come from renewable sources such as wind, solar, and geothermal power.

California's renewable electricity standard requires that 33 percent of the electricity consumed in the state in 2020 come from renewable sources.<sup>1</sup> This will mostly involve utility-scale wind and solar installations, but may also include smaller scale projects installed within urban centers where electricity demands are highest.

To promote the development of customer-owned, small-scale solar power generating capacity, the state has created

the California Solar Initiative (CSI), a program offering up-front incentives for solar installations on existing residential buildings and on new and existing commercial, agricultural, government and industrial properties.<sup>2</sup>

To encourage solar installations in new homes, the California Energy Commission (CEC) launched the New Solar Homes Partnership in January of 2007. This program is also part of the California Solar Initiative and has a goal of ensuring that solar electric systems are installed on half of all new homes built in California by 2016.<sup>3</sup> Reaching the goals of the California Solar Initiative and the New Solar Homes Partnership, along with similar programs administered by the state's numerous municipal utilities, should result in outfitting the equivalent of 1,000,000 rooftops in California with solar panels.<sup>4</sup>

California has also launched a new program to promote solar water heating as a way to reduce the state's dependence on natural gas. Through a special program within the California Solar Initiative, the state has set a goal of installing 200,000 new solar water heaters by 2017 through an upfront rebate program for residential, government, industrial, and commercial buildings.<sup>5</sup>

Reaching the goals of the California Solar Initiative and the New Solar Homes Partnership, along with similar programs run by the state's numerous municipal utilities, should result in outfitting the equivalent of 1,000,000 rooftops in California with solar panels.

## Investing in Energy Efficiency

California has invested heavily in energy efficiency for decades, and these measures have held the state's per capita electricity consumption constant over the last 30 years, despite economic growth.<sup>6</sup> Over the same time period, per capita consumption across the U.S. increased 40 percent.<sup>7</sup> California's energy efficiency efforts include:

- Rebates offered by utilities to consumers on hundreds of efficient items, including appliances such as washers, dryers, and refrigerators; commercial lighting and compact fluorescent bulbs; central air conditioners and ceiling fans; air duct sealing; and interior and exterior building insulation.
- Weatherization of more than 52,000 buildings in California, paid for with funds from the 2009 American Recovery and Reinvestment Act.<sup>8</sup>
- Adoption of strong efficiency standards for new homes, which are expected to save more than \$23 billion for consumers by 2013.<sup>9</sup>
- Adoption of appliance efficiency standards requiring manufacturers to reduce energy use in a wide variety of residential and commercial appliances, including clothes washers, light fixtures, televisions, and vending machines.

## Acting on Climate Change

California's Assembly Bill 32 (AB 32), passed in 2006, mandates that the state reduce its global warming emissions to 1990 levels by 2020 through a single, economy-wide emissions cap.<sup>10</sup>

The law is designed to encourage early adoption of pollution reduction strategies by state agencies and private companies,

thereby creating a new market for green technologies.<sup>11</sup> Innovation sparked by AB 32 could include “the next wave of energy-efficient lighting, appliance standards and industrial refrigerants,” according to California Air Resources Board Chairman Mary Nichols.<sup>12</sup>

## Advanced Vehicles and Fuels

California’s legislative requirements to address air pollution and global warming emissions from vehicles have already led to sweeping changes in vehicle and fuel technology. As California continues to battle air pollution, environmental policies along with consumer demand for greener cars will spur further innovation toward cleaner cars.

California’s Clean Cars program—which limits tailpipe emissions of smog-forming pollution and global warming pollution, and calls for the sale of advanced technology vehicles—has already contributed to the growing number of ultra-clean gasoline vehicles and hybrid-electric vehicles that have made their way onto California’s roads over the past decade. In the coming years, those standards will lead to the deployment of increasing numbers of high-tech plug-in vehicles, including plug-in hybrids and fully electric vehicles.

Fuel providers, too, have a role to play by developing less-polluting fuels. The state’s Low Carbon Fuel Standard seeks to lower the carbon content of transportation fuels in the state by 10 percent by 2020.<sup>13</sup> Fuel sellers can comply with this requirement by selling large volumes of fuel that is less polluting than gasoline and diesel, such as various types of ethanol and biodiesel, as well as by selling fuels with much lower lifecycle emissions, including electricity from low-carbon sources.

The Clean Cars program and the Low Carbon Fuel Standard will result

in sweeping changes in vehicle and fuel technology.

- If the latest updates to the Clean Cars Program are adopted, up to 14 percent of new vehicles sold in California in 2025 could be electric vehicles and up to 68 percent could be hybrids.<sup>14</sup>
- Low Carbon Fuel Standard regulations will gradually replace gasoline with cleaner fuels. The California Air Resources Board demonstrated that by 2020, up to 3.5 million cars could operate on 85 percent ethanol, most of which would be cellulosic or advanced ethanol rather than the corn-based ethanol in use today.<sup>15</sup> Hydrogen and electricity could also be in widespread use as vehicle fuels.<sup>16</sup>

## Clean Energy Policies Are Spurring Economic Growth and Demand for Skilled Workers

California’s aggressive limits on pollution and strong programs to promote clean energy have energized new growth in clean energy industries, such as solar power,



*Environmental Control Technology students at the Laney College training facility in Oakland learn how to wire and test single and three-phase motors and controls, which are often used in large-scale industrial retrofits, especially in heating and cooling systems. Photo courtesy of Laney College*

energy auditing, and the development of alternative fuels. These clean energy-related businesses have already been hiring thousands of workers and expect to hire far more in the coming years as the state continues to move toward a clean energy economy.

Clean energy policies have sparked investment in new businesses and clean energy research. Overall, from 1998 to 2007, more than 10,000 businesses in California created 125,000 green jobs.<sup>17</sup>

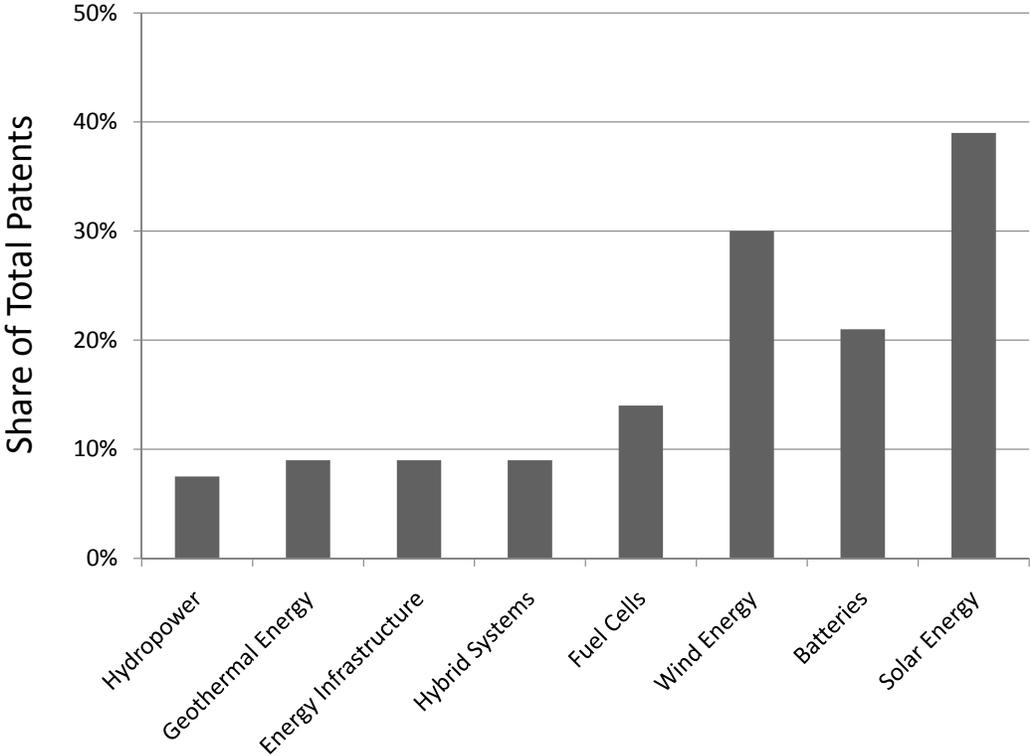
Encouraged by the promise of new markets, entrepreneurs have built new facilities in California. In January 2010, for instance, Cobalt Technologies opened the world's first bio-butanol plant in Mountain View; the plant will create about 1,300 full-time jobs and generate \$250 million annually in economic activity.<sup>18</sup> When then-Gov. Arnold Schwarzenegger spoke at the opening of the new plant, he credited California's global warming legislation with bolstering

investor confidence in the pilot project's ability to "grow into a profitable mass production of...advanced biofuel in the near future."<sup>19</sup>

The state's consistent support for clean energy also helps it attract more cleantech venture capital than any other state. In the first half of 2010, approximately 40 percent of global clean technology-oriented venture capital came to California. Since 2006, California has received \$11.6 billion of this cleantech funding, supporting clean energy, energy efficiency, green transportation, energy infrastructure and storage, materials research and other activities.<sup>20</sup>

This financial support is part of the reason that researchers and entrepreneurs in California hold a large share of the nation's green technology patents. From 2007 to 2009, nearly 40 percent of the nation's solar energy patents and 20 percent of battery patents were registered in California.<sup>22</sup> (See Figure 1.)

**Figure 1. California's Share of the Nation's Green Technology Patents in 2009<sup>21</sup>**



In the first half of 2010, approximately 40 percent of global clean technology-oriented venture capital came to California.

This venture capital funding has also helped to create jobs. Every \$100 million of venture capital creates an estimated 2,700 jobs, from positions for skilled hourly workers to university researchers.<sup>23</sup> During the recession, strong clean energy policies have enabled the clean energy economy to continue to grow, even as other types of employment have declined. Though employment overall fell from 2007 to 2008, employment in the green sector increased by five percent.<sup>24</sup>

Many of the green jobs located in California are in manufacturing and construction. According to the California Employment Development Department, more than 500,000 employees work in green jobs in the state.<sup>25</sup> Of those, more than 93,000 are in manufacturing, and nearly 68,000 are in construction.<sup>26</sup>

The promise of new jobs in the clean energy economy is a rare bright spot for workers at a time of mass unemployment.<sup>27</sup> A recent study by researchers at Lawrence Berkeley National Lab predicts that two to four times as many workers will be employed in the energy efficiency sector in 2020 compared to 2008.<sup>28</sup> California-

based energy efficiency firms surveyed by the researchers expected a 20 percent growth rate in their industry's jobs in the 12 months following the survey. Adding more than 50,000 person-years of energy-efficiency-related employment by 2020, as predicted in a 2010 study by the Institute for Research on Labor and Employment at UC Berkeley, will require providing some amount of training to more than 75,000 workers in the next decade.<sup>29</sup>

In some areas of the clean energy economy, jobs are being created more quickly than workers can be trained to fill them. For instance, the majority of California employers seeking to hire workers for energy efficiency projects have experienced difficulty finding skilled candidates.<sup>30</sup> This problem exists for both entry-level and managerial positions.

Sufficient training for workers in the skills required to create a clean energy economy is essential to California's successful transition to a new energy future.



*At Laney College, renewable energy students complete installation of solar panels and inverters. Photo courtesy of Laney College*

# Clean Energy Training Programs Respond to Call for Workers

California's aggressive policies to promote clean energy technologies and practices have spurred multi-billion dollar growth in that sector of the state's economy over the last decade. But without workers to build, operate and repair all the technological elements of a fully realized clean energy economy, California will have a difficult time maintaining the momentum it has built. Therefore, entrepreneurs, labor unions, local governments, community colleges, and non-profit organizations have begun to meet the demand for skilled workers by providing job training programs to train workers and instructors for California's clean energy economy.

## Clean Energy Jobs Require Specialized Training

Job training programs provide workers with new skills needed to function in a clean energy economy.

The skills required of a worker in a green job often overlap with those needed

for more traditional occupations. Many workers can transfer their existing skills to a new "green job" if they receive specialized training to fully take advantage of green job opportunities. For example, an electrician must perform many of the same steps when working in an efficient building as in a conventional one, but he or she must also be aware of the building's overall energy envelope and avoid compromising its insulation or allowing air to leak in. A mechanic servicing an electric vehicle may require some additional training to deal with more sophisticated electronics and braking, but other systems within the electric car may be identical to a conventional, gasoline-powered car.

Specialized training helps workers in many professions develop new skills appropriate to clean energy jobs. Improving energy efficiency, for example, may require the services of a range of professionals and technicians, including home energy raters and auditors, engineers, architects, weatherization technicians, project managers, HVAC technicians, lighting contractors, electricians, mechanical contractors, and general construction contractors.

## California Has Hundreds of Training Programs

California's vision for a clean energy future includes efforts to make millions of homes, commercial buildings, and vehicles more efficient, along with efforts to provide a rapidly increasing share of that energy from clean, renewable sources. The breadth and scale of California's clean energy efforts can be seen in the variety of training programs that have emerged to supply workers to the state's emerging clean energy economy.

**There are at least 298 clean energy education and training programs in California.** These programs may be single-course programs (such as the Building Performance Institute training offered by Train to Sustain) or multi-course programs (such as Sierra College's Solar Energy Technician Program). These programs include multi-year apprenticeships, community college programs for career entry, and short-term certification-preparation courses for unemployed or underemployed workers. They include programs focused on energy efficiency, renewable energy construction and maintenance, alternative transportation fuels, and electric vehicle-related design and maintenance jobs. However, this total excludes many other programs—such as programs in architecture or engineering—that are relevant to the clean energy economy, but that train workers for non-energy related work.

Between 12,600 and 15,100 students are enrolled in the 111 programs for which we received enrollment information. Of the 64 institutions who responded to our query, 19 offer college credit or certification that the student completed the course, 10 offer an associate's or bachelor's degree, and 32 institutions offer programs that either result directly in an industry-recognized certification or prepare students to sit for a certification exam.

California's training programs provide

points of entry into the clean energy economy for workers of all backgrounds and skill levels. Different institutions offer different models that suit the needs of workers. Private companies, for instance, often offer trainings at an accelerated pace, which may be advantageous to busy professionals who can't take much time off from work. The union model of long-term, on-the-job training may suit people who are looking to start out on a career path. Community colleges and trade-technical schools offer college credit for those workers who are considering furthering their education.

While training programs are often tailored to the needs of an individual worker, they are informed by the needs of industry, too. In fact, many training programs partner with private companies to ensure that students are learning skills and information relevant to positions available within the industry. Training programs represent a means for clean energy industries to ensure that new hires have the skills to do the job, but also a means to empower Californians to seek work in an expanding clean energy economy.

## Private Training Programs: Jumpstarting Workforce Preparation

California's energy policies have encouraged investors to channel millions of dollars into clean energy industries such as alternative fuels, solar, and wind. The same factors that have drawn these investors have also attracted private companies that provide training for workers interested in the clean energy economy. Private training programs represent a new industry, spawned by the state's active clean energy economy, and they turn out graduates rapidly.

These private training companies often

focus on preparing workers to take tests to obtain specific industry certifications, such as Leadership in Energy Efficiency and Design (LEED), Building Performance Institute (BPI), North American Technician Excellence (NATE), and Refrigeration Service Engineers Society (RSES).

### **CleanEdison: Certification Preparation**

CleanEdison, founded in 2008, is one of the nation's largest private providers of training for industry-recognized certifications in green construction, energy efficiency, wind, and solar.

In California, the company enrolls more than 1,200 students in its programs every year, according to Megan McInroy, CleanEdison's Director of Government Relations. The company has training facilities in Fremont, Sacramento, San Diego,



*A CleanEdison instructor points out technical variations in blower door testing during the hands-on field portion of a BPI Building Analyst course. Photo courtesy of CleanEdison*

Los Angeles, San Francisco, San Diego, San Jose, and Ventura. The number of students enrolled at each of these facilities is growing fast, she said, especially as demand for BPI weatherization certifications increases in California.

“Energy efficiency is poised for significant growth. I don’t think we’ve tapped into half the people who this training is going to mean something to.”

— Megan McInroy, director of Government Relations, Clean Edison

CleanEdison provides training to a variety of entrepreneurs and workers. According to McInroy, Californians who take classes at CleanEdison include workers already working in the construction industry, people who are new to green building but work in construction-related fields, and people who have no background at all in construction or in a related industry.

About 60 percent of CleanEdison students are already working in construction, according to McInroy, and they are either looking to add a clean energy service to their current offerings, train their staff members to comply with state standards, or start a new green building or energy efficiency business. Usually, these workers are self-employed or represent small businesses. Generally, they’ve already got a particular set of construction skills, such as plumbing or carpentry, as well as management skills.

“They aren’t training for new jobs,” says McInroy. “They’re adding another layer of skill over what was already there.”

Some of these students want specialized training on managing crews working

with green technologies or on how to run a green business, McInroy says. They need to know about sales, materials, suppliers, specialized software, industry trends, and green building codes. Therefore, in addition to the certification classes, CleanEdison is working to provide “ancillary” courses for administrative and support staff in these areas, as well as adding “crew chief” training for managers to its existing curriculum.

Another 10 to 15 percent of CleanEdison students don’t have a construction background but work in related sectors such as finance, real estate, sales and distribution, building materials, and manufacturing. According to McInroy, these students are generally entrepreneurs seeking to learn how solar, wind, energy efficiency, green building, and clean vehicles will impact their own businesses.

The rest of CleanEdison’s students are individuals who are receiving training through workforce development programs, McInroy said. In California, CleanEdison provides training for these individuals through partnerships with local workforce investment boards. In May 2010, for example, the North Orange County Community College District awarded CleanEdison a contract to provide energy audit training for 150 unemployed or underemployed workers in the county. The company made a similar arrangement with the San Bernardino County Workforce Investment Board in September 2010.

There is a positive feedback loop between policy, consumer demand, and clean energy jobs available for new graduates, according to McInroy.

“If states are putting out funds for job training, that’s one piece of the puzzle. But then if they don’t have incentives [for consumers] to buy the service, there’s no work for contractors, and therefore no one to train,” McInroy observes.

In California, the company is confident that its operations will continue to attract

a steady supply of workers seeking training to work in the state’s thriving clean energy sector. “Energy efficiency is poised for significant growth,” she says. “I don’t think we’ve tapped into half the people who this training is going to mean something to.”

## Community Colleges: Training for Every Background

Community and technical colleges—with their strong presence throughout the state, their flexibility in accommodating students from all backgrounds, and their rich pool of faculty expertise—are major providers of green job training in California. In fact, of the 130 green job training institutions identified in this report, at least 41 are community or technical colleges.

These institutions are not only important because they provide a stepping-stone to higher-level careers, but also because they work closely with community-based non-profits, unions, and utilities to broaden access to these training programs.

Community and technical college programs mirror the trends in the state’s clean energy economy. Most programs tend to focus on energy efficiency (22 percent), green building (20 percent), and solar (25 percent). Clean vehicle and other renewable energy programs make up another 27 percent, while wind energy represents around 6 percent of community and technical college programs.

### **Laney College: Tailoring Training for Students of All Backgrounds**

Laney College’s collaborative training program, which can be tailored for students with various skills and at different skill levels, has become a statewide green energy training model.

Laney College created the Oakland Green Job Corps Program in collaboration with local pre-apprenticeship programs, workforce investment boards, non-profits, and private companies to address the needs of the unemployed or underemployed. In this partnership, Laney is responsible for providing skills training. Private employers hire trainees and provide advice about the college's training programs. Workforce investment board partners channel unemployed workers into community college training programs. Non-profits provide support for non-traditional students, or help secure funding or additional resources for the other organizations in the network. Each partner brings unique resources to the table.

"The role of community colleges is crucial to high-quality skill development. Other organizations don't have the expertise or resources that we do, [such as] labs or qualified faculty. Community-based organizations are best at re-entry; they're good at pulling people back on their feet and getting their lives together. Community organizations create a bridge to the community college programs," says Peter Crabtree, dean of the Career and Technical Education Division at Laney College.

In 2009, the Oakland Green Job Corps program became the model for the new, statewide California Green Job Corps Program, which received \$20 million in grants to start pilot projects in 11 areas throughout the state. Crabtree thinks that the Green Job Corps Program is "highly transferable" and can be tailored to suit the needs of different regions.

Laney College develops short-term training "packages" that it offers through the Oakland Green Job Corps program. These training packages vary in scale and scope based on industry needs and Laney's market analysis as well as the specifications of an organization requesting the customized training.

For example, when Swords to Ploughshares wanted to train returning veterans in the field of solar power, Laney packaged a photovoltaic (PV) class with basic electricity instruction, a master electrician class, and a preparatory course for an industry-recognized solar certification.

When United Airlines laid off more than 10,000 aviation mechanics in the Bay Area, a local workforce investment board sought to retrain these workers in energy-efficient heating and cooling. In response, Laney College customized a training package for these displaced workers that "recognize[d] what they bring in the door, avoid[ed] redundancy, and [met] their needs," Crabtree explains.

"People are looking for training; they're looking for economic opportunities."

—Peter Crabtree, dean,  
Career and Technical  
Education, Laney College

For this reason, each program is unique. A program that is designed to train construction workers to become solar installers is shorter than a training program designed for unskilled workers because construction workers don't need as much basic training, according to Crabtree.

"We look at the job market and try to discern where the opportunities are so that we can design a package for them," Crabtree says. Laney has created customized short-term programs in energy efficiency and weatherization as well as residential energy auditing and sales. Administrators at Laney recognized early on that in order to weatherize millions of California homes, auditors and salespeople would have to reach millions of homeowners.

Laney recently completed an affiliation process with the Building Performance Institute (BPI), which certifies energy auditors, and is now able to provide BPI certification preparation and testing to its students at the end of their coursework and to provide BPI preparation and testing to contractors through a short, intensive course of study.

In addition to its Oakland Green Job Corps program, Laney College is “greening” its existing curriculum, according to Crabtree. A student majoring in Electrical Technology, for instance, will also get classes in solar. Laney has also developed a new program in Building Automation Systems which provides a two-year course of study in the latest processes and technologies supporting energy efficiency in commercial buildings.

“People are looking for training; they’re looking for economic opportunities,” Crabtree says, adding that the school’s tailor-made training programs have put Laney College on the “cutting edge” of training for workers of all backgrounds and experience levels.

## Technical Colleges: Training Workers of All Skill Levels

Like community colleges, technical colleges offer degrees or certifications that prepare students to enter specific vocations, such as auto repair or electrical work, within a year or two. Unlike community colleges, technical colleges do not typically attract students seeking to transfer to four-year academic institutions. Instead, there is a strong focus on “hands-on” learning, and these schools are generally equipped with training facilities that resemble a real-world work environment.



*Advanced Environmental Control Technology students at Laney College in Oakland conduct tests on commercial heating and air conditioning system components. Photo courtesy of Laney College*

## Los Angeles Trade-Technical College: Training Bank Tellers and Rocket Scientists in Green Technologies

Los Angeles Trade-Technical College has been providing job training for the city’s highest-demand industries and occupations since 1925. Like other two-year colleges in California, LATTC began providing green job training in response to sustained growth in the green building and clean energy sectors.

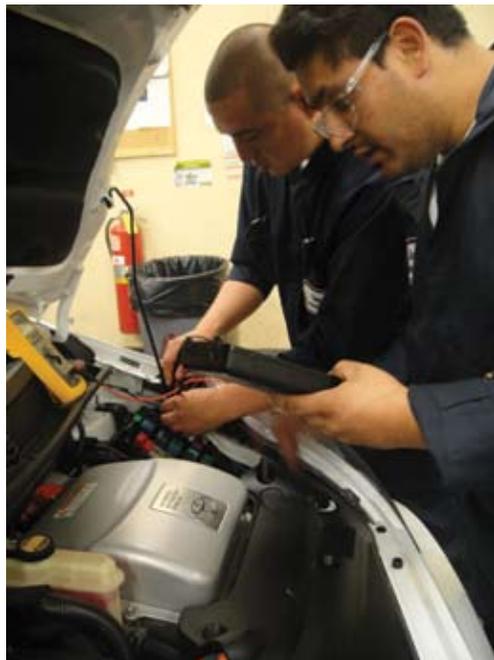
In 2006, the college adopted a Green College Initiative, which in addition to greening its campus, set goals for green education and training programs within its Workforce Development Department. The initiative, combined with funding from grants and other sources, resulted in an upgrade for the school’s training facilities, according to William Elarton, chair of the school’s Construction, Design, and Management Department. Elarton says that the school’s training facilities, which provide machinery and equipment for each student, set LATTC apart from other institutions. In June, the school became the eighth school in California to be an approved provider of a solar certification from the North American Board of Certified Energy Practitioners (NABCEP).

The school now offers more than 50

green-oriented classes and 14 degree and certificate programs in hybrid fuels, electric vehicles, energy efficiency, weatherization, and solar. The inclusion of green job programs at LATTC is broadening the institution's reach into the community. Historically, the institution has mostly enrolled young, low-income people. Now, the college is drawing students from a variety of backgrounds.

"We're starting to get folks from the Valley who would normally go to Pierce College," Elarton says. More locals from downtown Los Angeles are also enrolling. It is no longer easy to define the "typical" LATTC student, according to Elarton.

"In one class, I have a bank teller who has no mechanical skills whatsoever, a couple of [English as a second language] students ... and a rocket scientist from [NASA's Jet Propulsion Laboratory] who



*Two Transportation Technologies students at Los Angeles Trade-Technical College learn the inner-workings of a hybrid vehicle. Photo courtesy of Los Angeles Trade-Technical College*

wanted to learn solar," Elarton says.

"We're drawing a huge range of people ... who are really interested in solar and want to learn more about it," he says. Places like LATTC have the skills and background to train students in what they'll need to be successful, according to Elarton.

LATTC partners with community-based organizations to assist with the placement of trainees with contractors. These groups include Habitat for Humanity, Los Angeles Conservation Corps, and YouthBuild. The school also has indirect partnerships with large companies like Solar City and GRID Alternatives, whose executives sit on the advisory board for the Workforce Development Department. In addition, they make class visits to talk to students about industry issues, Elarton says. These relationships, which have been developing over the school's 85-year history as a trade school, are advantageous for students seeking employment after graduation, according to Elarton.

"In one class, I have a bank teller who has no mechanical skills whatsoever, a couple of [English as a second language] students ... and a rocket scientist from [NASA's Jet Propulsion Laboratory] who wanted to learn solar."

William Elarton, chair of the Construction, Design and Management Department at Los Angeles Trade-Technical College

## Union Training Programs: Providing Comprehensive Training

As the green job market expands, unions have begun to incorporate clean energy training into their existing curricula to prepare more highly skilled workers than ever before. Unions operate multi-year apprenticeship programs that train new electricians, plumbers and other skilled workers in the construction trades under the tutelage of mentors. These apprenticeship programs emphasize on-the-job training and real-world work experience.

Union programs are important because their model focuses on high-quality training and ongoing education while incorporating new technologies. Electrical workers who graduate from apprenticeships, for instance, have a wide range of skills that allows them to work on wind turbine motors, HVAC automation, solar panel installation, and energy-efficient lighting in addition to conventional electricity projects. This versatility allows them to take advantage of the full spectrum of clean energy opportunities, insulating them against fluctuations in local job markets.

Unions use regional training centers to place all apprentices into mentorships. These assignments change every year in order to provide a varied work experience for apprentices, who spend several thousand hours in on-the-job training over the course of the program. Unions may partner with community colleges for the classroom portion of the training. Typically, apprentices work for pay at their mentorship assignments during the day and take the for-credit college classes—which include both lectures and hands-on activities—two to three nights per week during the first half of the apprenticeship. During the second half of their apprenticeship, they work in a specialty field.

The apprenticeship training model reflects an emphasis on building up a

middle-class workforce. All union members may regularly contribute a small amount to a trust fund for new members, who receive benefits, pension plans, and middle-class wages during their training. Members generally don't pay college tuition for their classes during the apprenticeship, meaning they graduate without student loans. This lack of debt makes it easier for new graduates, or "journeymen," to start new businesses after their apprenticeship.

Aside from starting new businesses, graduates may also choose to apply the college credit earned during the apprenticeship toward the completion of a four-year degree in an area such as electrical engineering. Many graduates choose to continue working as journeymen for firms that partnered with the union during the training program.

Applicants for apprenticeships range from veterans to high school and college graduates. There are also mid-life professionals or single parents who have had a patchwork of different careers and are looking for a stable career to support a family. Non-union construction workers are often drawn to these programs by the promise of better benefits and a safer work environment.

## Teaching the Teachers

California's clean energy economy and training programs have grown so quickly that there are not enough experienced instructors to meet demand for training.<sup>31</sup> Training more instructors is a crucial element of allowing California's green workforce to expand.

The rapid changes in green technologies mean that teachers and administrators for clean energy and green building training programs are constantly challenged to keep up. In order to ensure that students

receive up-to-date training applicable to California's current green job market, teachers and programs need to receive periodic training and evaluation by those with expertise in both the green economy and in instruction.



*Brian Hurd, founder and CEO of Hands on Solar, Inc., conducts a teacher development workshop at Santa Monica College in 2009. Photo courtesy of Brian Hurd*

### **Hands on Solar, Inc.**

The majority of green job training programs in the state are targeted toward entry-level workers, with relatively few programs available for teachers, trainers, or program administrators. By 2007, there were still relatively few programs offering instruction in solar energy. Brian Hurd, founder and CEO of Hands on Solar, Inc., set out to change that.

“I started in solar back in the ’70s, before it was cool,” Hurd says. “I built a passive solar house in college that was totally energy-efficient in 1975, and my head was always into energy efficiency and conservation.” (Passive solar homes use no external power to move collected heat around the home.)

In 1979 Hurd attended a workshop on solar energy that changed his life.

Hurd pursued his interest in solar through construction projects after receiving his contractor's license, but it wasn't until he became the lead construction instructor at the East Los Angeles Skills Center (ELASC)—part of the Los Angeles

Unified School District (LAUSD)—in 2000 that he found an opportunity to teach it. The district had many “antiquated” classes for trades such as offset printing, machine shop, and textile sewing, and a few years after Hurd arrived, administrators called for “new and innovative instruction.”

So, in 2004 Hurd started incorporating passive solar, energy efficiency, and solar energy into his green construction classes.

“Solar was gaining a lot of attention in 2005. I tried to find out who else was teaching it in Los Angeles, and no other public school had formal classes in solar energy,” Hurd says.

In 2006, Hurd developed the Photovoltaics Installer curriculum at LAUSD, which went on to receive state approval. In 2007, the ELASC program became the first approved provider of solar training and examinations from the North American Board of Certified Energy Practitioners (NABCEP) in Southern California at a public school. The solar program grew popular, attracting students from as far away as Las Vegas, San Diego, and Santa Barbara. Then, a successful partnership with Homeboy Industries—a non-profit group focused on employing at-risk inner city youth and young adults—resulted in opportunities for entry-level employment in solar installation for the students, many of whom went on to finish the class and pass the NABCEP Entry Level Exam. The story drew attention from NPR, *Good Morning America*, the BBC, and the *Wall Street Journal*, according to Hurd.

“Our approach to teaching the Homeboys was the same as teaching our other students. We held them to a very high standard, and they responded,” Hurd says.

The attention the East Los Angeles Skills Center PV program received led to a flurry of e-mails to Hurd from other schools looking to start similar programs. Over the next year and a half, in addition to teaching full time at ELASC, Hurd

conducted free workshops for teachers and schools throughout California on how to start successful solar programs. Most of these events had the support of the Interstate Renewable Energy Council (IREC), Advanced Transportation Technology and Energy (ATTE), and the National Science Foundation CREATE consortium, among others.

“So many schools wanted to start instruction in solar and didn’t know where to start. We wanted to make sure they were pointed in the right direction,” says Hurd.

In 2009, Hurd took an early retirement from LAUSD and has since worked to help schools throughout California improve or start effective programs in solar energy and energy efficiency.

“Inconsistency in training is a real problem. There are brief, one-week courses that can’t offer very thorough training, and then there are yearlong, 400-hour programs. The quality of instruction is all over the board. If solar is going to have a future, we have to have minimum instructional standards and legitimate training opportunities with curriculum that is based on industry-set standards,” Hurd said.

Since 2008, Hurd has conducted 34 workshops with more than 600 participants at schools and colleges throughout California. These training events include: first, an orientation course to introduce teachers and administrators to what it takes to run a solar program; second, a site visit to schools to evaluate their facilities and determine what additional resources would be needed for an effective training program; third, if the schools are still serious about a solar program after a site visit, an intensive workshop for instructors. Finally, Hurd makes follow-up visits to evaluate how schools are doing.

The introductory workshops introduce administrators and teachers to the industry. The workshops address the importance of alternative energy and energy efficiency,

“We have a mind-boggling energy resource in the sun. The earth receives 970 trillion kilowatt hours of energy from the sun every day. That’s more energy than we could use in 20 years at current rates of consumption. We are accelerating the loss of fossil fuels, and it is not sustainable. Solar is our only real chance, and it’s not going to go away. Solar is the future, so I don’t ever worry about not having anything to do.”

– Brian Hurd, CEO, Hands on Solar, Inc.

the problem of global warming, the expansion of alternative energies and green technologies, projections of likely job growth areas, and the important role of trade schools and community colleges in the training mix, according to Hurd.

Other introductory workshops address generating local interest, industry support, and local government support for the training programs, as well as curriculum development and funding sources. Site visits address equipment requirements, lab set-ups, teacher training requirements, and space requirements. They also address finding qualified instructors, determining the scope and length of instruction, and developing a realistic budget, Hurd says. After a site visit, some schools decide to take the next step and send instructors to teacher development workshops.

Hands on Solar, Inc. training events have been attended by schools interested in starting programs and by those with existing programs wishing to enhance their instruction. Typically, Hurd trains around 25 to 35 teachers per workshop.

“The teacher development workshops are two-day, intensive events,” Hurd says. The teachers trained at the workshops come

from varying backgrounds. “They’re industry professionals with worlds of practical experience but with no formal teaching experience, or tech instructors from related fields who are new to solar technology—and everything in between,” he says.

These workshops cover what to teach and how to teach it, according to Hurd. Topics include: how to conduct classes and write effective lesson plans, where to find instructional resources and supporting information, how to structure lessons around the NABCEP Entry Level Learning Objectives, how to conduct hands-on activities, and how to teach the importance of safety.

While Hurd is convinced that the teacher trainings are starting to have an impact on the quality of training programs in California, he says the launch of the U.S. Dept. of Energy’s Solar Instructor Training Network (SITN) presents “a wonderful opportunity to take it to the next level.”

In January 2011, at Rio Hondo College in Los Angeles County, Hurd helped conduct the first of three, five-day, SITN teacher training events to help instructors currently teaching PV or planning to teach PV in the near future. Hurd, along with Tom Chatagnier of Diablo Valley Community College, will be a lead instructor at the following two SITN workshops; one is scheduled for March 2011 at American River College, and the other is scheduled for June 2011 at Fresno City College.

“We have a mind-boggling energy resource in the sun. The earth receives 970 trillion kilowatt hours of energy from the sun every day. That’s more energy than we could use in 20 years at current rates of consumption. We are accelerating the loss of fossil fuels, and it is not sustainable. Solar is our only real chance, and it’s not going to go away,” Hurd says. “Solar is the future, so I don’t ever worry about not having anything to do.”

# Policy Recommendations

California's pioneering clean energy policies are projected to result in the installation of solar panels on one million rooftops, the renovation of millions of homes to be more energy-efficient, the deployment of electric vehicles, and numerous other changes that will affect how the state produces and consumes energy. Realizing this vision will require the training of thousands of workers in a wide variety of fields.

California is already on its way to creating a clean energy economy with both policies and training programs that will be essential to future progress. By maintaining its commitment to clean energy, California can not only protect its environment but also create new economic opportunities for thousands of Californians. Specifically, California should:

- Continue to create demand for green technologies by ensuring that the requirements outlined in clean energy legislation and regulations are enforced. For example, state and local governments should ensure that the state meets its goal of getting 33 percent of its electricity from renewable sources by 2020. Furthermore, in order to continue to grow the market for clean energy in California, state and local policy makers should adopt policies that put California on a path to generating 100 percent of its electricity from clean energy sources.
- Support policies that will lead to the creation of a self-sufficient market for small-scale clean energy technologies. Providing rebates or tax credits for energy efficiency improvements or technologies like wind, solar, or solar water systems will foster the growth of these industries and keep trained labor in high demand. Rebates and other incentives should be secured for at least a 10-year period to give industries the confidence to invest in production, research, and development. To accomplish this, California policy makers should ensure that the goals of the Million Solar Roofs Initiative, the Solar Water Heating and Efficiency Act, and other such policies are achieved within their 10-year timeframes. State

and local policymakers should also go beyond these programs to build more renewable energy projects in the state through policies such as an expanded feed-in-tariff program.

- Require that all new government buildings at the municipal and state levels install solar technologies and other energy efficiency measures to offset electricity and natural gas usage, save taxpayers money, and help meet targets for reducing global warming pollution.
- Support efforts to improve the quality and expand the reach of green job training programs. Those efforts include building upon the successful cooperative model pioneered by Laney College and improving the teaching and technological skills of instructors at green job training programs. Adequate funding for community and technical college programs will enable all interested students to enroll in green job training programs and help fund the purchase of up-to-date equipment for students.

# Methodology

To assess California's capacity to train its labor force for jobs in the state's new clean energy sector, we identified green job training programs offered by academic and non-academic institutions in both the public and private sectors. A preliminary database of these programs was created in the summer of 2010.

## Identifying Training Programs

To identify an initial list of green job training programs in the state, we searched the websites of the following places: California Community College Chancellor's database; the California Association of Regional Occupational Centers and Programs; Advanced Transportation Technology and Energy (ATTE); the International Brotherhood of Electrical Workers; California State University College of Continuing and Professional Education; the Ella Baker Center: Green-Collar Jobs Campaign; Mother Earth

News; and the Ernest Orlando Lawrence Berkeley National Laboratory.

## Outreach Efforts

In order to find out how many students were enrolled in each training program and to correctly classify the focus and outcome of each program, we began contacting program directors or administrative officials at each institution in late September. We contacted them with an e-mail containing a questionnaire requesting the following information: name of institution; type of institution (non-profit, college or university, technical college, union, conference and training provider, private company, association, community college, workforce investment board, or regional occupational program); program name; program area of focus (solar, wind, energy efficiency, green building, clean vehicles, other renewable energy); and degree or certification received.

After tracking down contact information

for all programs, we sent an e-mail to all institutions offering only one program. After three days, we updated our program database with information from the responses and sent out a second e-mail, this time to institutions offering multiple programs. Three days later, we sent out a second round of e-mails to all of our single-program contacts who had yet to respond, as well as to new training programs discovered during the course of our outreach. After yet another three days, we sent another e-mail to our multiple-program contacts, as well as to any new programs. We then sent an e-mail to roughly 20 new contacts whom we had not previously contacted, either because of bad addresses or because they were new programs recently added to the database. In mid-October, we sent out a final e-mail to all institutions that had yet to respond to the survey, including both single- and multiple-program institutions. All responses were recorded in the program database.

Through our outreach efforts, we identified at least 298 training programs offered by 130 institutions. Of these institutions, 64 responded to our survey, though not all offered complete information. We received enrollment information from 42 of these institutions concerning 111 green job training programs. Where enrollment numbers were given as a range (i.e. 40-80 students per year), we calculated high and low enrollment estimates for each institution in our final tally of students. Therefore, we found that in the 111 training programs identified in this research, there are between 12,600 to 15,100 students enrolled every year.

Of the institutions who responded to our query, 19 offer college credit or some sort of certificate verifying completion of a program, 10 offer at least an associate's degrees, and 32 institutions offer programs that either result directly in an industry-recognized certification or qualify students to sit for a certification exam.

# Appendix A.

## Glossary of Acronyms

AED: Automated External Defibrillation	CEP: Certified Environmental Professional
AEE: Association of Energy Engineers	CET: Center for Employment Training
ARRA: American Recovery and Reinvestment Act	CGBP: Certified Green Building Professional
ASE: Automotive Service Excellence	CGD: Certified GeoExchange Designer
ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers	CHEERS: California Home Energy Efficiency Rating Services
BCA: Building Commissioning Association	CLEP: Certified Lighting Efficiency Professional
BEP: Business Energy Professional	CMVP: Certified Measurement and Verification Professional
BESA: Building Energy Simulation Analyst	CNG: Compressed Natural Gas
BOMA: Building Owners and Managers Association	CPQ: Certified Power Quality Professional
BPI: Building Performance Institute	CRM: Customer Relationship Management
CALCTP: California Advanced Lighting Controls Training Program	CSA: Canadian Standards Association
CBCA: Certified Business Continuity Auditor	CSDP: Certified Software Development Professional
CBCP: Certified Business Continuity Professional	DGCP: Distributed Generation Certified Professional
CBPCA: California Building Performance Contractors Association	DOE: Department of Energy
CEM: Certified Energy Manager	EBCP: Existing Building Commissioning Professional

EMIT: Energy Manager in Training	NATE: North American Technician Excellence
EPA: Environmental Protection Agency	NEASI: National Energy and Sustainability Institute
ESCO: Energy Services Company	NECA: National Electrical Contractors Association
ETA: Electronics Technicians Association	OSHA: Occupational Safety and Health Administration
GBE: Green Building Engineer	PE: Professional Engineer
GCP: Green Certified Professional	PV: Photovoltaic(s)
HEA: Home Energy Assistance	REA: Residential Energy Auditor
HERS: Home Energy Rating System	REP: Renewable Energy Professional
HVAC: heating, ventilation, and air conditioning	RESNET: Residential Energy Services Network
IBEW: International Brotherhood of Electrical Workers	HESP: Home Energy Survey Professional
LEED: Leadership in Energy and Environmental Design	RETA: Refrigerating Engineers and Technicians Association
LEED AP: Leadership in Energy and Environmental Design Associated Professional	RSES: Refrigeration Service Engineers Society
LNG: Liquefied Natural Gas	USGBC: United States Green Building Council
NABCEP: North American Board of Certified Energy Practitioners	
NAHB: National Association of Home Builders	

# Appendix B. Green Economy Training Programs

# Appendix B. Green Economy Training Programs

Type of Institution	Institution Name	Programs
Association	National Association of the Remodeling Industry	Green Professionals Certification Program
Association	Association of Energy Service Professionals	Energy Efficiency Training Program
Association	California Building Performance Contractors Association	Home Performance Training
Association	National Association of Home Builders	Green Building Certification Program
Association	North American Board of Energy Practitioners	Solar Thermal Installer Program, PV Installer Program, and Small Wind Turbine Installer Program
Association	American Institute of Architects - California Council	Green Building Codes Educational Collaborative
Association	Building Commissioning Association	Certified Commissioning Professional
Association	Building Owners and Managers Association	Building Energy Efficiency Program
College or University	University of California Energy Institute, California Wind Energy Collaborative	Small Wind Energy Systems, Wind Power Engineering, and Wind Energy Technician Training
College or University	University of California, Davis Extension	Green Building and Renewable Energy Certification Program
College or University	University of California, Berkeley Extension	Solar Energy and Green Building, Sustainability and Energy, Sustainability and Transportation, and Leadership in Sustainability and Environmental Management
College or University	Humboldt State University	Environmental Resources Engineering: Energy Resources
College or University	CSU East Bay	Biofuel Production Operations Certificate Program, Principles of Green Building Certificate Program, Wind Energy Apprentice Certificate Program, Building Analyst Quick Start Certificate Program, Certified Indoor Environmentalist Certificate Program, Green Supply Chain Professional Certificate Program, and Senior Sustainability Professional Certificate Program
College or University	CSU Fullerton	Green Building Certificate Program, Green HVAC Program, Green Data Center Management, Applied Sustainability, and Commercial Building Energy Auditing Certificate Program
College or University	Sonoma State University	Energy Management and Design Program and Green Building Certificate Program
College or University	Stanford University	Solar Energy Conversion Program
College or University	University of California, Davis, Energy Efficiency Center	Energy and Resources Group
College or University	University of California, Berkeley	Renewable Energy Program, Bioenergy Program
College or University	Hartnell College	Monterey Bay Green Building Pre-Apprenticeship Training Program, Renewable Energy Training Program, and Green Building Program
Community College	Los Angeles Community College District	California Clean Energy Workforce Training Program: Green Building Retraining Partnerships and Alternative and Renewable Fuel and Vehicle Technology Workforce Development Partnerships
Community College	San Diego City College	Solar Energy
Community College	Cerro Coso Community College	Wind Certificate Program, Industrial Technology Associate of Science Program

	<b>Program Classification</b>	<b>Annual Enrollment*</b>	<b>Degree Received</b>	<b>Associated industry certifications**</b>
	Green Building	60		
	Energy Efficiency			
	Energy Efficiency			BPI, CBCPA, and HERS
	Green Building			
	Solar and Wind			
	Green Building			
	Green Building			
	Energy Efficiency			
	Wind	50-60		
	Green Building, Solar, and Other Renewable Energy	110-220		
	Solar and Green Building	1,500		PE, ASHRAE, and LEED
	Energy Efficiency and Other Renewable Energy	340	Bachelor's degree in Environmental Resources Engineering; Master's degrees in Environmental Systems, Specialization in Engineering, Energy and Society	
	Other Renewable Energy, Wind, and Green Building			
	Green Building and Energy Efficiency			
	Energy Efficiency			
	Solar			
	Energy Efficiency			
	Other Renewable Energy			
	Green Building and Other Renewable Energy			
	Green Building and Clean Vehicles	225		
	Solar	40-80		
	Wind and Solar	30-40	Associate's degree	

Type of Institution	Institution Name	Programs
Community College	MiraCosta College	Hybrid Vehicle Service Technician Training and Green Building Pre-Apprenticeship Training Program
Community College	Rio Hondo College	Advanced Transportation and Energy Technology (ATTE) Program
Community College	Diablo Valley College	Energy Systems: Photovoltaics and Solar Thermal
Community College	North Orange County Community College District	Clean Energy Workforce Training Program: Green Building Training Program
Community College	Grossmont-Cuyamaca Community College	Solar Photovoltaic Installation and California Clean Energy Workforce Training Program
Community College	College of Siskiyous	Environmental Resources
Community College	Kern Community College District Clean Energy Center	WindTech and SolarTech
Community College	Sierra College	Solar Energy Technician Program
Community College	Merritt College	Environmental Management and Technology
Community College	American River College	Green Pre-Apprenticeship and Solar Program
Community College	Imperial Valley College	Building Green Retrofitted Energy Efficient Neighborhoods Program
Community College	San Mateo County Community College District	Solar Installer Training Program
Community College	Contra Costa College	Richmond BUILD Green Careers Academy (RBGCA): Energy Efficiency Program, Solar Installation Program, Green Diesel Program, and Hybrid Technology Program; Contra Costa Green Building Retraining Partnership
Community College	Consumnes River College	Weatherization and Green Building Program
Community College	De Anza College Occupational Training Institute	Solar Program and Energy Management Training
Community College	Glendale Community College	Greentech Environmental Program
Community College	Imperial Valley College	Biofuel Industry Program
Community College	Long Beach City College	Advanced Transportation Technology and Energy (ATTE) Program, Electric Hybrid Vehicles Program, Clean Diesel Training Program, and Green Building and Water/Energy Efficiency Workforce Training Partnership
Community College	Modesto Junior College	CTE Valley Sierra Collaborative
Community College	Cypress College	Advanced Transportation Technology and Energy (ATTE) Program

	<b>Program Classification</b>	<b>Annual Enrollment*</b>	<b>Degree Received</b>	<b>Associated industry certifications**</b>
	Clean Vehicles and Green Building	120-140		
	Clean Vehicles	200	Associate's degree in Automotive Technology	ATTE Certificates
	Solar	185	Associate's degrees in Energy Systems with a Specialty in Photovoltaics and Energy Systems with a Specialty in Solar Thermal	
	Green Building	150		
	Solar, Green Building, and Energy Efficiency	137		OSHA 510 and 3095 certifications, 10-Hour OSHA Construction Safety card and CPR/First Aid/AED certification, and BPI Home Analyst and Envelope Shell certifications
	Solar, Energy Efficiency, and Other Renewable Energy	100	Associate's degree	
	Wind and Solar	77		NABCEP Entry Level Solar PV and 10-Hour OSHA Construction Safety card
	Solar	40		NABCEP Entry Level Exam
	Energy Efficiency	30	Associate's degree	
	Other Renewable Energy and Solar			
	Energy Efficiency and Solar			
	Solar			
	Energy Efficiency, Solar, and Clean Vehicles			
	Energy Efficiency and Green Building			
	Solar and Energy Efficiency			
	Other Renewable Energy			
	Other Renewable Energy			
	Clean Vehicles, Green Green Building, and Energy Efficiency	477-1227	Associate's degrees in Alternative Fuels and Electric Vehicles	ATTE certificates in Alternative Fuels with an emphasis on CNG/LNG and Electric Vehicles and Light- and Medium-Duty Alternative Fuels and Heavy-Duty Alternative Fuels; CSA CNG Systems Inspector certification exam; ASE F1 CNG systems exam; Smog Check Technician's Exam; Certified Green Building Professional (Build it Green), LEED Green Associate (USGBC), Home Energy Rating System (CaCERTS), and Building Performance Analyst with Energy Star (CBPCA and BPI)
	Clean Vehicles			

Type of Institution	Institution Name	Programs
Community College	Laney College and Oakland Green Job Corps	Customized Energy Efficiency Programs, Energy Efficiency Sales and Auditing Programs, Renewable Energy Program, Building Automation Systems Program, and Building Performance and Energy Efficiency Program
Community College	San Bernardino Community College District	Green Building Program, Solar Installation Program, and Energy Efficiency Program
Community College	Santa Monica College	Solar Photovoltaic Installation Training, Solar Power Systems Training, Energy Efficiency Auditing Training, Certified Green Building Professional (CGBP) program, Building Performance Institute (BPI) Certified Professional programs, Home Energy Rater (CalCERTS, CBPCA, CHEERS), Leadership in Energy and Environmental Design (LEED) Certificate, Certified Commissioning Professional (AEP) Certificate, Sustainable Development Professional (BCA) Certificate, Certified Photovoltaic Installer (NABCEP), Certified Water/Energy Auditor (Green Plumbers USA), Certified Solar Hot Water Installer (NABCEP), Accredited Green Plumber (Green Plumbers USA), and HVAC Contractors (NATE)
Community College	Solano Community College	Green Building Program and Renewable Energy Program
Community College	Victor Valley College	Biofuel Production Training
Community College	Cerritos College	Advanced Transportation Technology and Energy (ATTE) Program
Community College	Advanced Transportation Technology and Energy (ATTE) Initiative	Economic and Workforce Development program
Community College	College of the Desert	Desert Region Renewable Energy Program and Advanced Transportation Technology and Energy (ATTE) Program
Community College	City College of San Francisco	Advanced Transportation Technology and Energy (ATTE) Program; San Francisco Green Building Pre-Apprenticeship Training Program/ Bay Area EV Training Consortium: Green Building Program, Solar Installation Program, Energy Efficiency Program, Electric Vehicle Program, and Alternative Fuels Program
Community College	Fresno City College	Solar PV, Wind Tech Training, Architecture, LEED, and Weatherization
Community College	Sacramento City College	Advanced Transportation Technology and Energy (ATTE) Program
Community College	San Diego Miramar College	Advanced Transportation Technology and Energy (ATTE) Program
Community College	West Valley College	Advanced Transportation Technology and Energy (ATTE) Program
Conference and Training Provider	Airstreams Renewables, Inc.	Wind Turbine Technician Training
Conference and Training Provider	Building Operator Training	Building Operator Certification
Conference and Training Provider	Contractors State License Services	Solar Program and PV Installation Program
Conference and Training Provider	Pacific Energy Center in San Francisco	
Conference and Training Provider	PG&E Energy Training Center - Stockton	HVAC Technology

	<b>Program Classification</b>	<b>Annual Enrollment*</b>	<b>Degree Received</b>	<b>Associated industry certifications**</b>
	Energy Efficiency, Other Renewable Energy, and Green Building	2,000		
	Green Building, Solar, and Energy Efficiency			
	Solar, Energy Efficiency, and Green Building			BPI certificates: Building Analyst Professional, Envelope Professional, and Building Performance Contractor; CGBP Certificate, CalCERTS, CBPCA, CHEERS, LEED, AEP, BCA, NABCEP, Green Plumbers USA and NATE
	Green Building and Other Renewable Energy			
	Other Renewable Energy			
	Clean Vehicles			
	Clean Vehicles		Associate's degrees	SCRTCC, CSA, CALCTP, CNG, and LNG
	Other Renewable Energy and Clean Vehicles			
	Green Building, Solar, Energy Efficiency, Clean Vehicles, and Other Renewable Energy			
	Solar, Wind, Green Building, Other Renewable Energy, and Energy Efficiency	196	Associate's degrees	NATE, HERS, RETA, and Weatherization
	Clean Vehicles			
	Clean Vehicles			
	Clean Vehicles			
	Wind	150		
	Green Building			
	Solar			
	Energy Efficiency			

Type of Institution	Institution Name	Programs
Conference and Training Provider	San Diego Energy Resource Center	
Conference and Training Provider	Southern California Edison Customer Technology Application Center in Irwindale	
Conference and Training Provider	Sacramento Area Electrical Training Center	Energy Efficiency Program and Solar Program
County Government	Kern, Inyo, and Mono counties	Green Building Pre-Apprenticeship Program
County Government	Alameda County Office of Education	Green Pathways Pre-Apprenticeship Program
County Government	County of Humboldt Economic Development Division	Redwood Coast Pre-Apprenticeship Clean Energy Training Program and Redwood Coast Dislocated Worker Clean Energy Training Program
County Government	Windsor Institute for a Sustainable Economy	Electric Vehicle Training Program
Non-Profit	Rising Sun Energy Center	California Youth Energy Services (CYES) and Green Energy Training Services
Non-Profit	East Los Angeles Skills Center	Alternative Fuels Program, Powerline Program, and Photovoltaic Installation Certification Preparation
Non-Profit	Twin Rivers Adult School	Master Green Retrofit Builder Certification Program, BPI Building Analyst and Envelope and Shell Certification Program, Air Sealing and Insulation Weatherization Program, Thermography Program, Wrightsoft HVAC Software Certificate Program, Pro Energy Modeling Software Certificate Program, Photovoltaic Training Program, Solar Thermal Training Program, Wind Energy Training Program
Non-Profit	Center for Employment Training	HVAC/Green Technology Training and CET Weatherization Program
Non-Profit	Association of Energy Engineers	Certified Energy Manager, Green Building Engineer, and Renewable Energy Professional
Non-Profit	Building Performance Institute (BPI)	Energy Efficiency Certification Program
Non-Profit	Clean Tech Institute	Certified Electric Vehicles Technician, Certified Clean Tech Technician, Certified Photovoltaic Systems Specialist, Certified Clean Tech Project Manager, and Certified Clean Tech Engineer
Non-Profit	Community Development Technologies Center (CDTech)	Green Corps Program
Non-Profit	Eco-Hut Academy	Green Construction, Small Wind, and Green for Real Estate Agents
Non-Profit	International Ground Source Heat Pump Association	Geothermal Heat Pump Installation
Non-Profit	JobTrain	PV Systems Design and Installation
Non-Profit	Los Angeles Conservation Corps	Energy Efficiency Program and PV Installation Program
Non-Profit	LEED Northern California	Energy and Environment
Non-Profit	North American Technician Excellence	Certification in HVAC efficiency
Non-Profit	Residential Energy Services Network	Energy Efficiency Program
Non-Profit	SEE Green Careers	Solar Installation Training Program
Non-Profit	Solar Living Institute	Solar Training
Non-Profit	Solar Tech Institute	Solar Installation Program
Non-Profit	US Green Building Council Certification Institute	LEED Certification Program
Non-Profit	Build it Green	Green Building Program

	<b>Program Classification</b>	<b>Annual Enrollment*</b>	<b>Degree Received</b>	<b>Associated industry certifications**</b>
	Energy Efficiency and Solar	800		
	Green Building			
	Green Building			
	Green Building	71-104		10-Hour OSHA certification card and BPI Certified Envelope Professional, and Build It Green certification
	Energy Efficiency and Green Building	30		
	Energy Efficiency	150-200		
	Other Renewable Energy, Energy Efficiency, and Solar	600		NABCEP
	Green Building and Wind	350-1,000		Level-one thermography certification
	Green Building and Energy Efficiency	17		ESCO Institute and Green Mechanical Council Exams
	Energy Efficiency, Green Building, and Other Renewable Energy			BEP, BESA, CBCP, CEA, CEM, CEP, CGD, CLEP, CMVP, CPQ, CRM CSDP, DGCP, EBCP, EMIT, GBE, REA, and REP
	Energy Efficiency			
	Clean Vehicles, Other Renewable Energy, and Solar			
	Green Building, Energy Efficiency, Wind, and Solar	32		BPI Building Analyst and NABCEP
	Other Renewable Energy			
	Solar			
	Energy Efficiency and Solar			
	Green Building			
	Energy Efficiency			GCP
	Energy Efficiency			
	Solar			
	Solar			
	Solar			
	Green Building			
	Green Building			

Type of Institution	Institution Name	Programs
Non-Profit	Sacramento Employment and Training Agency	Clean Energy Workforce Training Program: Green Building Pre-Apprenticeship, Green Building Retraining, and Alternative Vehicles and Fuels
Private Company	Everblue Energy Training Institute-San Jose	LEED certifications: Green Associate, Building Design and Construction, Operations and Maintenance, Commercial Interiors, Neighborhood Development, Homes, Project Management, and Consulting; CALGREEN Building Code training; BPI certifications: Building Analyst, Envelope Professional, Heating Professional, Multi-Family Professional, and Air Conditioning / Heat Pump Professional; Weatherization: Air Sealing & Insulation Technician; Business of Energy Auditing and Energy Retrofits; Commercial Energy Manager; Basics of Solar; Business of Solar; Solar Bootcamp; and Basics of Wind
Private Company	Energy Conservation Institute	Construction and Building Inspector program
Private Company	Green Career Institute	Solar Installation Program
Private Company	Greener Dawn Inc.	BPI Affiliate Program
Private Company	Verve Solar Consulting	Solar Industry Primer, The Business of Solar, Solar Careers and Opportunities, and Energy Careers and Opportunities
Private Company	Solar Training Institute	Solar Training Program
Private Company	Renova Energy Academy	PV Training Program, Solar Thermal, and Energy Efficiency
Private Company	Environmental Institute of America	Energy Efficiency and Green Building Program, Solar Program, and Biogas Program
Private Company	Sun Pirate	Fundamentals of Solar Hot Water Heating, Photovoltaic System Design and Installation, and Electric and Safety Basics for Solar Installers
Private Company	Community Alliance for Career Training and Utility Solutions (CACTUS)	Online Weatherization Training
Private Company	Advanced Vocational Institute	RESNET Home Energy Survey Professional, BPI Building Analyst, RESNET HESP, Solar Design and Installation, Solar Sales/Marketing, Home Energy Auditor, HEA and Weatherization, HEA and Energy Retrofitter, Wind Energy, and Solar Hot Water/Thermal Heating
Private Company	Boots on the Roof	Renewable Energy Program, Solar Retraining Program, and Wind Retraining Program
Private Company	Brooks Engineering, LLC	PV Installation Training Program
Private Company	CalCERTS, Inc.	Home Energy Rating System (HERS) Rater certification training
Private Company	California Wind Tech	Wind Energy Training Program
Private Company	CleanEdison	LEED Green Associate Training; BPI certifications: Building Analyst, Envelope-Shell, Heating Professional, AC/Heat Pump Course, Multifamily Building Analyst; Training; Solar Training; Wind Training; GeoThermal Training; Thermographer Training; Infrared Building Science Training; Weatherization Certification
Private Company	Green Exam Prep	LEED Green Associate Training

	<b>Program Classification</b>	<b>Annual Enrollment*</b>	<b>Degree Received</b>	<b>Associated industry certifications**</b>
	Green Building and Clean Vehicles	576		Certified Green Building Professional (Build It Green)
	Green Building, Solar, Other Renewable Energy, Wind, and Energy Efficiency	1,000		LEED and BPI certifications, RESNET HERS Rater, and NABCEP Entry Level Solar Certification
	Green Building			
	Solar			
	Green Building			
	Solar	300-500		
	Solar	180-200		NABCEP Certified PV Installer
	Solar and Energy Efficiency	80		
	Energy Efficiency, Green Building, Solar, and Other Renewable Energy			LEED certifications: Green Associate, Accredited Professional in Building Design and Construction, Interior Design and Construction, and Operations and Maintenance; BPI certifications: Building Analyst and Building Envelope Specialist; and NABCEP Certified Installer
	Solar	300		NABCEP Entry Level Certificate of Knowledge
	Energy Efficiency			
	Other Renewable Energy, Energy Efficiency, Wind, and Solar			RESNET HESP, BPI Building Analyst, and NEASI
	Other Renewable Energy, Solar, and Wind			
	Solar			
	Energy Efficiency			HERS Rater
	Wind			OSHA 10-Hour Construction Safety card; MEDIC First Aid certification in CPR and AED
	Green Building, Energy Efficiency, Solar, Wind, Clean Vehicles, and Other Renewable Energy			BPI and LEED certifications
	Green Building			

Type of Institution	Institution Name	Programs
Private Company	Solar Richmond	Solar Installation Training Program
Private Company	Train to Sustain Los Angeles	BPI Training Program
Private Company	Green Plumbers USA	California Winter Series
Regional Occupation Program	Mission Valley ROP	Construction Technology
Regional Occupation Program	Coastline ROP	Environmental and Energy Technology
Regional Occupation Program	Colton Redlands Yucaipa ROP	PV Solar Installer Program and Energy Efficiency Training Program
Regional Occupation Program	East Bay ROP	Green Construction Program
Regional Occupation Program	North Orange County ROP	Green Construction Program
Regional Occupation Program	Tri-Valley ROP	Alternative Energy Program
Technical College	Applied Professional Training	Renewable Energy Program
Technical College	Abram Friedman Occupational Center	PV Systems Certification Program
Technical College	Allied American University	Green Architecture Program, Solar Energy Business Program
Technical College	Allied Schools	Training4Green: Green Building Program, Solar Installation Program, and Energy Auditing Program
Technical College	Los Angeles Trade-Technical College	Clean Energy Pre-Apprenticeship (CEPA) Program, Weatherization and Energy Efficiency, Solar PV, Solar Thermal, and Alternative Fuels and Hybrid Program; Los Angeles Infrastructure and Sustainability Jobs Collaborative: Solar Program and Energy Program
Union	International Brotherhood of Electrical Workers (IBEW) Locals 11, 551, and 569	Inside Wireman 5-Year Apprenticeship Program and PV Design and Installation
Union	Fresno Area JATC	PV Installation Training Program
Union	Inland Empire JATC	Energy Auditing Program and Solar Installation Program
Union	IUOE Local 39	LEED Certification Program
Union	Solano-Napa Counties JATC	Wind Generation Installation Program and PV Installation Program
Workforce Investment Board	South Bay Workforce Investment Board	Gateways to Green Building Program (GGB) and Renewable Energy Program
Workforce Investment Board	Northern Rural Training and Employment Consortium: Butte, Del Norte, Lassen, Modoc, Nevada, Plumas, Shasta, Sierra, Siskiyou, Tehama, and Trinity counties	Green Building Program and Energy Efficiency Training Program
Workforce Investment Board	San Luis Obispo County	Green Building and Clean Energy Pre-Apprenticeship Training Partnerships: Energy Weatherization Program and Energy Efficiency Retrofit Program
Workforce Investment Board	Green Regional Education and Employment in the Northbay (GREEN): Napa, Marin, Solano, and Sonoma counties	Green Building and Clean Energy Retraining Partnerships: North Bay Employment Connection

\* Enrollment information for some programs has been omitted at the the institutions' request

\*\* This column includes industry-recognized certification exams that students may take after completing a program, as well as certifications that re

	<b>Program Classification</b>	<b>Annual Enrollment*</b>	<b>Degree Received</b>	<b>Associated industry certifications**</b>
	Solar			
	Green Building			
	Other Renewable Energy			
	Solar and Energy Efficiency	75		
	Energy Efficiency and Other Renewable Energy	26		
	Solar and Energy Efficiency			
	Green Building			
	Green Building			
	Other Renewable Energy			
	Other Renewable Energy	100		ETA Solar Certification Level 1 and NABCEP Entry Level Exam
	Solar			
	Green Building and Solar			
	Green Building, Solar, and Energy Efficiency			
	Other Renewable Energy, Energy Efficiency, Solar and Clean Vehicles	450-550	Associate's degrees	NABCEP
	Solar and Energy Efficiency	1,060-1,660		California State Certification for Electricians, Journeyman Inside Wireman, and California Photovoltaic Solar Electrician/Installer Certification
	Solar			
	Energy Efficiency			
	Green Building			
	Wind and Solar			
	Green Building and Other Renewable Energy	70		BPI certifications, RHA, CBCA, Build it Green Certified Building Professional and Association of Energy Engineers Sustainable Development Technician
	Green Building and Energy Efficiency			
	Energy Efficiency			
	Green Building			

result directly from program completion.

# Notes

- 1 DSIRE Database of State Incentives for Renewable Energy, *California Incentives/Policies for Renewables and Efficiency*, downloaded from [www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=CA25R&re=1&ee=1](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA25R&re=1&ee=1), 20 February 2011.
- 2 California Public Utilities Commission, *About the California Solar Initiative*, downloaded from [www.cpuc.ca.gov/puc/energy/solar/aboutsolar.htm](http://www.cpuc.ca.gov/puc/energy/solar/aboutsolar.htm), 23 November 2010.
- 3 DSIRE Database of State Incentives for Renewables and Efficiency, *California Incentives/Policies for Renewables and Efficiency: CEC – New Solar Homes Partnership*, downloaded from [dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=CA150F&re=1&ee=1](http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA150F&re=1&ee=1), 23 November 2010.
- 4 Calculation assumes an average rooftop installation of 3 kilowatts.
- 5 Go Solar California, *About the California Solar Initiative*, downloaded from [www.gosolarcalifornia.ca.gov/about/csi.php](http://www.gosolarcalifornia.ca.gov/about/csi.php), 8 December 2010.
- 6 American Council for an Energy Efficient Economy, *State Energy Efficiency Policy Databases: California*, downloaded from [www.aceee.org/sector/state-policy/california](http://www.aceee.org/sector/state-policy/california), 23 November 2010.
- 7 California Energy Commission, *Energy Almanac, U.S. Per Capital Energy Use by State in 2009*, downloaded from [www.energyalmanac.ca.gov/electricity/us\\_per\\_capita\\_electricity.html](http://www.energyalmanac.ca.gov/electricity/us_per_capita_electricity.html), 14 January 2011.
- 8 California Workforce Investment Board, *Local Weatherization Projects Stimulus Dollars*, 18 May 2009.
- 9 California Energy Commission, *California's Energy Efficiency Standards for Residential and Non-Residential Buildings*, downloaded from [www.energy.ca.gov/title24/](http://www.energy.ca.gov/title24/), 20 December 2010.
- 10 California Air Resources Board, *Climate Change Scoping Plan*, December 2008.
- 11 Mary D. Nichols, "Climate Policies Drive California's Economic Future,"

*Sustainable Industries*, 31 May 2010.

12 Ibid.

13 California Air Resources Board, *California's Low Carbon Fuel Standard: Final Statement of Reasons*, December 2009.

14 Nic Lutsey, California Air Resources Board, *Discussion of Joint-Agency Technical Assessment Report in Context of LEV III GHG Standards* (powerpoint), 16 November 2010.

15 See note 13.

16 California Air Resources Board, *Proposed Regulation to Implement the Low Carbon Fuel Standard, Volume I, Staff Report: Initial Statement of Reasons*, 5 March 2009.

17 Letter from Governor Schwarzenegger and Treasurer Lockyer to Senators Steinberg and Hollingsworth and Assemblymembers Bass and Blakeslee in support of Assembly Bill 1111, 27 August 2009.

18 See note 11.

19 Ibid.

20 Next Ten and Collaborative Economics, *2010 California Green Innovation Index*, 7 October 2010.

21 Ibid.

22 Ibid.

23 Cleantech Group, LLC, *Cleantech Thriving in California Under AB 32, Shows Data*, 5 April 2010.

24 See note 11.

25 Californian Economic Development Department, "State Survey Identifies Over 300,000 Jobs in California With Major Emphasis on Green Practices" (press release), 21 April 2010.

26 California Economic Development Department, Labor Market Information Division, *California's Green Economy*, 21 April 2010.

27 U.S. Department of Labor, Bureau of Labor Statistics, *Local Area Unemployment Statistics*, downloaded from [www.bls.gov/lau](http://www.bls.gov/lau), 2 November 2010.

28 Charles Goldman et al., Lawrence Berkeley National Laboratory and Research Into Action, Inc., *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*, March 2010.

29 Institute for Research on Labor and Employment, Donald Vial Center on Employment in the Green Economy, University of California, Berkeley, *Workforce Strategies, Energy Efficiency, and Green Jobs: A summit to discuss needs, challenges, and opportunities in California*, downloaded from [www.irlle.berkeley.edu/vial/events/](http://www.irlle.berkeley.edu/vial/events/), December 2010.

30 See note 28.

31 Ibid.

