California Workforce Education and Training Needs Assessment

For Energy Efficiency, Distributed Generation, and Demand Response

DONALD VIAL CENTER ON EMPLOYMENT IN THE GREEN ECONOMY
Institute for Research on Labor and Employment
University of California, Berkeley

2011




My Fellow Californians,

Over three years ago, the California Public Utilities Commission recognized that California's ambitious energy efficiency and greenhouse reduction goals required long term strategic planning. In September 2008, the Commission approved the California Long-Term Energy Efficiency Strategic Plan (Plan) in September 2008 providing a roadmap, through the year 2020 and beyond, for a dramatic scaling-up of statewide energy efficiency efforts designed to meet California's clean energy challenges and goals. The objective of the Plan is to push forward sustained market transformation, thus moving California toward long-term, deep energy savings.

The Plan targets, chapter-by-chapter, four market sectors and seven cross cutting sectors. While the industry and cross cutting sectors are the bones of the Plan, four specific programmatic goals—the big bold energy efficiency strategies—may be considered its heart. In the development of the Plan, we recognized that California would not be able to meet these ambitious goals without adequate numbers of trained personnel working the various fields of energy efficiency. Thus we directed the utilities to include a workforce education and training component as one of the cross cutting sectors in the Plan.

With the input of the utilities and other relevant stakeholders at the Plan workshops, the Commission adopted a vision for workforce education and training:

By 2020, California's workforce is trained and fully engaged to provide the human capital necessary to achieve California's economic energy efficiency and demand site management potential.

The Plan lays out two goals to achieve this vision. First, establish energy efficiency education and training at all levels of California's educational systems. Second, ensure that minority, low income and disadvantaged communities fully participate in training and education programs at all levels of the energy efficiency and demand side management industries.

While the Plan provides several strategies to meet each of the goals, it recognized that in the immediate future, the state must initiate a needs assessment: an in-depth formal statewide training and education resource inventory of current efforts and an assessment of the training and education resources necessary for successful delivery of the long range goals set forth in the Plan. Thus over the past year, the Donald Vial Center has been conducting interviews and collecting and analyzing data on California workforce resources and issues in the energy efficiency sector. The information and recommendations provided within this report summarize the information collected and present an independent analysis of these issues.

This report is a key step in the implementation of the Workforce Education and Training Chapter of the Plan. It gives us a strong idea of where we are and recommendations on how we can ensure that we have a properly trained workforce to enable us to meet California's clean energy goals, particularly with regard to energy efficiency.

Sincerely,

Dian M. Grueneich
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All errors, editorial decisions, and conclusions are the sole responsibility of the lead authors, Carol Zabin and Karen Chapple.

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ACRONYM GLOSSARY

ACRONYM	DEFINITION
ABET	Accreditation Board for Engineering and Technology
ACCA	Air Conditioning Contractors of America
AEE	Association of Energy Engineers
AFL-CIO	American Federation of Labor-Congress of Industrial Organizations
AgTAC	Agricultural Technology Application Center
AIA	American Institute of Architects
AMI	Advanced Metering Infrastructure
ANSI	American National Standards Institute
ARE	Architect Registration Examination
ARRA	American Recovery and Reinvestment Act
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
AVI	Advanced Vocational Institute
BBEES	Big Bold Energy Efficiency Strategies
BEAP	Building Energy Assessment Professional
BEMP	Building Energy Modeling Professional
BII	Building Industries Institute
BOC	Building Operator Certification
BPI	Building Performance Institute
BTP	Building Technologies Program
CA HERCC	California Home Energy Retrofit Coordinating Committee
CAC	California Apprenticeship Council
CAD	Computer-Aided Design/Drafting
CALBO	California Building Officials
CALCTP	California Advanced Lighting Controls Training Program
CARB	California Air Resources Board
CAROP	California Association of Regional Occupational Centers and Programs
CBC	Community Business College
CBCP	Certified Building Commissioning Professional
CBO	Community-Based Organization
CBPCA	California Building Performance Contractors Association
CCA	California College of the Arts
CCSE	California Center for Sustainable Energy
CEA	Certified Energy Auditor
CEC	California Energy Commission
CEM	Certified Energy Manager
CEWD	Center for Energy Workforce Development
CEWTP	Clean Energy Workforce Training Partnership
CFL	Compact Fluorescent Lamp

ACRONYM	DEFINITION
CHEERS	California Home Energy Efficiency Rating Services
CIDP	Comprehensive Intern Development Program
CLTC	California Lighting Technology Center
CMAA	Construction Management Association of America
COE	California Community Colleges Centers of Excellence
CPA	California Partnership Academy
CPMP	Commissioning Process Management Professional
CPUC	California Public Utilities Commission
CREECN	California Regional Environmental Education Community Network
CSD	California Department of Community Services and Development
CSDP	Certified Sustainable Development Professional
CSE	California Supplemental Examination
CSI	California Solar Initiative
CSLB	Contractors' State Licensing Board
CSU	California State University
CTAC	Customer Technology Application Center
CTE	Career Technical Education
DAS	California Division of Apprenticeship Standards
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
DSM	Demand-Side Management
E-DRAM	Environmental Dynamic Revenue Analysis Model
EDD	California Employment Development Department
EE	Energy Efficiency
EECBGP	Energy Efficiency and Conservation Block Grant Program
EEI	Education and the Environment Initiative
EERE	Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy
EFM	Employ Florida Marketplace
EIS	Employment Information Systems
EIT	Engineer in Training
EOPS	Extended Opportunity Programs and Services
EPA	Environmental Protection Agency
ERC	Energy Resource Center
ERP	Emerging Renewables Program
ESCO	Energy Service Company
ETA	Employment and Training Administration
ETC	Energy Training Center
ETP	Employment Training Panel
FE	Fundamentals in Engineering
FEMP	Federal Energy Management Programs

ACRONYM	DEFINITION
FEWC	Florida Energy Workforce Consortium
FSTC	Food Service Technology Center
GBCI	Green Building Certification Institute
GBE	Green Building Engineer
GCI	Green Career Institute
GCJC	Green Collar Jobs Council
GED	General Educational Development
GIS	Geographic Information Systems
HERS	Home Energy Rating System
HHS	U.S. Department of Health and Human Services
HPBDP	High Performance Building Design Professional
HVAC(R)	Heating, Ventilation, and Air Conditioning (and Refrigeration)
IAC	Industrial Assessment Center
IBEW	International Brotherhood of Electrical Workers
IDP	Intern Development Program
IDSM	Integrated Demand-Side Management
IHACI	Institute of Heating and Air Conditioning Industries, Inc.
IOU	Investor-Owned Utility
ITP	Industrial Technologies Program
JAC, JATC	Joint Apprenticeship Committee, Joint Apprenticeship Training Committee
KEEP	K-12 Energy Education Program
LADWP	Los Angeles Department of Water and Power
LATTC	Los Angeles Trade–Technical College
LEA	Local Educational Agency
LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
LEED AP-BDC	LEED Accredited Professional–Building Design and Construction
LIEE	Low Income Energy Efficiency
LIHEAP	Low Income Home Energy Assistance Program
LIOB	Low Income Oversight Board
LiUNA	Laborers' International Union of North America
LMCC	Labor Management Cooperation Committee
MAAC	Metropolitan Area Advisory Committee
MASH	Multifamily Affordable Solar Housing
MEP	Maximizing Engineering Potential
MITC	Minimum Industry Training Criteria
MNREM	Minnesota's Renewable Energy Marketplace
NABCEP	North American Board of Certified Energy Practitioners
NAHB	National Association of Home Builders
NAICS	North American Industry Classification System

ACRONYM	DEFINITION
NARI	National Association of the Remodeling Industry
NATE	North American Technician Excellence
NCEES	National Council of Examiners for Engineering and Surveying
NCQLP	National Council on Qualifications for the Lighting Professions
NECA	National Electrical Contractors Association
NEEC	Northwest Energy Efficiency Council
NEED	National Energy Education Development Project
NYSERDA	New York State Energy Research and Development Authority
OA	Office of Apprenticeship, U.S. Department of Labor
OJT	On-the-Job Training
OPMP	Operations & Performance Management Professional
PACE	Property Assessed Clean Energy
PAHRA	Partnership for Air-Conditioning, Heating, Refrigeration Accreditation
PE	Professional Engineer
PEC	Pacific Energy Center
PG&E	Pacific Gas and Electric
PIER	Public Interest Energy Research
PIP	Program Implementation Plan
PLA	Project Labor Agreement
PSA	Project Stabilization Agreement
QI/QM	Quality Installation and Quality Maintenance
REDI	Regional Equitable Development Initiative
RESNET	Residential Energy Services Network
RFP	Request for Proposals
RHA	Richard Heath and Associates, Inc.
ROP, ROCP	Regional Occupational Program, Regional Occupational Centers and Programs
RSES	Refrigeration Services Engineering Society
RSI	Related Supplemental Instruction
SCE	Southern California Edison
SCG	Southern California Gas
SDG&E	San Diego Gas and Electric
SDSU	San Diego State University
SDUSD	San Diego Unified School District
SEER	Seasonal Energy Efficiency Rating
SEP	State Energy Program
SFSU	San Francisco State University
SGIP	Self-Generation Incentive Program
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMUD	Sacramento Municipal Utility District
SMWIA	Sheet Metal Workers' International Association

ACRONYM	DEFINITION
SOC	Standard Occupational Code
SWH	Solar Water Heating
TABB	Testing, Adjusting and Balancing Bureau
TANF	Temporary Assistance for Needy Families
TSLA	Train to Sustain Los Angeles
TWI	Training Within Industry
UA	United Association of Plumbers, Pipefitters and Sprinkler Fitters
UAC	Unilateral Apprenticeship Committee
UC Berkeley	University of California–Berkeley
UC Davis	University of California–Davis
UCLA	University of California–Los Angeles
USC	University of Southern California
USGBC	United Stated Green Building Council
VIP	Veterans in Piping
WAP	Weatherization Assistance Program
WASC	Western Association of Schools and Colleges
WE&T	Workforce Education and Training
WHPA	Western HVAC Performance Alliance
WIA	Workforce Investment Act
WIB	Workforce Investment Board
WIP	Weatherization and Intergovernmental Programs

EXECUTIVE SUMMARY

I. PURPOSE AND SCOPE OF STUDY

This report presents the results of the California Workforce Education and Training Needs Assessment for Energy Efficiency, Demand Response, and Distributed Generation (CA Workforce Needs Assessment, or the WE&T Needs Assessment), conducted throughout calendar year 2010. It has benefitted from the contributions of many individuals and organizations, including those who helped plan and participated in the December 2010 Workforce Strategies, Energy Efficiency, and Green Jobs Summit.

This project was carried out under joint management by the California Public Utilities Commission (CPUC) and the investor-owned utilities (IOUs) of California, with Southern California Edison (SCE) serving as the lead utility for the IOUs.[1] The project was funded by the ratepayers of California under the auspices of the CPUC.

The WE&T Needs Assessment is a third-party report and does not necessarily represent the viewpoints of the CPUC or the four IOUs, although it was reviewed by CPUC and IOU staff for factual accuracy.

I.A. WHY A WORKFORCE NEEDS ASSESSMENT?

The WE&T Needs Assessment was called for in the California Long Term Energy Efficiency Strategic Plan (EE Strategic Plan).[2] The EE Strategic Plan, adopted by the CPUC in September 2008, provides a road map for a dramatic scaling up of statewide efforts to meet California's clean energy goals for energy efficiency.[3] The objective of the Plan is to compel sustained market transformation, thus moving California toward long-term deep energy savings in the residential, commercial, industrial, and agricultural sectors of its economy. The EE Strategic Plan is a central element in the implementation of the California Global Warming Solutions Act of 2006 (AB 32) and is also a main component of the implementation of AB 758, California's Comprehensive Energy Efficiency Program for Existing Residential and Nonresidential Buildings law, passed in 2010.

Workforce Education and Training was one of the key issues addressed in the EE Strategic Plan, with this WE&T Needs Assessment identified as a necessary first step to guide further action. The importance of the workforce in achieving the state's clean energy goals was articulated in the EE Strategic Plan in the following vision statement:

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[1] The four major IOUs serving California's electric and natural gas customers are: Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), San Diego Gas and Electric Company (SDG&E), and Southern California Gas Company (SoCalGas).

[2] California Public Utilities Commission (2008). *California Long Term Energy Efficiency Strategic Plan: Achieving Maximum Energy Savings in California for 2009 and Beyond*. Retrieved from: http://www.cpuc.ca.gov/NR/rdonlyres/D4321448-208C-48F9-9F62-1BBB14A8D717/0/EEStrategicPlan.pdf.

[3] California Public Utilities Commission (2008). D.08-09-040. *Decision Adopting the California Long Term Energy Efficiency Strategic Plan* (D.0809040). Retrieved from: http://docs.cpuc.ca.gov/published/FINAL_DECISION/91068.htm. The CPUC adopted the plan and also required that beginning in 2009 the adopted strategies were to be incorporated in energy efficiency program planning and implementation.

> *"By 2020, California's workforce is trained and fully engaged to provide the human capital necessary to achieve California's economic energy efficiency and demand-side management potential."*[4]

The Plan also recognizes the impact of energy efficiency programs and policies on career opportunities for California's students, job seekers, and workers. It specifically calls for promoting the inclusion of low-income, minority, and disadvantaged communities in energy efficiency training programs; establishing energy education and training for employment in the energy efficiency workforce at all levels of California's educational system; and engaging in a collaborative effort among state agencies, educational institutions, community-based and non-profit organizations, private industry, and labor to these ends. This direction explicitly articulates the importance of equity issues and career opportunities for all Californians, not only those with ready access to college and professional jobs. It also recognizes that developing a qualified energy efficiency workforce involves working with collaborators from the workforce community who have as their primary goal improving job opportunities and workforce outcomes for Californians.

The CPUC's mandate is focused on the regulation of the energy and several other industries, but as a driver of investment in energy efficiency and related activities its actions impact the quantity and kinds of jobs that are created in the state. The CPUC's recognition that its work affects the state's workforce goals is analogous to its early foresight that achieving the state's environmental objectives is intertwined with and heavily influenced by state energy policy.

The dual goals of clean energy and improving job opportunities and workforce outcomes for Californians, including those from disadvantaged communities, has led the WE&T Needs Assessment to focus explicitly on strategies that value both of these two goals, as well as to identify the trade-offs between these goals where they exist. The conceptual framework for connecting these goals is based in business and economic literature and is known as *high-road economic development*. High-road economic development consists of a market environment that favors business strategies built on quality work and innovation, resulting from investments in a workforce that is both highly skilled and rewarded for those skills. Such workforce investments, in turn, encourage the development of a stable and professionalized workforce with the capacity to adapt to new technologies and practices. In contrast, *low-road economic development* consists of a competitive environment that favors competing on the basis of cost rather than quality. This leads to jobs that do not pay as well and/or do not have career ladders and results in higher turnover, undermining worker and employer incentives to invest in training.

I.B. STUDY SCOPE AND RESEARCH DESIGN

The WE&T Needs Assessment addresses three key elements of California's clean energy policy: energy efficiency, demand response, and distributed generation. These elements are focused on the customer side of the energy market and are strategies that result in the more efficient use of energy resources. Energy efficiency reduces the amount of energy required for specific services, while demand response is aimed at reducing peak demand and the need for new generation resources. For this study, distributed generation is limited to customer-owned renewable energy generation and supporting storage technologies that are less than 20 MW in size. This set of strategies is referred to as *demand-side management* in the energy community. In the rest of this document we use the term

[4] California Public Utilities Commission (2008). *Long Term Energy Efficiency Strategic Plan: Achieving Maximum Energy Savings in California for 2009 and Beyond,* page 74. Retrieved from http://www.cpuc.ca.gov/NR/rdonlyres/D4321448-208C-48F9-9F62-1BBB14A8D717/0/EEStrategicPlan.pdf.

energy efficiency and related strategies (or policies/programs) or *energy efficiency and related DSM strategies (or policies/programs)* as a shorthand for all these demand-side management strategies.

The WE&T Needs Assessment is a statewide study and includes all policies and programs within the scope just described, not only those under the jurisdiction of the CPUC or implemented by the IOUs. In addition, the recommendations for workforce strategies are not limited to those that can be carried out only by the CPUC or the utilities, but rather are aimed at all entities with the capacity to effectuate the needed changes.

Our research approach considers the effects of energy efficiency and related policies on both the demand and supply sides of the labor markets. The study relies on a mix of quantitative and qualitative methodologies, which are explained in each chapter and the appendices.

The first area of research analyzes the impact of federal and state energy efficiency policies and programs on jobs and the labor market. It includes both a quantitative analysis of job growth, job transformation, and unemployment, and a qualitative analysis of workforce and labor market dynamics that affect the state's achievement of energy efficiency goals and workforce goals in three key sectors. Given the lack of widespread industry-recognized licenses, certifications, and other skill standards, this study does not assess the specific skills required to meet the work quality standards for all jobs impacted by energy efficiency and related policies and programs.

The second area of research is a comprehensive assessment of the many pieces of California's workforce development system and its collective capacity to prepare, place, and/or retrain workers for the jobs that are created or transformed by energy efficiency and related policies and programs. It includes analyses of issues related to the inclusion of low-income, minority, and disadvantaged communities and to the development of K-12 career development programs. Given that reliable outcomes data is not available for most training programs, this study is not an evaluation of the effectiveness of each specific training program in imparting skills and competencies to participants.

The final part of the study identifies lessons learned and recommendations for action. In order to make the Needs Assessment as useful as possible in motivating and guiding future action, the research team was directed to engage and gain feedback from stakeholders in both the energy and the workforce development communities. This engagement began with the participation of the Energy Efficiency WE&T Task Force, a CPUC stakeholder committee addressing workforce issues related to the EE Strategic Plan, which helped define the scope of the Needs Assessment. In addition to group and individual discussions throughout the research process, the research team presented preliminary results and recommendations at the Workforce Strategies, Energy Efficiency, and Green Jobs Summit (the Workforce Summit), held at UC Berkeley on December 8, 2010, and offered opportunities for feedback through participatory workshops and solicitation of comments. A stakeholder committee guided the development of the Workforce Summit, which included then-CPUC Commissioner Dian Grueneich, legislative leadership staff, and key policymakers and stakeholders in the workforce development and energy communities. The research team is confident this report reflects broad (though not universal) agreement among stakeholders about the major issues and recommendations, but remains solely responsible for its contents.

II. SUMMARY OF RESULTS

II.A. PART ONE: ECONOMIC RESTRUCTURING AND LABOR MARKET ISSUES AFFECTING THE STATE'S CLEAN ENERGY AND WORKFORCE GOALS

The condition of the California economy sets the overall context for analyzing the impact of energy efficiency and related policies and programs on jobs, and subsequently the possible need to adjust workforce development policies and programs. At present, two major problems plague the California economy. The first, a result of the Great Recession and the jobless recovery, is California's unemployment rate, which remains at over 12 percent as of early 2011. The second problem is the long-term structural bifurcation of the state's labor market into well-paid, higher-skill jobs and low-wage, lower-skill jobs, with little growth of jobs in the middle.

This situation has two implications for the WE&T Needs Assessment. First, the high and persistent unemployment rate means that, at present, there is a large queue of unemployed workers, particularly in the construction sector, where the number of jobs dropped over 40 percent since the peak in 2006. Second, the bifurcation of the labor market means that, without specific policy interventions, the jobs created by the investments in energy savings will mimic the wage disparities seen in the rest of the economy, with some high-wage jobs in professional occupations and many low-wage jobs for those without a college degree. These wage disparities have immediate and serious social implications for families and communities in California, and they ultimately affect the competitiveness and efficiency of the California economy.

II.A.1. JOB IMPACTS AND LABOR SUPPLY

The WE&T Needs Assessment forecasts the number of jobs that will be created in 2010, 2015 and 2020 as a result of the energy efficiency and related policies and programs in California, using a variety of modeling and estimation techniques and three scenarios for levels of investment (low, medium, and high) during the next ten years. Using our medium scenario, we project these programs and policies will result in an investment of about $11.2 billion dollars from ratepayers, state, federal, and private sources for 2020, as shown in Figure 1, up from an investment of about $6.6 billion in 2010. This investment is projected to create a total of 211,000 jobs for that year, including *direct jobs* generated by the investments in energy efficiency activities, *indirect jobs* resulting from demand for inputs for these activities, and *induced jobs* resulting from the increased household and business incomes and reduced energy expenditures from these activities. These are person-year jobs, meaning that each job represents one full-time, one-year job, not one *permanent* job. This forecast shows that energy efficiency and related investments resulting from programs and policies identified in this report provide a significant stimulus to the California economy.

The number of directly-generated jobs in energy efficiency and related activities is projected at 52,371 full-time equivalent jobs for the year 2020; the remaining jobs are the result of the indirect and induced labor demand. These direct jobs represent a significant growth from the 27,718 total direct jobs we estimate were generated in 2010 from energy efficiency and related policies and programs. Direct jobs are the focus of this study because they are directly linked to energy efficiency and related activities and thus to the potential need for skill development.

As shown in Table 1, the number of trained workers needed to fill the new jobs created is projected to be at least 78,205 over the 11-year period beginning in 2010. This number is larger than the number of full-time equivalent jobs (38,937 net of 2009) because most jobs include both energy efficiency and other work. That is to say, the work from one new full-time equivalent job will distributed to more than one worker. To forecast training needs, the key estimate is the yearly increment of workers needed to fill new positions, above and beyond those hired in the previous year, since the latter were presumably already trained before hire. For the year 2020 alone, the number of new workers that require specific training in energy efficiency and related sectors is forecast at 5,262. Thus, from a total job creation forecast of 211,000 workers in 2020, the number of new slots available for workers needing specific skills in energy efficiency and related activities is only 5,262.

Figure 1. Investment in Medium Scenario by Source and Year

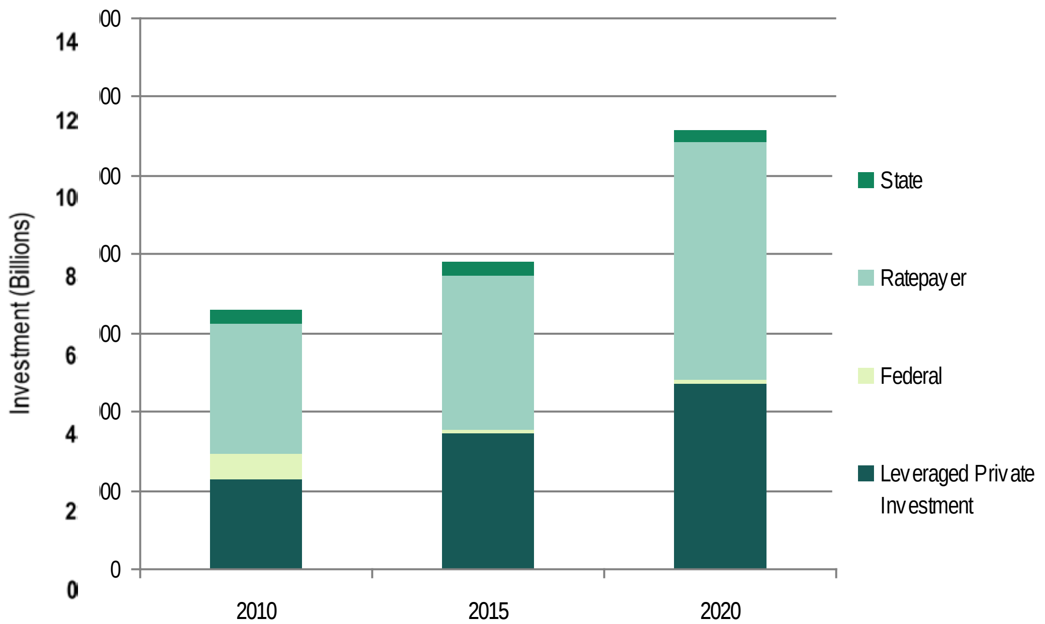

Table 1. Energy Efficiency Incremental Worker Training Projections, Medium Scenario, by Occupational Group, Total and Per Year

Occupational Group	Total Direct New Workers (Net of 2009)		Direct New Workers Per Year (Net of All Previous Years)	
	2015	2020	2015	2020
Administration	2,205	3,798	104	319
Administration (Sales-Related)	3,110	4,961	195	370
Architecture and Engineering	2,812	4,748	—	387
Building Envelope (Construction Trades)	27,452	37,282	1,145	1,966
Building Envelope (Performance Trades)	1,004	1,487	39	96
Management (Blue-Collar)	5,883	8,395	173	502
Management (White-Collar)	1,096	1,855	62	152
Manufacturing	48	97	—	10
Mechanical and Electrical Trades	8,286	15,582	628	1,459
Total	51,896	78,205	2,301	5,262

Two-thirds of the direct jobs are expected to be in the construction trades (e.g., electricians, plumbers and pipefitters, sheet metal workers, carpenters, laborers, and construction supervisors). Another 17 percent of the jobs are in the fields of architecture and engineering, management, and public administration (including utility and third-party program administrators). The remaining 16 percent are in manufacturing, advertising, office administration, and other industries.

Most of the new jobs are in traditional occupations, dwarfing the number of workers in new and emerging specialized occupations (e.g., solar installers or energy auditors). This finding is based on current staffing patterns; if specialized energy efficiency occupations become more prevalent over time, this balance may change. The degree of specialization depends partly on business decisions, but also on what certifications the state encourages and which training programs it funds.

At present, there are a significant number of unemployed and underemployed skilled workers in all of these industries. Graduates of training programs will compete against these experienced workers and can be expected to have difficulty in finding work utilizing their newly acquired skills, a point echoed many times in interviews we conducted with training providers as part of this study. In all sectors, this pool of unemployed workers is likely to exceed the number of new jobs created in the energy efficiency and related sectors at least until 2020.

In addition, the number of workers *currently* employed in energy efficiency and related occupations far outweighs the number of new workers that are projected to enter these fields through 2020. Some, if not many, of these incumbent workers are likely to require skills upgrade training as new best practices and new technologies are introduced.

The quantitative analysis shows that, at least through 2020, concerns about shortages of new workers for energy efficiency and related work are unwarranted, particularly for the most prominent energy efficiency occupations. There may be difficulty hiring for specialized niches, such as professionals with significant work experience, or short-term shortages for positions with new certification requirements, but these are the exception. In contrast, concerns about shortages of *jobs* for graduates from education and training programs are real and likely to persist through 2020, particularly for those with less than four years of college. As a result, great caution should be used in considering the funding of new training programs. For achieving energy efficiency goals the focus should be on upgrading the energy efficiency skills and knowledge of the incumbent workforce.

II.A.2. WORK QUALITY AND JOB QUALITY IN KEY ENERGY EFFICIENCY SECTORS

We conducted qualitative case studies of three critical energy efficiency related markets—heating, ventilating, & air-conditioning (HVAC); residential home retrofits; and commercial lighting. Through these in-depth examinations we sought to better understand the dynamics behind the quantitative analysis and to detect any labor market problems that are impeding the state's efforts to achieve its clean energy and workforce goals. Each of the sectors chosen for the case studies has the potential for vastly reducing energy use and thus is the focus of major policies and programs that incentivize or mandate specific action.

The HVAC sector (which cuts across residential and commercial sectors) is the single largest contributor to peak load demand, with residential and small commercial HVAC comprising up to 30 percent of peak load demand in summer months. The EE Strategic Plan targets a 50 percent improvement in efficiency in the HVAC sector by 2020, and a 75 percent improvement by 2030. The statewide IOU budget for the HVAC sector in 2010-2012 is approximately $127 million.

The residential sector represents about one-third of California's current electricity and natural gas consumption. The EE Strategic Plan sets ambitious targets for energy use reduction in existing housing stock,[5] and aims to give all eligible low-income customers the opportunity to participate in the fully-subsidized Low-Income Energy Efficiency (LIEE) program. The statewide residential retrofit incentive program mandated in AB 758 is now under the umbrella of Energy Upgrade California and has a budget of approximately $275 million from all funding sources. The IOU LIEE program has a budget of approximately $310 million for 2010 and the federally funded low-income programs have increased their budget to $257 million due to a temporary influx of 2009 American Recovery and Reinvestment Act (ARRA) funds.

The commercial lighting sector represents about 35 percent of all energy use in the state's commercial sector. The EE Strategic Plan aims to reduce commercial lighting energy use by 60 to 80 percent in 2020. The 2010-2012 IOU program budget dedicates $89 million for programs to support advanced lighting in the commercial sector.

In all three sectors, the key workforce issue that surfaced in our interviews was the high incidence of poor quality installation, affecting immediate energy savings and the growth of the energy efficiency sector. This issue is most dramatic in the HVAC sector, where prior studies have reported that 30 to 50 percent of new HVAC systems and up to 85 percent of replacement systems are installed incorrectly, and that by 2020 potential energy savings from higher quality HVAC installation and maintenance could eliminate the need for the equivalent of two combined-cycle gas-fired 500 MW power plants.[6] This same issue is prevalent in the residential retrofit and commercial advanced lighting sectors, where poor quality installation and the resulting failure to deliver on expected energy savings has undermined market growth, including financing.

Our analysis suggests that training workers with appropriate skills is necessary, but not sufficient, for achieving proper installation and maintenance of energy efficiency materials and equipment. In the residential and small commercial sectors, including HVAC and other retrofit activities, markets are characterized by low-road conditions that make it difficult for businesses to compete on the basis of quality. These conditions include lax enforcement of building permits, codes and standards, and employment laws, and in some trades contractor licensing that does not require testing of competency. In the HVAC sector, for example, less than 10 percent of HVAC change-outs are carried out with building permits, so code enforcement is rarely triggered.[7]

One of the results of these low-road conditions is that workers are not rewarded for high standards of competence. Although additional documentation and assessment are needed, interviews revealed that there are low wage floors and limited career ladders for most jobs in the low-income weatherization, residential building retrofit, and residential and small commercial HVAC markets. Low wages are correlated with high turnover, and do not encourage employers or workers to invest in training.

In these circumstances, public investments in workforce education and training are frequently lost as workers leave the field in search of better opportunities. These investments also do not lead to changes in practice because, without enforcement of building permits, codes and standards, and other quality standards, employers compete on cost and have little incentive to improve quality. Thus, poor outcomes for workers in the energy efficiency and related sectors are closely related to the loss in energy savings due to improper installation and poor maintenance practices.

[5] "By 2020: 25% of existing homes have a 70 % decrease in purchased energy from 2008 levels; 75% of existing homes have a 30% decrease in purchased energy from 2008 levels; 100% of existing multi-family homes have a 40% decrease in purchased energy from 2008 levels." (CPUC, 2008, p.19).

[6] Messenger, M. (2008). Strategic Plan to Reduce the Energy Impact of Air Conditioners. California Energy Commission Staff Report. CEC-400-2008-010. p. 31

[7] Ibid.

In contrast, the commercial lighting industry is a high-road industry. General electrician, the key trade in commercial light installations, is the only specialty trade in California that requires both workers and contractors to obtain a license based on a test of competency. The trade also has a large unionized contractor base that funds five-year apprenticeship training programs and ties skill increases to wage increases, and as a consequence has a stable and professionalized workforce. These conditions provide the infrastructure needed to make investments in skills upgrading that lead to actual improvements in work quality and energy savings. Thus, when specific work quality problems are identified, the mechanisms are in place for quickly upgrading skills to address them.

While it is challenging for policies and programs whose primary objective is energy efficiency to fundamentally change these markets' broader dynamics, policymakers do have options in terms of how they address these conditions. Although constrained by budgets and program goals, in the fully subsidized low-income sector, the CPUC and the utilities can, for the most part, set the rules of the labor market.

As a general rule, utility ratepayer- and publicly-funded programs have addressed quality through back-end inspections and verification, but not by conditioning incentives or contracts on up-front contractor and worker quality standards. This is now changing. There are several examples of new programs that are attempting to "carve out" higher quality segments in these markets and thereby improve installation and maintenance of energy efficient equipment and systems. Clearly, the utility programs cannot drive the market by themselves, but they can contribute to building the high road. In the sectors discussed here, they are collaborating with other state agencies and federal programs in new attempts to do just that.

HVAC: The utilities are part of a statewide effort to improve quality in residential and small commercial HVAC using several strategies. These include the development of the Western HVAC Performance Alliance, an industry and government partnership convened by the utilities to solicit feedback and build support for the implementation of the EE strategic plan. The statewide effort also includes the combined efforts of several agencies to close off the low road by improving enforcement of building permits and the state's new energy efficiency building codes.

At the same time, the IOUs are helping to build the high road through new incentive programs focused on quality installation and maintenance that have very stringent quality and certification requirements for both contractors and workers. They are also making substantial investments in HVAC training, though currently these do not incorporate a clear strategy to link training to changes in employer practices. If these statewide efforts are successful, they will support the development of a more stable and professionalized workforce. They will also likely drive up the up-front costs of HVAC installation. While further evaluations are warranted, the expectation is that over the long run, higher energy savings, particularly the more valuable peak energy savings from properly installed HVAC systems, along with savings from higher worker retention rates, will compensate for these higher initial costs.

RESIDENTIAL BUILDING RETROFIT: Energy Upgrade California is the new statewide effort by the California Energy Commission (CEC), CPUC, and others to implement AB 758 and the EE Strategic Plan for the residential sector. Its main strategies are to encourage a whole-house (rather than single measure) approach to retrofit, to align funding and quality assurance mechanisms, and to expand financing. These strategies are designed to carve out a home performance market with a strong focus on quality work and the delivery of substantial energy savings. At present, whether this program will be able to create good jobs (e.g., living wages, benefits, and career ladders) for the residential retrofit workforce is less certain, as near-term cost considerations seem to be paramount. Thus far, the program design only includes standards and certification for contractors, with no requirements for workers. In addition, the standards that do exist emphasize building envelope and auditing, rather than quality installation of HVAC and other building systems with known quality concerns.

Low-Income Energy Efficiency programs, which have received significant additional funding through both one-time ARRA funds and on-going ratepayer funds, continue to take a traditional single measure approach to energy retrofits. Sometimes this work is based on subcontracting individual measures to other firms or individuals in ways that discourage leveraging of all available funding sources or linking of measures in a whole-house approach. The IOU LIEE programs, whose goal is to help low-income families reduce energy bills, may have an opportunity to both increase energy savings and improve access to good jobs if they are restructured.

Two sometimes overlapping strategies to encourage quality jobs and quality work can inform California's residential programs. These are high-road agreements and certification strategies. Both of these efforts are being promoted by the Obama administration through its Recovery through Retrofit Working Group.

High-road agreements governing retrofit programs or other construction projects require contractors to abide by labor standards (wage floors) and local hire requirements, thereby promoting both job quality and access to jobs for workers from low-income, minority, and disadvantaged communities. If tied to training investments, high-road agreements can lead to a more qualified, stable, and professionalized workforce. Many retrofit programs that incorporate high-road programs are attempting to incorporate bundling of work to achieve greater scale and lower cost, and to attract contractors that are more accustomed to these types of requirements. High-road agreements have been instituted in a number of cities in California. In Los Angeles, for example, any project funded by the LA Redevelopment Agency (the largest redevelopment agency in the country) must adhere to a high-road agreement. Showing federal support for this strategy, the Department of Energy (DOE) ARRA Better Buildings Initiative is funding a number of residential retrofit programs based on high-road agreements, including programs in Portland and Seattle. High-road agreements and other demand side strategies are not as well developed in California as in some parts of the country, but similar strategies are being explored in Oakland, Los Angeles, Santa Clara, and San Francisco.

Certification strategies encourage employers to adopt graduated levels of certifications that are tied to corresponding wage progressions. Responding to the focus on certification, the DOE has developed a set of industry guidelines for skill standards and certifications for the main worker job categories in residential retrofit and is encouraging their voluntary adoption by states and employers. These guidelines include skill standards for the installer job category, the most numerous job in retrofit projects, paving the way for higher skills and perhaps higher wages in these entry-level jobs.

COMMERCIAL ADVANCED LIGHTING CONTROLS: Efforts to expand the market for advanced commercial lighting controls have also been stymied by deficiencies in quality installation. However, innovative leadership by the utilities and the International Brotherhood of Electrical Workers-National Electrical Contractors Association (IBEW-NECA) labor management partnership, combined with more favorable labor market conditions, are successfully addressing the problem. In the lighting sector, the utilities proactively set standards that support quality work when strategies to deploy advanced lighting controls were in early stages of development. They did so through the creation of an industry partnership, now called the California Advanced Lighting Controls Training Program (CALCTP), which developed a new certificate available only to already skilled licensed electricians. This type of industry partnership is known in the workforce development world as a *sector strategy*.[8] Initially, Southern California Edison funded curriculum development for this skills upgrading, and in a relatively short period of time this training has been disseminated throughout the network of electrical apprenticeship programs, community college programs, and utility training centers. New knowledge, imparted in a 40-hour journey upgrade training, is integrated into a pre-existing base of solid occupational training, usually achieved through a five-year apprenticeship program.

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[8] Sector strategies will be explained more fully in section II.B.1. Overview of California's Workforce Development Infrastructure and Strategies, below.

This sector strategy was embedded in the apprenticeship structure, where employers are already at the table, so the partners and mechanisms are in place to work out agreements on skill standards and changes in practice. Setting standards and targeting incentive programs to contractors whose workforce has achieved these standards, has paved the way for contractors to compete on the basis of quality in this industry. Though the training is not for entry level workers, the expansion of the market will allow new apprentice slots to open up, providing new opportunities for long-term occupational training and pathways into middle class careers.

The CALCTP presents a model for future IOU workforce planning and sector strategies for the deployment of new clean energy measures and initiatives. Examples of emerging areas include new forms of energy storage, integrated demand-side management, electric vehicle charging stations, commercial building benchmarking, and others not yet ready for deployment.

CALCTP shows how utilities (with ratepayer funds) can participate in sector strategies that convene industry stakeholders and partner with existing state training and education institutions to implement training programs that directly tie training to jobs. In addition, the utilities have a clear role in helping to determine and promote rigorous skill standards and certifications. Certification requirements contribute to quality by both improving the technical skills of workers and raising the bar for contractors, enabling them to compete on quality rather than cost cutting. Certifications should ideally be industry-recognized and/or state-approved standards that measure high levels of competence through third-party testing *and* work experience requirements. To the extent possible, certifications should also be linked to post-secondary degrees or state-certified apprenticeships.

With the support of the CPUC, the utilities can take critical leadership roles in expanding the high quality segments of the market and addressing the workforce obstacles that impede achievement of the state's clean energy goals. Spearheading sector initiatives and mandating certification standards in ratepayer programs can support improved worker outcomes, as well as the improved work quality needed to meet the state's clean energy goals. With strong pre-apprenticeship programs to provide pipelines into the skilled trades, this model also has the potential to provide opportunities for Californians from disadvantaged communities.

II.B. PART TWO: WORKFORCE TRAINING AND EDUCATION INFRASTRUCTURE

II.B.1. OVERVIEW OF CALIFORNIA'S WORKFORCE DEVELOPMENT INFRASTRUCTURE AND STRATEGIES

California's workforce development system is extensive but fragmented. Key components are the state's Workforce Investment Act (WIA) funding entities comprising the state and local Workforce Investment Boards (WIBs)—funded by the federal Department of Labor—and the postsecondary education system, which consists of universities, four-year colleges, community colleges, and the state's Department of Education. The state's involvement in workforce development also includes funding incumbent worker training through the Employment Training Panel, and certifying and regulating the apprenticeship programs. In addition, private organizations run fee-for-service training, and philanthropy supports community-based training organizations and other training initiatives. There is limited coordination among the WIBs, the community colleges, apprenticeships, and other training and education agencies. The WIA system is currently driven by a "work first" mandate, with the bulk of resources going to the One-Stop Career Centers to help job seekers find any job as quickly as possible, rather than make investments in training. The limited resources in WIA for training specific populations are funneled through individual training vouchers, and do not facilitate training and education infrastructure planning and development.

The effectiveness of the training and education system differs by sector and skill level. There is a coherent system for training workers in professional and managerial occupations, as California's community colleges are articulated with the state's four-year colleges and universities through the California Master Plan for Higher Education. Many professional occupations, such as engineers and architects, also have widely recognized systems of certification and licensing, which support competency as well as providing assurance that workers will be compensated for their skill level.

On the other hand, with the exception of apprenticeship, the training system for middle-skill occupations is much less effective—often neither helping workers obtain good jobs nor helping employers recruit and retain skilled workers. This is due to the lack of coordination and articulation among training institutions, the common disconnect between training and jobs, and the lack of widely recognized skill standards and associated credentials that measure competency.

Two complementary and interrelated strategies have been supported by both the Obama administration and the state of California as key directions for reform of the middle skill job training system. The first is sector strategies, which are training initiatives built on partnerships among business, labor, post-secondary education institutions (including apprenticeship), and other stakeholders. Sector strategies usually involve intermediaries who organize multiple employers in a specific sector, and plan and execute training initiatives based on employers' commitment to consider hiring training program graduates, and/or train incumbent workers. The second and related strategy is the development and industry adoption of portable and stackable credentials and certifications. These then provide clear guideposts for training institutions and can support high-road development by putting an emphasis on quality training and quality work. Apprenticeship embodies both sector and certification strategies, but they are not widespread in other parts of the state's workforce development infrastructure.

Widespread agreement on the importance of these strategies has led to state efforts to improve training for middle-skill jobs in energy efficiency and other green sectors in California. With the influx of ARRA dollars for investments and training funds in these sectors, the Green Collar Jobs Council, a committee of the California WIB, became an important venue for interagency coordination and collaboration, particularly between the California Energy Commission and the state's workforce development agencies. The Green Collar Jobs Council's stated vision is to "serve as a catalyst for the creation of sustainable regional sector strategies." It was instrumental in launching the California Clean Energy Workforce Training Program, which attempted to integrate some of the elements of sector strategies into energy efficiency occupations, and the Regional Industry Clusters of Opportunity Grants, which promoted sector planning. At this time, these efforts are too new to be evaluated.

II.B.2. TRAINING AND EDUCATION PROGRAMS IN ENERGY EFFICIENCY RELATED FIELDS

With this overall context in mind, the WE&T Needs Assessment developed a resource inventory of existing training and education programs serving the industries and occupations affected by energy efficiency and related policies and programs. Table 2 provides an overview of the seven key institutional categories we discerned in this inventory. We were able to identify about 1,080 training programs consisting of 1,540 individual training tracks among four-year colleges and universities, community colleges, apprenticeships, community-based training organizations (CBOs), private training organizations, and Regional Occupational Programs (ROPs). A training program refers to a department at a particular college or ROP, an apprenticeship committee, or a distinct community-based or private organization, some of which have multiple tracks (i.e., they may issue credentials at different levels or with different specializations). These individual tracks are the relevant unit of analysis for Part 2, because they lead to different career pathways and employment outcomes.

Table 2. Institutional Overview

Institution	Description	Average Length of Training
Four-Year Colleges and Universities	• Training for qualified high school graduates and community-college transfer students • Long-term pre-employment education for professional or managerial jobs that are linked to professional licenses and continuing education	4 years
Apprenticeships	• Long-term training in the building and mechanical trades • Apprentices typically start with little or no experience, and learn to be experts in their trade while working full-time for an employer and receiving classroom instruction • Wages increase with skill level • Most joint apprenticeships offer skills upgrade training for journey workers to update or enhance their skills*	3 to 5 years
Community Colleges	• Post-secondary education that is open to those with limited resources and low basic skill levels • Students may obtain an associate's degree after two full-time years of study, and/or receive a vocational certificate in a shorter amount of time, usually one year • There are multiple pathways, including into apprenticeship, transfer to four-year, or stand-alone training for entry-level, semi-skilled jobs** • Incumbent workers also access community college classes, primarily for re-skilling or skills upgrade training	6 months to 2 years (some custom programs as short as 4 weeks)
Community-Based Training Organizations (CBOs)	• Serve disadvantaged, minority, and low-income populations with limited occupational skills and work experience at the front end of the career pathway • Most provide work readiness and pre-employment skills training, and may offer pre-apprenticeship • Typically short-term	3 days to 3 months
Private Industry Training Organizations	• Can be private for-profit organizations, non-profits, or trade associations • Offer pre-employment or incumbent worker training in the energy efficiency, renewable energy, or the building trades • Training is typically very short-term with longer programs for some specialty trades • Programs are often costly compared to other institutions, but receive some public Workforce Investment Act (WIA) funds when trainees can use WIA individual training accounts to pay for training	1 day to 6 months
Regional Occupational Programs (ROPs)	• Offer career and technical education courses at high schools • Help provide students with the skills needed for entry-level positions within the career track of their choice, or for entry into additional vocational or post-secondary training	6 months to 2 years
IOU Energy Training Centers	• Energy Training Centers primarily provide short-term classes and seminars • Although open to anyone, many classes are targeted toward experienced incumbent contractors and professionals looking to acquire specific skills in energy efficiency and related topics • Main goal is to provide knowledge that will help save energy	1 to 5 days

* We did not capture complete information on journey upgrade courses in our inventory of training programs, although they are a critical part of continuing education for journeypersons which were mentioned in almost all apprenticeship interviews.

** We did not capture complete information on contract education in our analysis because we were focused on community college programs that lead to a certificate or a degree.

The inventory includes all programs that train for the most prominent occupations based on our job projections, as well as programs that self-identify as training for "green jobs" skills. This captures both traditional occupations that are involved in implementing energy efficiency work, as well as the new and emerging "specialty" occupations focused solely on a particular set of energy efficiency-related skills. This inventory includes administrative program data (where available) including graduation information for institutions in the relevant occupations throughout California. From the inventory we drew a random sample and then carried out an in-depth survey. The survey instrument was designed to capture the role, depth and breadth, skills, and range along a career path from lower to higher skills of each type of training and education institution, and to address distinctions across them. Out of 1,540 individual tracks, we interviewed 485.

Table 3 shows a summary of the occupational specialties of the programs identified in the training program inventory, documenting the number of programs training for each major occupation within each institutional type. Each primary occupation was classified as one of three main occupational types: professional, traditional trades, and emerging energy efficiency trades.

The majority of training programs—and the most comprehensive—are in traditional construction trades occupations and professional/managerial occupations. Universities and apprenticeships offer the longest, most in-depth training programs, serving to bring workers from a novice level to a level of competence and mastery of their field over the course of a number of years. The minority of training programs that are specialized in energy efficiency are either very short advanced incumbent worker classes, mostly for professionals, or short-term, narrowly focused entry-level or intermediate-level technical training at CBOs, private organizations, or community colleges.

Community colleges have the most programs and serve multiple purposes, including as transfer institutions to four-year professional education, as skills upgrading for incumbent workers and as career technical training leading to terminal certificates and degrees. Although the community colleges issue a number of certificates and degrees, these do not always have value in the market because in many occupations there are not clear industry-recognized certifications. This lack of market value may partially explain the disproportionately low number of graduates per program. Private training organizations also offer certificates to graduates, but a significant portion of these are self-issued and their value to students and employers is not clear.

Figure 2 shows the career pathways that exist in the professional occupations (architecture, engineering, construction management, etc.), including the clear training pathways and articulation agreements between community colleges and four-year colleges and universities. The community colleges provide a path of educational opportunity for disadvantaged students, and themselves articulate with high school or adult bridge programs to help break down barriers to post-secondary education. There are about 660 students obtaining transfer degrees and about 9,700 students obtaining four year or postgraduate degrees (mostly engineering) for the relevant subject areas each year.

In addition to the long-term occupational training in preparation for a professional career, over 1,000 individual skills upgrading classes are available at IOU Energy Training Centers each year, and about 2,000 classes at private organizations. Professional workers can count some of these as continuing educational requirements for licensure or professional association membership renewal. These short-term, high-volume trainings focus on a particular skill and are generally open and applicable to many different, but related occupations. For example, the U.S. Green Building Council offers training in the Leadership in Energy & Environmental Design (LEED) system, which is often attended by architects, engineers, real estate developers, construction managers, and others.

Table 13.2 Number of Program Tracks by Primary Occupation, 2010

Main Trade Or Skill Set	Four-Year and Graduate	Community College	Private	Appren-ticeship —Joint	Appren-ticeship—Unilateral	ROP	CBO	TOTAL
Professional / Managerial								
Architecture	24	70	1					95
Civil Engineering	45	5						50
Construction Management	11	31	17					59
Electrical Engineering								0
Engineering, General	54	123	3			26		206
Engineering and Architecture (Drafting / Design)		162				44		206
Law/Policy	2	1						3
Management	3							3
Mechanical Engineering	63							63
Total for Professional / Managerial	202	392	21	0	0	70	0	685
Traditional Trades								
Boilermaker				1				1
Bricklayer				3	1			4
Carpenter		13		20	5			38
Cement Mason				1	1			2
Construction Inspector		41	5					46
Electrician		24	4	42	13			83
Elevator Constructor				2	1			3
General Construction Worker		29				117	17	163
Glazier				3				3
Heat and Frost Insulator				2	1			3
HVAC/R Worker[1]	2	64	11	15	4			96
Laborer				10	3			13
Operating Engineer[2]				9	3			12
Plasterer				5				5
Plumber, Pipefitter, and Steamfitter		2		58	7			67
Roofer / Waterproofer				8	2			10
Sheet Metal Worker[1]		5		33	4			42
Sprinkler Fitter				5	3			8
Total for Traditional Trades	2	178	20	217	48	117	17	599
New and Emerging Trades								
Auditing and/or Inspection		11	107					118
Renewable Energy and Energy-Efficiency Specific[3]		25	56		2	24	22	129
Total for New and Emerging Trades	0	36	163	0	2	24	22	247
Total	204	606	204	217	50	211	39	1,531

Note: We did not include information for utility Energy Training Centers here because data by occupation is not collected according to primary occupation. See Chapter 12 for information on training areas.

Table 3 (continued) Number of Program Tracks by Primary Occupation, 2010

[1] Most HVAC/R training tracks for apprenticeship are incorporated in the committees for plumbers, pipefitters, and steamfitters. Others are refrigeration-specific committees. Sheet metal workers work with HVAC systems as well.

[2] Including stationary engineers as well.

[3] Many emerging occupational training programs teach a variety of skills for energy efficiency and renewable energy so we use a broad category here. Audit and/or inspection refers to programs specializing only in audit and/or inspection. Some renewable energy and energy-specific programs may also teach some aspects of auditing or inspection in addition to other skills.

Figure 2. Pathways: Professional and Managerial Occupations, Estimated Annual Graduates Statewide

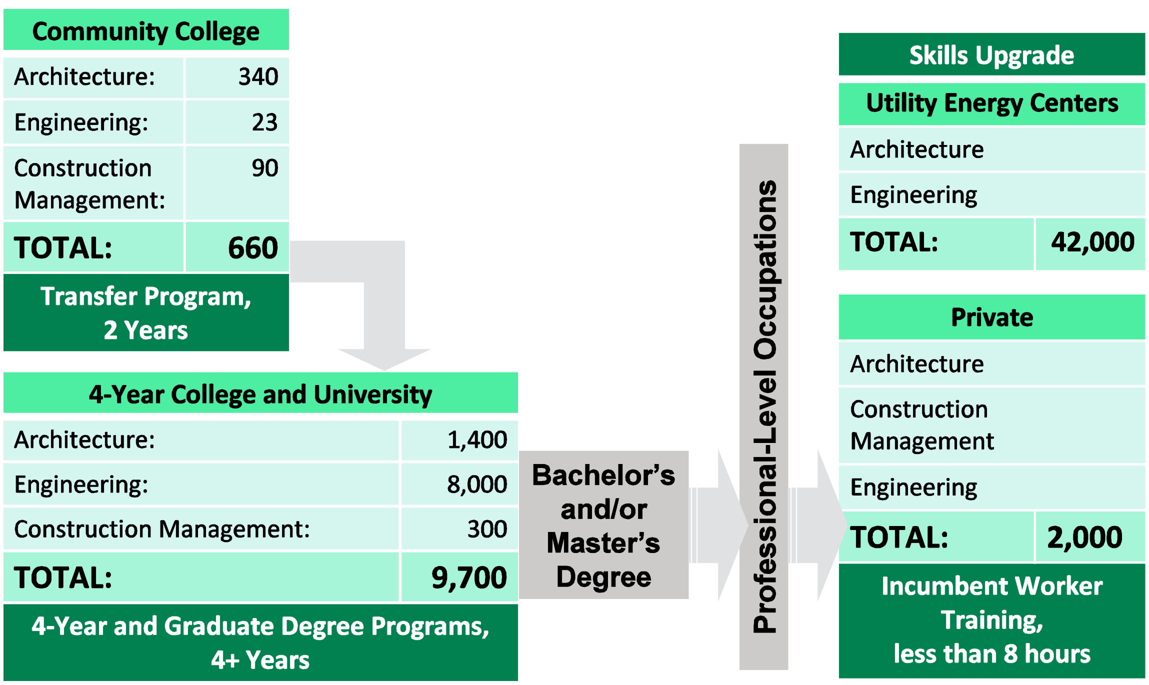


Figure 3 shows career pathways in the commercial and public sectors for construction trades. The primary occupations are in the traditional building trades, with energy-specific skills training included in broader occupational training. Apprenticeship is the main site of long-term, advanced training for these jobs, with about 4,500 graduates per year. Compared to other training programs for construction trades, apprenticeships offer training with significantly greater depth and scope, incorporate numerous industry recognized certifications, and result in the best worker outcomes in terms of jobs and wages. Although apprenticeship has few educational requirements other than testing, there are many applicants for few slots, and disadvantaged workers often face barriers to entry. Pre-apprenticeships help increase access to apprenticeship by offering short-term training in basic soft and hard skills, introductory occupational skills, and preparation for the entrance exams. Pre-apprenticeship programs are operated by CBOs, community colleges, and ROPs. However, not all pre-apprenticeship programs are clearly linked to apprenticeship, nor do these programs consistently follow best practices.

Figure 3. Pathways: Commercial and Public Sectors, Construction Trades and Energy Specialties, Estimated Annual Graduates Statewide

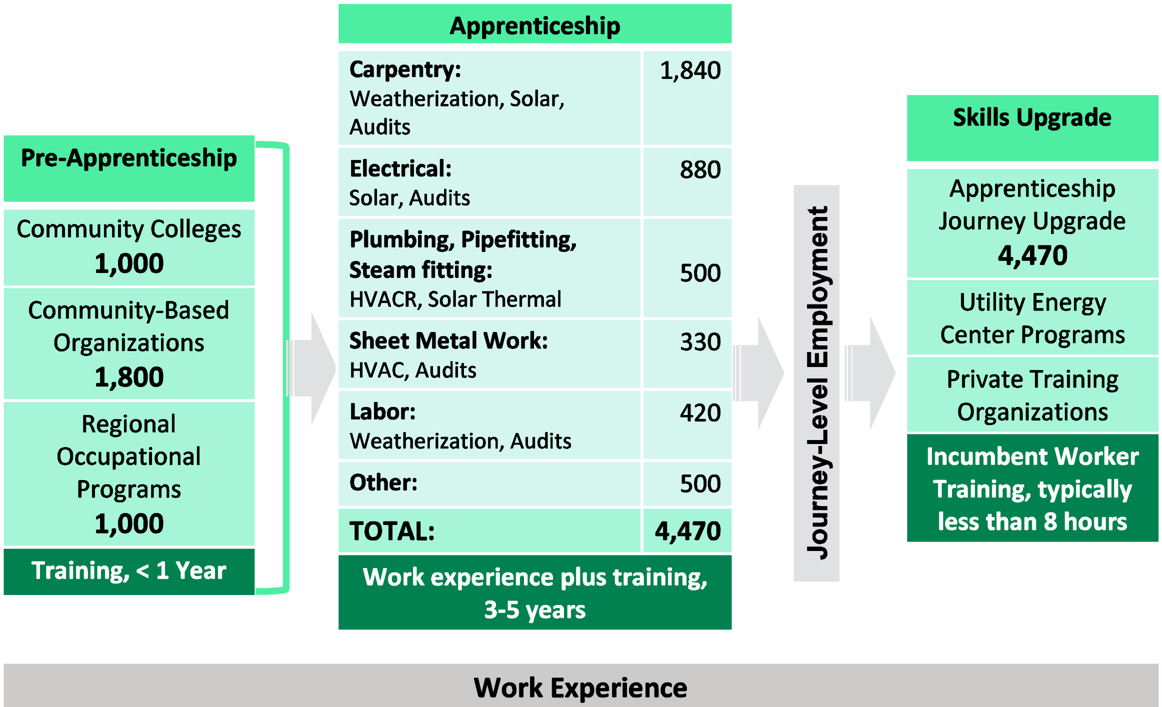
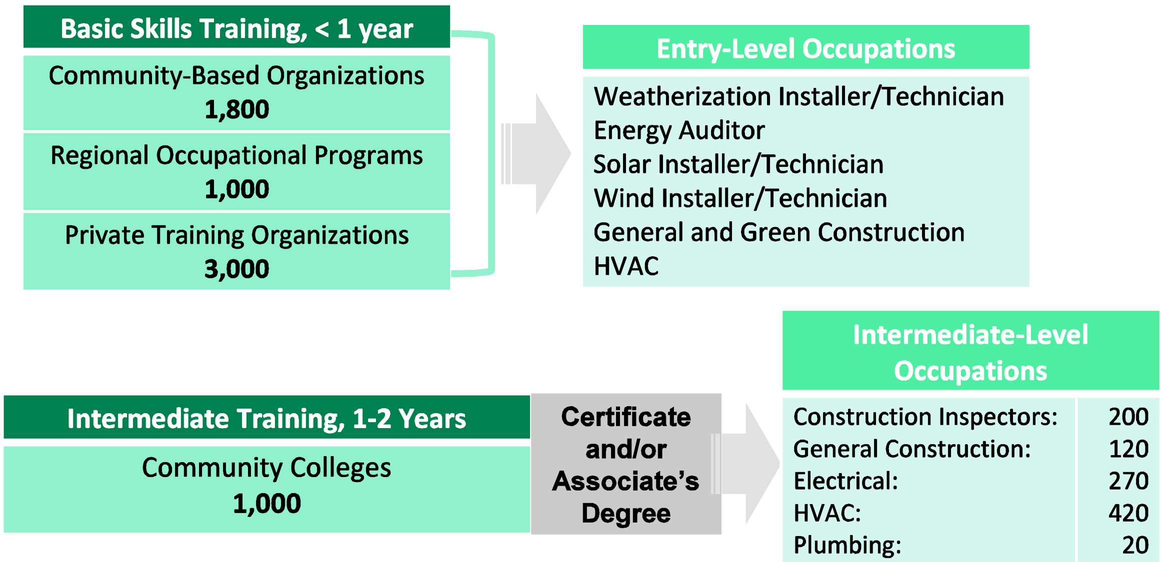


Figure 4 shows that career pathways are not well developed in the residential sector. In this sector there is a much spottier training infrastructure and many fewer graduates from training programs. Most workers enter the residential construction industry with no formal training and learn the trade on the job. As a result, workers gain skills primarily through work experience, based on the particular needs of the employer rather than on industry-wide standards. There are some entry-level programs at CBOS, ROPs, and community colleges, but these are of short duration and low skill levels, and seem to mostly lead into low-wage jobs. Private training institutions are the most prominent in entry-level residential work, but have unknown outcomes for workers.

Community colleges graduate about 1,000 students per year, statewide, with either certificates or two-year degrees in residential technical specialties such as HVAC worker, auditor, and building inspector. Some community colleges have started new energy programs, such as those for training solar technicians, or offer classes within other programs that focus on solar or energy efficiency. Although there are also classes in the IOU Energy Training Centers for the residential sector, these are typically taken by contractors or professionals, and less commonly by construction workers (illustrated in Figure 2).

Not only is formal training in residential construction sparse, but the different levels of training are not linked to each other in either the job market or in training pathways. Some programs at community colleges are attempting to forge these links—to create career paths from weatherization installer to auditor to HVAC technician, for example. However, we found no evidence that these efforts have yielded tangible results so far.

Figure 4. Pathways: Residential and Small Commercial Sectors, Construction Trades and Energy Specialties, Estimated Annual Graduates Statewide



The IOU WE&T programs funded by utility ratepayers are the only state resources dedicated to skills and knowledge development specifically in energy efficiency and closely related areas and, thus, these programs are an essential resource for skills upgrade training for professionals and contractors. The eight IOU Energy Training Centers, located throughout California, are particularly important as hubs of best practice skills and knowledge in energy efficiency and related areas, including training for deployment of emerging technologies. The Energy Training Centers have a budget of about $76 million for the 2010-2012 program cycle. In 2009, they offered over 1,000 classes to almost 43,000 attendees in a variety of areas related to energy efficiency and other DSM activities; most classes are a few hours in length and are taken by contractors, engineers, and other professionals. The Energy Training Centers are expanding their collaborations to reach beyond professionals and contractors and into relevant career education programs in community colleges, and four-year colleges and universities. There are opportunities to collaborate on curriculum review and updating with apprenticeship programs, four-year engineering and architecture programs, and community college technical programs. Sector strategies offer a model for utility participation in industry partnerships, particularly with employer groups that have ongoing commitments to training a stable workforce.

The IOUs also administer the smaller (approximately $16 million for 2010-2012) *Connections* initiatives, which include five programs targeting K-12 and college student populations. These are mostly energy awareness initiatives carried out in collaboration with schools and colleges, but they have begun to integrate career education. For the K-12 programs, the IOUs are developing deeper ties with the career preparation programs in California high schools. Of particular note are the IOU collaborations with the California Partnership Academies, which are the state's primary career technical initiative aimed at lowering drop-out rates and guiding students into post-secondary training and career tracks in specific occupations.

Another critical piece of the workforce development system is labor exchange—the matching of job openings to job seekers. The WE&T Needs Assessment identified and reviewed two main types of electronic job matching services: niche green job boards and comprehensive job matching services. Niche job boards are generally privately operated and paid for by the employer or job seeker, serve clean energy or other green niche markets. Job boards generally serve professionals. Comprehensive job matching services, for the most part, are connected to one of the state's 259 WIA funded One-Stop Career Centers, and provide a full set of services including job listings, resume writing, career counseling, and, for eligible groups, training and support services. One-Stop Career Centers represent a federal investment of billions of dollars and cover all sectors, not just energy efficiency and related sectors.

The WE&T Needs Assessment also specifically analyzed the barriers keeping low-income, minority, and other disadvantaged individuals from entering energy efficiency careers, as well as the policy solutions and best training practices that can help create access to good jobs in these sectors. The large public investment in the energy efficiency and related sectors presents a potentially viable opportunity to build pathways out of poverty for individuals who have been historically disadvantaged in the labor market, particularly because of the relatively high percentage of energy efficiency jobs that do not require a college degree. The analysis showed that the lessons learned in other sectors about pathways out of poverty apply to the energy efficiency sectors as well. First, training that is integrated into sector strategies with strong employer commitment have shown the most success in linking job seekers to living wage jobs with career paths. Second, when targeted sectors are not resulting in living wage jobs with career pathways, as in many jobs in the residential sector, strategies to build pathways out of poverty must address policies and other interventions to improve job quality. In energy efficiency sectors, specifically, opportunities for inclusion of disadvantaged, minority, and low-income workers will emanate from support for pre-apprenticeship programs that can prepare job seekers for entry and success in apprenticeship programs, as well as from labor demand strategies, such as high-road agreements and industry adoption of stackable and portable certifications tied to wage ladders.

III. FINDINGS

The WE&T Needs Assessment findings provide the basis for developing the specific recommendations presented below.

Key findings from Part 1 of the WE&T Needs Assessment include:

- → The forecast of large overall stimulus and job creation coupled with the relatively small number of new jobs needing workers with specific training in energy efficiency and related skills;
- → The primacy of the building and construction trades, which make up about two-thirds of the overall jobs resulting directly from energy efficiency and related programs and policies;
- → The predominance of work in traditional construction trades, rather than in narrow specialized emerging occupations, disproving the view that such jobs are fundamentally different than other construction trades jobs, and highlighting the importance of greening the traditional trades;
- → The long queue of experienced unemployed workers, particularly in the construction trades;
- → The problems of work quality, particularly in residential and small commercial retrofit and HVAC, which are attributable to low-road market conditions and cannot be solved by training alone; and
- → The limited existence of industry recognized skill certifications in the relevant occupations.

Key findings from Part 2 of the WE&T Needs Assessment include:

- → The overabundance of training programs that can serve energy efficiency and related occupations, spread in many institutions but not coordinated under one strategy;
- → The availability of the state-certified apprenticeship infrastructure for the most prominent occupations, one of the few highly functional forms of training for middle-skill jobs, serving the needs of both employers and workers;

- → The availability of a strong public post-secondary education system (though now under acute budgetary pressure) that is effective for professional occupations requiring a four-year degree, but less so for other occupations;
- → The partial incorporation of energy efficiency skills and knowledge into apprenticeship programs and the two- and four-year colleges, and the opportunity for greater degrees of incorporation;
- → The particular weakness in articulated training paths or links to good jobs for the residential occupations compared to the more strongly articulated training paths in the professions and the commercial and public sector trades;
- → The lack of guideposts on which skills to train for, particularly in the residential sector, due to lack of industry recognized credentials;
- → The recent growth of short-term training for new workers in specialized occupations in private organizations and community colleges, which does not build on the strengths of California's workforce infrastructure and may not lead to good careers for graduates.

IV. RECOMMENDATIONS

Our targeted recommendations fit into two overarching prescriptions that are driven by the state's intertwined clean energy and workforce goals. They address the role that the California state government has in shaping the kinds of jobs that are created as the state moves towards a clean energy economy, as well as the role of the workforce development infrastructure in effectively responding to this economic restructuring. Implementing these recommendations will require some redirection of programs since clean energy programs have not consistently addressed their implications for the state's workforce objectives. The recommendations are not limited to those that can be carried out only by the CPUC or the utilities, but rather are aimed at a broader set of state agencies and stakeholders that can drive the needed changes.

- CREATE AND ENFORCE STANDARDS to expand the higher quality segments of energy efficiency sectors: Establish policies and require utility and other publicly-funded programs focused on energy efficiency and other demand-side management activities to clearly delineate and align the skills, certifications, and additional standards governing workers and contractors, so that quality work conditions can be maintained and workforce planning can occur.
- IMPROVE WE&T PLANNING AND COORDINATION: Establish state-level policies, support effective collaborations, and provide incentives to improve workforce planning and coordination among clean energy agencies and workforce agencies, and among the major education and training institutions, particularly apprenticeships, community colleges, and utility training programs. Emphasis should be placed on sector strategies built on partnerships between business, labor, and training and educational institutions.

Below we present specific recommendations, which will require partnerships, coordination, and collaboration on the part of all stake-holders.

IV.A. RECOMMENDATIONS FOR CPUC, CEC, UTILITIES AND OTHER AGENCIES AND STAKEHOLDERS SUPPORTING INVESTMENT IN ENERGY EFFICIENCY AND DEMAND-SIDE MANAGEMENT ACTIVITIES

State agencies, utilities, and others involved in energy efficiency and related programs and policies should determine and align skill certifications and analyze costs and options for encouraging their adoption by industry in the following ways:

- INCENTIVE PROGRAMS: Require contractors who participate in energy efficiency rebate and incentive programs to have third-party certifications, licenses, building permits, and/or meet other relevant standards and certifications. Certification requirements should apply to both workers and contractors.

- DIRECT CONTRACTS: Award state and utility direct-install contracts using a best-value contractor rating system that includes documented history of high-quality work, hiring of workers with appropriate certifications, ongoing investments in worker training, and compliance with building codes and employment laws.

- LOW-INCOME STATE AND IOU RESIDENTIAL PROGRAMS: For fully subsidized low-income programs, modify program objectives to include workforce outcomes. Assess current workforce outcomes and if they are not adequate, use high-road agreements and sector strategies to pilot incorporation of the new national DOE skill standards and certifications or other strategies to improve both energy efficiency and workforce outcomes.

- ENERGY UPGRADE CALIFORNIA FOR RESIDENTIAL: Require Energy Upgrade partners and implementation contractors to include, not only building envelope standards, but also standards for HVAC installations and other building systems. Establish pilot programs that include high-road agreements as part of the portfolio of funded programs, paying particular attention to strategies that bundle jobs to achieve a large enough scale to attract a broad set of contractors, including those with strong administrative and training capacity.

- ENERGY UPGRADE CALIFORNIA FOR COMMERCIAL: Require the use of high-road agreements, including apprenticeship, prevailing wage, and local hire provisions. The use of high-road agreements will support higher quality installations, increase the benefits of training investments, and promote the achievement of California's workforce goals.

- LICENSING: Review and, if warranted, change licensing requirements for building and construction trades contractors and technicians to ensure competency-based licensing.

- PUBLIC CHARGE REAUTHORIZATON: Include desired workforce outcomes in the list of goals for energy efficiency, low-income, and renewable energy programs (including distributed generation) with the reauthorization of the public goods charge.

- SECTOR STRATEGIES: Encourage drivers of energy efficiency investments to support sector strategies for deployment of new measures and technologies such as energy storage, integrated demand side management, commercial building benchmarking, and others, through co-funding, participation in setting work and skill standards, and serving as conveners of contractors and other key stakeholders.

- REPORTING OF WAGES, TURNOVER, AND OTHER LABOR CONDITIONS: Modify program evaluation methodologies and protocols for energy efficiency, demand response, and distributed generation to require the inclusion of worker outcomes, including compensation, benefits, turnover, and retention rates. Existing methodologies address energy and environmental costs and benefits but do not address workforce costs and benefits. Workforce issues affect both the costs and benefits of these programs, by way of the quality of installations and maintenance and the benefits associated with investments in training. Moreover, the achievement of the state's energy efficiency goals needs to be considered alongside the achievement of the state's workforce goals.

IV.B. RECOMMENDATIONS FOR WORKFORCE DEVELOPMENT POLICYMAKERS, FUNDERS, AND PRACTITIONERS

- SECTOR STRATEGIES: Support workforce development funders (including Workforce Investment Boards, the Employment Training Panel, etc.) and training and education institutions as they develop, serve as intermediaries for, and coordinate their programs with sector strategies. When key elements of sector strategies already exist, as in the case of the Western HVAC Alliance for example, the workforce development community should participate by providing co-funding and technical assistance on sector strategy best practices, in addition to providing training and education services.

- GREENING TRADITIONAL OCCUPATIONAL PROGRAMS: Incorporate energy efficiency skills and knowledge into traditional occupations in the construction trades and the relevant professions, particularly engineering and architecture. This greening should focus on the main training institutions of apprenticeship, community college, and four-year colleges, and be a preferred alternative to creation of new, shorter-term, narrowly focused programs in specialized skills related to energy efficiency.

- INCUMBENT WORKER TRAINING: Focus resources on incumbent worker training and journey upgrade training. Consider the adoption of meaningful continuing education requirements for licenses and certifications to support participation of incumbent workers in these trainings and to integrate energy efficiency into the main knowledge and skill base of the relevant professions and trades.

- COMMUNITY COLLEGE AND APPRENTICESHIP COLLABORATION: Promote system-wide collaboration between the community colleges and the apprenticeship programs at the pre-apprenticeship, apprenticeship, and continuing education levels. Leverage the strength of the community colleges in providing pathways for students from disadvantaged communities.

- CERTIFYING PRE-APPRENTICESHIP: Support and strengthen pipelines into skilled trades work, using models such as PG&E's Power Pathways program, other successful community college pre-apprenticeship programs, and high school career academies. These pre-apprenticeship programs should be linked to state-certified apprenticeship programs and built on best practice models. Efforts to build stronger pipelines should be connected to clean energy investment policies, including high-road agreements with local hire clauses.

- DATA ON TRAINING OUTCOMES: Promote improved data availability on outcomes for training program participants by making available (with security safeguards) administrative data on employment of publicly-funded training program graduates. Job placement rates and career advancement should be adopted as priority metrics of program success. New policy is needed to make existing data available for research, while safeguarding privacy and confidentiality.

IV.C. RECOMMENDATIONS FOR CHANGES TO UTILITY WORKFORCE EDUCATION AND TRAINING PROGRAMS

- SUPPORT SECTOR STRATEGIES: Initiate, help fund, and partner with other organizations to develop robust sector strategies in key energy efficiency sectors such as HVAC, building operations and maintenance, benchmarking, and other emerging areas (as well as LIEE or other programs undergoing review or redesign).

- TRAINING CENTER CLASSES: Modify the structure of classes offered by the Energy Training Centers to increase the number of course series that are longer in length than current typical classes, focus on a specific occupation, have a workplace-based hands-on component, and offer clear learning objectives that lead to certification.

- COLLABORATIONS: Expand collaborations between the Energy Training Centers and building and construction trades associations. The emphasis should be on collaborations with high-road associations demonstrating commitment to investments in ongoing workforce training, such as participating in apprenticeship programs.

- CURRICULUM DEVELOPMENT OR UPDATING: Actively participate in the content development, review, and updating of curricula, and support instructor professional development for the main "home institutions" that train building and construction professionals and trades people, such as apprenticeship programs, community colleges, and four-year institutions. Energy Training Center staff should be encouraged to share their expertise as appropriate to ensure that curricula incorporate up-to-date information on new technologies and practices.

- GOALS FOR INCLUSION OF DISADVANTAGED WORKERS: Adopt as a goal for the Energy Training Centers the inclusion of low-income, minority, and disadvantaged workers and job seekers. Develop and implement specific programs in collaboration with organizations that have a track record in this arena, emphasizing sector strategies that can lead to placement in good jobs with career ladders.

- EVALUATION OF WORKFORCE OUTCOMES: Assess and determine what additional information is required to evaluate workforce outcomes for the Energy Training Centers. At a minimum, the Energy Training Centers should begin to collect information from participants on occupation, prior education, and work experience and demographic characteristics.

- CAREER DEVELOPMENT AND ENVIRONMENTAL INTEGRATION IN K-12 PROGRAMS: Increase the emphasis on career awareness and career exploration in ratepayer-funded education programs serving K-8 students and support career preparation programs in career academies and Regional Occupational Programs. Evaluate and work toward the integration of environmental and ratepayer-funded energy curricula. There is substantial evidence that the integration of environmental and energy curricula will increase the support of teachers for these programs. These efforts should be supported by strong collaborations with K-12 schools, particularly those programs, like the California Partnership Academies, that target disadvantaged students.

- EVALUATION OF K-12 EDUCATION PROGRAMS: Work with education agencies, schools, and funding partners to allow for the collection and reporting of demographic information on students participating in ratepayer-funded Connections education programs. The present lack of information hampers the evaluation of existing programs.

IV.D. RECOMMENDATIONS FOR FURTHER RESEARCH AND CAPACITY BUILDING

- WORKFORCE OUTCOMES OF ENERGY EFFICIENCY PROGRAMS: Expand funding for research on the implications of energy efficiency and related investments on jobs, job quality, and job access, and on employment and career outcomes for training program graduates. Comparative research that captures the impact of different labor conditions on energy efficiency outcomes should be prioritized. Basic job and workforce information is needed for the state's major clean energy and efficiency investments, including wages, turnover, retention and workforce characteristics.

- SECTOR STRATEGIES RESEARCH AND TECHNICAL ASSISTANCE: Provide funding to support research on, and technical assistance and capacity building for, existing and emerging sector strategies in the energy efficiency sectors. These funds should be used to disseminate best practices of CALCTP and other successful sector initiatives to new initiatives, and to provide technical assistance to these initiatives.

- FUTURE WE&T NEEDS ASSESSMENTS: Future studies in targeted sectors are needed to assess the specific skill requirements and effectiveness of training programs. These needs assessments, including the one programmed for HVAC, should not be limited to skill gaps analyses but should include analyses of key labor conditions such as wages, career ladders, turnover and retention rates, and employer investments in training and retention. Needs assessments should include an employer survey of the various segments of the targeted sector in order to gather this information. This approach is critical to assess the higher quality segments of the industry, determine skill standards and certifications when necessary, and ensure that training investments help support the higher quality segments of each market.

- NATIONAL CENTER FOR THE CLEAN ENERGY WORKFORCE: Support the California Energy Commission's proposal to create a National Center for the Clean Energy Workforce. The mandate of the proposed center is to help California grow a clean energy economy by promoting high-road economic and workforce development. The proposed center would work toward these ends by supporting research, providing technical assistance, and serving as an information clearinghouse and communications hub. In these ways, the center would help the state achieve energy savings while improving the lives of California workers.

PART ONE:

POLICY IMPACT ON JOBS AND ECONOMIC DEVELOPMENT

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CHAPTER ONE:

1. INTRODUCTION TO THE WORKFORCE EDUCATION & TRAINING NEEDS ASSESSMENT

This report presents the results of the California Workforce Education and Training Needs Assessment for Energy Efficiency, Demand Response, and Distributed Generation (WE&T Needs Assessment). This project was carried out under joint management by the California Public Utilities Commission (CPUC) and the investor-owned utilities (IOUs) of California with Southern California Edison (SCE) serving as the lead utility for the IOUs.[1] The project was funded by the ratepayers of California under the auspices of the CPUC.

Consistent with the direction of the CPUC, this is a third party report and does not necessarily represent the viewpoints of the CPUC or the four IOUs, though CPUC and utility staff reviewed it for factual accuracy. The WE&T Needs Assessment was conducted throughout calendar year 2010.

1.1 WHY A WORKFORCE EDUCATION AND TRAINING NEEDS ASSESSMENT FOR CALIFORNIA?

The WE&T Needs Assessment is one of the products resulting from the California Long Term Energy Efficiency Strategic Plan (EE Strategic Plan or Plan), which the CPUC adopted in September of 2008.[2] Developed using an intensive stakeholder process in 2007 and 2008, the Plan provides a road map for a dramatic scaling up of statewide energy efficiency efforts designed to meet California's clean energy goals. The objective of the Plan is to compel sustained market transformation, thus moving California towards long-term deep energy savings. The Plan delineates a set of strategies for residential, commercial, industrial, and agricultural sectors. In addition, the Plan is a central element in the implementation of California's Global Warming Solutions Act of 2006 (AB 32) and is also a main component of the implementation of California's Comprehensive Energy Efficiency Program for Existing Residential and Non-residential Buildings law, passed in 2010 (AB 758).

Workforce Education and Training (WE&T) was one of the key issues identified in the EE Strategic Plan. The WE&T section of the Plan begins with a vision statement followed by detailed goals, strategies and implementation plans. The vision statement states:

> *"By 2020, California's workforce is trained and fully engaged to provide the human capital necessary to achieve California's economic energy efficiency and demand-side management potential."* [3]

[1] The four major IOUs serving California's electric and natural gas customers are: Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), San Diego Gas and Electric Company (SDG&E) and Southern California Gas Company (SoCalGas).

[2] California Public Utilities Commission (CPUC) (2008). D.08-09-040. *Decision Adopting the California Long Term Energy Efficiency Strategic Plan.* The CPUC both adopted the plan and "… required that adopted strategies be incorporated in energy efficiency program planning and implementation starting in 2009."

[3] California Public Utilities Commission (2008). California Long Term Energy Efficiency Strategic Plan: Achieving Maximum Energy Savings in California for 2009 and Beyond. p. 74. Retrieved from: http://www.cpuc.ca.gov/NR/rdonlyres/D4321448-208C-48F9-9F62-1BBB14A8D717/0/EEStrategicPlan.pdf.

The Plan calls for the establishment of "…energy efficiency education and training at all levels of California's educational system," and for ensuring that "…minority, low income and disadvantaged communities fully participate in training and education programs at all levels of the DSM [demand-side management] and energy efficiency industry." Both of these goals emphasize the potential for energy efficiency investments to create careers for Californians of all background, not just for the college educated or for those with ready access to a college education. The Plan also recognizes that an extensive collaborative effort among state agencies, educational institutions, community-based and non-profit organizations, private industry and labor is required for an effective and comprehensive WE&T program for a new energy efficient economy.

Following adoption of the Plan in September 2008, a process of refining the needs assessment took place, which included gathering stakeholder input, drafting a Request for Proposals (RFP) based on that input, and selecting a third-party group to conduct the study. This process was completed by December 2009 and resulted in the research presented in this WE&T Needs Assessment report.[4]

The CPUC's direction for the WE&T Needs Assessment initially focused on achieving California's energy efficiency goals and the need to have a "trained and fully engaged" workforce to do so. However, the CPUC also recognized the importance of workforce outcomes through its explicit consideration of disadvantaged workers and its emphasis on collaborating with state training agencies, educational institutions, community-based and non-profit organizations, and industry and labor organizations, whose priority is to improve job opportunities and outcomes rather than energy efficiency outcomes. To support the development of collaborative arrangements and to address equity concerns, the WE&T Needs Assessment thus addresses two distinct goals—worker outcomes and energy efficiency outcomes.

It is also important to draw attention to the fact that the WE&T Needs Assessment is meant to identify all workforce strategies that could help achieve the state's clean energy and workforce goals, and does not limit the review of possible strategies to expanding or changing training and education programs. As we will see, training and education is often a necessary, but not sufficient, strategy to solve the various workforce issues that might impede desired energy outcomes or improve job opportunities for Californians.

1.2 SCOPE

The WE&T Needs Assessment focuses on the customer side of the energy market, meaning strategies that reduce the need for power from the electrical grid or gas distribution networks. This limited slice of the clean energy economy encompasses energy efficiency, distributed generation, and demand response. Energy efficiency reduces the amount of energy required for specific services, while demand response is aimed at reducing peak demand.[5] For this study, distributed generation is limited to customer-owned generation that relies on solar and other renewable fuel sources and is less than 20 MW in size.[6] In the rest of this document we use the terms "energy efficiency" or "energy efficiency related" as a shorthand for these demand-side management strategies, including distributed generation and demand response.

[4] During this process and in the initial months of the project, the goals and scope of the project were delineated to include a more comprehensive understanding of California's workforce infrastructure, a module on employment information systems to support the development of the WE&T web program, and a number of specific efforts designed to disseminate the preliminary findings of the study.

[5] Demand response generally involves reductions in load during on-peak periods and the possible shifting of this load to off-peak periods; these shifts are in response to direct load control programs as well as significant variations in customer energy prices. Energy storage and smart meters are part of demand response.

[6] The various types of distributed generation facilities are addressed by the CPUC in D.09-08-026. *Decision Adopting Cost-Benefit Methodology for Distributed Generation.* Distribution generation facilities that rely on natural gas or fuel oil (e.g., combined heat and power facilities) were excluded from the scope at the direction of the CPUC and IOUs.

This scope uses categories that are meaningful to the CPUC and the utilities and is not a definition of specific economic sectors per se. In fact, energy efficiency, and some demand response activities, mostly entail changes in processes—changes in the way we do things—rather than specific products or services, i.e., changes in what we produce. Some types of firms specialize in energy efficiency services, like home performance contractors and energy service companies (ESCOs). In other cases, however, energy efficiency activities are carried out (and can be incentivized) during new construction, remodeling or other activities whose primary goal is not energy savings. This is less the case with distributed generation, which consists mostly of solar, but also encompasses wind or fuel cells on customer sites. Solar and wind energy distributed generation can be more directly defined as a specific clean energy sector, but even here, many solar installations are installed by general or electrical contractors rather than by solar-specific contractors.

The definition described above has some grey areas, and the study team followed CPUC direction regarding what to include or exclude. For example, in the demand response area, smart meters were included but smart grid work was not. Transportation related activities, such as the construction of electric vehicle plug-in stations were also excluded. See Chapter 3 for a detailed list of the policies under consideration.

The WE&T Needs Assessment defines the scope of its economic sectors as all those that are impacted by policies and programs aimed at reducing energy use as defined above. Once we identify the industries impacted, these form the core of our analysis of job impacts and workforce education and training issues. As we will see, the largest industry segments that are affected are the construction industry and the professional services industries linked to construction—such as engineering and architecture. The only part of the utility workforce that is under study are employees directly involved in the energy efficiency program areas and these form a very small proportion of the overall workforce.

The WE&T Needs Assessment is statewide and includes the study of all policies and programs within the scope just described, not only those under the jurisdiction of the CPUC or implemented by the investor-owned utilities (IOUs). In addition, the recommendations for workforce strategies are not limited to those that can be carried out by the CPUC or the utilities, but rather are aimed at all those with the capacity to effectuate the needed changes. The EE Strategic Plan specifically called for collaborative solutions to workforce issues among state agencies, including the CPUC, the education and training agencies, and others.

1.3 RESEARCH APPROACH AND CONCEPTUAL FRAMEWORK

In order to address the two broad goals of the WE&T Needs Assessment, our research design encompasses investigation into both the demand and supply sides of the labor markets affected by energy efficiency and related policies. In order to develop the information base needed to analyze workforce strategies, the first area of research focuses on the impact of federal and state energy efficiency policies on job growth and job transformation. The second area of research is a comprehensive assessment of the many pieces of California's workforce development system and its collective capacity to prepare, place, or retrain workers in the jobs that are created or transformed by the energy efficiency policies and programs under the scope of this study. The study relies on a mix of quantitative and qualitative methodologies, which are explained in each chapter.

1.3.1 JOB IMPACTS OF ENERGY EFFICIENCY POLICIES

The first research goal requires an analysis of the specific job impacts of the policies and programs designed to support energy efficiency and demand-side management. This includes an identification of all the policies and programs that impact energy efficiency, distributed generation and demand response and their impact on the number of jobs that will be created or transformed, the industries and occupations affected, the businesses carrying out these activities (including both the specialized energy efficiency firms and other firms carrying out this work), the skill sets for new jobs, skill changes for transformed jobs, the wages and other job characteristics, and the demographics of the workers in these sectors (including the numbers of dislocated and unemployed workers).

This also includes an understanding of the market environment in which these policies operate and the overall forces shaping the workforce and workplace in California. Thus, in addition to the quantitative analysis just described, our approach includes a qualitative analysis of the impact of market dynamics and policy interventions on the labor market and, in turn, an analysis of how this labor market impacts both energy savings outcomes and workforce outcomes.

This qualitative analysis is a critical part of our research because the overall labor market in California is beset by two critical problems—very high unemployment rates and very high wage inequality. While the high unemployment rate is a cyclical problem and is expected to eventually abate, the growing wage inequality and increasing percentage of low wage jobs is a structural problem with deep implications for this needs assessment. As we will see, the prevalence and dynamics of low-wage labor markets in California results in poor outcomes for workers in many jobs requiring less than a four-year college degree, which directly impacts the workforce goals under study here. Low wage labor markets also affect product and service quality by impacting businesses' capacity to attract, retain, and fully engage qualified workers. Training must be viewed within this complex labor market, which can potentially undermine the value of training investments. Given the complexities of how training works in the labor market, the study tries to identify all strategies for addressing the workforce goals, including, but not limited to, expanding or changing our current portfolio of workforce education and training programs.

1.3.2 WORKFORCE DEVELOPMENT INFRASTRUCTURE

The research on California's workforce development infrastructure comprises an assessment of California's education and job training programs at all educational and career levels that are relevant to the energy efficiency and related sectors. It includes both an inventory of education and job training programs in key occupations related to energy efficiency and a random sample survey of programs in the inventory, looking at the following institutions:

- → Four-year universities
- → Community colleges
- → Certified apprenticeship programs
- → Private industry training programs
- → Community-based organization training programs
- → Regional Occupational Centers and Programs
- → Utility training programs

It also includes an analysis of K-12 programs in the energy efficiency sectors and an analysis of employment information systems (online job matching systems). The emphasis of the analysis is on the key roles that each institution plays and how they fit together, including an assessment of the various planning arenas and mechanisms in the state to link economic development and workforce development and coordinate workforce development efforts.

To address strategies supporting the full participation of minority, low-income and disadvantaged communities, the Needs Assessment includes a separate chapter focused on identifying best practices for workforce education and training programs and other interventions and policies. Again, the researchers do not assume that training and education is the only avenue that is needed to improve opportunities for disadvantaged workers, but also look at policies and programs that intervene in the demand side of the labor market to affect the kind of jobs created and who is hired. Although initially asked to focus on overcoming barriers to entry into training programs, the research team found that a more important consideration is overcoming barriers to placement in good jobs—not just in training programs—that may or may not lead to good jobs. Consideration of the issues facing disadvantaged workers is integrated throughout the report, as well as separately addressed in this chapter.

As with any research project, choices are made in terms of the levels of analysis and the resources expended on each piece of the puzzle. This is the most in-depth study of workforce issues in energy efficiency sectors in California to date, encompassing both the restructuring of jobs and the relevant workforce development infrastructure. Our emphasis is on providing as complete an overall picture as possible in order to surface all the issues that affect a project's energy savings and workforce goals. However, it is impossible to be completely comprehensive and we focus our efforts particularly on an analysis of middle skills construction jobs. The reasons for this emphasis are that our projections show that most of the jobs needing energy efficiency training are middle skills construction jobs, and that middle skill jobs are in the segment of the labor market plagued by low wages, poor links between training programs and jobs, and other labor market challenges. Finally, recent studies have focused on the energy efficiency professional workforce and there is a paucity of prior research on the construction trades workforce.[7]

As is apparent in the approach just described, the research team puts front and center the analysis of both the demand and supply sides of the labor market, and embeds issues of education and training within the larger labor market issues that impact both energy savings and workforce outcomes. Training investments operate within a complex labor market affected by the factors that determine what kinds of jobs are created (labor demand) and those that determine the availability and preparation of workers (labor supply).

1.4 PAVING THE HIGH ROAD AND CLOSING OFF THE LOW ROAD

The dual goals of saving energy and improving job opportunities and outcomes for low-income and disadvantaged Californians suggest that the WE&T Needs Assessment focus explicitly on strategies that can maximize the complementarities of these two goals, as well as identify the trade-offs between them where they exist. The conceptual framework for connecting these goals is based on the business and economic literature known as high road economic development. This approach focuses directly on the relationship between quality work and quality jobs. High road development consists of business competitive strategies built on quality and innovation, on jobs that pay well, use training to increase skills, and provide wage ladders to encourage learning and tenure within the same employer or industry.[8] In contrast, low road development consists of business strategies based on cutting

[7] Goldman, C., J. Peters, N. Albers, E. Stuart, M. Fuller (2010, March). Energy Efficiency Services Sector: Workforce Education and Training Needs. Lawrence Berkeley National Laboratories; Research Into Action, Inc.; Goldman, C., M. Fuller, E. Stuart, J. Peters, M. McRae, N. Albers, S. Lutzenhiser, M. Spahic (2010, Sept.). Energy Efficiency Services Sector: Workforce Size and Expectations for Growth. Lawrence Berkeley National Laboratories; Research Into Action, Inc.

[8] According to the business and economic development literature, a high road economic development strategy is one in which businesses compete by investing in a committed workforce that is both highly skilled and rewarded for those skills. JRank.org's online Encyclopedia of Business Management states, "The 'high road' to competitiveness is based on the cultivation of employee commitment and an exchange of high wages for high productivity." For a more thorough discussion see: Parker, E. & J. Rogers (2001). Building the High Road in Metro Areas: Sectoral Training and Employment Projects. *Rekindling the Movement: Labor's Quest for Relevance in the 21st Century*, eds. L. Turner, H. Katz and R. Hurd. Ithaca: ILR Press.; Bernhardt, Annette, Laura Dresser and Joel Rogers (2004). Taking the High Road in Milwaukee: The Wisconsin Regional Training Partnership. In *Partnering for Change: Unions and Community Groups Build Coalitions for Economic Justice*, ed. D. Reynolds. Armonk, NY: ME Sharpe.; Schweke, B. (2006). *A Progressive Economic Development Agenda for Shared Prosperity: Taking the High Road and Closing the Low*. Washington DC: Corporation for Enterprise Development.

costs, which leads to jobs that do not pay as well, do not use training, do not have career ladders and result in high turnover.

Increasingly, the U.S. economy, and particularly the California economy, are characterized by low road development, and there is no reason to expect that the sectors under study here will be different. Green jobs are likely to resemble other private sector jobs in California i.e., there will be some good professional jobs and many low-wage jobs, but not enough of the middle-wage jobs that are required for economic growth built on shared prosperity. Low-wage jobs are almost always jobs in which little investment in skill development occurs, which in turn affects the quality of the products and services produced. Thus, the dominance of low road firms in an energy efficiency industry often undermines both clean energy and workforce goals. To the extent that achieving our energy goals requires consistent work quality and a highly skilled workforce, policies that close off the low road and pave the high road may be necessary.

The high road conceptual framework allows us to address the two goals of the WE&T Needs Assessment in a comprehensive way and to study training and education within this larger context. Effective investments in training are necessary, but will not build the high road unless they are accompanied by labor demand policies to support work quality and job quality.

1.5 WHAT THE STUDY DOES NOT DO

This study is not able to assess the specific skills required to meet the work quality standards for all jobs impacted by energy efficiency policies and programs. It is also not an evaluation of the effectiveness of training programs in imparting specific skills and competencies to participants. Rigorous job task analyses that document work quality specifications for each job or activity and a translation of these specifications into skill standards, are the exception rather than the rule in the energy efficiency sectors. Given the wide variability of the firms entering these activities and the related variability of staffing patterns, as well as lack of widespread industry recognized licenses, certifications and other standards, identifying the specific skills related to the main occupations was far beyond our scope.

If skill standards were in fact specified and documented and a clear certification system were already developed, the WE&T Needs Assessment could have assessed gaps much more precisely. Unfortunately, that is not the case, which is one of the fundamental problems in this labor market. Lacking an objective measure of quality and a methodology to compensate for that, the study relied on self-reporting of the ways in which energy efficiency principles and skills were integrated into curricula.

1.6 IMPACT OF THE CURRENT ECONOMIC CRISIS

It is important to underscore that when the EE Strategic Plan was developed, there was real concern that the state might not have a workforce in place to carry out all the policies and programs designed to promote energy efficiency. Leading up to the adoption of the Plan, some stakeholders identified the lack of a trained workforce as a potential barrier to the achievement of California's aggressive energy efficiency and other demand-side management goals. Newspaper headlines questioned whether there would be a sufficient number of skilled workers to meet the increased demand for energy efficiency and other green economy workers, including the skilled workers required for environmentally friendly (i.e., energy-efficient) construction.[9]

The world has changed dramatically since 2008, and the deep recession has lowered concerns about the availability of sheer numbers of skilled workers. Instead, there are many unemployed and dislocated workers with years of experience in the broad occupational categories linked to energy efficiency. At the end of 2010, the number of construction jobs in California was down 44 percent from its peak in 2006, while jobs in engineering and architecture firms were down about 10 percent.[10] Though unemployment is much lower in the professional occupations, overall worker shortages are clearly not the issue in the short run. This dramatic change in the economic environment critically impacts the results of the needs assessment in a number of ways, which will be explained both in this introduction and in each chapter where relevant.

1.7 STAKEHOLDER ENGAGEMENT

The research team has engaged stakeholders throughout the project with the objective of making the WET Needs Assessment as useful as possible to those involved in the achievement of California's clean energy and workforce goals. This engagement began before the start of the project, with the participation of stakeholders in the CPUC Energy Efficiency WE&T Task Force in defining the scope and goals for the WE&T Needs Assessment, and continued with individual and group feedback sessions throughout the research process.[11]

The research team also planned and organized the Workforce Summit under the guidance of a high level government and stakeholder planning committee.[12] This committee included senior officials or their staff from the CPUC, the CEC, the legislature, the CWIB and representatives from leading community-based organization, labor, private industry and the education and training community. The Summit, held on December 8, 2010 at UC Berkeley, was structured to present preliminary findings and recommendations from the WE&T Needs Assessment and obtain feedback through participatory workshops and solicitation of comments. Representatives from the CPUC and utilities staffs have also managed the project, participating in monthly project update meetings, providing information and contacts, reviewing proposed methodologies, and reviewing the final project report for accuracy and clarity.

The research team appreciates the input provided by the various stakeholder groups and is confident that this report reflects broad (though not universal) agreement among stakeholders from both the workforce and clean energy communities. Despite the extensive input received, the research team remains solely responsible for the contents of this report.

1.8 NEXT STEPS

This report presents recommendations for policymakers and program implementers in both the energy and workforce communities, including, but not limited to the CPUC and utilities. As part of the continued effort to

[9] Krieger, S. Green Gap—As environmentally friendly construction takes off, a question looms: Who's going to do all the work? (2008, Nov. 17). Wall Street Journal. p. R12.

[10] Calculated from California Employment Development Department industry employment data: http://www.labormarketinfo.edd.ca.gov/?pageid=166.

[11] The Task Force was formed following the adoption of the EE Strategic Plan and includes representatives from the utilities, public agencies, educational institutions, community-based organizations, and private industry and unions.

[12] See Appendix N for a description of the Workforce Summit

involve stakeholders, the IOUs in conjunction with CPUC staff will be hosting a public meeting within a month of the release of this report. The purpose of this meeting will be to disseminate the results of this report and to obtain public input on how best to incorporate the findings into existing IOU WE&T programs, which are the focus of Chapter 12.

From the perspective of the research team, this workshop should only be the beginning of efforts to fully integrate workforce issues into programs focused on achieving the state's clean energy goals. Efforts should be made to match the specific relevant components of this report to the appropriate proceedings. The research team encourages the use of this report by other energy and workforce agencies, policymakers, and stakeholders, and looks forward to supporting these efforts.

1.9 ORGANIZATION OF REPORT

This report is divided into two main sections: Part One gives an overview of the state of California's labor market and the prospects for green jobs in the energy efficiency, distributed generation of renewable energy, and other demand-side energy management related sectors. The analysis presented in this section takes into account both the investments and the labor market dynamics in these industries. Part Two examines the existing workforce education and training infrastructure in the state and assesses how well it is prepared to meet the labor demand projected in Part One. The final chapter presents the implications of this research and puts forth recommendations for strengthening and improving the existing workforce education and training infrastructure, as well as for directing new investments in this area.

PART ONE: POLICY IMPACT ON JOBS AND ECONOMIC RESTRUCTURING

- CHAPTER 2: PROSPECTS FOR GREEN JOBS AND THE CALIFORNIA ECONOMY presents the current economic and labor market context in the state, including an overview of how the current economic recession has affected employment trends.
- CHAPTER 3: IMPACT OF ENERGY EFFICIENCY POLICIES AND PROGRAMS ON JOBS: LABOR DEMAND AND SUPPLY presents projections for employment trends based on the estimated aggregate public and private investment in target industries through the year 2020.
- CHAPTER 4: SECTOR CASE STUDIES analyzes work quality and job quality issues through an in-depth qualitative look at three energy efficiency related sectors—Residential Retrofits, Heating, Ventilation, and Air Conditioning (HVAC), and Commercial Lighting—that illustrate how market and policy conditions impact workforce and energy savings outcomes.

PART TWO: WORKFORCE AND EDUCATION INFRASTRUCTURE

- CHAPTER 5: CALIFORNIA'S WORKFORCE DEVELOPMENT INFRASTRUCTURE provides an introduction to the context and framework of our training survey and the workforce system as a whole, including an overview of the various parts of the workforce infrastructure, best practices in training strategies, the role of certification, the specific venues for green workforce planning and coordination in California, and a summary of the survey methodology.
- CHAPTERS 6–12 present the findings from our in-depth SURVEY OF SEVEN TYPES OF TRAINING PROVIDERS, including Four-Year Colleges and Universities, Certified Apprenticeship Programs, Community Colleges, Private Organizations, Community Based Organizations, Regional Occupational Programs, and Utility Training Centers.

- CHAPTER 13: ANALYSIS OF WORKFORCE EDUCATION AND TRAINING SURVEY compares the survey results presented in the previous chapters in order to provide a better understanding of the role of each type of training institution, its scale and training niche, as well as to provide an analysis of the gaps and shortcomings of the existing training system.

- CHAPTER 14: K-12 EDUCATION AND TRAINING describes career education programs relevant to energy efficiency occupations at the elementary and high school levels, which were not included in the training survey.

- CHAPTER 15: EMPLOYMENT INFORMATION SYSTEMS presents information about the job matching services available to assist job seekers and employers in energy efficiency related industries.

- CHAPTER 16: PIPELINES FOR DISADVANTAGED WORKERS looks at the barriers that prevent low income, minority and other disadvantaged individuals from entering energy efficiency careers, as well as the policy solutions and best training practices that can help create access to good jobs in these sectors.

- CHAPTER 17: IMPLICATIONS, CONCLUSIONS, AND RECOMMENDATIONS draws out the policy implications from the research presented in this report and recommends a future course of action for energy-efficiency related workforce policy.

CHAPTER TWO:

2. PROSPECTS FOR GREEN JOBS AND THE CALIFORNIA ECONOMY[1]

2.1 INTRODUCTION

Two major problems plague the California economy: The first stems from the Great Recession of 2007–09 and the subsequent very weak recovery, which have plunged the state into an economic crisis that is much more severe than in most other states. Of course, at some point economic recovery will resume and employment levels will return to pre-crisis levels, but it is difficult to forecast when that will occur. The second problem stems from the decades-long pattern of rising pay inequality in California. The growth of professional jobs has not been matched by the growth of the state's college-graduate population, while the elimination of many middle-paying jobs and the growth of low-paying jobs, which are also high-turnover and low-productivity jobs, have reduced living standards in California and kept the state's economic growth well below its potential level.

The expected growth of green jobs will help the state's employment problems. However without public policy support, green jobs are likely to resemble other private sector jobs in California. That is, the green sector will generate some good professional jobs and many low-wage jobs, but not enough of the middle-wage jobs that the state needs. Training programs for green jobs therefore are necessary to overcome the state economy's two major problems. But investments in training will not solve these problems unless they are accompanied by labor demand policies to grow the economy and to support job quality.

This context frames our study of the future California labor market for green jobs. Forecasts of the demand for and supply of workers of various skill levels who work in green jobs are affected by a number of factors. On the labor demand side, the key variables are: the rate at which the aggregate California economy will grow, the changing relation between economic growth and the demand for workers, the growth rate among specific economic sectors that are green-job intensive, and how business policy will respond to the demand for green jobs. On the labor supply side, the key variables include workers' projected entry and exit rates from the labor force and public policy, including the entire spectrum of educational and training institutions, both in the green energy efficiency related jobs context and more generally.

We, therefore, first discuss the economic crisis and recent employment trends and their implications for forecasts of green jobs in the coming decade. Section 2.3 examines the functioning of the California education system and the implications for the supply of workers of different skill levels, as well as the implications for pay inequality trends. Until the Great Recession, the economic return to a four-year college degree was increasing, and most college graduates obtained employment once they received their degree. However, the cost of college has been increasing faster than pay for college-level jobs, reducing the economic return to college degrees, while also creating higher mobility barriers for disadvantaged and asset-constrained households. As a result, the growth of enrollment levels among college-age cohorts has slowed down. Even if these trends are reversed by market forces, it already appears that the number of new college graduates will be insufficient to replace the large baby boom cohort of college graduates that are expected to retire in the next decade.

[1] Although the scope of this study includes only particular subsectors of the green economy, we use the term green throughout this chapter to allow a broader survey of the economic literature and to provide context for the more specific analysis to follow.

For those with high school and some college, the returns to middle skill jobs are often not as high. This labor market does not function as well, because of a lack of recognized credentials and certifications, lack of wage ladders, and a lack of links between training programs and employers. These deficiencies, however, can be ameliorated by public policy.

Section 2.4 discusses what we know about recent trends in the quantity and quality of green jobs, with special emphasis on California. A key policy issue here concerns whether business and public policy will follow what is referred to in the economic development literature as a high road or a low road. High road development consists of business competitiveness strategies built on quality and on jobs that pay well, use training to increase skills, and provide wage ladders to encourage learning and tenure within the same employer or industry. [2] In contrast low road development consists of business strategies based on cutting costs and jobs that do not pay as well, do not use training, do not have career ladders and result in high turnover. Section 2.5 examines labor standards that successfully encourage high road development. We briefly outline some policy measures with proven track records that could improve both the quantity and the quality of jobs within green sectors.

2.2 THE ECONOMIC CRISIS, RECENT EMPLOYMENT TRENDS AND FORECASTS

2.2.1 THE SOURCES OF THE CRISIS

The Great Recession began in December 2007 and ended in July of 2009, using the standard dating scheme that relies heavily on movements in gross domestic product. This recession was the deepest and longest of any of the post-WWII U.S. recessions. The recovery thus far has been extraordinarily anemic, even compared to the very weak recovery after the dotcom bust of 2000–01. The damage has been so great that most forecasters do not expect the unemployment rate to return to its pre-recession levels until late in the current decade.

For the U.S. as a whole, the Great Recession began with the collapse of house prices and residential construction, spread quickly to finance and then to the entire economy However, these developments only delineate the proximate causes. Rajan has argued persuasively that the cause of the crisis lies ultimately in a decades-long pattern of stagnating pay despite steadily rising productivity, and the accompanying concentration of income, especially at the very top of the income distribution.[3] Saez has documented the extraordinary run-up of the concentration of top incomes in the U.S, to levels not seen since 1929.[4] Those who received the largest income gains invested much of those gains in increasingly speculative mortgage markets, while those whose income fell or did not increase incurred increased debt to maintain their living standards.

[2] According to the business and economic development literature, a high road economic development strategy is one in which businesses compete by investing in a committed workforce that is both highly skilled and rewarded for those skills. JRank.org's online Encyclopedia of Business Management states, "The 'high road' to competitiveness is based on the cultivation of employee commitment and an exchange of high wages for high productivity." For a more thorough discussion see: Parker, E. & J. Rogers (2001). Building the High Road in Metro Areas: Sectoral Training and Employment Projects. Rekindling the Movement: Labor's Quest for Relevance in the 21st Century, eds. L. Turner, H. Katz and R. Hurd. Ithaca: ILR Press.; Bernhardt, Annette, Laura Dresser and Joel Rogers (2004). Taking the High Road in Milwaukee: The Wisconsin Regional Training Partnership. In Partnering for Change: Unions and Community Groups Build Coalitions for Economic Justice, ed. D. Reynolds. Armonk, NY: ME Sharpe.; Schweke, B. (2006). A Progressive Economic Development Agenda for Shared Prosperity: Taking the High Road and Closing the Low. Washington DC: Corporation for Enterprise Development.

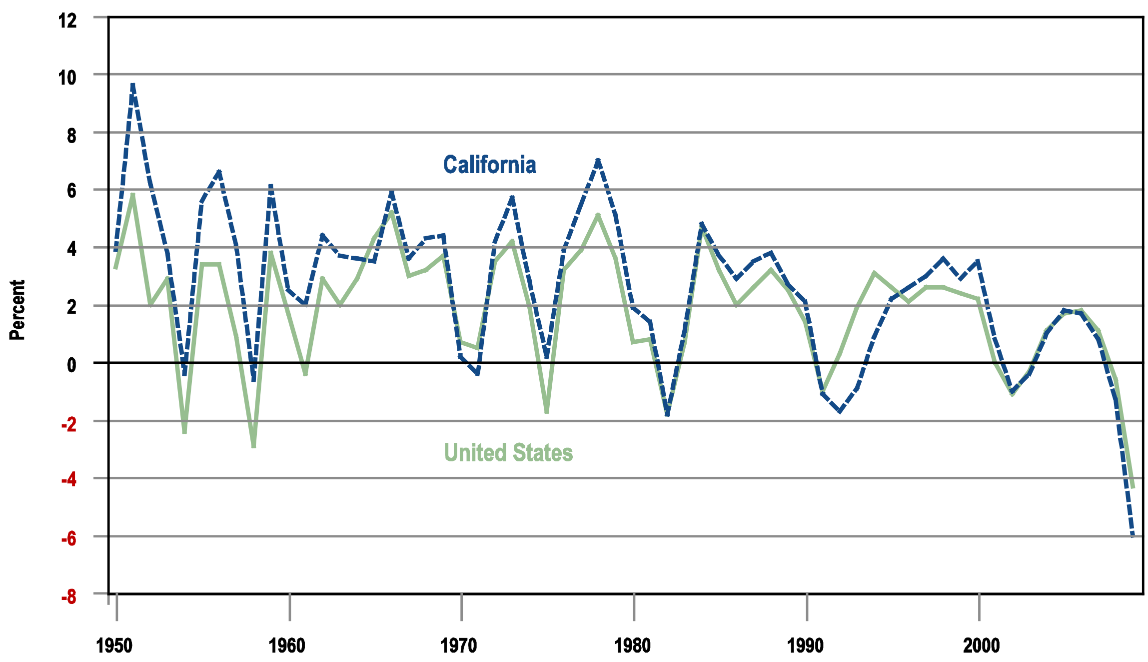
[3] Rajan, R. (2010). *Fault Lines: How Hidden Fractures Still Threaten the World Economy*. Princeton NJ: Princeton University Press.

[4] Saez, E. (2010). "Striking it Richer: The Evolution of Top Incomes in the United States." http://elsa.berkeley.edu/~saez/saez-UStopincomes-2008.pdf

Deregulated financial markets—especially but not exclusively mortgage markets—thereby came to play a larger role in the U.S. economy. At the same time, financial institutions created, on a massive scale, an increasingly more speculative set of instruments whose greater risk levels were hidden from view. The resultant twin financial and economic crises have made the recovery process for the U.S. especially lengthy and difficult.

If we think of the U.S. economy as a sick patient, clearly in need of further healing, what is the health of the California economy? State-level indicators suggest that the California economy is very sick and will need an even longer period to recover. Usually, as Figure 2.1 shows, California employment trends closely track national employment trends. But this crisis has been more severe in California. Why? The same factors that led to the national crisis are not only present in California, they are also stronger. As Table 2.1 and Figure 2.2 show, these trends occurred in California as well. As we document below, the growth of income inequality in California has been greater than in the U.S. as a whole. Moreover, as documented by a University of North Carolina study, the deregulation of financial and mortgage industries proceeded farther in California than in most other states.[5] The current prognosis is that California will need substantially more time to recover than was previously predicted.

Figure 2.1 Annual Change in Nonfarm Employment, California and the U.S.



Source: Public Policy Institute of California (2010). *California 2025: Planning for a Better Future.* Using data from the California Employment Development Department and the Bureau of Labor Statistics.

[5] Ding, L., R. Quercia, C. Reid, A. White (2010). "The Impact of State Anti-Predatory Laws on the Foreclosure Crisis." Research Report. Center for Community Capital, University of North Carolina.

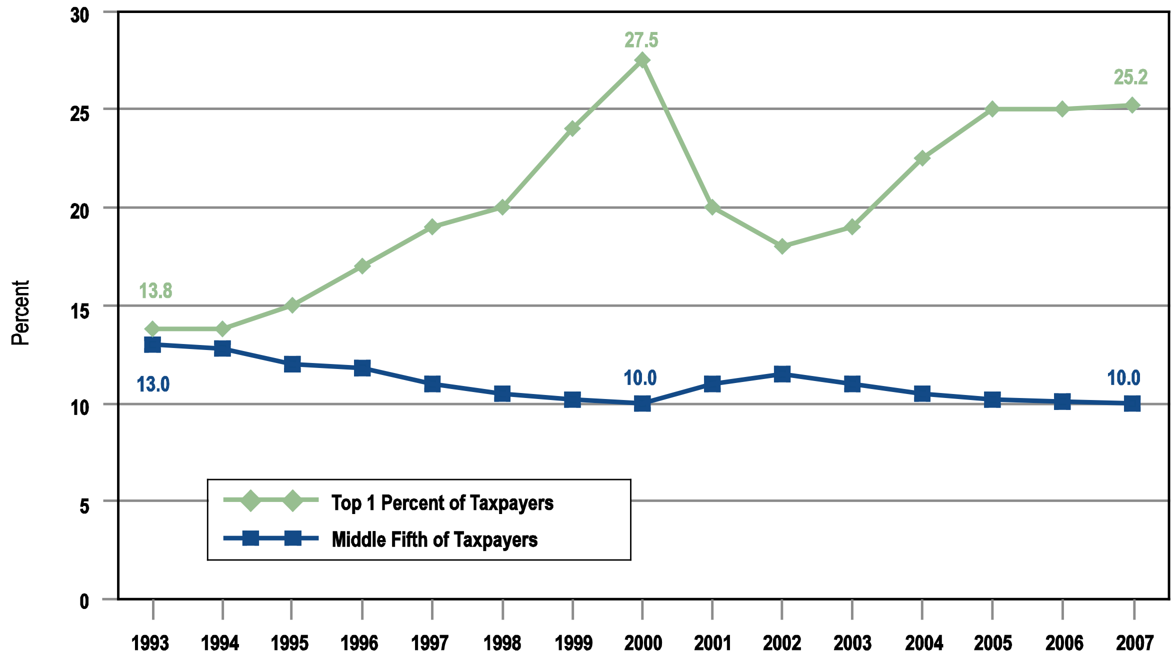
Table 2.1 Uneven Growth in Income in California

Income Category	Percent Change in Average Adjusted Gross Income 1995 to 2007	Percent Change in Average Adjusted Gross Income 2006 to 2007
Bottom fifth	7.7	-2.8
Second fifth	8.7	-0.7
Middle fifth	9.1	0.5
Fourth fifth	11.3	2.2
Top fifth	51.0	4.2
Top 10 percent	64.1	4.2
Top 1 percent	117.3	4.3

Source: California Budget Project (2009, June). New Data Show that California's Income Gaps Continue to Widen, *Policy Points*, p. 2. Retrieved from: http://www.cbp.org/pdfs/2009/0906_pp_IncomeGaps.pdf. Analysis of California Franchise Tax Board Data.

Note: Inflation-adjusted dollars.

Figure 2.2 Gains for Californian's Wealthiest Taxpayers More than Double those of Middle Class, 1993 to 2007



Source: California Budget Project (2009, June). New Data Show that California's Income Gaps Continue to Widen, *Policy Points*, p. 3. Retrieved from: http://www.cbp.org/pdfs/2009/0906_pp_IncomeGaps.pdf. Analysis of California Franchise Tax Board Data.

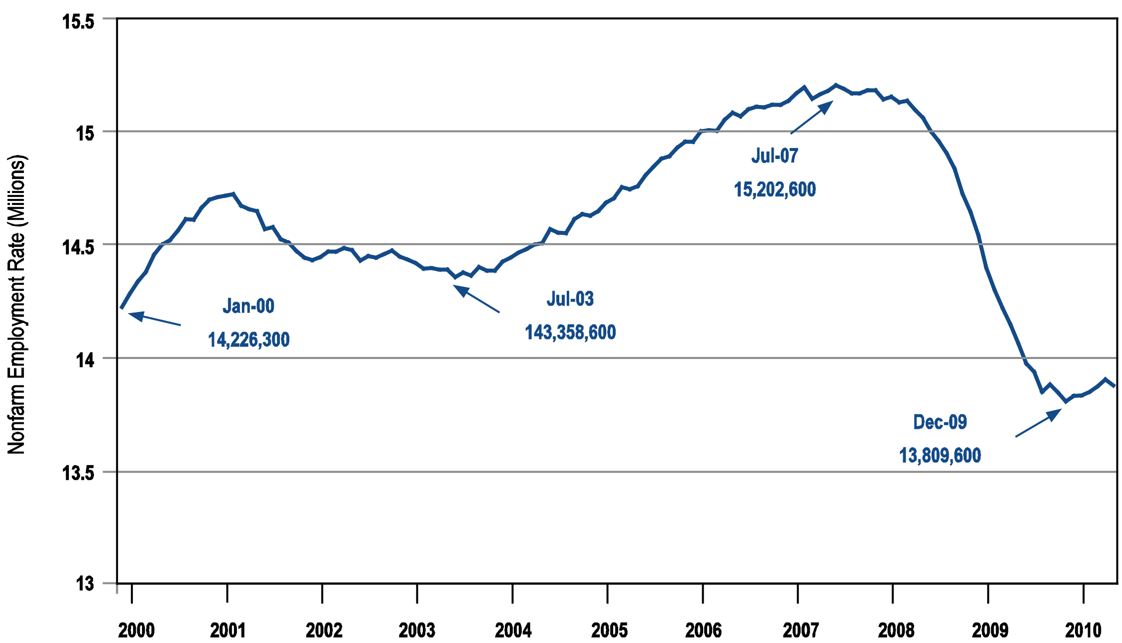
Note: Inflation adjusted dollars.

This context is critical for the California Workforce Education and Training Needs Assessment, which was initially proposed before the onset of the Great Recession. At that time, there was palpable concern about worker and skills shortages. In the current context, many highly skilled construction and other workers are unemployed or underemployed and turnover rates are much lower than in normal times. On the other hand, the February 2009 American Recovery and Reinvestment Act (ARRA) has provided a huge amount of short-term funds, including support for green training programs. ARRA also contains other key programs, such as support for housing retrofits and for development of new technologies, which affect the clean energy sectors. The high levels of unemployment in construction and the role of ARRA influence both the demand for green jobs and training, as well as the supply of trained workers for the green economy. However, since ARRA funds will run out in 2011, it remains to be seen whether the short-term support for green jobs will generate a long-term demand for those jobs.

2.2.2 EMPLOYMENT TRENDS IN THE RECOVERY

In 2000, the California unemployment rate stood at 4.9 percent, its lowest point since the 1980s. It then rose slightly to 5.3 percent in 2007. The national recession began in December 2007; the recovery, as measured by GDP, began by July of 2009. Since the economic recovery, at current writing, is now well over a year old, one would expect employment also to be recovering. However, as Figure 2.3 indicates, employment thus far has not grown to any substantial extent, either in the U.S. or in California. Job losses in California during the recession have been very severe. The current level of employment equals that of 1999, representing more than a decade of lost job growth.

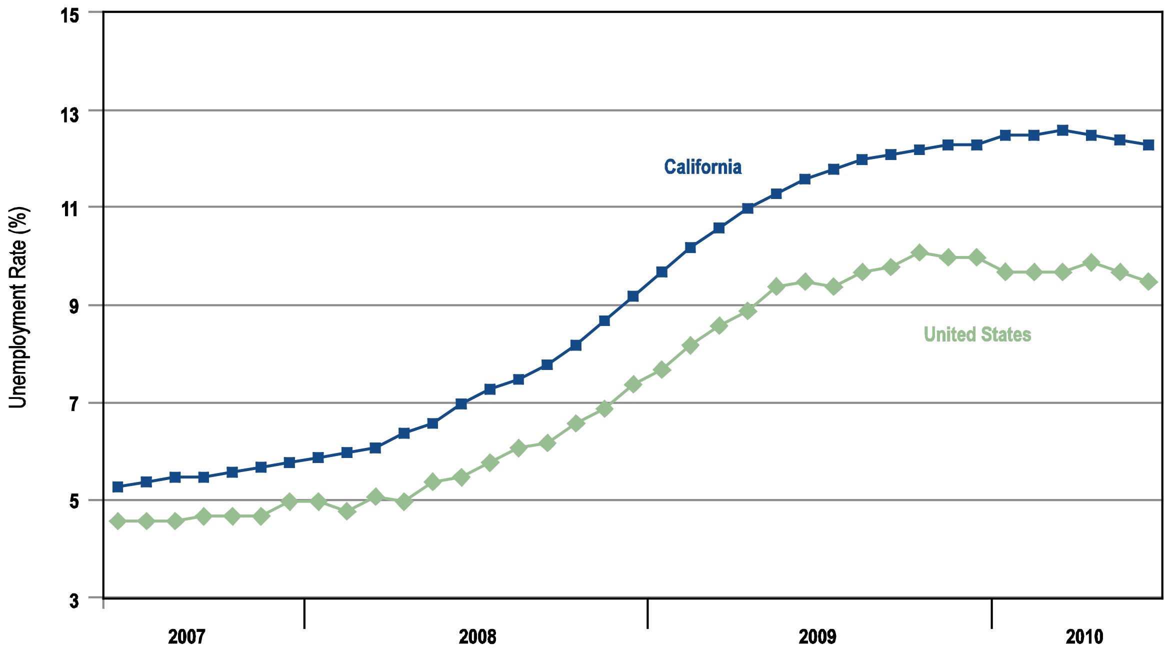
Figure 2.3 California Employment has Fallen Below the 1999 Level



Source: California Employment Development Department, Labor Market Information Division, Historical Industry Employment Data Files: http://www.labormarketinfo.edd.ca.gov/?pageid=166.

Figure 2.4 compares California's unemployment rate to the U. S. rate, from June 2007, six months before the recession began, through June 2010. Prior to the recession, the California unemployment rate was less than one percentage point higher than the national rate. This differential had generally remained stable since the 1970s. It results primarily from the greater inflow of workers into the state, relative to the U.S. as a whole. The greater California inflow reflects domestic and international migration into the state, as well as the resulting larger proportion of adults in California, relative to the nation as a whole.

Figure 2.4 California and U.S. Unemployment Rates, Seasonally Adjusted Data



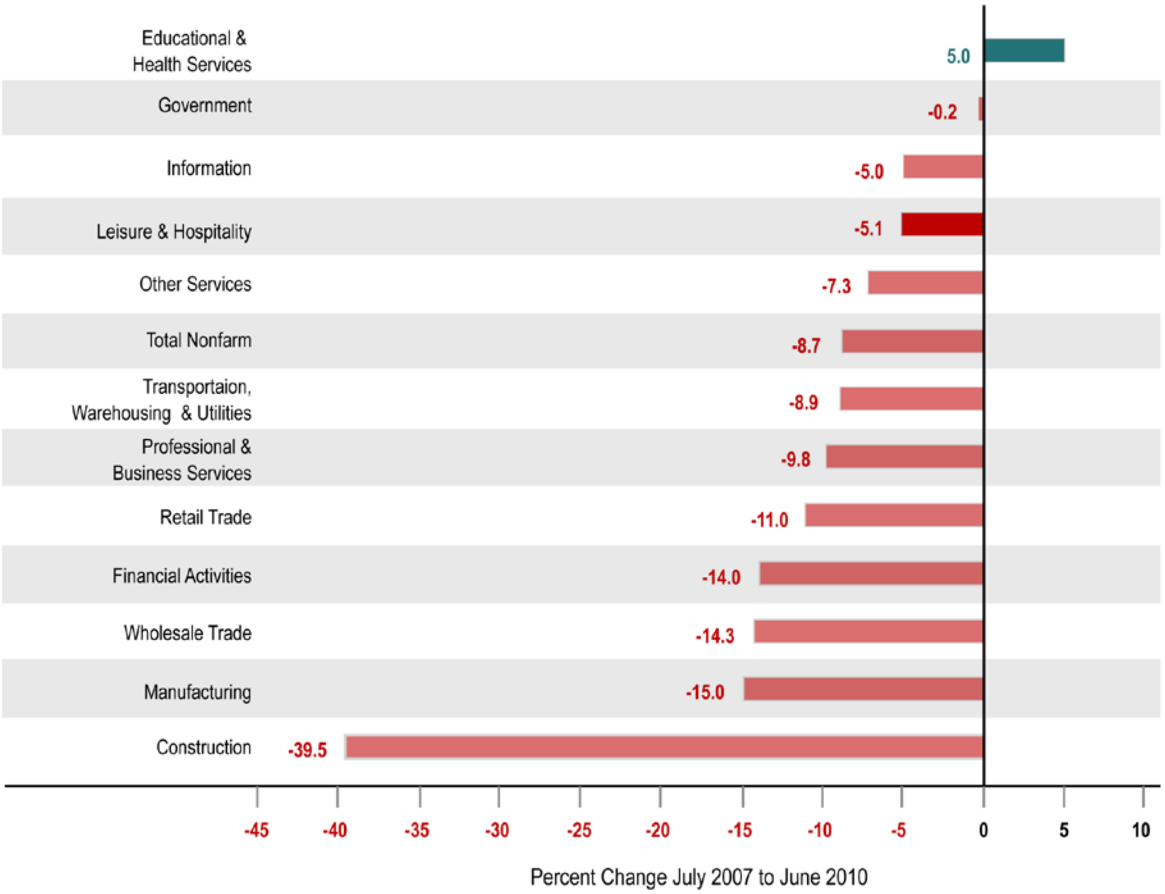
Source: California Employment Development Department, Labor Market Information Division, Labor Force and Unemployment Data: http://www.labormarketinfo.edd.ca.gov/?pageid=164.

But beginning in late 2007, when the U.S. unemployment rate increased rapidly, the California unemployment rate increased even faster. The CA–U.S. unemployment differential grew to about 2.6 percentage points by 2009 (about 12. 2 percent in California and about 9.6 percent in the U.S.) and the differential has remained at about 2.6 points during the recovery. Unemployment rates in the U.S. and in California have remained essentially unchanged during the recovery, leading many observers to label it as a jobless recovery.

Compared to previous recessions, the current recession is much broader, affecting nearly all sectors except health and education. As Figure 2.5 shows, construction experienced the biggest decline, due primarily to the bursting of the housing bubble and the subsequent steep decline in construction of new homes, with a loss of nearly 30 percent of jobs in this sector.[6] Since employment in the 1930s fell about 25 percent, one can characterize the downturn in California construction as at Great Depression levels. Financial services, manufacturing, and retail trade have the highest jobs losses after construction. Excluding construction, California job losses in declining sectors ranged from 3 to 11 percent.

[6] Nationally, construction employment fell by about 20 percent.

Figure 2.5 California Job Loss by Sector, July 2007 to June 2009



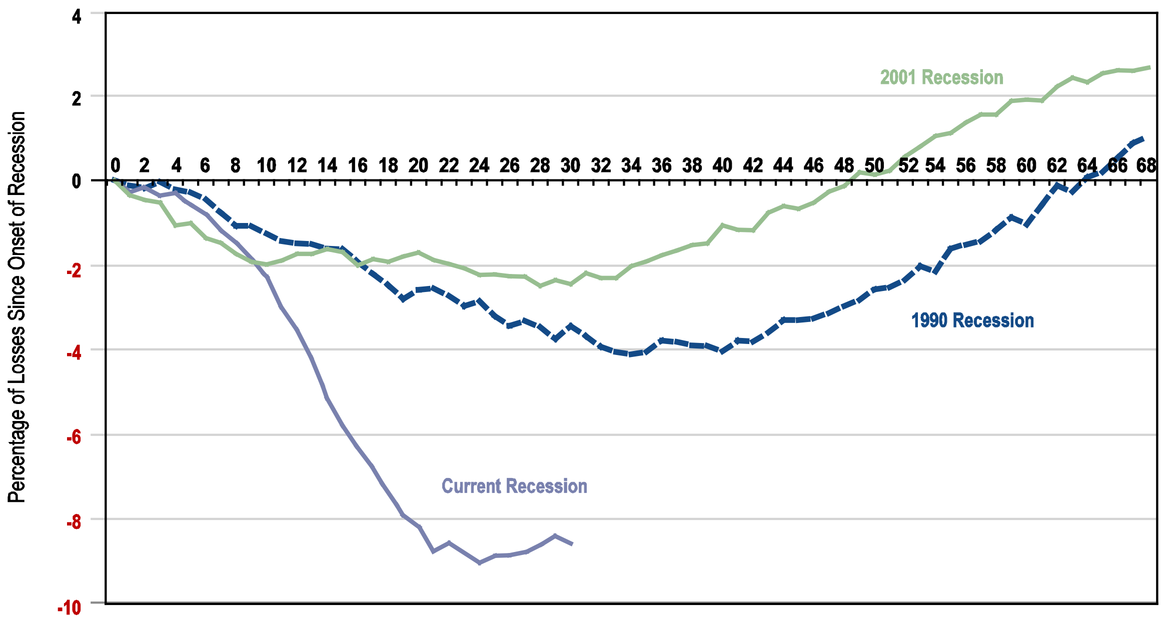
Source: Authors' calculations using California Employment Development Department, Labor Market Information Division, Historical Industry Employment Data Files: http://www.labormarketinfo.edd.ca.gov/?pageid=166.

Figure 2.6 compares job losses with the previous two recessions. Job losses from the current recession are significantly greater than either of the previous two recessions. The largest job losses in this recession reached approximately 8.5 to 9 percent at the deepest point, while job losses fell 2 and 4 percent in the 2001 and 1990 recessions, respectively.

Nevertheless, at some point the economy will recover and economic growth will resume. As Figure 2.7 shows, Department of Finance forecasts suggest that the economy will grow steadily from 2009 on, with nonfarm employment increasing from about 14 million in 2010 to about 15.25 million by the year by 2015.

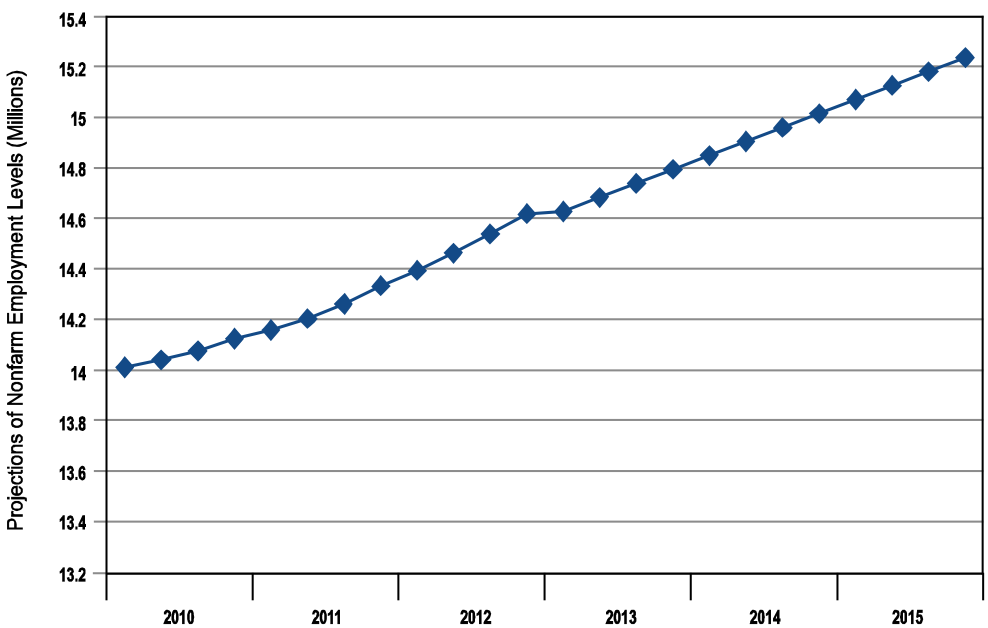
How long will it take for unemployment to fall to prerecession levels? Figure 2.8 shows our projections of unemployment rates and levels from 2010 to 2015, as extrapolated from the Department of Finance 2010–2012 projections. Figure 2.8 suggests that the unemployment in 2015 will be approximately 8 percent. This projection might be overly optimistic since unemployment in California has hovered at above 12 percent since July of 2009. The unemployment rate may not decline to 8 percent until 2020. Yet an 8 percent unemployment rate is quite high and indicative of a surplus labor supply.

Figure 2.6 Job Losses in California Compared



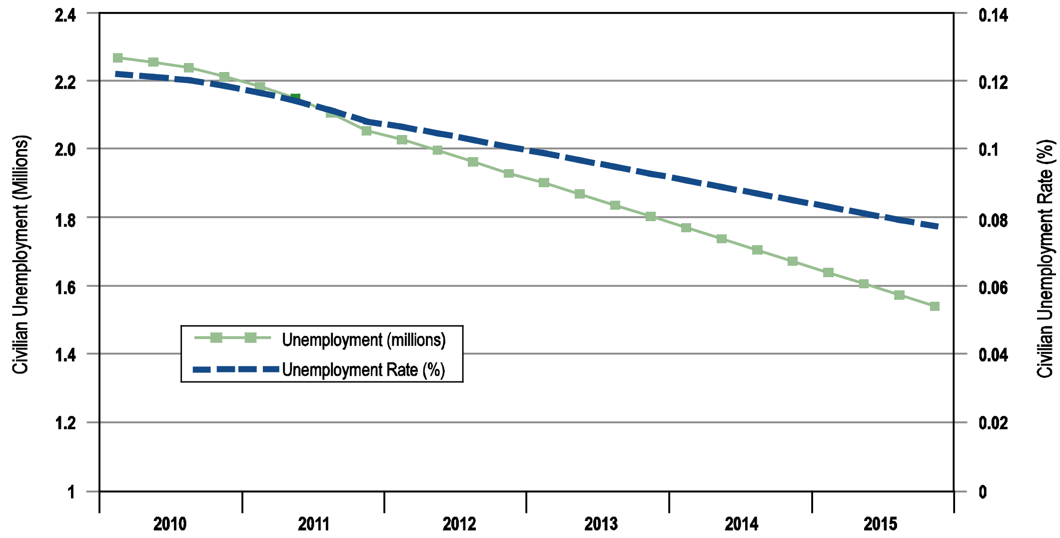
Source: Analysis of Current Employment Statistics data by Sylvia Allegretto, IRLE.

Figure 2.7 Projection of California Nonfarm Employment Growth, 2010 to 2015



Source: Extrapolated by the authors using the California Department of Finance 2009 Economic Forecasts. Projections for the years 2013 to 2015 were extrapolated using the parameters of a linear projection onto the CA DOF data for 2010.

Figure 2.8 Projections of California Civilian Unemployment, 2010 to 2015



Source: Extrapolated by the authors using the California Department of Finance 2009 Economic Forecasts. Data were extrapolated using the parameters of a linear projection onto the CA DOF 2010 to 2012 figures.

2.2.2.1 IMPLICATIONS FOR THE BLS TEN-YEAR EMPLOYMENT FORECASTS

Figure 2.9 displays the 2006–16 projections from the BLS ten-year forecasts of California job growth, disaggregated by industry.[7] But the economic recovery is already proceeding much more slowly than the rate used by BLS to generate these forecasts. What are the implications? We divide our brief discussion into three parts: one focuses on the construction industry, as many green jobs depend upon it; a second on the aggregate forecasts; and a third focuses on workforce aging and retirement issues.

2.2.2.2 CONSTRUCTION AND GREEN JOBS

As we will see below, many green jobs are dependent upon the residential and commercial construction industries. However, both the residential and commercial construction industries have been especially hard hit by the recession. High levels of inventory in the residential housing market in California and high vacancy rates in commercial buildings imply that there will not be as much new residential and commercial construction in the near future. Since these sectors are closely related to green jobs, the rate of green job growth may be slower.[8]

The boom years of 2001–07 are not likely to return. At the same time, a substantial number of the unemployed, especially those with prior experience in construction, possess skills needed in the green economy. Therefore,

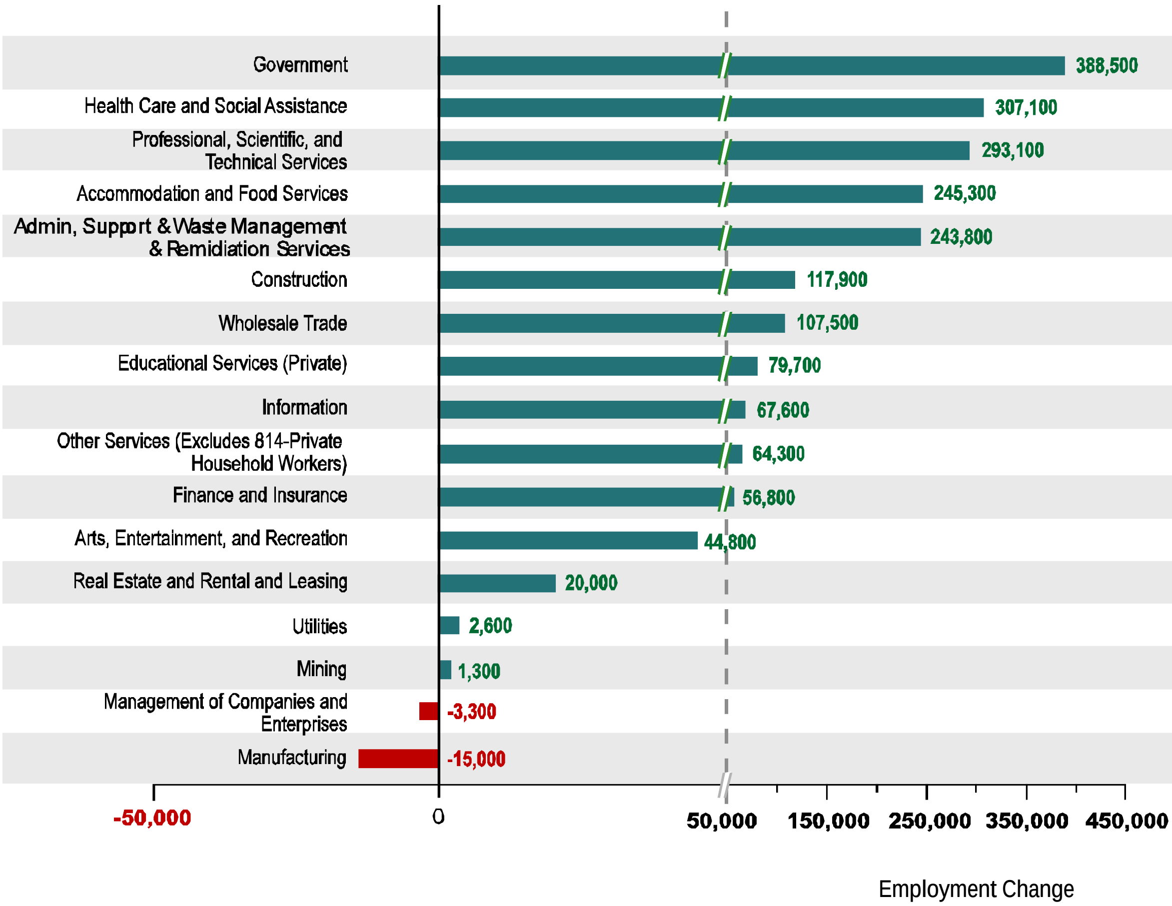
[7] The BLS released projections for 2008-2018 in July, 2010, after this chapter was written.

[8] The construction industry has been partly assisted by ARRA and other public policy programs that have targeted infrastructure projects and energy retrofits of existing buildings. Thus far, however, ARRA-financed infrastructure and retrofit projects are running well behind schedule in California. To replace a substantial portion of *residential* construction demand, retrofits would have to occur on a significantly larger scale, demanding substantial financing from taxpayer or ratepayer dollars. These do not seem likely to be forthcoming.

forecasts of green jobs and the supply of workers with green job skills should recognize that we can expect a sizeable surplus of skilled workers for much of this decade.

Once the economy recovers to the point that substantial job growth begins again, and the skilled unemployed find jobs, an excess demand for skilled construction labor may again develop. As shortages develop, pay for workers with those skills will increase, but at that point it will necessarily take time for the supply of workers with those skills to increase. These shortages can be prevented if public policies for education and workforce development do not wait for them to appear.

Figure 2.9 California Employment Change Projections by Industry, 2006-2016



Source: California Employment Development Department, Labor Market Information Division, Projections of Employment by Occupation: http://www.labormarketinfo.edd.ca.gov/?pageid=1011.

2.2.2.3 AGGREGATE EMPLOYMENT

What are the implications of the economic crisis for the growth of overall employment? First, the most recent Bureau of Labor Statistics forecasts were released in 2007, before the crisis began.[9] These forecasts of job growth by occupation and industry for the period 2008–16 therefore are likely to be too optimistic. Employment forecasts

[9] Franklin, J. (2007, Nov.). Employment Outlook 2006-2016: An overview of BLS projections to 2016. *Monthly Labor Review* 130, 11. Retrieved from: http://www.bls.gov/opub/mlr/2007/11/art1full.pdf.

depend substantially upon forecasts of economic growth. However, economic growth in the near future is likely to be much slower than was projected because of the length and depth of the Great Recession.

Economic growth will also be lower because labor force participation rates, except for the older part of the work force, are falling more rapidly than was forecast. The economic slowdown increases the number of workers leaving the labor force and then, in turn, the smaller labor force reduces the potential rate of economic growth. Furthermore, we will have fewer immigrant workers and therefore slower population growth. In other words, since employment growth forecasts are, in part, a function of forecasts of economic growth, and the post-recession rate of economic growth will be slower than expected, the forecast estimates of job growth are likely to be too large.

A second issue that calls for downward adjustments to the BLS forecasts relates to recent changes in the relationship between economic growth and employment growth. Employment forecasts are based in part upon a relationship called Okun's law, which predicts the rate of employment growth as a function of the rate of economic growth. However, the quantitative relationship between economic growth and employment growth specified by Okun's Law broke down in the Great Recession, when unemployment nationally increased by over 2 percentage points more than the law predicted.[10] If this change in Okun's Law persists, employment growth will be even smaller than was predicted, even if economic growth were to occur at the predicted rate. This change would then provide another source of upward bias to the BLS projections.

The breakdown in the reliability of Okun's law as an employment estimator is related to unforeseen changes in productivity growth, in the rate of adoption of technological change during a recession, and possibly, as well, to outsourcing of economic activity abroad. Forecasts of technological change by industry and skill level are based upon observations of recent patterns of technological change and concomitant job growth by industry and skill level. Labor productivity has grown faster in this recession than in previous ones, leading to the overestimates of job growth by industry. Since aggregate employment growth and aggregate productivity growth are inversely related, the recent increases in productivity will lead to lower employment growth.

2.2.2.4 WORKFORCE AGING AND RETIREMENT ISSUES

The BLS projections of future labor demand are based not only on the expected number of jobs, but also on the forecast of job openings due to replacement needs from growing numbers of retirements. As Table 2.2 indicates, the California working-age populations will age significantly by 2018, especially among those approaching retirement ages. (This table also documents the growing Latino share of the California workforce.) Moreover, for several decades, retirement ages have been falling, especially among men.

But since the mid-1990s, previous trends have reversed and the retirement age has been rising—for both men and women. Figure 2.10, for example, shows that increasing numbers of men and women work past the ages of 55 and 65. Estimated replacement needs are therefore more likely to be lower than was once expected. While the BLS forecasts do take this trend into account, they believe that it will subside. The argument is that the recession is discouraging workers who lose their jobs to continue to search for work and stay in the labor force. A contrary argument suggests that labor force participation will continue to increase because the recession has placed a growing number of people in financial crisis. In particular, with the trend away from defined benefit pension plans and toward defined contribution plans, many workers have lost substantial portions of their retirement savings due to the recession and they can be expected to continue working past their planned retirement age.

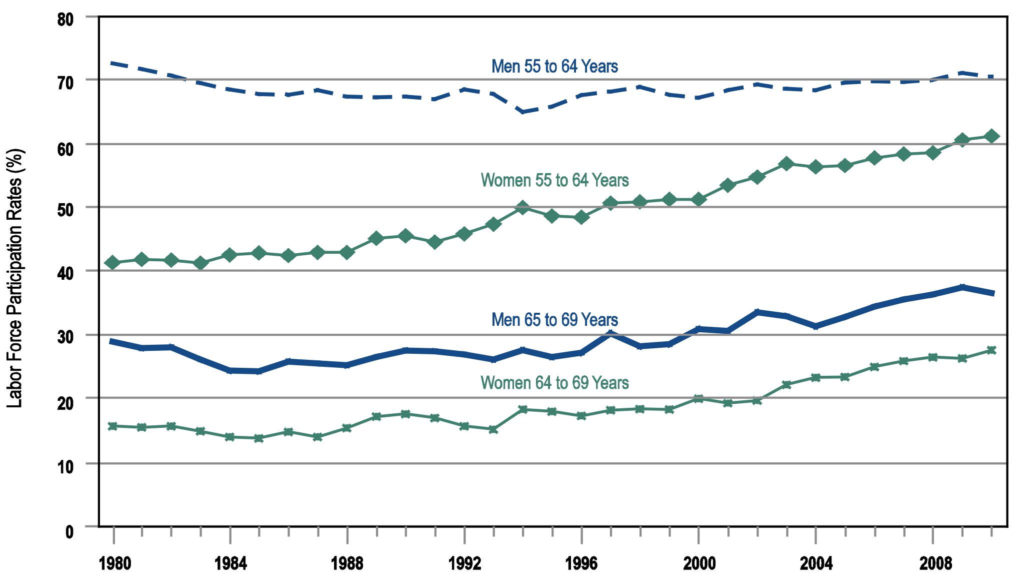
[10] Reich, M. (2010). "High Unemployment after the Great Recession Why? What Can we Do?" Policy Brief, Center on Wage and Employment Dynamics, IRLE, UC Berkeley.

Table 2.2 Demographics of California's Working-Age Population Age 16 and Over, 2008 and 2018

Demographic	Percentage of Persons 2008	Percentage of Persons 2018
Ethnicity / Race		
White	46.6	41.1
Hispanic	32.3	37.3
Asian	12.4	12.9
Black	6.0	5.5
All others	2.6	3.1
Total	100.0	100.0
Age		
16 to 24	17.5	16.1
25 to 54	54.8	50.8
55 and older	27.6	33.1
Total	100.0	100.0

Source: California Budget Project citing California Department of Finance: http://www.dof.ca.gov/research/demographic/data/race-ethnic/2000-50/.

Figure 2.10 Trends in Labor Force Rates, Ages 55 to 64 and 65 to 69, by Gender



Source: Current Population Survey through the Bureau of Labor Statistics: http://data.bls.gov/pdq/querytool.jsp?survey=ln.

It is likely that the trend toward later retirement will be partly counteracted by higher rates of labor force withdrawal among the *very* long-term unemployed—those who have been unemployed for one year or more.[11] This effect may be higher among workers in construction, where overall unemployment and very long-term unemployment remain especially high. Thus, while many older workers may remain in the workforce longer due to financial issues, discouraged workers, especially in the construction industry, may choose to quit looking for work, pushing the supply of skilled workers in the other direction. Given the opposing trends and uncertainty about their magnitudes, substantial uncertainty surrounds forecasts of labor force participation rates.

In summary, by all indications California will take longer to recover from the recession and the mortgage crisis than the U. S. as a whole. Forecasts of employment growth by industry and occupation, for both the overall U.S. and California economies, and for the green economy, therefore require some downward adjustments. Forecasts are not a guarantee and are subject to substantial uncertainty. There can also be unexpected events, which can change outcomes. Equally important, public policy at state and federal level can make a difference, both positively and negatively. For example, a large cut in California's state budget will most likely weaken further the state's recovery, while more aid from the federal government to support teachers or in the form of aid for Medicaid spending can be expected to spur economic growth and ease unemployment.

2.3 CALIFORNIA'S EDUCATIONAL AND TRAINING SYSTEM AND LABOR MARKET SKILL SEGMENTS

We turn now to a discussion of California's educational system. While California's educational system worked extremely well in providing a high quality and highly educated workforce from the 1950s to the 1970s, the same cannot be said of the past three decades. Problems in the educational system have had direct, but avoidable, deleterious effects on living standards in California. We review briefly trends in pay and pay inequality, then discuss trends in the college wage premium, and then the workings of the middle skill component of the labor market.

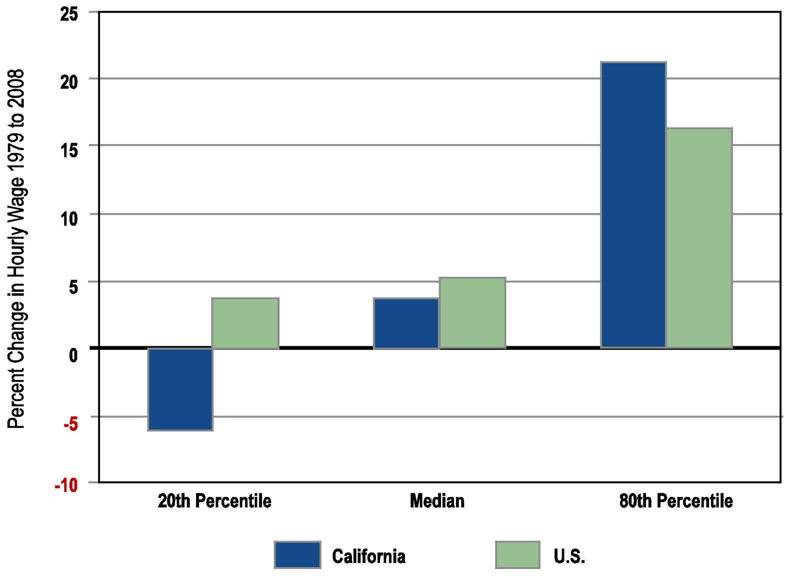
Wages in California have been stagnating for three decades, with very little increase in earnings for the median worker. In the same period, pay inequality in the state has increased substantially. Indeed, pay inequality in California is greater than in any other industrial country and exceeds that in the rest of the U.S. As Figure 2.11 shows, from 1979 to 2008 real wages in the U.S. for workers at the 20th percentile of the wage distribution increased by less than 4 percent, while pay for workers at the 80th percentile increased by 16 percent. In contrast, in California over the same period, hourly pay for workers at the 20th percentile declined five percent, while pay for workers at the 80th percentile increased by more than 20 percent.

2.3.1 THE LABOR MARKET FOR COLLEGE GRADUATES

A substantial part of the growth in pay inequality results directly from the rising college wage premium—the percent increase in pay of those with a bachelor's degree relative to those with a high school diploma. Figure 2.12 depicts trends for California from 1970 to 2006. As Figure 2.12 shows, the college wage premium declined from 1970 to 1980, a decade with rapid increases in college enrollments. In subsequent decades the premium increased substantially. In 1980, male college graduates earned 40 percent more than male high school graduates. By 2006, this wage differential grew to 86 percent. This trend was similar for women, although in a smaller amount.

[11] Reich, 2010.

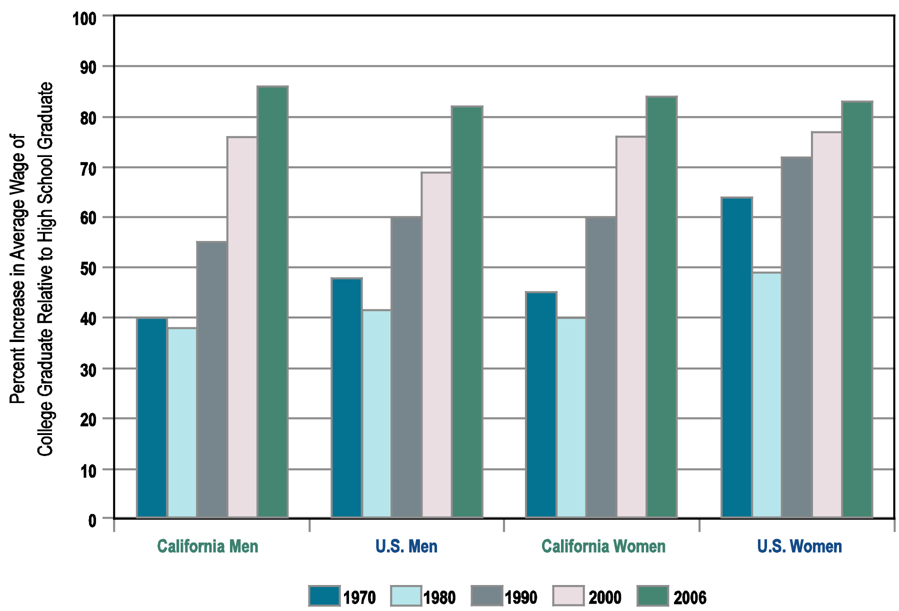
Figure 2.11 Change in Hourly Wages for Low and High Wage Workers, 1979 to 2008



Source: California Budget Project (2007, August). *A Generation of Widening Equality: The State of Working California, 1979 to 2006*. Retrieved from: http://www.cbp.org/pdfs/2007/0708_swc.pdf.

Note: Inflation-adjusted dollars.

Figure 2.12 Trends in the Earnings Gap between College and High School Graduates in California



Source: Reed, D. (2008). *California's Future Workforce: Will There Be Enough College Graduates?* Retrieved from: http://www.ppic.org/content/pubs/report/R_1208DRR.pdf. A Public Policy Institute of California report based upon the decennial Census and the 2005 and 2006 American Communities Survey.

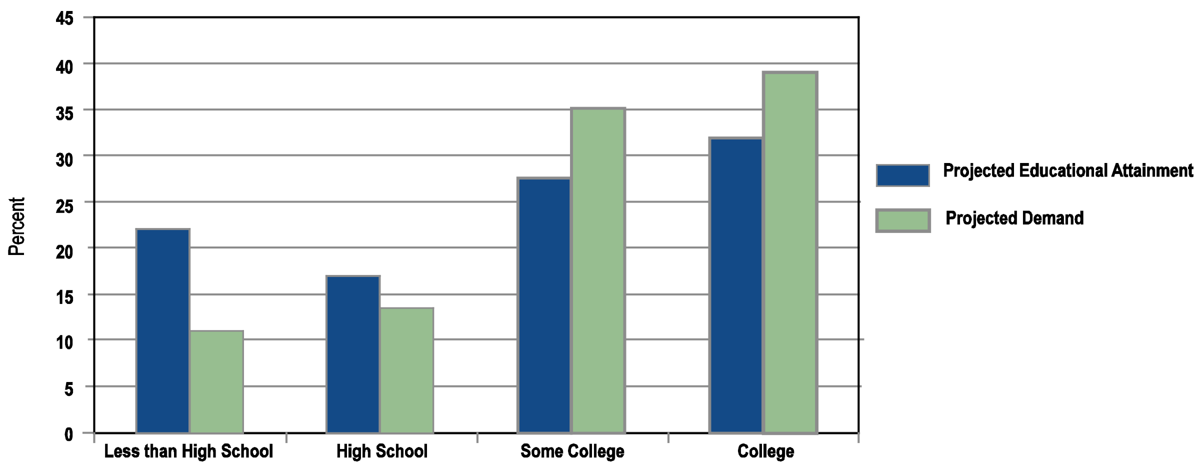
Note: The vertical axis depicts the percentage increase in average hourly wage for College graduates relative to high school graduates.

However, for both men and women in California, the growth in the college wage premium was even greater than in the U.S. as a whole.

Trends in the college wage premium are likely to continue to increase, absent public policies that would significantly and rapidly increase higher education attainment rates among working-age Californians. Projections cited by PPIC estimate that by 2020, 33 percent of the working age population will have a four-year degree, while 39 percent of jobs will require one, resulting in an even larger skills gap than today (Figure 2.13).[12]

Nonetheless, the share of college-educated workers in California increased from 33 percent in 1980 to 37 percent in 2006 (Figure 2.13). Why then did the college pay premium grow? A simple supply and demand framework suggests that demand growth for college-educated workers outstripped the increase in supply, resulting in a rising wage premium for these workers.

Figure 2.13 Demand for College-Educated Workers Projected to Outstrip Supply by 2020 in California



Source: Reed, D. (2008). *California's Future Workforce: Will There Be Enough College Graduates?* Retrieved from http://www.ppic.org/content/pubs/report/R_1208DRR.pdf.

According to this logic, if California had increased the number of spaces in its higher education system more rapidly, as it did in the 1960s and 1970s, the growth in the supply of college-educated workers would have held down the growth in the college pay premium. Equally, important, given the growing demand for college-educated labor, an increase in the supply would have made the California economy grow more rapidly.

The number of new college graduates could have increased if more families had been able to afford paying for a college education. Instead, support for financial aid fell, while the price of going to college rose faster than family incomes. These trends particularly affected low-income families, many of them minorities, who are not able to obtain or pay for student loans.

As for jobs that demand more skills, California higher education institutions have not expanded sufficiently to keep up with the demand for educated workers. [13] The increasing skills mismatch has several causes. On the demand

[12] Reed, D. (2004). "Wage Trends in California." San Francisco: Public Policy Institute of California.

[13] College enrollment rates also slowed down in the U.S. as a whole. In the 1980s the slowdown was partly the result of slowdowns in Federal grants for college students. This slowdown is also visible among graduate students support. For example, NSF graduate fellowships would

side, the trends contributing to the growth in the demand for college-educated workers discussed above are likely to continue. On the supply side, college attainment rates for the working age population are likely to decrease, because of retirements of highly educated groups in the workforce and faster growth in demographic groups who are historically underrepresented in the higher education system. For example, while educational attainment rates among Latinos, the fastest-growing demographic group, are improving, they are not growing quickly enough. In 1990 only 7 percent of Latinos had attained a bachelor's degree. This rate is expected to grow to 12 percent by 2020, still well below the state average and below the rates of other ethnic or racial groups.[14]

Even with significant increases in college attainment rates, the state is likely to experience an excess demand in jobs requiring a college education. PPIC estimates that if college graduation rates increased immediately to 50 percent for adults aged 25 to 29, and then continued at that rate, the share of workers with a college degree would reach 38 percent by 2020, just under the share—39 percent—needed to meet demand (Reed, 2008). Therefore, even with continuing growth in the college/high school pay differential, and even with swift, immediate, and strong public policy action today, it will take some time to close the educational attainment–jobs mismatch.

2.3.2 MIDDLE SKILL JOBS

Recently there has been significant growth in middle skill level jobs that require some technical skill and that cannot be fully outsourced. These middle skill level jobs require less than a BA degree but do require some college, apprenticeship or other technical training and are found in the health care, construction, transportation, and green technology industries. Examples of middle skill occupations include imaging specialists, lab technicians, respiratory specialists, air traffic controllers, electricians, and carpenters.

Middle skill level jobs represent 49 percent of all jobs, and they are expected to account for 43 percent of all new job openings in 2016.[15]A large percentage of green-related jobs are middle skill jobs and these occupations are expected to grow into the future. For example, 66 percent of jobs in energy efficiency, 77 percent of jobs in wind power, and 56 percent of jobs in the bio-fuels industry require middle skill level training.

However, there is already a shortage of workers with sufficient training for these jobs. Too few working age adults are attaining these degrees and certificates to meet the growth in these types of occupations, resulting in an emerging skills mismatch for this group. Market forces are unlikely to remedy this shortage, since expanding training capacity takes considerable time. A report by a coalition of non-profit organizations focusing on workforce development needs in the state, including Skills2Compete, the Workforce Alliance, and the California Edge Campaign, argues that while ARRA will generate a significant number of new jobs in middle skill occupations within the construction, manufacturing and transportation industries, governments and policymakers have placed disproportionate focus on increasing college and graduate level education relative to education and training needs for growth in middle skill occupations.

In 2007, 50 percent of jobs were classified as requiring less than a BA degree but requiring some college, apprenticeship training, or vocational certification; however, only 38 percent of all workers in the U.S. had attained

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have to triple in number to match the proportions to college seniors in the 1970s. Increasing the number and benefit levels of scholarships and fellowships grants has been shown to be the best stimulus to increasing enrollments, especially among disadvantaged populations.

[14] As Card (2005) notes, the educational distribution of foreign-born workers in the U.S. is bimodal, meaning that both college graduates and those with less than high school education are overrepresented relative to native-born workers.

[15] The Workforce Alliance, Skills2Compete and the California EDGE Campaign (2009). "California's Forgotten Middle-Skill Jobs, Meeting the Demands of a 21st Century Economy." October 2009. Retrieved from: http://www.nationalskillscoalition.org/assets/reports-/skills2compete_forgottenjobs_ca_2009-10.pdf.

this level of skills certification. Many of these training programs are provided at the community college level and particularly in construction, in state-certified apprenticeship programs.

As others have argued, the middle-level job market in the U.S. suffers from several problems that lower the value of training in this segment of the labor market.[16] A greater connection between training programs and employers would improve the curricula in these programs and is necessary to better link their graduates to jobs. Equally important, middle skill jobs often lack adequate wage ladders to provide an incentive for employees to remain with the same employer or in the same industry. High turnover rates, in turn, discourage employment-based training, as employers are not able to capture the benefits of training employees who are likely to leave the firm.

2.3.3 LOW SKILL JOBS

Many analysts have expected that low skill jobs would shrink as a proportion of all jobs, for the same reasons that the demand for college-educated workers would grow.[17] In particular the computer revolution in the workplace was said to have increased the demand for skilled labor and reduced the demand for unskilled labor.[18] Increasing automation has especially supplanted routinized work that could be done by computers and smart machines. Economists also refer to the growth in international trade, which increased the demand for goods and services produced by more educated workers in the U.S. while less-educated American workers were increasingly replaced by lower-paid counterparts abroad. Both these explanations—technological change and growing international trade with low-wage countries—suggest that low-wage jobs should be shrinking in number.

More recently, economists have increasingly recognized that low-wage jobs have instead increased in large numbers in the U.S., contrary to the technological change and international trade explanations.[19] These growing jobs—restaurant workers, janitors, hotel employees, security guards, landscapers and others—are located in service industries and occupations. They cannot be reduced to repetitive routines, often because they involve interpersonal interaction, and therefore they are not as subject to automation or outsourcing abroad.

But why are these expanding jobs low-wage jobs? Three primary explanations have been offered; the decline in inflation-adjusted minimum wage standards; the low and declining levels of unionization in these occupations; and the growth in the supply of less-educated workers, many of them immigrants. As Table 2.3 shows, unions have declined in California and in the U.S. as a whole. Much research suggests that low-wage jobs do pay much more when labor standards are in place.[20] Clearly, if public policy on education and on labor standards were to respond appropriately, wage levels in these jobs would be higher and wage inequality would be much lower.

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[16] Holzer, H., & R. Lerman (2007). America's Forgotten Middle Skill Jobs. Washington, DC: The Workforce Alliance.

[17] For a survey, see Acemoglu, D., & D. Autor (2010, June). Skills, Tasks and Technologies: Implications for Employment and Earnings. NBER Working Paper Series, Vol. w16082.

[18] Goldin, C.,& L. Katz (2008). The Race between Education and Technology. Cambridge, MA: Harvard University Press.

[19] Acemoglu & Autor, 2010

[20] Gautie, J., J. Schmitt, eds. (2010). Low-wage Work in the Wealthy World: Case Studies of Job Quality in Advanced Economies. New York: Russell Sage Press.

Table 2.3 Unionization Rates of Workers in the U.S. and California

Year	U.S.	California
1989	24.8	21.4
2000	19.6	16.9
2006	18.9	14.8
2009	12.3	17.2

Source: California Budget Project (2007). *A Generation of Widening Equality: the State of Working California, 1979 to 2006*. Retrieved from: http://www.cbp.org/pdfs/2007/0708_swc.pdf.

2.4 TRENDS IN THE NUMBER OF GREEN JOBS

2.4.1 DEFINITION OF GREEN ECONOMY AND JOBS

How large is California's green economy? The California Employment Department defines the green economy to include businesses that are involved in generating or storing renewable energy, recycling, producing, distributing, maintaining, or implementing products that increase energy efficiency, environmental education, compliance, and training, and production of natural and sustainable products. Other studies have used alternative definitions, including some that focus on energy efficiency and renewable generation. Since the California Workforce Needs Assessment addresses only a subsector of the green economy, our focus is limited to energy efficiency, demand response, and distributed generation, or what is sometimes termed "demand-side management."

Studies that examine the green economy distinguish between goods that are *produced* specifically to reduce environmental impacts or "green goods," such as energy-efficient lighting or windows, versus businesses that revamp their processes to be more environmentally friendly, and thus are becoming greener in their practices. To capture most of the green economy, both types of activities should be included in measuring the green economy. As generalizable activities, such as improving energy efficiency or recycling resources, become more widespread, the number of green jobs can increase far beyond the companies that produce green products.

This distinction is similar to one commonly made in the Information Technology (IT) industry. Although only a select group of businesses produce IT-related products, in the past two decades the use of IT has changed organizational practices in almost every economic sector. Thus, in addition to specialized sectors that have emerged to address environmental concerns, environmental measures and policies are increasingly permeating a broad spectrum of the economy and traditional occupations, such as electricians and plumbers, are increasingly incorporating practices that save energy, conserve water, or reduce pollutants. This trend is likely to increase as the pressures of climate change and other environmental issues grow and bring environmental laws and policies to the forefront of the public policy sphere.

2.4.2 STUDIES ESTIMATING THE SIZE OF CALIFORNIA'S GREEN JOB ECONOMY

Despite the tremendous emphasis on and public policy around green jobs and measures to address environmental concerns, the numbers of green jobs in California and in the U.S. constitute a small proportion of their respective labor markets. As we discuss below, however, the available studies do suggest that green jobs are growing rapidly. Three studies have attempted serious assessments of the size of California's green economy. The most detailed study is by the Center for Community Innovation at UC Berkeley.[21] The two others were conducted by Collaborative Economics[22] and by the California Employment Development Department.[23] Of course, the size of the sector depends on how it is defined. The range in these three studies indicate that green jobs comprise between one and four percent of total employment, a small part of California's total economy. Nevertheless, as we discuss below, green jobs are growing much faster than jobs overall.

Innovating the Green Economy, a report by the Center for Community Innovation at UC Berkeley, examines the green economy in the context of innovation in California and its role in regional economic development within the state. Chapple et al. surveyed 34 metropolitan regions within California, ranging from the most economically vibrant regions, such as San Francisco and Los Angeles, to more distressed regions, such as Riverside–San Bernardino and the Upper San Joaquin Valley. The study defines the green economy as any "economic activity that reduces energy use and/or improves environmental quality." This definition includes new and traditional industries, as well as industries further up the production chain, such as clean tech manufacturing, and those that make green consumer products and services, such as household cleaning products.

Chapple et al. combine data analysis, business surveys, and interviews to identify green industries and innovation. They estimate the number of green establishments and jobs through an inductive and iterative process, drawing from green businesses, using lists from local cluster initiatives and from the National Employment Time-Series (NETS) database, which provides information on businesses at the detailed eight-digit SIC level. These industries are then grouped into six main green sectors: (1) energy research and services, (2) environmental services, (3) green building, (4) green manufacturing, (5) green transportation, and (6) recycling. This method results in a broader list of industries (194) compared to a previous study by Collaborative Economics (75).

Chapple et al. identify 12,253 green establishments employing 163,616 people in California in 2008. They find that green establishments on average employ more workers per business than do all businesses in the state (13.4 compared to 7.5 per establishment). The largest share of green employment was found in the environmental services sector (38,042 jobs), followed by the green transportation sector (36,107 jobs) and recycling (33,529 jobs). Growth in the environmental services sector far outpaced any other green sector, growing by 98 percent, from a base of 19,229, from 1990 to 2008. Green jobs are geographically concentrated in the largest five metropolitan areas, Los Angeles, the San Francisco Bay Area, San Diego, Orange County, and Riverside–San Bernardino, accounting for 70 percent of the jobs in the state.

Chapple et al. estimate that overall green employment accounts for less than one percent of total state employment. They attribute the small figures, in part, to the study's conservative definition of the green economy. But Chapple et al. emphasize that growth in green economic activity from 1990 to 2008 far outpaced overall growth (79 percent sales growth compared to 47 percent overall).

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[21] Chapple, K., M. Hutson and A. Saxenian (2010). Innovating the Green Economy in California Regions. U.S. Economic Development Administration, Retrieved from: http://communityinnovation.berkeley.edu/publications/ige_karen-chapple_cci-ucb.

[22] Collaborative Economics, & Next10 (2009). *Many Shades of Green: Diversity and Distribution of California's Green Jobs.*

[23] Employment Development Department (2009, May). *California Labor Market Analysis 2009.* Labor Market Information Division, Employment Development Department.

The Collaborative Economics study examines self-identified green businesses and counts the number of people employed in those businesses to estimate green jobs. This approach thus examines only businesses that are specialized in green products (or the supply of green goods as discussed above). Collaborative Economics finds that these jobs are diverse, dispersed widely across the state, and offer a broad range of occupational opportunities. They identify 15 segments in the green economy. The largest number of green job opportunities is located in Energy Generation, Air and Environment, Recycling and Waste, Waste and Wastewater Treatment, Energy Efficiency, and Green Buildings. A majority of the green jobs they identified are found in the areas of Air and Environment, Energy Generation, and Recycling, Waste management, and Energy, accounting for roughly 110,000 of the total 160,000 direct green jobs in 2008.

The estimated 160,000 direct green jobs account for approximately one percent of total nonfarm jobs in California. While green jobs are still a small part of total jobs, the Collaborative Economics study also found that these jobs are growing much faster than the rest of the economy, in both California and the U.S. From 1995 to 2007, green jobs in the U.S. grew by 17 percent, compared to 9 percent for all employment.[24] In California, growth in the green economy is even more marked. In just one year, 2007 to 2008, green jobs increased by an estimated five percent, while total employment declined by one percent. From 1995 to 2008, the number of green establishments in California grew by 45 percent, from a base of approximately 9,000, and green jobs grew by 36 percent, from just under 117,000 to 160,000. In the same period, total nonfarm employment grew by just 13 percent (from roughly 13.6 million to 15 million jobs) in the state. As we discuss below, the faster growth of green jobs in California reflects the earlier adoption of green activities in the state. If the recent growth rate continues, these jobs are likely to become a significant part of the California economy in the near future.

The California Employment Development Department (EDD) study takes a broader approach to estimating the size of the green economy. EDD conducted an employer survey, ending in January 2010, to collect information on all green industries, including jobs generated through the supply of green-related products, as well as a result of businesses implementing green practices. Using this method, green jobs comprise a larger percentage of the whole economy, compared to the previous study—approximately 3.4 percent (433,000 jobs) of all jobs in California.

As Figure 2.14 shows, the green jobs identified by the EDD study are concentrated in manufacturing (88,815) and construction (61,300). Specifically, more than three fourths of all workers identified were employed in industries related to recycling, (27 percent), Energy Efficient Product Manufacturing, Distribution, Construction, Installation, and Maintenance (27 percent), or Natural and Sustainable Product Manufacturing (24 percent). Common green-related occupations include carpenters, hazardous materials removal workers, sustainable farmers, assemblers, recycling center workers, electricians, plumbers, architects, industrial production managers, and construction managers.

2.4.3 JOBS CREATED BY ENERGY SAVINGS

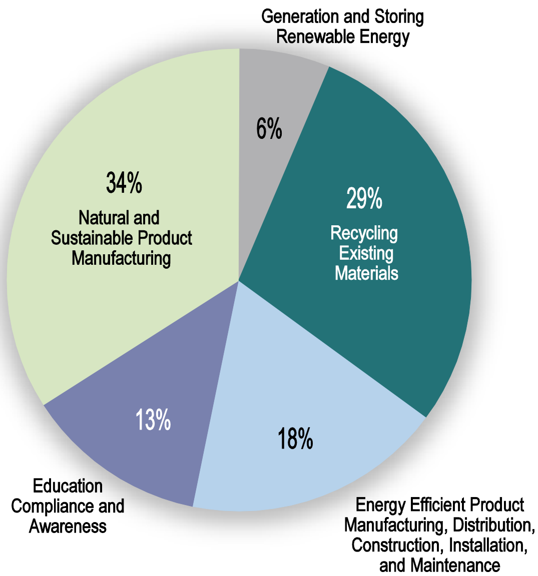
Since the early 1970s, California has implemented significant energy efficiency mandates and incentives, such as higher mileage requirements on vehicles, building energy efficiency standards, and a wide range of utility programs aimed at reducing the demand for energy and increasing the efficiency of energy supply. As a result, today California's consumption of energy per dollar of economic output is more than 40 percent below the national average, giving it an important competitive edge. The savings generated by these policies were spent primarily on increased consumption of services, which are relatively labor-intensive and produced almost entirely within the

[24] Grose, T (2010, Jan. 21). "Progress and Promise: Trends in the Emerging Green Economy." Presentation to Innovating in the Green Economy Conference, UC Berkeley. Retrieved from: http://communityinnovation.berkeley.edu/publications/ige_tracey-grose_ce.pdf.

state. Consequently, the number of new in-state jobs that were created far outweighed the number that were destroyed in California's traditional energy sector.

Moreover, as a result of the same policies, California also gradually reduced its dependence from traditional energy sources outside of the state and increased its consumption of renewable sources within the state. In 1970, California drew most of its energy from traditional energy sources, which were and remain highly capital-intensive and more than two-thirds of it came from outside the state, generating jobs in Bahrain and Beaumont, Texas but not in Bakersfield.[25] This shift to renewable in-state sources thereby created many more in-state jobs than it destroyed.

Figure 2.14 Total Green Employment by Category



Source: Graybill, B. (2010, March 17). *California's Green Economy.* Presentation to the Green Collar Jobs Council. Retrieved from: http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/CA-Green-Economy-GCJC-032010.pdf.

A study at the University of California at Berkeley by David Roland-Holst reviews these policies and provides quantitative estimates of their effects on job growth in California over a 35 year period.[26] Roland-Holst's analysis accounts for both the shift to using less energy and the shift to consuming renewables from within the state. Roland-Holst estimates that over the 35-year period of the study, consumers and businesses realized $56 billion in energy savings. These savings, spent on other goods and services, led to a cumulated 1.5 million additional full-time equivalent jobs and an additional $45 billion in earnings over the period. Roland-Holst's forecasts, like any

[25]As Roland-Holst observes, crude oil and natural gas production within California have been steadily declining to the point where collectively they supply only 21 percent of state energy consumption. In contrast, renewable energy, which includes hydroelectric, geothermal, solar, and wind power, has been increasing but at a relatively slow 1.9 percent annual rate since 1970, supplying 13 percent of the state's energy. See Roland-Holst, D. (2008). *Energy Efficiency, Innovation, and Job Creation in California.* Research Papers on Energy, Resources, and Economic Sustainability, Center for Energy, Resources, and Economic Sustainability (CERES), UC Berkeley.

[26] (Roland-Holst, 2008) This study looks at induced job creation as a result of green measures. The term "induced" refers to job growth due to economic activity that is stimulated from green measures that results in a greater demand for labor whether or not the specific occupation involves the production of a green product itself. In contrast, "direct" refers to jobs specifically created in occupations that involving producing goods and services that increase sustainability of their consumption or reduces environmental impacts relative to their conventional counterparts. "Indirect" refers to jobs created through the spread of environmentally related concepts.

forecasts, are subject to uncertainty about the future. In particular, his assumptions about the extent of household savings from reduced energy expenditures may lead to overly optimistic estimates of job growth. Although we do not know the scale of this effect of energy savings, Roland-Holst presents a convincing argument that it is an additional stimulus from clean energy investments that policymakers should be aware of.

2.4.4 THE ROLE OF VENTURE CAPITAL INVESTMENTS

The growth of green jobs is closely related to innovation and investments in clean technologies. California is a leader in green technology development adding to its competitive edge in the world and national economy. Its energy productivity, defined as gross domestic product (GDP) per unit of energy consumed, has been on an upward trend since the early 1990s, and was 70 percent higher than that of the United States in 2007. In 2008, California's clean technology investments totaled $3.3 billion for the entire year.[27] California receives the lion's share of all capital investments in clean technology, amounting to $980 million in the second quarter of 2010 alone and accounting for two-thirds of all clean technology venture capital investments in North America.[28] Unfortunately, venture technology investment in California, including in clean technology, has been hard hit by the recession. Although such investments grew 14 percent from 2007 to 2008, these clean technology investments declined 36 percent from 2008 to 2009.

California's proactive stance on energy and environmental issues and its leadership in the area of green technology investments, incentives, and mandates, has played an important role in creating a burgeoning green economy. Rekindling these investments will be an important strategy in fostering the state's recovery and the creation of green jobs.

2.4.5 THE QUALITY OF GREEN JOBS

Job quality depends to a large extent on labor market standards attached to the job. While the growth in the environmental and sustainability sectors, along with venture capital investments, can be expected to generate jobs in the long run and contribute to California's recovery, not all green jobs are necessarily quality jobs. To date, however, the wage, benefit and other quality indicators of green jobs has not been the subject of much research.

The quality of green jobs has been examined in a study by Good Jobs First.[29] This study examined jobs in wind and solar energy component manufacturers, green buildings construction companies, and materials recycling facilities, finding that labor standards vary widely among green industries. Many jobs are in low wage labor markets such as residential construction and many are not covered by collective bargaining agreements. Hourly wages ranged from a low of $8.25 in a recycling processing plant, to $11 per hour in a manufacturing facility related to renewable energy. Wages in many wind and solar manufacturing facilities were below the average paid for other types of durable goods, and many of these jobs were not covered by collective bargaining agreements. Among non-unionized construction workers, such as laborers, carpenters, painters, and roofers, a majority make less than $12.50 an hour and a third make less than the federal poverty wage for a family of four ($10.19 an hour). The

[27] Next10 (2009). California Green Innovation Index. Retrieved from: http://www.next10.org/pdf/GII/Next10_GII_2009.pdf.

[28] Clean Tech Group (2010). "Global Clean Technology Venture Investment Increases 65 Percent in 1H 2010 Finds Cleantech Group and Deloitte." Retrieved from: http://cleantech.com/about/pressreleases/Q2-2010-release.cfm.

[29] Mattera, P. (2009). *High Road or Low Road: Job Quality in the New Green Economy*, Washington, DC: Good Jobs First.

study found many higher paying green jobs as well, including plumbers making $36 an hour, solar panel assemblers at $22 an hour, and some at a recycling plant earning $20 an hour.[30]

A key finding of the study: government policies made the difference between low and high quality jobs. For example, the highest wages were found where state and local governments had conditioned subsidies for green technology production on high labor standards and then enforced those standards.

2.5 LABOR MARKET STANDARDS

A growing research literature has shown that higher labor standards can lead to more productive workers, less turnover, and a more stable workforce.[31] When employers and employees are engaged in long-term employment relations, each has an interest in training and other learning activities that result in higher worker productivity as well as higher worker pay. One example of broader-based skills standards consists of industry-based agreements or policies that specify the skills that are needed in a particular occupation. When they are mandated, such skill standards are known to create higher quality jobs and worker output among workers who have acquired these skill standards.[32] Such standards result in better quality, higher paying jobs and allow for more broadly based prosperity and economic growth. Skill standards could be applied, for example, to occupations that involve the installation of heating and ventilation systems and solar panels.[33] Of course, developing skills standards in often fragmented industries can be challenging, but still worthwhile.[34]

Examples of mandated labor standards that are common, although by no means ubiquitous in California include living and minimum wages, prevailing wages, and project labor agreements. Some economists maintain that living wage and minimum wage standards reduce employment. Other economists have challenged such findings. Numerous rigorous research studies have demonstrated that both living wage laws and minimum wage laws raise earnings without leading to job losses, in part because they substantially reduce employee turnover.[35]

Living wage laws, which have been adopted by over 140 local governmental entities, apply to government-funded or subsidized contracts, and often, as well, to service providers located on government-owned property, such as a stadium or airport. Such laws are particularly common in California, in all of its large cities and many of its smaller ones, and also at many of the state's major airports.[36]

In the past two decades, over thirty states have enacted minimum wage standards that exceed the federal standard. Currently, typical state minimum wage laws set a standard of $7.50 to $8.00 per hour, and ten states

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[30] We defer discussion of the skill sets and training requirements for green jobs to a later chapter in this report.

[31] For two examples, see Reich, M., P. Hall, P., K. Jacobs (2005). Living Wage Policies at the San Francisco Airport: Impacts on Workers and Businesses. *Industrial Relations: A Journal of Economy and Society*, 44: 106–138. doi: 10.1111/j.0019-8676.2004.00375.xy.; Dube, A., W. Lester, M. Reich (2010b, October). “Do Frictions Matter in the Labor Market? Accessions, Separations and Minimum Wage Effects.” IRLE Working Paper.

[32] On industry-based skill standards, see: Marshall, R., & M. Tucker (1992). *Thinking for a Living*. New York: Basic Books.; or studies done by the Center on Wisconsin Strategy at the University of Wisconsin.

[33] Skills standards can have downside risks if they are not modernized as technology changes or if they are inflated and thereby used to exclude groups who lack certification in those standards.

[34] See the case studies in later sections of this report.

[35] Dube, A., W. Lester, M. Reich (2010a). “Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties.” *Review of Economics and Statistics*. 92, 4: 1-20.; Dube, A., W. Lester, M. Reich (2010b, October). “Do Frictions Matter in the Labor Market? Accessions, Separations and Minimum Wage Effects.” IRLE Working Paper.; Fairris, D., & M. Reich (2005). “A Survey of Living Wage Research.” *Industrial Relations*.

[36] For a survey of California living wage ordinances and their impacts, see: Reich, M. (2002). “Living Wage Ordinances in California.” In *The State of California Labor*, Ruth Milkman ed. University of California, Los Angeles, Institute for Research on Labor and Employment.

index the minimum wage to the consumer price index. Citywide minimum wage laws in Santa Fe, NM and San Francisco, which provide a minimum of $9.65 per hour, have also been found not to have had negative employment effects.[37]

Labor standards form a key component of Project Labor Agreements (PLAs), which are often present in large construction projects. They involve labor–management cooperation to solve problems related to coordination issues among a multiple of contractors and job requirements on large projects. Although the literature contains conflicting claims, the most rigorous and credible research is by Belman et al. [38] They conducted a careful analysis of construction costs among similar projects, such as construction of public school buildings, and were able to control for differences in the complexity buildings. They find that the costs and time to completion are smaller at PLA projects relative to non-PLA sites, despite the higher union pay rates in place at PLA sites.

Prevailing Wage Standards in construction provide an example of labor standards that promote higher labor productivity by coupling the standards with training programs. So while labor costs are higher, the offsetting increases in worker productivity often leave unit labor costs unchanged.[39]

In summary, a variety of labor standards have been shown to be highly effective in increasing pay, while also improving worker productivity, often by reducing employee turnover and with support from training programs. These programs are especially common in California, although by no means ubiquitous. The most effective programs provide mandated rather than voluntary participation. Although such programs are found in the green economy, they typically are not mandated.

2.6 SUMMARY AND CONCLUSIONS

The current economic crisis has deeply affected California's labor market and it is not expected to recover to pre-recession conditions for some time. According to our extrapolations of the Department of Finance's projections, California unemployment rate is expected to remain above 8 percent until 2020. While lower than the present unemployment rate, an unemployment rate above 8 percent is substantially higher than the 6 percent unemployment rate of 2007 for California. These projections suggest that it will take more than a decade to return to pre-recession unemployment levels. Consequently, employment forecasts that were made prior to the recession need considerable downward adjustments.

The California construction industry, in which many green jobs are located, has been more deeply affected than any other industry. Indeed, the decline of roughly 30 percent in state construction employment exceeds national employment declines in the Great Depression. The continuing overhang in both residential and nonresidential construction is likely to dampen the number of new green jobs for the near future. Many of the currently unemployed construction workers already possess skills applicable to the green economy and will need only limited additional training when they return to work.

Job training will still be important in the long run. In particular, increasing access to and levels of job training, certification and AA degrees can go a long way toward not only meeting future labor demand, but also increasing the quality of jobs and reducing income inequality in the state.

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[37] Dube, A., S. Naidu, M. Reich (2007, January). "The Economic Effect of Citywide Minimum Wage Laws." *Industrial and Labor Relations Review,* 60, 4: article 4. Available at: http://digitalcommons.ilr.cornell.edu/ilrreview/vol60/iss4/4.

[38] Belman, D., M. Bodah, P.Philips (2007). Project Labor Agreements. Retrieved from: http://www.onlinecpi.org/downloads/PLA-report.pdf.

[39] Reich, M. (1996). "Prevailing Wages and the California Economy." UC Berkeley Institute of Industrial Relations. Available online at: http://sbctc.org/default.asp?id=170; Mahalia, N. (2008). "Prevailing Wages and Government Contracting Costs: a Review of the Research." Briefing Paper no. 215.Washington, DC: Economic Policy Institute.

Income inequality is greater in California than in the rest of the U.S., and greater than in any other industrial country. Since 1979, earnings for the lower end of the distribution have been stagnating or declining, while earnings for the top twenty percent of workers have grown substantially. The growth in the number of professional jobs has not been met with sufficient matching investments in higher education at the two and four year degree levels. As the demand for workers with higher education levels has outstripped the supply, wages for college educated workers have grown faster than those of workers with lower educational attainment, resulting in a growing skills–job mismatch and college wage premium. This trend is likely to worsen without immediate increases in higher education investments as well as efforts to increase access to higher education for underrepresented demographic groups.

The green economy has been defined to include industries that directly produce products and services that reduce the environmental impact of economic activity, as well as activity indirectly created as a result of becoming more environmentally sustainable. To date, the size of the green economy is still small, but the growth rate of green jobs is substantially higher than the overall growth rate for all California jobs. Since California has been a leader in environmental initiatives, the state receives a large share of clean technology venture capital investments. For these reasons the green economy is likely to continue to grow at a faster rate than other sectors.

Given the growing importance of environmental issues, combined with the pressures of climate change, the green sector is likely to grow and will comprise a more significant share of all jobs in the long run. Moreover, as California's economy continues to become more energy-efficient and less dependent upon fossil fuels, which are capital intensive and require a large share of foreign inputs, many jobs will be created indirectly through the substitution of consumer purchases toward more labor intensive goods and services produced within the state.

The future economic growth of California in large part depends on decisions in Washington D.C. and Sacramento. We can take different growth paths: A high-road path would involve more rapid growth, and would foster shared prosperity and the growth of high quality good paying jobs. A low-road path would foster slower growth, higher inequality, and poor quality jobs.

The policy path that the U.S. and California have been on for three decades has been the low road; one of deregulated financial and mortgage markets and greater inequality, which resulted in slower economic growth compared to the high road path of the earlier postwar decades. The low road policy path culminated in the Great Recession and the continuing jobless recovery. In earlier decades the U.S. and California each invested more in education, training and infrastructure, and maintained regulations that fostered higher labor standards.

California can pursue a high road again—with the green economy and green jobs as one of its foundations. However, as we stated at the outset, the California economy suffers from two large problems: the economic crisis, which although temporary will be protracted, and the decades-old problem of increasing wage inequality. The growth of green jobs will provide an important source of new employment. But without appropriate public policies, the quality of these jobs will resemble those of other private sector industries—some high-paying professional jobs and many more low-wage jobs, but not enough high quality middle skills jobs. In this context training investments are necessary to expand the supply of middle skilled workers. By themselves, though, training programs are not sufficient. The state also needs public policies to generate economic growth and labor demand and employment policies that support job quality.

CHAPTER THREE:

3. QUANTIFYING LABOR DEMAND AND SUPPLY

3.1 INTRODUCTION

In order to assess the need for workforce education and training, it is necessary to quantify present and future labor demand. This chapter develops labor demand and supply projections for this Workforce Education and Training (WE&T) Needs Assessment as the first step toward understanding how the potential demand for workers in energy efficiency, distributed generation, and demand response ("energy efficiency and related activities" or "energy efficiency") matches the current and future California workforce.

This chapter addresses five main questions:

1. What are the existing energy and environmental policies and programs that are expected to result in job creation in energy efficiency, distributed generation, and demand response through 2020?
2. How much funding (both government dollars and private investment) is currently being provided by these policies and programs, and how much is expected to be provided in 2010, 2015, and 2020?
3. How many jobs are expected to be created as a result of this investment, and in which industries and occupations?
4. How many workers are currently employed in energy efficiency occupations, and how many are expected to be employed in the future in these occupations?
5. Given this projected future labor demand and supply, what are the needs for workforce education and training?

These five questions all attempt to describe the nature and scale of labor demand and supply for energy efficiency, distributed generation (including solar, wind, fuel cells, and storage but not combined heat and power), demand response, and other demand-side management activities.

The first step in projecting future labor demand in the energy efficiency and related sectors is to determine what activities are likely to drive the increased demand, and where funding for these activities comes from. To develop our projections, we analyze increased demand that stems from public and utility investments as well as from the private market. Public investments, which accounted for over 60 percent of the total projected investments in energy efficiency and related sectors in 2010, come from state sources, federal sources, investor-owned utilities (IOUs), and publicly owned utilities (POUs). Private investment, almost 40 percent of the 2010 total, is of two distinct types. The first type is *participant costs*, or the amount that businesses (commercial, industrial, agricultural, and municipal) and households pay directly for energy efficiency improvements that are linked to a publicly supported policy or incentive. Examples include IOU/POU appliance rebate programs, IOU/POU equipment incentives, and solar power subsidies. (Tax incentives are *not* included in this analysis; see note 2.) The second type of private investment that we analyze comes from purely private sources, meaning this investment is not subsidized by, matched by, or in any way tied to public or utility moneys. These include investments in energy efficiency resulting from compliance with increased codes and standards found in Title 24[1] and through implementation of

[1] Title 24 Part 6 of the California Code of Regulations is the Energy Efficiency Standards for Residential and Nonresidential Buildings, established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to

the Big Bold Energy Efficiency Strategies (BBEES) in the California Long Term Energy Efficiency Strategic Plan (EE Strategic Plan), which was adopted by the CPUC in 2008. Taking both private components together, we refer to this source of investment in energy efficiency as *leveraged private investment.* Thus, our analysis of the sources of increased demand for energy efficiency and related investment incorporates the impact of major public sector and utility programs and policies, as well as shifts in private spending that can be directly attributed to these programs and policies. A comprehensive consideration of all possible private investments was beyond the scope of this study.[2, 3]

In this chapter we describe our methodology for developing labor demand and supply projections for the WE&T Needs Assessment and then present the summary results. Since the WE&T Needs Assessment requires an analysis of broad shifts in demand on the one hand, and a detailed description of employment growth for key occupations on the other, we developed a unique, hybrid "investment" methodology that meets both needs. While this method is necessarily more complex than either a bottom-up (micro) case study of an individual policy, or a statewide macro-level modeling exercise, it can be divided into seven distinct steps that, when taken together, bring to the WE&T Needs Assessment a relatively balanced and realistic estimate of future training needs. We present enough detail on the methodology for replication and regular updating of forecasts.

Below is a brief overview of the seven steps we used to project labor demand.

STEP 1. POLICY AND PROGRAM IDENTIFICATION: The first step in our analysis was the identification of all utility, state, and federal policies that were directly or indirectly designed to promote energy efficiency and other demand-side management activities. This step required a clear definition of the scope of policies to be analyzed and a division of policies into primary "target sectors" (e.g., residential, commercial/public, and agricultural/industrial).

STEP 2. MEASURING INVESTMENT LEVELS: After identifying the set of policies and programs that will influence demand for energy efficiency by sector, we then researched individual policy budgets. After having determined the investment levels for the baseline year of 2009, we used a variety of techniques to estimate the dollar amount of the predicted public and private investments associated with each of these policies and/or funding streams for three different years: 2010, 2015, and 2020. These different methodologies were required because of differences in the type of information available for the various policies and programs. For each policy/year combination, we estimated the investments under three different scenarios: low funding, medium funding, and high funding. [4]

STEP 3. INDUSTRY ALLOCATION: For each program or policy, we developed a method to allocate expenditures to detailed industry categories as defined by the North American Industrial Classification system (NAICS).[5] *These results are referred to as dollars per NAICS.*

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allow consideration and possible incorporation of new energy efficiency technologies and methods. The 2008 Standards went into effect January 1, 2010, and supersede the 2005 Standards.

[2] It is important to emphasize that our analysis of future private investment in energy efficiency and related activities excludes investments resulting from tax incentives, changes in market prices, changes in consumer preferences, and new technologies. We do not account for investments that are undertaken without a connection to some type of policy or program. Thus, the estimates for private investment rely exclusively on information on program participant costs (based on prior program experience, where available). In the case of the Big Bold goals, we only include private investment related to existing programs.

[3] The study's assumptions about policy-driven investment had to be finalized by June 2010 in order to conduct the rest of the analysis; any changes after June 2010 are not reflected in the estimates. Updating the investment numbers could be expected to change the specific expenditures in the short term (e.g., 2010). However, the overall conclusions would not be modified unless the reductions (or increases) in expenditures were known to be much different than projected for 2015 and 2020.

[4] Appendix A provides a detailed description of the first two steps.

[5] NAICS is the standard hierarchical coding system that classifies all economic activity into specific industry sectors.

STEP 4. JOBS CREATED BY PROGRAMS AND POLICIES: Next we used the E-DRAM model to provide an overall projection of the number of jobs created by increased demand in energy efficiency and related industries. The expenditures allocated to individual industries, as computed in step 3, were used as input. The E-DRAM model accounts for the indirect and induced impacts of the investments and also takes into account job creation (and destruction) due to energy savings.

STEP 5. DIRECT JOBS BY INDUSTRY: While the outputs of the macro-modeling conducted in step 4 are important for the big pictures, an accurate needs assessment requires details on job creation in individual industries. We used the "input-output" model IMPLAN to estimate the number of "direct jobs created by the energy efficiency investments in the relevant industries, using the dollars per NAICS figures from step 3 as inputs. The IMPAN model allowed us to account for which jobs will stay in California and which will be transferred outside the state. In step 5 we estimated the net new number of jobs by NAICS industry sector for each year (2010, 2015, 2020) for all three funding scenarios.

STEP 6. DIRECT JOBS AND WORKERS BY OCCUPATION: In step 6 we first estimated the number of *job person-years* in each occupation (classified by the Standard Occupational Code (SOC)). To do this, we applied the average distribution of jobs by occupation in the relevant industries using staffing patterns data from the California Employment Development Department (EDD), as well as the EDD Green Economic Survey. We next estimated the number of workers needing training for each job person-year.

STEP 7. GEOGRAPHIC DISAGGREGATION: The final step in this methodology was estimating the distribution of the number of workers requiring training by occupation needing training across California counties, metropolitan areas, and IOU regions.

3.1.1 CLARIFICATION OF KEY ASSUMPTIONS

Net new job creation due to energy efficiency and related investment occurs in many different industries. We refer to those industries in which jobs are *directly* generated from these public and private investments as *energy efficiency and related industries*. These *direct jobs* are in such industries as construction, administration, manufacturing, and technical services such as engineering and architecture. Others, such as accounting firms, also gain jobs, because they are providing goods and services to the direct beneficiaries of energy efficiency and related investment. These are called *indirect jobs*. A third group of industries, such as grocery stores, also experience job growth, primarily because the workers holding the direct and indirect jobs, as well as their employers, spend more money on consumption goods. Such newly created jobs are called *induced jobs*. Finally, some industries (such as fossil fuels) lose jobs, because households are substituting more energy efficient goods and services for their products. While we produced statewide projections for total jobs (direct + indirect + induced – jobs lost), we only developed detailed occupational projections and training needs assessments for the direct jobs.

Additionally, not every new job will require new education and training. For the purposes of this analysis, we conservatively assume that only the industries that engage directly in energy efficiency related activity (such as sheet metal working or photovoltaic panel manufacturing) will need to train their workers in energy efficiency and related skills. Within the energy efficiency and related industries, there are hundreds of occupations, from

secretaries to CEOs to construction laborers. Some of these occupations need energy efficiency related training, but others do not. Given the objective of the Needs Assessment, we only examine in detail the job projections for occupations that need some sort of training.

Our analysis calculates new jobs in the form of full-time equivalents per year (hereafter *job person-years*). However, workers in most occupations do not spend all of their time on energy efficiency related activity. For instance, sheet metal workers may work on HVAC systems (which are central to energy efficiency), but also on rain gutters, roofs, outdoor signs, and other products that may not involve energy efficiency. If a sheet metal worker spends one-fourth of his or her time (hypothetically) on energy efficiency activity, then four sheet metal workers (whether new or incumbent) will need energy efficiency training for every one job person-year created. Thus, based on previous empirical work (described further below), this analysis translates the projections of job person-years into the numbers of workers that will need training.

Another set of assumptions underlies the development of funding scenarios. We base scenarios on a range of assumptions about the levels of investment, the rates at which state, federal, and IOU/POU money will be allocated and spent, and the pace at which the state's energy efficiency and related goals will be met. The report compares these scenarios in 2010, 2015, and 2020 to the baseline economy in 2009 – a year by which considerable energy efficiency and related programs and activity had already been launched.

These job projections are for a *subsector* of California's green economy, and are limited to energy efficiency and other related demand-side management activities for residential, commercial, industrial, agricultural, and municipal pumping. Thus the analysis excludes activities and related jobs commonly included as part of the green economy, including utility scale renewable generation, transportation, and environmental services (e.g., recycling). As a result, these job projections, including both the direct job projections for specific occupations and the overall job projection for direct, indirect, and induced jobs, are not directly comparable to those produced by studies examining the broader green economy.

Our analysis should be carefully interpreted with regard to the recession. Since our projections are based on jobs generated by public (including ratepayer) dollars, they may not be affected by the slowdown in growth in the overall economy. However, political changes and fiscal constraints may alter funding patterns in ways we cannot anticipate, and if our scenarios about continued public investment funding levels are too optimistic, our projections of job demand will be too optimistic as well. Further, for the projections of jobs generated by private investment, the business cycle may affect the projected private investments, as consumers may be less willing or able to contribute participant costs or pay the extra cost associated with new construction built under tightened codes and standards.

The recession is also addressed in our analysis of labor supply. Given the high levels of unemployment, a queue of experienced workers exists that can fill the projected new jobs. We estimate this supply of unemployed workers for each forecast year, as well as net new jobs after this queue has been absorbed.

As with any set of assumptions used to develop projections, ours have limitations. There are substantial uncertainties related in particular to private investments, i.e., how they are affected by public investments, electricity and natural gas prices, the availability and prices of new technologies, and various other conditions.

3.1.2 SUMMARY OF FINDINGS

Based on these assumptions, we estimate that energy efficiency and related annual investments in California will increase from approximately $6.6 billion in 2010 to $11.2 billion in 2020, assuming the scenario of medium funding. These increases are due largely to projected increases in ratepayer-funded programs. Under the medium scenario, investments generate a total of 38,937 additional job person-years in 2020 when compared to job person-years in

2009.[6] Approximately one-fourth of the workers needing training for the new jobs that will result from this investment are in construction and other industries directly related to energy efficiency and related industries. The principal directly affected industries (with over 1,000 new workers in 2020) include HVAC and electrical contractors; residential and nonresidential building construction; administrative services; engineering, and other scientific and technical consulting services; and semiconductor manufacturing.

The number of additional job person-years (after subtracting job person-years in the 2009 baseline) projected in these directly affected industries for the year 2020 ranges from approximately 23,000 in the low scenario, to 39,000 in the medium scenario, and 42,000 in the high scenario. For comparison, the California Employment Development Department (EDD) anticipates an average of 165,200 permanent (not one-year) new jobs per year from 2008 to 2018 in the California economy as a whole.

Our analysis shows that the full-time jobs generated for a particular year are not all in occupations working directly in energy efficiency and related activity. However, approximately 70 percent are expected to require some form of energy efficiency and related job training. But since energy efficiency activities comprise only a share of a worker's job, there will be about 2.5 workers needing training for every full-time job created. Because the number of incumbent workers in affected occupations (such as electricians and sheet metal workers) is much higher than the number of new job person-years created by policy-driven energy efficiency investment, these existing workers create most of the need for energy efficiency training.

The remainder of this chapter is organized as follows. Section 3.2 provides a brief conceptual overview of the overall methodology selected and describes why our "hybrid" modeling choice is the best fit for the WE&T Needs Assessment. In section 3.3, we describe in detail the policies and programs that are relevant to achieving California's goals for energy efficiency, demand response, and distributed generation. These policies and programs include those funded by ratepayers of the IOUs and POUs, those funded by federal and state sources, and those concerning building codes and appliance and equipment standards. Also in this section is a discussion of the scenarios developed (i.e., low, medium, and high) for each broad policy category. Section 3.3 thus covers the first two steps in our analysis. Section 3.4 describes how we developed labor demand projections for the industries and occupations that stem from the investment inputs. This section covers steps three through six above. Section 3.5 presents our methodology for allocating statewide job estimates to individual California metropolitan regions and to the service territories of the four major IOUs. Section 3.6 describes the methodology for and results of projecting California's energy efficiency labor supply, and section 3.7 discusses the match between projected labor demand and supply. Section 3.8 summarizes the results.

3.2 METHODOLOGICAL APPROACH

To develop our overall conceptual approach for the labor demand methodology, we reviewed many studies that describe or forecast green jobs, and developed a hybrid methodology that builds upon existing work while meeting the objectives of the Needs Assessment. As described below, the methodology makes some important advances over previous studies.

Green jobs forecasts typically rely on either a micro or macro approach. The micro approach uses small-scale surveys or interviews with businesses to examine past hiring patterns and identify likely future job creation in the short term. In contrast, the macro approach starts from an overall picture of a region's economy, using the best available data on all sectors of the region's economy. This approach relies on macroeconomic models that are designed to consider the interactions among the major sectors of the region's economy over multiple time

[6] We refer to these additional job person-years in projection years 2010, 2015, and 2020 as "net of 2009."

periods. These models yield an aggregate picture without information on how specific industries and particularly specific occupations are affected. For the Needs Assessment, it was necessary to develop a methodology that, using both macro and micro approaches, could provide long-term employment projections (through 2020), which in turn could be used to determine training needs for specific occupations.

The strength of the micro approach lies in its empirical basis, utilizing recent data from actual firms from specific regions. Two examples of using the micro approach to study employment in California's green economy are the 2009 surveys of both the California Community Colleges Centers of Excellence (COE) and the EDD.[7] The COE study, conducted in 2009, surveyed several thousand firms from across the state in three broad industry sectors (utilities, building design and construction, and facility maintenance) to determine the energy efficiency occupations in demand and the future hiring plans of employers. The EDD survey, also conducted in 2009, surveyed over 51,000 California employers from a broad cross-section of industry sectors in order to estimate the number of green jobs in California and identify emerging green occupations.

Yet this micro approach may misrepresent actual employment patterns, as employers' decisions about hiring may change as conditions change. Further, short-term hiring preferences of a sample of current employers are not an appropriate basis on which to project long-term job growth, particularly when industries are undergoing rapid change and when public policy is driving industrial development. Many employers, particularly in small firms, base hiring decisions on current local conditions and are not a reliable source for projecting overall employment changes resulting from policies or other macro-economic forces. Finally, employer surveys are not able to take into consideration the interactions within the economy, including the indirect job creation due to changes in demand for intermediate products up the supply chain, and induced job creation due to changes in demand for products and services resulting from changes in household income induced by policy or other macroeconomic changes.

Macro models analyze how past policy expenditures or other shocks (e.g., a crisis such as an oil shortage, a war, a recession, or a natural disaster) have altered economic patterns and use such information to build assumptions about how the economy will create jobs in response to future changes. The models examine how new policy-related expenditures are expected to generate indirect and induced spending (and jobs) in other sectors, within and outside of the state or region under consideration, due to changes in demand for inputs (e.g., the material used to build photovoltaic panels) and changes in household expenditures. The Environmental Dynamic Revenue Analysis Model (E-DRAM), which was employed in this study, is one of two such California-focused computable general equilibrium models that are being used to model the effects of energy policy. Such dynamic models are considered appropriate because, unlike simple input–output models, they are able to incorporate labor market changes such as in-migration, as well as price changes and their impact on demand and supply. These labor market changes are especially critical for accounting for the total jobs created and/or destroyed by energy efficiency and related investments.

Our approach, which combines elements of both micro and macro approaches, allows us to consider the implications on economic growth and employment of increased investments in policies designed to promote energy efficiency (i.e., policy-driven effects) while sacrificing as little important detail as possible on changes in specific green subsectors and occupations. The approach we selected, which we refer to as the *investment methodology*, ties job projections directly to policy initiatives, and provides a means of developing job projections

[7] California Community Colleges Centers of Excellence, Economic and Workforce Development Program (2009). *Understanding the Green Economy in California: A Community College Perspective*. Retrieved from: http://www.coeccc.net/Environmental_Scans/GreenEcon_Scan_SW_09.pdf.; For the most recent release of the results from the California 2009 Green Economy Survey see: California Employment Development Department (2010, July 12). "Green Analyses of Occupations and Industries." http://www.labormarketinfo.edd.ca.gov/article.asp?articleid=1229.

for alternative views (or scenarios) of future developments. It also relies on the results of the aforementioned green economy surveys conducted by the EDD and the COE to help clarify which industries and occupations are affected by investments (see Appendix B).

In its detailed focus on investments and occupations, our methodology is similar to the first comprehensive national study of the energy efficiency workforce by Chuck Goldman of the Lawrence Berkeley National Laboratory.[8] However, it differs in several respects. First, the E-DRAM model, a general equilibrium model developed specifically for California, is used to calculate the total jobs that will be created as opposed to only the direct jobs. Second, we use empirical data sources on the specific industries that receive investments, the regions where these industries are distributed, and the affected occupations; this allows us to link investments to employment and job projections by sector, occupation, and geographic area for the direct jobs. In section 3.7, we compare this detailed information to the future labor supply in California.

Figure 3.1 illustrates our seven-step, "hybrid" methodology for estimating labor demand stemming from energy efficiency investments. While this chapter presents considerable detail on the analysis of public and private investments, the development of scenarios, and the steps used to estimate job figures by detailed industry and occupation, it explicitly reserves the more technical steps for presentation in Appendix A, *Task 2 Methodology*, which provides additional detail about the data sources and assumptions throughout this analysis.

3.3 POLICIES, PROGRAMS, SCENARIOS, AND INVESTMENTS

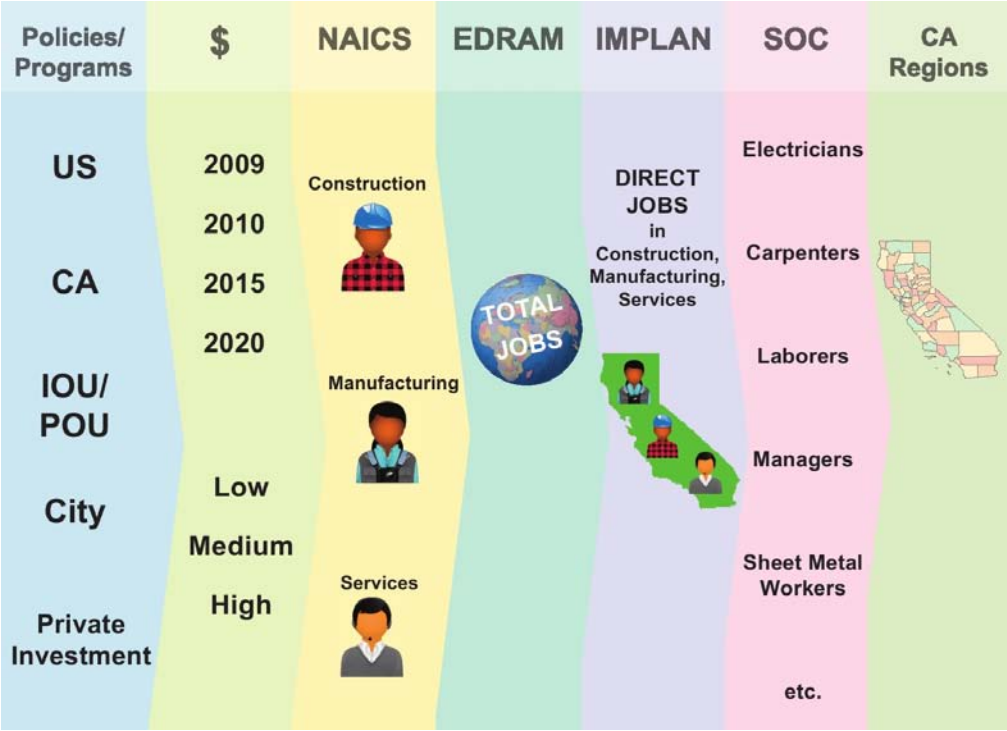
The first step in developing job projections is to identify the policies and programs, by sector, that contribute to achieving the cost-effective energy efficiency and other demand-side management potential as described in the *EE Strategic Plan*. Consistent with the scope of the WE&T Needs Assessment, the analysis identifies (step 1) and estimates (step 2) investments for programs and policies associated with energy efficiency, demand response, and distributed generation, with distributed generation limited to the customer-side of the meter facilities (excluding combine heat and power).

The energy efficiency programs include (1) incentive and education programs funded by utility ratepayers, state and federal government expenditures, and participant costs; and (2) state and federal codes and standards, which are funded almost exclusively by leveraged private investments. These energy efficiency programs also include weatherization programs for low-income customers. In addition, we also consider the CPUC's Big Bold Energy Efficiency Strategies (BBEES) and develop a methodology that measures the additional leveraged private investment that would be needed to meet specified goals. The demand response programs include expenditures for implementation and utility investments in smart meters. Within the demand response programs we only consider private investments that are participant costs associated with specific utility-run programs; other private investments resulting from demand response, such as the wages paid to building managers hired to take advantage of special demand response programs, are not explicitly addressed. As mentioned previously, there is considerable uncertainty about the extent and type of private investment, so we conservatively exclude investments not related to specific public programs and policies. The distributed generation programs include financial incentives and subsidized rates for photovoltaic installations, wind turbines, fuel cells, and energy storage at customer facilities. The demand response and distributed generation programs are funded by both government expenditures and

[8] Goldman C., M. Fuller, E. Stuart, J. Peters, M. McRae, N. Albers, S. Lutzenhiser, and M. Spahic (2010). *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*. LBNL-3987E. Retrieved from: http://eetd.lbl.gov/ea/emp/reports/lbnl-3987e.pdf.

utility ratepayers, however participants also contribute funds to the distributed generation and demand response programs.[9]

Figure 3.1 Methodological Approach



The "target sectors" we identified in step I are consistent with energy-using sectors addressed in the EE Strategic Plan (i.e., residential, commercial, industrial, agricultural, and municipal pumping sectors). These sectors are classified based on usage (and not ownership), with commercial including schools, hospitals, prisons, and other institutions. Since state and federal programs group such public uses under the "public sector," this analysis henceforth combines commercial and public into one sector. We also group the goods-producing sectors (industrial and agricultural) together. The following sectors were excluded: transportation, distribution and transmission (e.g., electric distribution and transmission systems, pipelines), and utility-scale generation. Distributed generation was restricted to the customer-side of the meter facilities relying on solar, wind, and fuel cells; combined heat and power was excluded. The geographical scope is California (i.e., the projections are not limited to the IOU service territories) and the time horizon is 2020. Projections are also provided for 2010 and 2015. Although projections could be developed for each year through 2020, these projections would provide little or no additional information and would take resources away from other important tasks.

Our job projections are incremental to the 2009 baseline year. We obtained funding levels for 2009 using the same policy-specific sources we used for 2010.[10] For codes and standards, we assumed that the economic effects were already accounted for in the base year of 2009, since the standards were already several years old by then. Both

[9] As mentioned previously, tax incentives are not included, in part because of the lack of data on their use, and in part to avoid double counting.

[10] In some cases we were able to find direct budget information from a previous funding cycle. For instance the IOU portfolio of programs had a 2006-2008 funding cycle (and a 2009 bridge year) with detailed budgets by year. However, the specific programs changed from 2009 to the 2010-2012 funding cycle, not allowing direct funding comparisons for specific programs. In other cases, such as the California Solar Initiative (CSI), the program existed since 2006 and continued through 2016. We estimated an annual average public and private investment for all years, resulting in a 2009 investment that was identical to annual investments for 2010-2016.

the 2008 Standards (implemented in 2010) and future year changes are incorporated into the model.[11] For a detailed description of data sources for each individual policy, see Appendix A.

The federal government, state government, and utilities, including both the IOUs and POUs, administer a complex array of programs, some overlapping or combined, all designed to achieve the cost-effective energy efficiency and demand-side management potential. Table 3.1 shows the policies examined by sector, and organized by major program area and/or regulator (federal, IOU/POU, and state). For energy efficiency, these policies include customer information, customer incentives, upstream incentives for manufacturers and suppliers, and building codes and standards for appliances and equipment.[12] Distributed generation includes similar policies, as well as subsidized rates to encourage solar installations in residential and commercial establishments. For demand response, policies include dynamic rates (e.g., rates that are tied to prices or load conditions), direct load control, and incentives for permanent load. Smart meters will enable some demand response programs.

Since the effects of these policies and programs will depend, in part, on funding and implementation decisions to be made in the future, we developed three funding scenarios that describe different levels of penetration for these policies. Scenarios generally depend on whether or not the policy or program is proposed or approved, the amount of money allocated for a program, past and current expenditure rates, and whether or not it is meant to meet related approved goals (such as the Big Bold Energy Efficiency Strategies in the CPUC's Energy Efficiency Strategic Plan). We constructed each scenario independently with explicit assumptions that can be replicated. (Appendix A provides more detail on scenario development.)

We first illustrate the three scenarios by funding source and by program. We then provide a detailed explanation, by program, of how we derived the investment numbers and the specific assumptions for each scenario. As Figures 3.2, 3.3, and 3.4 show, energy efficiency and related annual investments in California (generated by both government programs and market activity) are projected to increase from approximately \$6.6 billion in 2010 to a 2020 total of \$7.3 billion in the low scenario, \$11.2 billion in the medium scenario, and \$11.7 billion in the high scenario. These increases are due largely to projected increases in ratepayer-funded programs under all scenarios, as well as leveraged private investments in the medium and high scenarios.

Figure 3.5 presents an overview of public and private investments in 2010 according to the medium scenario. For the estimates developed for this study, public investment dominates, at 62 percent of investment (\$4.1 billion), while private investment contributes 38 percent (\$2.5 billion). IOU and POU energy efficiency programs, as well as demand response and smart meter programs, dominate investment in this year, despite the influx of American Recovery and Reinvestment Act (ARRA) funds. Leveraged private investments figure most prominently in the IOU/POU energy efficiency programs, as well as Title 24 (California's building code) and the distributed generation programs such as the California Solar Initiative. Private investments are not estimated for all programs both because the private investments are not part of the program (LIEE programs) and because developing private investment estimates would likely result in double counting (ARRA program).

[11] Issues of non-compliance were not addressed in the macro analysis.

[12] We intentionally exclude taxes and subsidized loans in order to minimize the risk of double-counting participant costs.

Table 3.1 Study Sectors and Policies Analyzed

Policy Area / Sector	Residential	Commercial / Public	Industrial / Agricultural
Federal Programs			
Retrofits	X	X	X
Low-Income Weatherization	X		
Appliances and Equipment	X	X	X
Energy Efficiency and Renewable Energy Programs	X	X	X
ARRA Programs	X	X	X
Utility Energy Efficiency Programs			
IOUs Energy Efficiency Related Portfolio	X	X	X
Water-Energy Nexus	X	X	X
Low-Income Programs (LIEE)	X		
POUs Energy Efficiency Related Portfolio	X	X	X
Title 24 Codes & Standards and CPUC Big Bold Energy Efficiency Strategies			
Title 24 Codes and Standards	X	X	
Big Bold Energy Efficiency Strategies	X	X	
Distributed Generation			
California Solar Initiative	X	X	X
New Solar Homes Partnership	X		
POU Solar Programs	X	X	X
Other Renewable (SGIP and ERP)		X	
Demand Response and Smart Meters			
Pricing and Direct Load Control	X	X	X
Demand Response Device Rebates	X	X	X
Smart Meters	X	X	X

In the medium scenario, investments in energy efficiency increase substantially over the ten years, more than tripling over 2009 baseline levels of $3.6 billion. The share of private investment increases over time, from 38 percent of the total in 2010 to 46 percent in 2015 and 44 percent in 2020. Figures 3.6 and 3.7 show the changes by program area for 2015 and 2020. By 2015, increases in IOU/POU funding more than compensate for the loss of federal stimulus dollars. Over time, energy efficiency funding is projected to grow much more rapidly than distributed generation funding. Demand response and smart meter programs will shrink considerably after 2015. This reduction in expenditures is due to the completion of the initial installation of new smart meters by the utilities. As smart meters are installed, the penetration of demand response programs is expected to increase. Private investment responding to the increased penetration of demand response programs has not been addressed. State funding, largely for distributed generation programs, also will decline rapidly after 2015.

Below is a description of the programs, policies, and regulations at the federal, state, and IOU/POU levels that will foster investment in energy efficiency, demand response, and distributed generation in the next ten years. We also detail the assumptions behind the scenarios developed for each policy or program area. For simplicity in presentation, we present numbers for the medium scenario only.

Figure 3.2 Investment in Low Scenario by Source and Year

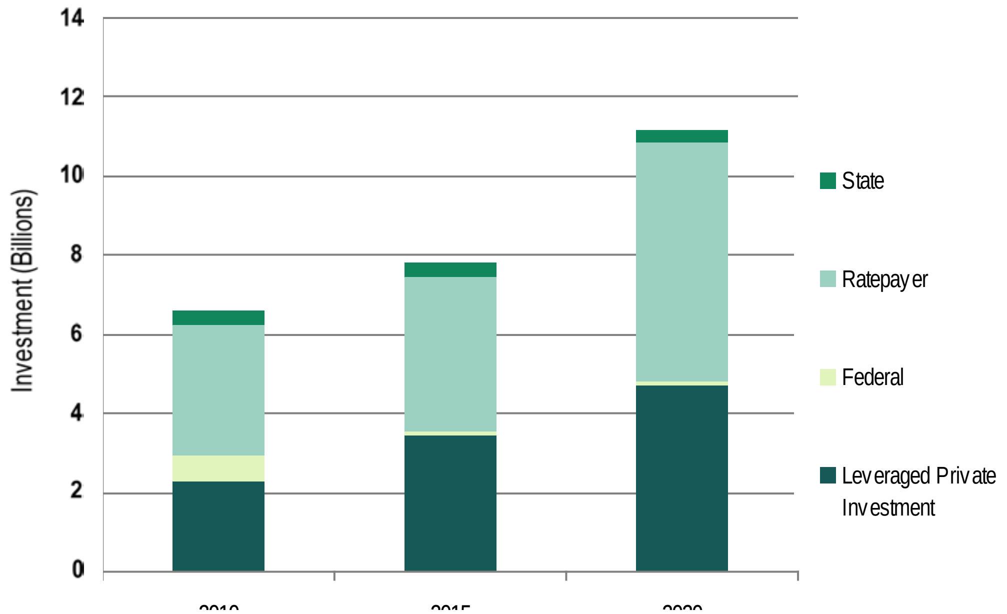


Figure 3.3 Investment in Medium Scenario by Source and Year

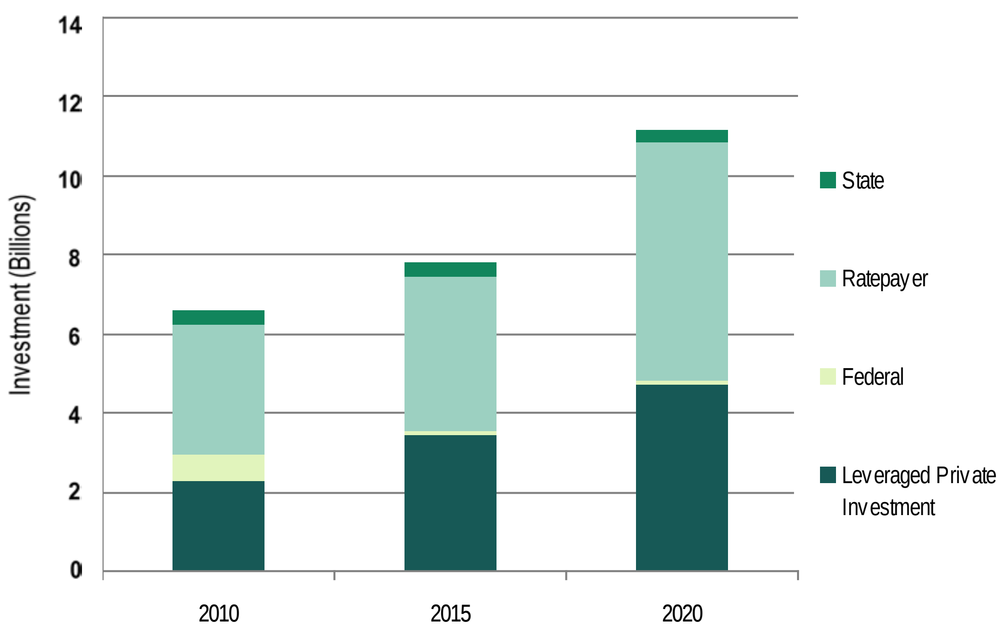


Figure 3.4 Investment in High Scenario by Source and Year

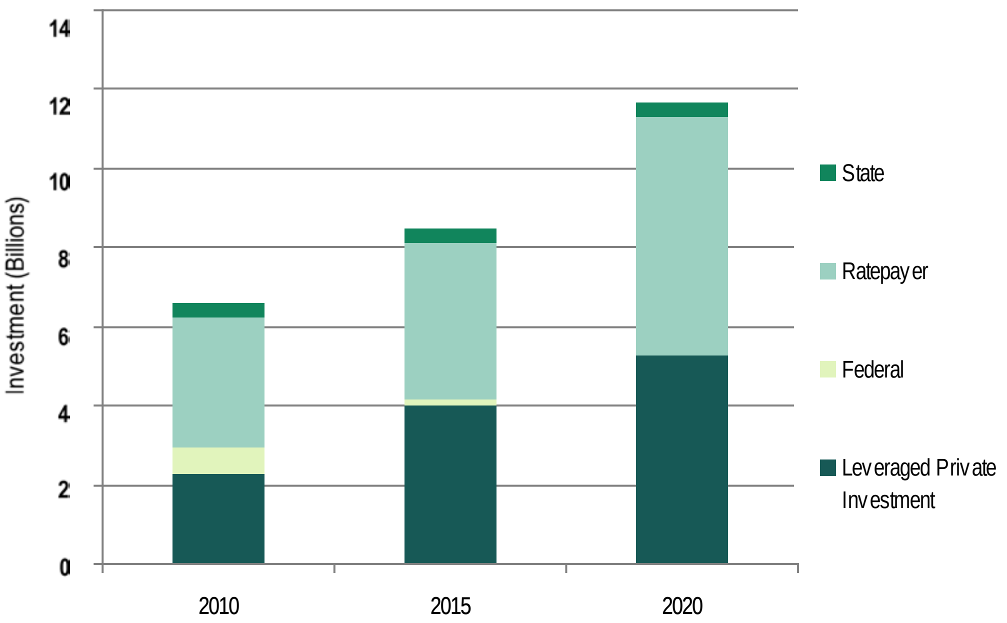
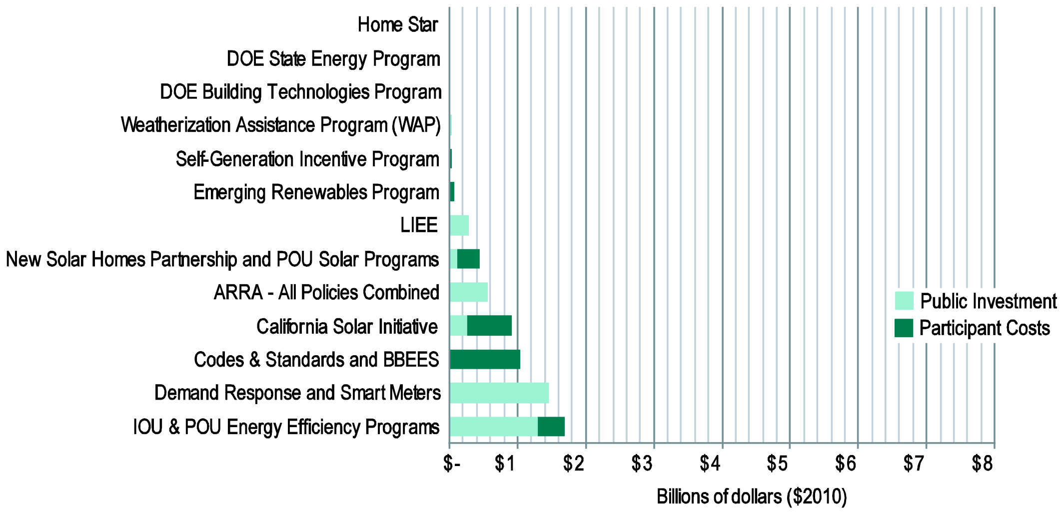
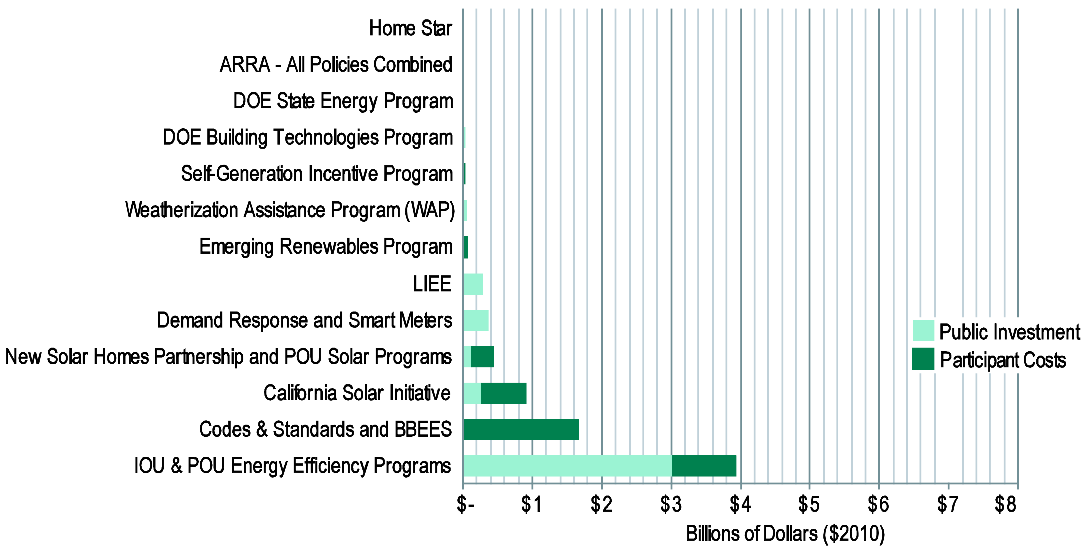


Figure 3.5 Summary of Policy Budgets and Leveraged Participant Costs by Major Program Area, 2010 Medium Scenario



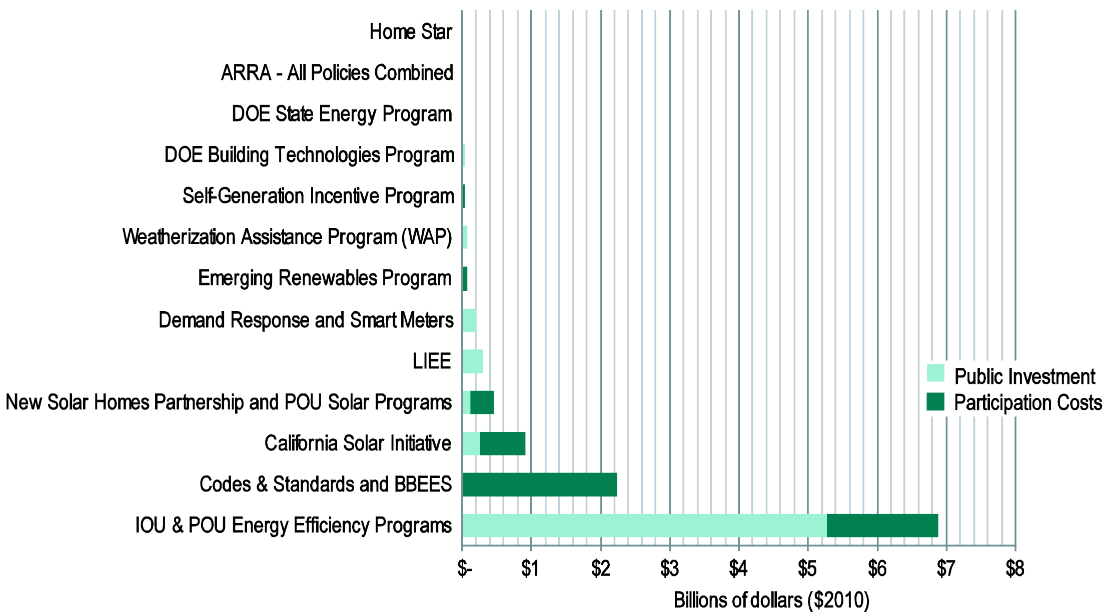
Note: No participant costs are included for ARRA to avoid potential double-counting of participant costs included in state programs.

Figure 3.6 Summary of Policy Budgets and Leveraged Participant Costs by Major Program Area, 2015 Medium Scenario



Note: No participant costs are included for ARRA to avoid potential double-counting of participant costs included in state

Figure 3.7 Summary of Policy Budgets and Leveraged Participant Costs by Major Program Area, 2020 Medium Scenario



3.3.1 ENERGY EFFICIENCY

Energy efficiency investment (narrowly defined) comes from a complex array of federal, state, IOU/POU, and local programs, incentives, and standards. (For the data sources relied upon, see Appendix A.)

3.3.1.1 FEDERAL PROGRAMS

Federal spending in energy efficiency and distributed generation in California comes mainly from the Department of Energy (DOE) annual budget for Energy Efficiency and Renewable Energy and the American Recovery and Reinvestment Act (ARRA), which fund DOE and several other agencies. Further, the proposed Home Star program would provide families with up to $3,000 per home for investments in energy saving home improvements. Home Star alone could bring about $700 million to the energy efficiency sector in California in the coming years.

DOE funds for energy efficiency and renewable energy are mostly channeled through its Office of Energy Efficiency and Renewable Energy (EERE); the following EERE programs are within the scope of the WE&T Needs Assessment (described by sector):

- → BUILDING TECHNOLOGIES PROGRAM: The BTP funds research and technology development to reduce commercial and residential building energy use. We estimate that funding goes half to the residential sector, half to the commercial sector.
- → INDUSTRIAL TECHNOLOGIES PROGRAM: The ITP seeks to reduce energy intensity and carbon emissions by changing the way industry uses energy. ITP sponsors cost-shared R&D and supports advanced technologies and energy management best practices. This program is 100 percent for the industrial sector.
- → FEDERAL ENERGY MANAGEMENT PROGRAM: The FEMP facilitates the federal government's implementation of sound, cost-effective energy management and investment practices in federal buildings to enhance the nation's energy security and environmental stewardship. FEMP guides federal agencies to use funding more effectively in meeting federal and agency-specific energy management objectives. This program funds public sector projects exclusively.
- → WEATHERIZATION ASSISTANCE PROGRAM: The WAP enables low-income families to reduce their energy bills by making their homes more energy efficient. Eligible residents must have incomes at or below 200 percent of the 2009 Federal Poverty Income Guidelines. This program is entirely residential.
- → STATE ENERGY PROGRAM: The SEP provides grants to states and directs EERE technology program funding to state energy offices. States use grants to address their energy priorities and program funding to adopt emerging renewable energy and energy efficiency technologies. SEP is intended to promote both energy efficiency and renewable energy. This program funds public sector initiatives.
- → OTHER WEATHERIZATION AND INTERGOVERNMENTAL PROGRAMS: The WIP programs are composed primarily of the Weatherization Assistance Program (WAP) and SEP. There are some other subprograms such as the International Renewable Energy Program or the Tribal Energy Activities that relate to energy efficiency. This funding supports both residential and public sector projects.

The American Recovery and Reinvestment Act (ARRA), the $787 billion economic stimulus package approved in February 2009, provides generous funding for energy efficiency and renewable energy programs in an effort to decrease U.S. dependence on foreign fossil fuels, fight climate change, and create green jobs in the construction and energy sectors. This study estimates that ARRA will invest almost $1.6 billion in energy efficiency related projects in California.[13] The EERE and most of the ARRA funding that comes to California goes through the federal Department of Energy. However, we also identified relevant programs in the General Services Administration, the Department of Defense, the Department of Veterans Affairs, and the Department of Housing and Urban Development.

Some of the largest ARRA programs are managed at the state level, including the expanded WAP and a variety of energy efficiency and renewable energy programs run through the California Energy Commission (CEC). Specifically, the CEC administers three ARRA programs included in the analysis:

- STATE ENERGY PROGRAM: ARRA augments the SEP with funding in the following areas:
  - → **Energy Efficiency Program**
    Funding supports three areas: Residential Building Retrofit, Municipal and Commercial Building Retrofit, and the Municipal Financing District Program.[14] This funding supports projects in the residential, commercial, and public sectors.
  - → **Department of General Services**
    The Energy Efficient State Property Revolving Loan Program retrofits state buildings. Funding is 100 percent for the public sector.
  - → **Energy Conservation Assistance Account One Percent Low-Interest Loans Program**
    These one percent loans are for energy conservation fund public sector projects.
  - → **Clean Energy Business Financing Program**
    These low-interest loans to private companies in the clean energy sector fund commercial projects.
  - → **Clean Energy Workforce Training Program**
    The Clean Energy Workforce Training Program supports regional partnerships in developing regional plans for training workers in new green technologies.
  - → **Contracts and Program Support**
    Auditing, measurement, and evaluation or ARRA contracts and programs

- THE ENERGY EFFICIENCY AND CONSERVATION BLOCK GRANT PROGRAM (EECBGP): Funded for the first time under ARRA, this program provides funds to units of local and state government, Indian tribes, and territories to develop and implement projects to improve energy efficiency and reduce energy use and fossil fuel emissions in their communities. This "Retrofit Ramp-Up" program, now called the Better Building Program (and part of Energy Upgrade California), has funded innovative models for rolling out energy efficiency improvements to hundreds of thousands of homes and businesses in a variety of communities across the country. California has received $30 million under this program. For the purposes of this analysis, we estimate that the program is 38 percent residential 29 percent commercial, and 34 percent public sector.

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[13] Our estimate is consistent with recent literature and reports in the field. (1) Goldman et al., 2010. (2) U.S. Department of Energy (2010). “Recovery and Reinvestment Funding Breakdown.” http://www.energy.gov/recovery/breakdown.htm; (3) California Energy Commission (2010). “California Economic Recovery Energy-Related Programs.” http://www.energy.ca.gov/recovery/ (4) California Energy Commission (2011). *2010 Integrated Energy Policy Report Update*. CEC-100-2010-001-CMF. Retrieved from: http://www.energy.ca.gov/2010publications/CEC-100-2010-001/CEC-100-2010-001-CMF.PDF; (5) National Association for State Community Services Programs (2009). *Weatherization Assistance Program PY 2008 Funding Survey*. Retrieved from: http://www.nascsp.org/data/files/weatherization/py%202008%20funding%20survey.pdf

[14] The Municipal Financing District Program was cancelled July 28, 2010.

- THE ENERGY EFFICIENT APPLIANCE REBATE PROGRAM: Three residential appliance categories receive rebates: clothes washers ($100 rebate), refrigerators ($200 rebate), and room/window air conditioners ($50 rebate). These rebates, which go fully to the residential sector, are in addition to existing rebates funded by ratepayers and offered through California's utilities or appliance manufacturers.

Additional ARRA funding for energy efficiency comes through the HUD Green Retrofit Program for Multifamily Housing. HUD's Office of Affordable Housing offers grants and loans to make retrofit investments in multifamily housing projects.

In addition, President Obama's proposed Home Star energy efficiency rebate program would spur demand for insulation, water heaters, and energy audits in the residential market. His latest proposal, which had yet to pass through Congress as of June 2010, would devote $6 billion for residential retrofits in the US.[15]

This analysis incorporates assumptions about federal ARRA funding allocation and expenditures based on information that was available by June 2010. Subsequent information about ARRA spending could not be incorporated into the study. Because it seemed highly likely that Home Star would pass in summer 2010, the analysis incorporates that program into the medium and high scenarios, beginning in 2011.

Table 3.2 outlines the specific scenarios for the federal energy efficiency and related programs. Together, this investment totals $795 million in 2010 (including ARRA), but is projected to decline to $107 million by 2020 under the medium scenario.

Table 3.2 Scenarios for Federal Energy Efficiency and Renewable Energy Programs

Low Scenario
75% of ARRA money is spent (2010-2012)
DOE Energy Efficiency and Renewable Energy Program (EERE) annual budgets continue constant until 2020 (no increase)
Home Star is not passed
Medium Scenario
100% of ARRA money is spent (2010-2012)
DOE Energy Efficiency and Renewable Energy Program (EERE) annual budgets increase according to congressional budget expectations
Home Star is passed (50% of the initially announced $6 billion)
High Scenario
100% of ARRA money is spent (2010-2012) and an extra 25% is spent/rolled over to the 2013-2015 period
DOE Energy Efficiency and Renewable Energy Program (EERE) annual budgets increase according to congressional budget expectations
Home Star is passed (100% of the initially announced $6 billion)

Federal programs, along with associated participant costs, help to create jobs in many different industries and occupations. The primary industries within California that benefit include: electrical contractors; plumbing, heating, and air conditioning contractors; engineering and architectural services; and nonresidential building construction.

[15] The White House, Office of the Press Secretary (2010, March 2). Fact Sheet: Homestar Energy Efficiency Retrofit Program. Retrieved from: http://www.whitehouse.gov/the-press-office/fact-sheet-homestar-energy-efficiency-retrofit-program.

These in turn mean jobs needing energy efficiency training primarily for electricians; plumbers, pipefitters, and steamfitters; sheet metal workers; heating, air conditioning, and refrigeration mechanics and installers; and construction managers and supervisors.

3.3.1.2 IOU/POU PROGRAMS

The state's investor-owned utilities (IOUs) and publicly-owned utilities (POUs) provide a wide array of energy efficiency programs, as well as the Low-Income Energy Efficiency (LIEE) programs. These programs are all ratepayer-funded.[16]

In California, ratepayers of the four IOUs in California make the largest investment in energy efficiency programs (excluding LIEE programs).[17] Beginning in 2006, the CPUC has approved, with some modifications, the energy efficiency programs proposed by each IOU on a three-year funding cycle. Each IOU manages an array of programs and partnerships that promote energy efficiency for most of the customers served by the utility (residential, commercial, industrial, agricultural, and municipal pumping). Each IOU designs, implements, and manages a set of specific programs; the number of separately identified programs ranged from 10 to 50 in the 2010–12 funding cycle. Each individual program has a specific energy efficiency goal and target sector. Examples include appliance rebate programs, HVAC equipment subsidies, energy audits, and the direct installation of energy efficient appliances and materials (e.g., insulation). In addition, increased attention has recently been given to the relationship between water efficiency and energy efficiency.[18]

The major public energy programs aimed at low-income ratepayers are Low Income Energy Efficiency (LIEE) programs and California Alternative Rates for Energy (CARE), both for the residential sector. The LIEE program provides no-cost weatherization services to low-income households. Services provided include attic insulation, energy efficient refrigerators, energy efficient furnaces, weather stripping, caulking, low-flow showerheads, water heater blankets, and door and building envelope repairs, which reduce air infiltration. Low-income customers that are enrolled in the CARE program receive a 20 percent discount on their electric and natural gas bills.

In 2007, the CPUC adopted a programmatic initiative to provide all eligible customers the opportunity to participate in Low Income Energy Efficiency (LIEE) programs and, by 2020, to offer all cost-effective residential energy efficiency measures to all eligible customers.[19]

IOUs provide utility service to 73 percent of the California's residential and commercial customers, while POUs serve 27 percent.[20] While the POUs across the state range from very large entities, such as the Los Angeles Department of Water and Power (LADWP), to very small, rural districts, most offer a set of energy efficiency programs similar to those offered by the IOUs. However, information on these programs, approved separately by each POU, is not as readily available. As described further in Appendix A, we use whatever relevant POU data are available to estimate investments for all POUs.

[16] Because little programmatic detail is available on POU programs, we generally extend the modeling methodology developed for the IOU energy efficiency programs to the POUs. See Appendix A for more detail.

[17] Excluding private investments and investments due to codes and standards.

[18] In a 2005 report, the CEC concluded that water-related energy use consumes 19 percent of the state's electricity; water energy use is 28 percent residential, 43 percent commercial/public, and 28 percent industrial/agricultural. California Energy Commission (2005). California's Water-Energy Relationship. Retrieved from: http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF

[19] For a summary of recent CPUC policies, including the 2007 decision referenced above, see California Public Utilities Commission (2008, Nov. 10). *Decision on Large Investor-Owned Utilities' 2009-11 Low Income Energy Efficiency (LIEE) and California Alternate Rates for Energy (CARE) Applications* (D.08-11-031). Retrieved from: http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/93648.pdf

[20] California Energy Commission, Energy Consumption Data Management System (ECDMS) (2009 Data). Available at http://www.ecdms.energy.ca.gov/elecbyutil.aspx.

Table 3.3 outlines the specific scenarios for the IOU and POU energy efficiency programs.[21] Overall, public and private investment under the Medium Scenario totals almost $2 billion in 2010, reaching $7.2 billion in 2020.

Table 3.3 Scenarios for Utility Energy Efficiency Programs

Low Scenario
Follows low scenario in the CEC *Incremental Impacts of Energy Policy Initiatives* report (2010)*
LIEE will continue at 25% of the objective for each three-year cycle (2012-14, 2015-17, 2018-20)
Medium Scenario
Follows medium scenario in the CEC *Incremental Impacts of Energy Policy Initiatives* report (2010)
LIEE will continue at 25% of the objective for each three-year cycle (2012-14, 2015-17, 2018-20)
High Scenario
Follows high scenario in the CEC *Incremental Impacts of Energy Policy Initiatives* report (2010)
LIEE will continue at 25% of the objective for each three-year cycle (2012-14, 2015-17, 2018-20)

* California Energy Commission, Electricity and Natural Gas Committee (2010, May). *Incremental Impacts of Energy Policy Initiatives Relative to the* 2009 Integrated Energy Policy Report *Adopted Demand Forecast*. CEC-200-2009-001-CTF. Retrieved from: http://www.energy.ca.gov/2010publications/CEC-200-2010-001/CEC-200-2010-001-CTF.PDF.

IOU/POU energy efficiency programs, along with associated participant costs, help to create jobs in many different industries and occupations. The primary California industries that benefit include electrical contractors; plumbing, heating, and air conditioning contractors; drywall and insulation contractors; corporate, subsidiary, and regional managing offices; office administrative services; and engineering and other scientific and technical consulting services. Although manufacturers see significant job creation as well, most are located outside of California. The workers employed in these industries who need energy efficiency training are primarily electricians; plumbers, pipefitters, and steamfitters; heating, air conditioning, and refrigeration mechanics and installers; drywall and ceiling tile installers; construction managers and supervisors; customer service representatives; general and operations managers; business operations specialists; civil engineers; architects and architectural drafters; and management analysts.

3.3.1.3 CALIFORNIA CODES AND STANDARDS

Unlike the other federal and state policies, codes and standards related to energy efficiency do not involve a dedicated funding mechanism. Rather, the application of tougher building codes is an explicit government mandate on private sector actors such as developers, contractors, and homeowners to change their behavior. The expectation is that these codes and standards will result in a shift of final demand towards energy efficient building materials and methods and away from other goods in the economy. Adjustments to California's Energy Efficiency Standards for Residential and Non-Residential Buildings (Title 24) are made by the CEC, which solicits input from the construction industry, environmental stakeholders, and experts. The Title 24 provisions related to energy efficiency are (usually) revised on a five-year cycle. Since the current 2008 standards took effect on January 1st, 2010, we assumed that the previous 2005 Standards were already included in the base case (i.e., firms and

[21] There is some uncertainty about the degree to which the CPUC will mandate funding levels in future cycles. Thus, we adopt the scenarios developed by the California Energy Commission (Jaske, M. & C. Kavalec (2009). *Incremental Impacts of Energy Policy Initiatives Relative to the 2009 Integrated Energy Policy Report Adopted Demand Forecast* (CEC-200-2010-001-D). Retrieved from: http://www.energy.ca.gov/2010publications/CEC-200-2010-001/index.html.)

consumers have already made adjustments to them). Thus we only model the incremental impact of moving from the 2005 Standards to the 2008 Standards in future years (2010, 2015, and 2020).

Based upon documentation provided by the California Energy Commission, we developed a series of limiting and simplifying assumptions to develop a best approximation of the impact of more stringent codes and standards on the California labor market (see Appendix A for details). First, we included only building codes and standards in our analysis and ignored standards for other goods, such as appliance standards or consumer electronics standards.[22] Second, our analysis of stricter building codes is confined to the broad regulations set at the state level by the CEC as part of the update to Title 24; it was not possible to evaluate efforts by some local governments to surpass the standards in Title 24.

New building codes and standards essentially create demand for jobs through the increased work required to meet the stricter codes. The price of the construction also increases. Although final demand shifts toward energy efficient construction, there may also be some long-run negative elasticity effects on housing or commercial space. For this study, we look at these shifts in demand and supply.

The primary industry within California that is affected by codes and standards is new construction. This in turn means jobs needing energy efficiency training are primarily for carpenters and their helpers; construction laborers; construction managers and supervisors; cement masons and concrete finishers; electricians; drywall and ceiling tile installers; cost estimators; and civil engineers.[23]

3.3.1.4 BIG BOLD ENERGY EFFICIENCY STRATEGIES (BBEES)

As part of the Energy Efficiency Strategic Plan, the CPUC established four long-term strategies, which they term Big Bold Energy Efficiency Strategies:

- → All new residential construction in California will be zero net energy by 2020;
- → All new commercial construction in California will be zero net energy by 2030;
- → Heating, ventilation, and air conditioning (HVAC) will be transformed to ensure that its energy performance is optimal for California's climate; and
- → All eligible low-income customers will be given the opportunity to participate in the low-income energy efficiency program by 2020. [24]

Most of the BBEES do not specify a direct funding mechanism for their attainment. Thus, as with building codes and standards (Title 24), we assume that the private market will respond in such a way that the supply and demand for energy efficient forms of construction will shift upwards. The analysis only modeled these four specified

[22] The following logic dictates this decision. For an appliance or a television, the application of a higher energy standard on the market does not significantly alter consumer behavior; consumers will not change their timeframe for the purchase of these types of goods. However, after the higher energy standards are in place, if they are mandates, the consumer will only have a choice among competing products that already meet the standard (i.e., this is not like a rebate that induces a consumer to choose the more efficient product). Also, appliances and consumer electronics do not typically involve a high degree of labor at the time of purchase or installation.

[23] At present, demand for occupations related to code enforcement is very low, according to the staffing patterns (as modified by the EDD Green Economy Survey for this analysis). However, it is possible that there will be new demand for occupations related to enforcement that is not reflected in the data used for these projections.

[24] While 100% participation in LIEE among eligible households is a Big Bold initiative, we decided to model the LIEE strategy under the utility program section, as this particular strategy had actual funding behind it.

programmatic goals (i.e., it did not include other goals mentioned elsewhere in the *Plan*, like residential and commercial retrofit goals). [25,26]

A variety of existing and proposed programs could be adopted to help California meet the BBEES goals. The Property Assessed Clean Energy (PACE) bond program was thought by some to have substantial promise until a ruling from the Federal Housing Finance Agency resulted in the cancellation of implementation plans. [27] As proposed, PACE would have provided financing for energy retrofits (efficiency measures and small renewable energy systems) authorized by commercial and residential property owners who repay their loans over 20 years through higher property taxes via the annual assessment on their property tax bill. Municipal financing districts or finance companies would issue these PACE bonds and the proceeds typically would be available to retrofit both commercial and residential properties. If PACE is ever implemented, future research should estimate the expected employment effects of this innovative program.

Table 3.4 outlines the specific scenarios for codes and standards and the BBEES. Overall, investment under the Medium Scenario totals $1.2 billion in 2010, almost doubling (to $2.2 billion) by 2020.

Since this analysis treated the BBEES similarly to codes and standards, the same industry—new construction—and occupations are affected.

Table 3.4 Scenarios for Codes & Standards and BBEES

Low Scenario
10% increase from 2008 Title 24 in 2014
BBEES: 5 to 20% of new units by 2011, 10 to 30% of new units by 2015, 25 to 60% of new units by 2020
Medium Scenario
10% increase from 2008 Title 24 in 2014
Additional 10% increase from 2008 Title 24 in 2017
BBEES: 8 to 30% of new units by 2011, 25 to 60% of new units by 2015, 55 to 80% of new units by 2020
High Scenario
10% increase from 2008 Title 24 in 2011,
Additional 10% increases from 2008 Title 24 in 2014 and 2017
BBEES: 10 to 40% of new units by 2011, 40 to 90% of new units by 2015, 70 to 100% of new units by 2020

[25] As stated on p. 11 of the CPUC's 2008 *Energy Efficiency Strategic Plan,* the "goal results" for the goal of whole house retrofit are "Energy consumption in existing homes will be reduced by 20% by 2015 and 40% by 2020 through universal demand for highly efficient homes and products."

[26] Specific goals for the different sectors (commercial, industrial, agricultural, etc.) play a role in how the specific program measures for the IOU portfolio are crafted. These goals are thus already reflected in the projected IOU program budgets. Although we devised estimation techniques – involving making assumptions about the impact of changed private behavior—to analyze the impact of the BBEES, it was beyond our scope to make assumption about behavior within specific sectors.

[27] A dispute with the Federal Housing Finance Agency has placed the program on hold pending a court decision.

3.3.2 DISTRIBUTED GENERATION

Californians can participate in many different distributed generation programs. Distributed generation is defined generally as energy generation that is close to customer load and located on property owned either by the customer, the utility, or a third party. This study focused on distributed generation on the customer's side of the utility meter. The *Go Solar California!* Program, a joint initiative of the CPUC and the CEC to promote solar energy in California, combines most of the state's solar programs including the California Solar Initiative (managed by the CPUC), the New Solar Homes Partnership (managed by the CEC), and the POU solar programs. For most of programs, participants bear some share of the costs. There are also several federal renewable energy programs. However, this study excludes these programs to avoid double counting (since that investment is already included as participant costs).

3.3.2.1 CALIFORNIA SOLAR INITIATIVE

The components of the California Solar Initiative (CSI), funded by the state at $2.2 billion for the 2007–2016 period, included in the analysis are:

- → The Low-Income Single Family Program, managed by Grid Alternatives
- → The Multifamily Affordable Solar Housing (MASH) Program, managed by PG&E, SCE and the California Center for Sustainable Energy (in SDG&E territory)
- → The CSI–Thermal Program, in which homeowners may apply for cash rebates of up to $1,875 on the installation of qualifying solar water heating (SWH) systems.[28] To qualify for the rebate, the SWH system must displace the use of natural gas or electricity. The IOUs serve as the program administrators, with the California Center for Sustainable Energy administering the program in the SDG&E service territory

Overall, rebates cover approximately one-fourth of project costs, while participants (and the federal government) pay the remainder.[29, 30] In total, 41 percent of program expenditures go to the residential sector, 45 percent to the commercial/public sectors, and 14 percent to the industrial/agricultural sectors.

3.3.2.2 NEW SOLAR HOMES PARTNERSHIP AND POU SOLAR PROGRAMS

The New Solar Homes Partnership provides financial incentives and other support to home builders, encouraging the construction of new, energy efficient solar homes. The program is managed by the California Energy Commission and has a budget of $400 million for the period between 2007 and 2016.

In addition, the POUs have established a total of $784 million for the period between 2008 and 2016 for solar incentives in POU regions.

3.3.2.3 SELF-GENERATION INCENTIVE PROGRAM

The CPUC's Self-Generation Incentive Program (SGIP) provides incentives to businesses and individuals who invest in renewable and non-renewable distributed generation (other than solar) energy projects. To be eligible for the

[28] Solar thermal is the technology used in solar water heating, a kind of small version of a solar panel. More information on "California Solar Initiative: CSI-Thermal Program," is available at http://www.cpuc.ca.gov/puc/energy/solar/swh.htm.

[29] California Solar Statistics, available at http://www.californiasolarstatistics.ca.gov/.

[30] The CSI rebates "step down" (i.e., incentives decrease) over time. However, we used an annual average figure in order to project investment. Since we are not projecting jobs every year but only for 2010, 2015, and 2020, this approach does not affect the job projections presented.

program, distributed energy resources must achieve reductions in greenhouse gas emissions. SB 412 (Stats. of 2009, Chap. 182) authorizes annual collections for SGIP in 2010 and 2011 of not more than the amount authorized for SGIP in 2008 ($83 million). The legislation also extends administration of the program until January 1, 2016. There is approximately $310 million from past years that will be spent in the period between January 1, 2012 and January 1, 2016.[31] This funding goes entirely to the commercial sector.

3.3.2.4 EMERGING RENEWABLES PROGRAM

The CEC's Emerging Renewables Program (ERP) provides that a portion of the funds collected from the customers of the three major electric investor-owned utilities be used for statewide public benefit programs, including incentives for non-solar renewable electricity systems. The ERP distributes $65.5 million per year, collected from the ratepayers and held in the Renewable Resource Trust Fund.[32]The Energy Commission is currently seeking reauthorization of ratepayer funding for ERP, which is set to expire in January 2012.[33] This study assumes that 100 percent of ERP funding goes to the commercial/public sector.

Table 3.5 outlines the specific scenarios for the various distributed generation programs. Overall, public and private investment in distributed generation under the Medium Scenario totals $1.5 billion in 2010, tapering to $1.2 billion by 2020 due to the scheduled phasing out of state programs.

Table 3.5 Scenarios for Distributed Generation

Low Scenario
CSI funds continue until 2016 (as currently budgeted)
SGIP funds continue until 2015 (as currently budgeted)
ERP funds continue until 2011 (as currently budgeted)
Medium Scenario
CSI funds continue until 2016 and then stay flat until 2020
SGIP funds continue until 2015 and then stay flat until 2020
ERP funds continue until 2015 and then stay flat until 2020
High Scenario
CSI funds continue until 2016 and then stay flat until 2020
SGIP funds continue until 2015 and then stay flat until 2020
ERP funds continue until 2015 and then stay flat until 2020

Distributed generation programs, along with associated participant costs, help to create jobs in many different industries and occupations. The primary California industries that benefit include semiconductor and related device manufacturers (which make photovoltaic panels); electrical contractors; plumbing, heating, and air conditioning contractors; roofing contractors; corporate, subsidiary, and regional managing offices; and office administrative services. (Again, most of the manufacturers that benefit are located outside of California.) The workers employed in these industries who need energy efficiency training are primarily electricians; carpenters; heating, air conditioning, and refrigeration mechanics and installers; construction managers and supervisors; customer service representatives; general and operations managers; and business operations specialists.

[31] Interview with CPUC staff, 4/28/2010.

[32] Interview and correspondence with CEC staff, 4/9/2010.

[33] Interview with CEC staff, 4/9/2010.

3.3.3 DEMAND RESPONSE AND SMART METERS

Demand response refers to a set of activities and tools that allows electricity customers to reduce their electricity usage in a given time period, or shift that usage to another time period, in response to a price signal, a financial incentive, an environmental condition, or a reliability signal. The EE Strategic Plan calls for demand response policies and programs (such as air conditioning cycling programs, commercial and industrial pricing programs, and information technology programs) to be integrated with California's energy efficiency and other demand-side management policies. The CPUC authorizes funding for demand response programs for California's three major electric IOUs in three-year cycles. The CPUC-approved IOU budgets have a total cost of $350 million over 2009–2011, an average of $117 million per year.[34] Demand response funding is divided among sectors as follows: 11 percent for residential, 25 percent for commercial and public, and 64 percent for industrial and agricultural.

The CPUC has also authorized California's four major IOUs to spend a total of $4.94 billion to install advanced metering infrastructures (AMI), including smart meters for all electric and gas customers, from 2006 to 2015.[35] Advanced metering infrastructure consists of metering and communications infrastructure as well as the related computerized systems and software. Smart meters are capable of two-way information exchange between customers and the utility, allowing customers to have greater control over their energy usage and enabling demand response programs. The POUs have their own smart meter and demand response programs, funded in part by the DOE. Based on the number of customers in each sector, this study estimates that 87 percent of the smart meter funding will go to the residential sector, and the remainder to all the other sectors.

The IOUs have anticipated that there will be significant job loss associated with the smart meters, as the need for meter readers diminishes.[36] Because meter readers are not part of the IOU/POU energy efficiency and related programs (and thus are not included in the budgets analyzed for this study), those jobs are not in the baseline 2009 Scenario. Furthermore, this job loss does not directly affect the assessment of training needs, although of course the meter readers might be retrained for energy efficiency related occupations. Given the lack of precise estimates about the extent of future job loss, it does not make sense to include this in the scenarios in later years.

Table 3.6 outlines the specific scenarios for demand response and smart meters. Overall, investment in demand response and smart meters under the Medium Scenario totals $1.4 billion in 2010, tapering to $0.2 billion in 2020.

Demand response and smart meter programs help to create jobs in many different industries and occupations. The primary California industries that benefit include automatic environmental control manufacturing for residential, commercial, and appliance use; electrical contractors; corporate, subsidiary, and regional managing offices; and office administrative services. The workers employed in these industries who need energy efficiency training are primarily electricians; customer service representatives; general and operations managers; and business operations specialists.

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[34] California Public Utilities Commission (2009, Aug. 20). *Decision Adopting Demand Response Activities and Budgets for 2009 Through 2011* (D.09-08-027). Retrieved from: http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/106008.htm.

[35] California Public Utilities Commission (2006, July 20). *Final Opinion Authorizing Pacific Gas and Electric Company to Deploy Advanced Metering Infrastructure* (D.06-07-0270). Retrieved from: http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/58362.pdf; California Public Utilities Commission (2008, Sept. 18). *Decision Approving Settlement on Southern California Edison Company Advanced Metering Infrastructure Deployment* (D.08-09-039). Retrieved from: http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/91154.pdf; California Public Utilities Commission (2007, April 12). *Decision Approving Settlement on San Diego Gas & Electric Company's Advanced Metering* Infrastructure Project (D.07-04-043). Retrieved from: http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/66766.pdf; Southern California Gas Decision.

[36] SDG&E estimates a workforce reduction of 955 FTE to begin in 2012. Estimates are not available from the other IOUs.

Table 3.6 Scenarios for Demand Response and Smart Meters

Low Scenario
Annual demand response program funding continues indefinitely at 1/3 of 2009-11 approved level for IOUs and at 2012 level for POUs
IOU funding for smart meters continues until 2015 (as currently authorized)
POU funding for smart meters continues until 2013
Medium Scenario
Price-responsive demand response program funding increases by 11% per year through 2017, relative to a baseline of 1/3 of the 2009-11 approved level, then remains constant
IOU funding for smart meters continues until 2015 (as currently authorized)
POU funding for smart meters continues until 2013 (smart grid federal grants to LADWP and SMUD are scheduled to end in 2013)
High Scenario
Price-responsive demand response program funding increases by 11% per year through 2017, relative to a baseline of 1/3 of the 2009-11 approved level, then increases 5% through 2020
IOU funding for smart meters continues until 2015 (as currently authorized)
POU funding for smart meters continues until 2013 (smart grid federal grants to LADWP and SMUD are scheduled to end in 2013)

3.3.4 SUMMARY OF POLICIES AND SCENARIOS

There are several key differences between the scenarios for federal programs, utility energy efficiency programs, codes and standards, distributed generation, demand response, and smart meters. For federal agency programs, the Low Scenario assumes no budget increases, while in the Medium and High Scenarios, the annual budgets increase according to congressional budget expectations. For ARRA and Home Star, the rate at which the allocated money is spent increases across scenarios, with a 25 percent extra ARRA allocation assumed for 2013–2015.

The IOU/POU scenarios continue the low-income programs at 25 percent of the objective under all three scenarios. Otherwise, these scenarios follow the low, medium, and high scenarios developed by the CEC. As described in the CEC report *Incremental Impacts of Energy Policy Initiatives Relative to the 2009 Integrated Energy Policy Report Adopted Demand Forecast*, the Low Scenario uses historical rebate levels and program designs, the low range of savings from various lighting and appliance codes and standards, and no new savings from building code compliance programs. The Medium Scenario is based on higher rebate levels and savings from codes and standards and market transformation efforts, along with more significant revisions to Title 24 and federal appliance standards. The High Scenario assumes aggressive rebate programs and the higher range of savings for Title 24 and other standards.[37]

For codes and standards, the scenario development also follows those in the CEC report, with mandated increases in energy efficiency resulting in higher building costs. The BBEES scenarios assume that the share of new net zero

[37] Jaske and Kavalec 2009.

energy construction increases significantly from the Low to Medium to High Scenario, with the High Scenario share more than double the Low Scenario.

For distributed generation, the Low Scenario uses the current program budgets, which will run out between 2011 and 2016, depending on the program. For the Medium and High Scenarios, these budgets are extended to 2020.

The Low Scenario assumes that demand response funding will continue at its initial levels, while the Medium and High increase it by 11 percent per year through 2017, and the High Scenario increases it by an additional 5 percent per year through 2020. All scenarios for smart meters are the same: as currently authorized, IOU funds continue until 2015 and POU until 2013.

Funding for all three scenarios starts at a similar point in 2010 ($6.4 billion for the Low Scenario and $6.6 billion for the Medium and High Scenarios)—compared to a baseline of $3.6 billion in 2009 (see Figures 3.2–3.4).[38] The Low Scenario increases just five percent from 2010 to 2015 and seven percent from 2015 to 2020, due mostly to projected increases in IOU/POU (ratepayer) and codes and standards (consumers) investment. However, the Medium and High Scenarios see much greater increases: for the Medium Scenario, to $7.8 billion in 2015 and $11.2 billion in 2020, and for the High Scenario, to $8.4 billion in 2015 and $11.7 billion in 2020. These increases occur mostly because of projected increases in IOU/POU and codes and standards related investment. Due to the minimal differences among the scenarios, as well as the likelihood of a slow recovery from the current recession (see Chapter 2), this report focuses mostly on the projections of jobs and worker training needs for the Medium Scenario.

3.4 PROJECTIONS OF LABOR DEMAND AND WORKER TRAINING NEEDS

Having identified the relevant energy efficiency policies and estimated the associated public and private investments, the analysis proceeds to steps 3 through 6 in order to estimate the new jobs created by translating investments into industries (step 3), industries into direct, indirect, and induced jobs (step 4), direct jobs by industry into jobs by occupation (step 5), and jobs by occupation into workers by occupation that need energy efficiency training (step 6). The following provides an overview of the steps, with more detail provided below along with the actual projections.

First, as we will describe in more detail in the next section, research on prior investments yielded a list of the NAICS industries (primarily in construction, manufacturing, administration, and technical services such as engineering and architecture) that would most likely benefit from the investment.[39] We refer to these as the energy efficiency industries (or energy efficiency related industries to emphasize that the investment is for energy efficiency, demand response, and distributed generation). We then estimated the distribution of investments across these industries through empirical sources that provided detail on the allocation of funding across industries and/or estimated the costs of materials and labor.

Translating industries into jobs involved two distinct steps. These steps involved both E-DRAM model, to estimate overall impacts and the IMPLAN model to refine the analysis for direct jobs for the most comprehensive and accurate projections possible. To estimate the total number of jobs that stem from investments, we use the E-DRAM model. Specifically, we used E-DRAM to analyze the impact of the estimated energy efficiency related investment by broad industry and account for shifts in spending due to reduced energy consumption. The direct,

38 All figures are in 2010 dollars and give the investment for one year only.

39 The North American Industry Classification System (NAICS) is the standard hierarchical coding system that classifies all economic activity into specific industry sectors.

indirect, and induced jobs created are distributed across hundreds of industries, including the energy efficiency industries. These indirect and induced jobs are the result of energy efficiency related investments and are important to count when quantifying the total job projections due to any given level of government investment. However, since this research task is to estimate the number of direct new jobs for which training and education is needed, the indirect and induced jobs, which are not likely to require specific energy efficiency training, are not relevant.[40] The E-DRAM analysis and the determination of the overall number of new jobs due to energy efficiency investments composed step 4.

To calculate the number of direct jobs, in step 5, we looked at the investment estimated for all the energy efficiency related industries and calculated the amount of investment that is leaked outside of California using the IMPLAN input–output model. In this step we also applied the ratio of output per worker from IMPLAN in order to translate the remaining investment into California jobs in 2010, 2015, and 2020. After subtracting California jobs funded by this investment in 2009, we obtain the net new jobs in energy efficiency related industries. The job totals represent jobs generated in that year, or more specifically person-years of employment

Education and training programs are typically organized around occupations, in addition to, or instead of industries. Thus, for the purpose of the Needs Assessment, it is necessary to translate jobs by industry into jobs by occupation. In step 6 we estimate occupational employment using a tool commonly used in these analyses: the staffing patterns matrix prepared by the California Employment Development Department (EDD), which provides the distribution of occupations employed in energy efficiency activity within a particular industry. Every industry has hundreds of occupations, only a small share of which are actually engaged in energy efficiency activity. For instance, a large construction firm employs not only construction workers but also administrative staff, some of whom, such as customer service representatives, require training, but others, such as secretaries, who do not. Thus, the analysis next determines the subset of jobs that will be held by workers needing energy efficiency training.

Also in step 6, we translate these occupational projections into projections of the numbers of workers who need training. As described above, workers who engage in energy efficiency related activity in most cases do not spend all their hours on these activities, but rather spend just a portion of their time on these activities. If a construction laborer spends 25 percent of his or her time on energy efficiency and related activity, then one construction laborer person-year represents funding for four jobs at 25 percent time.

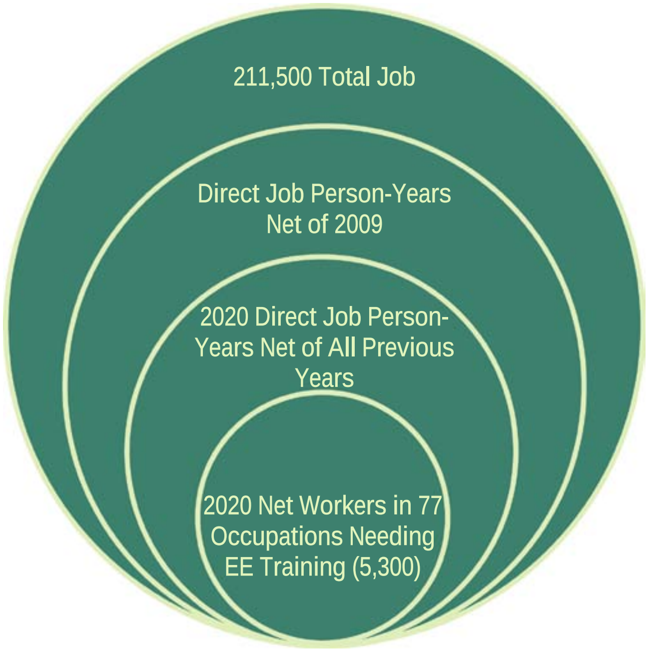
We thus transform the employment projection numbers from the total economic activity generated by energy efficiency and related investment (direct, indirect, and induced job person-years) to the subset of workers who need energy efficiency related training because investment is funding part of their work (Figure 3.8).

From the total job person-years projected to be generated in 2020 (211,500), we first take the subset of direct job person-years only (i.e., subtract the indirect and induced job person-years). We then subtract the subset of existing job person-years funded by energy efficiency in 2009 (based on the assumption that the workers holding these job person-years are already trained). Next, we subtract the subset of jobs generated from 2010–2019.[41] Finally, we translate the job person-years into the number of workers needing training because of the new job person-years generated just in 2020.

[40] For instance, a worker harvesting sustainable lumber holds an indirect job supplying construction firms but will not need energy efficiency and related skills. Similarly, a grocery store worker who holds an induced job most likely does not need special energy efficiency training.

[41] Since this analysis did not produce job projections for the intervening years between 2010, 2015, and 2020, we did the following to calculate net 2020 job person-years. First, we subtracted job person-years generated in 2015 from 2020, assuming, again, that workers funded by these job person-years are already trained. Then, we divided this total by five in order to obtain the yearly average, or the estimated increment from 2019 to 2020. This assumes that investment is evenly distributed across the five years – a conservative assumption, since it increases substantially over this period.

Figure 3.8 From Total Job Person-Years to 2020 Net Workers in 77 Occupations Needing Training



Not to Scale

This methodology was designed to be as transparent as possible. Apart from the E-DRAM model code, which is proprietary, the components of the analysis are available for review and are created in such a way that policy scenarios can be modified. The dollar amounts assigned to each policy—and the distribution of the dollars across NAICS codes (see next section)—can readily be changed via a set of spreadsheets that lays out all the policies as well as the ten allocation methods (see table 3.7).

3.4.1 PROJECTING JOBS IN CALIFORNIA

To undertake the third step in our methodology, we assigned the energy efficiency related investment dollars to economic sectors, using four-, five-, and six-digit NAICS codes. Assignment to detailed NAICS codes is a necessary step in order to link to occupations, and ultimately, education and training programs. We assigned investments to NAICS based upon empirical research on similar investments in the past, using ten different methods, described in Table 3.7 (as well as Appendix A). These methods differ depending on the availability of empirical data on the allocation of expenditures. Using previous studies, we tried to identify the NAICS industries receiving investment, the proportion of investment that goes to each industry and to administration, and, where appropriate, the share of investment that goes to labor versus materials.

Table 3.7 Overview of Allocation Methods for Assigning NAICS Codes to Energy Efficiency Related Program Areas

Program Area	Method / Source
Weatherization and Retrofits	Based on a New York State Labor Department study (2009) that identified specific NAICS of industries engaged in weatherization and retrofit activities, plus U.S. Department of Labor's Quarterly Census of Employment and Wages, which was used to identify the industry distribution in the economy as a whole, weighted by wages.[1] Includes weatherization assistance (ARRA and non-ARRA funds), HUD's Green Retrofit Program for Multifamily Housing, and Home Star.
U.S. Dept. of Energy Programs (EERE)	Based on public data for February 17 through December 31, 2009, provided by the Federal Government on ARRA recipients. Because data are organized by activity code (6-digit NAICS) and dollar amount, it is possible to identify both the industries receiving investment and the distribution of investment.[2]
ARRA Energy Efficiency Appliance Rebate Program	Based on public data for February 17 through December 31, 2009, provided by the Federal Government on ARRA recipients. Data are organized by activity code (6-digit NAICS) and dollar amount.[2]
ARRA Energy Efficiency Retrofit Programs	Based on public data for February 17 through December 31, 2009, provided by the Federal Government on ARRA recipients. Data are organized by activity code (6-digit NAICS) and dollar amount (specifically the General Services Administration-Federal Buildings Fund, Recovery Act). [2]
U.S. Dept. of Defense Programs	Based on public data for February 17 through December 31, 2009, provided by the Federal Government on ARRA recipients. Data are organized by activity code (6-digit NAICS) and dollar amount (specifically the Department of Defense funds, Recovery Act). [2]
IOU Energy Efficiency Programs (including LIEE)	NAICS assignment to materials NAICS and labor NAICS based on the authors' judgment of the best match between the measure's description and the standard list of NAICS codes.
Codes & Standards / Title 24	Allocated to NAICS 236, New Construction.
California Solar Initiative	Based on information for the CSI program, plus a 2007 report on solar photovoltaic system costs prepared by Itron for the CPUC, which included the distribution of costs among labor, materials, and administration. [3]
SGIP/ERP	Based upon the New York State Labor Department (2009) study, the CSI website, a fuel cell materials website, a Green Economy report prepared by the Washington State Department of Community, Trade, and Economic Development, and the judgment of the authors. [4]
Demand Response	Based upon a combination of methods: the NAICS allocations from the New York State Labor Department (2009) study; the method used for IOU EE programs; and the division of labor and materials from CSI.
Smart Meters	Based upon the method used for IOU EE programs and the division of labor and materials from CSI.

[1] New York State Department of Labor (2009), *New York State's Clean Energy Industry: Labor Market and Workforce Intelligence*, p. 56. Retrieved from: http://www.labor.state.ny.us/workforcenypartners/PDFs/NYS%20Clean%20Energy%20Jobs%20Report%20FINAL%2006-09-09.pdf (page 56). Five industries are supported by weatherization and retrofit investment (plumbing, heating, and air-conditioning contractors; insulation contractors; window and door installation; boiler and pipe insulation installation; and electrical contractors). Total wages for these five industries in 2009 are about $2.9 billion, but wages in plumbing, heating, and air-conditioning contractors (NAICS 23822) are about $1 billion. Thus this analysis assumes that about 1/3 of the investment will be allocated to this industry.

[2] U.S. Recovery Accountability and Transparency Board, Recovery.gov website. Download Center: Recipient Reported Data. http://www.recovery.gov/FAQ/Pages/DownLoadCenter.aspx

[3] Go Solar! California website, http://www.gosolarcalifornia.org; and Itron (2007). *CPUC Self-Generation Incentive Program: Solar PV Costs and Incentive Factors Final Report*. Retrieved from: http://www.energycenter.org/uploads/Selfgen_SolarPVCosts_FinalReport.pdf.

[4] New York State Department of Labor (2009), p. 56; Go Solar! California website; Fuel Cell Today website, http://www.fuelcelltoday.com/events/industry-review; and Washington State Department of Community, Trade, and Economic Development, E2SHB Implementation Team (2008, July 15). Initial Washington Green Economy Industry List. Retrieved from: http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/WA-NAICS-Industry-List.pdf.

Through this process we identified 59 four-, five-, and six-digit NAICS industries (equivalent to 41 four-digit NAICS industries) that are likely to receive energy efficiency related investment. We used data from three California studies to verify our selections, including green economy surveys by EDD and the Community College Centers of Excellence, as well as a study on green innovation by the UC Berkeley Center for Community Innovation (see Appendix B).[42] Table 3.8 shows how these industries are associated with the relevant program area(s).

Some of the firms receiving policy-driven investment are located in California, while others are outside the state or country. In general, those providing services tied to a particular place (e.g., construction) are located within the state, while many of those providing goods for export (e.g., communications equipment manufacturing) are located outside the state. We used IMPLAN to calculate the amount of investment (and jobs) that is leaked outside of California.[43] After calculating the amount of investment that is leaked outside of California, The next step was to translate the remaining investment into California jobs (using the ratio of output per worker from IMPLAN), yielding projections of direct jobs.

Table 3.9 presents the Low, Medium, and High Scenario job person-years for 2010, 2015, and 2020. (Job person-years are the appropriate unit of analysis in energy efficiency studies both because of the short-term nature of much of the work and because, as explained previously, one job person-year is not likely to be absorbed by a single worker, but rather divided among several workers who perform energy efficiency related activity as one component of their work.) Job person-years are presented in two ways: (1) job person-years created in a year relative to the 2009 baseline (new job person-years created by the additional funding in 2010, 2015 and 2020 after subtracting the 13,434 job person-years created by energy efficiency funding in 2009) and (2) job person-years created in a year relative to the previous forecast year (for instance, the 8,244 new Medium Scenario job person-years created by the additional funding in 2015 after subtracting both the 13,434 jobs created by energy efficiency funding in 2009 and the 14,284 incremental job person-years from 2010).[44] The totals net of 2009 (#1 above) illustrates the impacts of investment on energy efficiency and related employment generally, while the total for a particular year net of all previous years (#2) is the relevant number for the process of determining workforce training needs in a particular year.

Overall, the projected new jobs comprise approximately 0.2 percent of overall California employment. Given that the energy efficiency and related jobs are a subset of all green jobs, this estimate is consistent with the previous studies of the California green economy that have shown that approximately one percent of all jobs in the state are green.[45]

[42] All of the NAICS identified in this study as receiving energy efficiency related investment were also included in at least one of the other studies. Some of the industries in the other studies were not included in this study but that was expected because the scope of this study (i.e., the green economy sectors included) is narrower than in the other California studies. See: California Community Colleges Centers of Excellence (2009); California Employment Development Department (2010); and Chapple, K., & M. Hutson (2010). *Innovating the Green Economy in California Regions*. Berkeley, CA: UC-Berkeley Center for Community Innovation. Available at: http://communityinnovation.berkeley.edu/publications.html.

[43] This analysis did not calculate the amount of demand generated from out-of-state sources that creates jobs in California (e.g., policy-driven investment in Oregon that funds California photovoltaic panel manufacturers).

[44] These incremental new direct job totals do not include the non- energy efficiency -related jobs created due to AB32 – which are mostly in induced spending in consumption-related industries.

[45] See, for instance, Chapple & Hutson 2010 and Collaborative Economics & Next10 (2009). *Many Shades of Green: Diversity and Distribution of California's Green Jobs*. San Francisco, CA: Next10. Retrieved from: http://nextten.org/next10/publications/green_jobs.html. Note however that the EDD survey of green industries in California adopted a much broader definition of the green economy and thus reported a much higher share of jobs (3.4 percent).

Table 3.8 Industries Receiving Energy Efficiency Related Investment, by Program Area

Industry Description (NAICS)	Weather-ization and Retrofits	US Dept. of Energy Programs (EERE)	ARRA EE Appliance Rebate Program	ARRA EE Retrofit Programs	US Dept. of Defense Programs	Codes & Standards / Title 24	IOU EE Programs	California Solar Initiative	SGIP	ERP	Demand Response	Smart Meters
Fossil Fuel Electric Power Generation (221112)				X								
Other Electric Power Generation (221119)		X										
Electric Power Distribution (221122)		X			X							
Residential Building Construction (2361)						X	X					
Industrial Building Construction (236210)					X							
Nonresidential Building Construction (2362)						X	X					
Commercial and Institutional Building Construction (236220)		X		X	X							
Water and Sewer Line and Related Structures Construction (237110)					X							
Power and Communication Line and Related Structures Construction (237130)		X							X	X		
Other Heavy and Civil Engineering Construction (237990)					X							
Framing Contractors (238130)					X							
Roofing Contractors (238160)					X		X	X				
Electrical Contractors (23821)	X	X		X	X		X				X	X
Plumbing, Heating, and Air-Conditioning Contractors (23822)	X	X		X	X		X	X				
Boiler and Pipe Insulation Installation (23829)	X						X					
Insulation Contractors (23831)	X						X					
Window and Door Installation (23835)	X						X					
All Other Specialty Trade Contractors (238990)		X			X							
Asphalt Paving, Roofing, and Saturated Materials Manufacturing (32412)							X					
Other Nonmetallic Mineral Product Manufacturing (3279)							X					
Industrial Machinery Manufacturing (3332)							X					
Ventilation, Heating, Air-Conditioning, & Commercial Refrigeration Equip. Manf. (3334)							X					
Heating Equipment (except Warm Air Furnaces) Manufacturing (333414)				X				X				
Turbine and Turbine Generator Set Units Manufacturing (333611)									X	X		
Computer and Peripheral Equipment Manufacturing (3341)							X					
Communications Equipment Manufacturing (3342)							X					
Semiconductor and Related Device Manufacturing (334413)								X				

Table 3.8 (continued) Industries Receiving Energy Efficiency Related Investment, by Program Area

Industry Description (NAICS)	Weather-ization and Retrofits	US Dept. of Energy programs (EERE)	ARRA EE Appliance Rebate Program	ARRA EE retrofit programs	US Dept. of Defense programs	Codes & Standards / Title 24	IOU EE Programs	California Solar Initiative	SGIP	ERP	Demand Response	Smart Meters
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing (33451)											X	
Automatic Enviro. Control Manufacturing for Residential, Commercial & Appliance Use (334512)												X
Other Measuring and Controlling Device Manufacturing (334519)								X				
Electric Lighting Equipment Manufacturing (3351)							X					
Residential Electric Lighting Fixture Manufacturing (335121)								X				
Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing (335122)								X				
Household Appliance Manufacturing (3352)			X				X					
Other Major Household Appliance Manufacturing (335228)							X					
Storage Battery Manufacturing (335911)									X			
All Other Miscellaneous Electrical Equipment and Component Manufacturing (335999)									X	X		
Used Household and Office Goods Moving (484210)							X					
Offices of Real Estate Appraisers (531320)				X								
Other Activities Related to Real Estate (531390)				X								
Architectural Services (541310)				X								
Engineering Services (541330)		X		X	X		X				X	
Building Inspection Services (541350)				X			X				X	
Surveying and Mapping (except Geophysical) Services (541370)				X								
Administrative Management and General Management Consulting Services (541611)		X		X								
Environmental Consulting Services (541620)		X		X			X				X	
Other Scientific and Technical Consulting Services (541690)							X				X	
Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology) (541712)		X									X	
Advertising and Related Services (5418)			X				X				X	
Corporate, Subsidiary, and Regional Managing Offices (551114)			X				X		X	X	X	X
Office Administrative Services (5611)			X				X		X	X	X	X
Facilities Support Services (561210)		X										
Professional and Management Development Training (611430)				X								

Table 3.8 (continued) Industries Receiving Energy Efficiency Related Investment, by Program Area

Industry Description (NAICS)	Weather-ization and Retrofits	US Dept. of Energy Programs (EERE)	ARRA EE Appliance Rebate Program	ARRA EE Retrofit Programs	US Dept. of Defense Programs	Codes & Standards / Title 24	IOU EE Programs	California Solar Initiative	SGIP	ERP	Demand Response	Smart Meters
Commercial & Industrial Machinery & Equip. (exc. Auto. & Electronic) Repair & Maint. (811310)							X					
Executive Offices (921110)		X										
Executive and Legislative Offices, Combined (921140)		X										
Other General Government Support (921190)		X										
Administration of General Economic Programs (926110)		X										
Regulation and Administration of Communications, Electric, Gas, and Other Utilities (926130)		X						X	X	X	X	X

Table 3.9 Direct Job Person-Years by Scenario, Net of 2009, Total and Per Year

Scenario	Total Direct Job Person-Years (For 2010, 2015, and 2020, Net of 2009)				Direct Job Person-Years Per Year (Net of All Previous Years)		
	2009	2010	2015	2020	2010*	2015	2020
Low	13,434	13,482	17,779	22,926	13,482	860	1,029
Medium	13,434	14,284	22,528	38,937	14,284	1,649	3,282
High	13,434	14,284	26,336	42,208	14,284	2,411	3,174

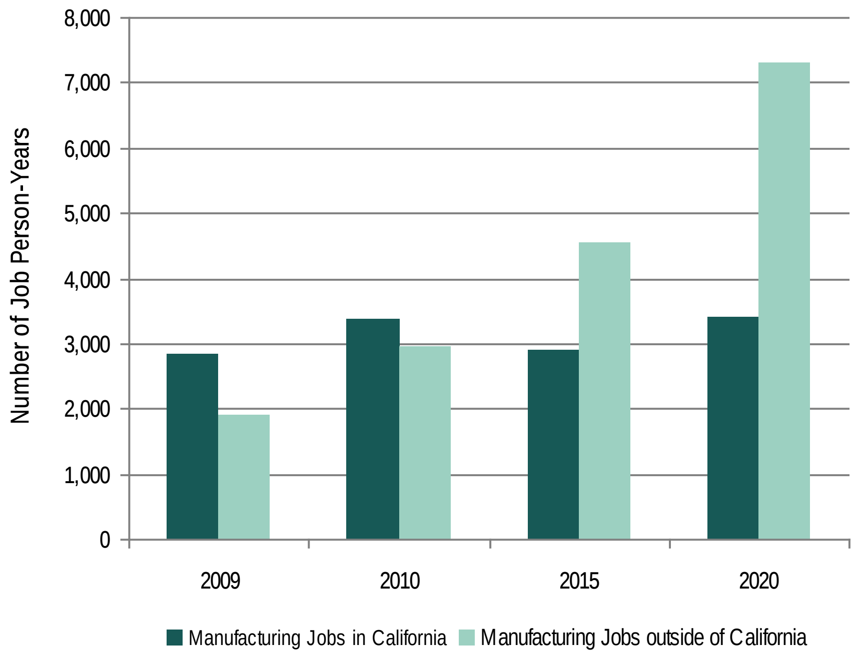
*Note: 2010 job person-years are significantly higher than in other years for two reasons: first, they include approximately 6,500 jobs in new construction resulting from the implementation of new Title 24 building codes; and second, they result from ARRA and smart meter funding that disappears later in the decade. Due to the economic slowdown, the Title 24 New Construction jobs are most likely to be created over several years, rather than in just one year.

The most important factor differentiating the scenarios is the growth in IOU programs in the Medium and High Scenarios and the implementation of the CPUC BBEES in the High Scenario. However, federal spending tends to smooth out the differences among the three scenarios. In particular, ARRA funding inflates even the Low Scenario for 2010, and other federal spending differs little between the Medium and High Scenarios. ARRA tends to fund industries with relatively more jobs per dollar of spending (e.g., weatherization occupations) than some of the other programs. It is because of this that the Low Scenario produces a disproportionate share of jobs relative to investment.

The E-DRAM model produced projections for indirect and induced incremental job creation as well as direct. As noted previously, these projections are less relevant for this WE&T Needs Assessment and thus are only discussed in detail in Appendix C. Overall, most of the new jobs will be in consumption-related sectors, because the main driving force for job growth is the cost savings from reduced energy use that is pocketed by consumers and spent on a wide variety of goods and services. By 2020, more indirect and induced jobs will be created in California by energy efficiency investment than direct energy efficiency jobs. By 2020, the Low Scenario will generate 179,950 total (direct, indirect, and induced) job person-years, while the Medium creates 211,471 total job person-years and the High Scenario results in 217,191.

As is described in more detail below, the vast majority of the new direct jobs are in construction and services, not manufacturing. Over time, the number of manufacturing jobs is projected to increase significantly due to increased purchasing of HVAC equipment, electric lighting, and other inputs related to energy efficiency investment. Manufacturing jobs come not just from these direct purchases (e.g., the solar photovoltaic panel purchased under the California Solar Initiative) but also from indirect purchasing (e.g., the purchase of inputs by the photovoltaic manufacturers). Figure 3.9 looks at the total incremental job creation in the energy efficiency-related manufacturing industries. Over three-quarters of manufacturing jobs in these industries are expected to be located outside of California, so this job creation will take place mostly out of state.

Figure 3.9 Total Manufacturing Job Person-Years in Energy Efficiency Related Industries Inside and Outside of California



3.4.2 PROJECTIONS BY INDUSTRY

The industries most affected by energy efficiency related spending are in the construction sector, professional services related to construction, administration, and manufacturing. Table 3.10 presents the direct job person-year projections by industry group for the Medium Scenario. Appendix D presents the detailed results for all energy efficiency industries. Construction-related jobs, particularly specialty contractors, dominate the projections, followed by administration, consulting services, and manufacturing.

Table 3.10 Total Direct Job Person-Years, Medium Scenario, by Industry Group, Total and Per Year

NAICS	Industry Group Description	Total Direct Job Person-Years (Net of 2009)		Direct Job Person-Years Per Year (Net of 2009)	
		2015	2020	2015	2020
2361	Residential Building Construction	5,072	7,104	486	406
2362	Nonresidential Building Construction	5,342	6,924	72	316
23821	Electrical Contractors	319	1,649	(110)	266
23822	Plumbing, Heating, and Air-Conditioning Contractors	4,859	9,407	653	909
23831	Drywall and Insulation Contractors	451	840	54	78
32412, 3279, 3332, 3334, 3336, 3341, 3342, 3344, 3345, 3351, 3352, 3353, 3359 (part)	Manufacturing	51	574	(96)	105
5418	Advertising and Related Services	956	1,794	131	168
541 (part)	Engineering Services, Architectural Services, Environmental Consulting Services, Other Scientific and Technical Consulting Services	2,118	4,026	92	382
5511, 92 (part)	Management of Companies and Enterprises, Public Administration	1,231	2,449	137	244
5611	Office Administrative Services	2,021	3,958	259	387
Multiple	All Other Industries	108	212	(29)	21
Total		22,528	38,937	1,649	3,282

Some industries experience a steady increase in jobs due to the energy efficiency related investments examined here throughout the ten-year projection periods, while others peak much earlier (usually due to ARRA funding). For instance, Plumbing, Heating, and Air-Conditioning Contractors (23822)—the five-digit NAICS industry that will see the most jobs in all three scenarios—will see steep increases over 2009 levels in 2010, 2015, and 2020 due largely to its inclusion in weatherization, retrofits, solar, and other energy efficiency programs funded by the IOUs and the federal government. Other Scientific and Technical Services (541690), an industry that gets funded because of demand response programs, sees significant increases over the projection years. In contrast, the increase in other industries, such as Drywall and Insulation Contractors (23831), is much more incremental, since it is funded only by weatherization and IOU energy efficiency programs.

The job projections show that many industries experience increases in the early part of the decade with very little growth in the latter part. For instance, Architectural Services (54131) and Engineering Services (54133) bump up in 2010 due to a combination of ARRA programs and demand response. Automatic Environmental Control Manufacturing (334512) has no job creation in 2020 because all of the new smart meters will have been installed prior to that year.[46] Semiconductor and Related Device Manufacturing (334413) stays the same in the 2020 Medium Scenario because of the assumption that the California Solar Initiative will continue at level funding.

[46] Undoubtedly new smart meters will be installed on an ongoing basis, requiring additional manufacturing. New buildings will require smart meters, and defective smart meters will have to be replaced. However, since the replacement rate is unknown, as well as the future labor needs, the analysis excludes this future investment.

The projections show that residential and nonresidential construction industries also increase steadily, though mostly in the early part of the decade. (Again, codes and standards are not included in 2009 because they are already in the baseline scenario.)

3.4.3 COMPARISONS TO CALIFORNIA PROJECTIONS

To provide some context to the scale of our labor demand projections, we compare our results to the overall projected new jobs in energy efficiency industry sectors for the California economy as a whole. This is important because, in addition to the jobs generated by the specific policies analyzed here, California will likely experience growth in jobs in the same industries, in occupations that may have similar training needs to those for the policy-driven new jobs.

A direct comparison cannot be made between the EDD projections, which are for permanent jobs, and these job person-year projections. However, for perspective, the EDD anticipates that the California economy will be composed of a total of almost 19 million jobs by 2018. In the medium scenario, the projected number of new direct job person-years comprises only 0.2 percent of that total. The EDD anticipates creating an average of 165,320 jobs per year from 2008 to 2018. Thus the 38,937 net new energy efficiency jobs in 2020 are equal to almost one-fourth of that yearly average.[47] In terms of permanent jobs, 14,284 energy efficiency jobs will last the entire period from 2010 through 2020, compared with the EDD's 2008–2018 estimate of 1.65 million jobs created throughout the entire economy. That is to say, over the long term, energy efficiency jobs make up about 0.9 percent of all permanent jobs.

3.4.4 JOB PROJECTIONS BY OCCUPATION

For the purposes of the WE&T Needs Assessment, the final output of the employment projections needs to be in terms of jobs in specific occupations, not jobs in entire industries, because education and training programs offer skills curricula tailored towards specific occupations (which may be concentrated in specific industries). Typically researchers and policymakers use the staffing patterns matrices (produced by the EDD and available at the four-digit level) to determine the occupational distribution (by Standard Occupational Classification [SOC] code and at the four-digit level) in each industry. These matrices offer average staffing levels across all of the state's firms in each four-digit sector. So, for instance, according to the staffing patterns, a residential construction firm with 100 workers will have 25 manual laborers, 50 semi- and high-skilled laborers (including on-site managers), six other managers, 18 administrative staff, and one staff architect. A four-employee residential construction firm will have one manual, two semi- or high-skilled laborers, and one administrative staff.

Some of the occupations involved in energy efficiency related activity are considered new and emerging—and thus are not included in the staffing patterns matrices. For instance, the US Bureau of Labor Statistics only recently recognized wind turbine technicians as its own occupation, and other occupations described in the Green O*NET as new and emerging (such as climate change analysts) are not yet included in official statistics.[48] To deal with this omission, we drew from the EDD green economy survey, which provides insight into the share of eight new

[47] EDD projections use a different methodology that does not account for specific investments in energy efficiency and related activities. Thus, it is not possible to determine whether these jobs are additional to the EDD projections or are accounted for within that figure.

[48] The National Center for O*NET Development has identified green economic sectors, green increased demand occupations, green enhanced skills occupations, and green new and emerging (N&E) occupations. For more information, see http://www.onetcenter.org/green.html.

occupations related to energy efficiency in industries at the three-digit NAICS level (see Appendix B for more detail).

Across the state, each industry comprises hundreds of occupations. Not every firm in a particular industry will hire workers in every occupation that is found in the industry; for instance, as noted above, not every small residential construction firm will hire in-house administrative staff. But several firms in an industry may support an administrative worker in another industry by purchasing administrative services instead of supporting an in-house worker. The EDD staffing patterns matrix provides an average occupational distribution across all industries, allowing us to translate industries into occupations. Although energy efficiency investment will affect job levels in hundreds of occupations, this analysis focuses on just the 77 occupations in energy efficiency and related industries that (1) are expected to grow by at least 100 jobs by 2020 and (2) are judged to require at least minimal energy efficiency related job training. This excludes workers in occupations like receptionists and truck drivers who, though employed by energy efficiency employers, perform work that is no different from that of similar workers in other industries.[49] Table 3.11 shows those 77 occupations, grouped into nine broad occupational groups. Within the 77 occupations, the top 18 occupations (those with job creation of more than 400 jobs statewide in 2020) are general and operations managers; construction managers; cost estimators; other business operations specialists; civil engineers; sales representatives, services, all other; first-line supervisors/managers of office and administrative support workers; customer service representatives; first-line supervisors/managers of construction trades and extraction workers; carpenters; construction laborers; drywall and ceiling tile installers; electricians; plumbers, pipefitters, and steamfitters; sheet metal workers; helpers, electricians; helpers, pipelayers, plumbers, pipefitters, and steamfitters; and heating, air conditioning, and refrigeration mechanics and installers.

Table 3.12 shows the job projections (total person-years of employment) for these nine occupational groups, as well as the group of occupations not requiring training, by residential, commercial/public, and industrial/agricultural sectors in 2020. More than half of all job person-years will be in the residential sector (with the remaining in the commercial/public and industrial/agricultural sectors), and occupations working in mechanical and electrical trades and the construction of building envelopes, including retrofitting of existing buildings as well as new construction, dominate job creation. The complete list of affected occupations by sector is in Appendix E.

Workers in most occupations do not spend all of their time on energy efficiency-related activity. Whether the occupation is in sheet metal work, architecture, or customer service, only a percentage of total work time will be spent doing the energy efficiency tasks that require training. Thus, this analysis next translates the projections of job person-years into the numbers of new workers that will need training, again relying upon the EDD Green Economy survey.

The EDD survey asked how many workers did any kind of EE work, and then how many spent over 50 percent of their time on EE work (i.e., are full time). These data allow us to estimate the share of each occupation that will benefit from energy efficiency investment. For instance, if, in engineering services, all workers are doing energy efficiency work full time, then a job person-year is equivalent to a worker. However, if just half of the workers are working full time on energy efficiency, then one job person-year is equivalent to two workers. Appendix B provides more detail about how this calculation was performed. Using this method, the 38,937 job person-years in the 2020 Medium Scenario (net of 2009) is translated into 78,205 workers who conduct energy efficiency activity requiring training, as part of their work—or 26,309 net new workers relative to 2015 (Table 3.13).

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[49] We focus on mechanical and electrical trades, building envelope construction and performance, and architecture and engineering for the workforce education and training inventory because the others are general occupations that require minimal changes in training because they are in energy and construction industries.

Table 3.11 Occupational Groups Affected by Energy Efficiency Related Investment

Occupational Group	SOC	Occupation Title
Mechanical Systems (Construction Trades)	47-2073	Operating Engineers and Other Construction Equipment Operators
	47-2111	Electricians
	47-2152	Plumbers, Pipefitters, and Steamfitters
	47-2211	Sheet Metal Workers
	47-3013	Helpers—Electricians
	47-3015	Helpers—Pipelayers, Plumbers, Pipefitters, and Steamfitters
	47-4021	Elevator Installers and Repairers
	49-1011	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers
	49-2098	Security and Fire Alarm Systems Installers
	49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers
	49-9042	Maintenance and Repair Workers, General
	49-9052	Telecommunications Line Installers and Repairers
	49-9098	Helpers—Installation, Maintenance, and Repair Workers
		Solar Photovoltaic Panel Installers and Technicians
Building Envelope (Construction Trades)	47-1011	First-Line Sup/Mgrs of Construction Trades and Extraction Workers
	47-2031	Carpenters
	47-2051	Cement Masons and Concrete Finishers
	47-2061	Construction Laborers
	47-2081	Drywall and Ceiling Tile Installers
	47-3012	Helpers—Carpenters
Building Envelope (Performance Trades)	47-4011	Construction and Building Inspectors
		Energy Auditors
		Building Performance or Retrofitting Specialists
Architecture and Engineering	17-1011	Architects, Except Landscape and Naval
	17-1022	Surveyors
	17-2051	Civil Engineers
	17-2061	Computer Hardware Engineers
	17-2071	Electrical Engineers
	17-2072	Electronics Engineers, Except Computer
	17-2112	Industrial Engineers
	17-2141	Mechanical Engineers
	17-2199	Engineers, All Other
	17-3011	Architectural and Civil Drafters
	17-3013	Mechanical Drafters
	17-3022	Civil Engineering Technicians
	17-3023	Electrical and Electronic Engineering Technicians
Manufacturing	51-1011	First-Line Supervisors/Managers of Production and Operating Workers
	51-8031	Water and Liquid Waste Treatment Plant and System Operators
	51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers
	51-9141	Semiconductor Processors

Table 3.11 (continued) Occupational Groups Affected by Energy Efficiency Related Investment

Occupational Group	SOC	Occupation Title
Administration (General)	13-1022	Wholesale and Retail Buyers, Except Farm Products
	13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products
	13-1041	Compliance Officers, Except Ag, Constr, Health-Safety, and Transportation
	13-1111	Management Analysts
	13-1199	Business Operations Specialists, All Other
	15-1021	Computer Programmers
	15-1031	Computer Software Engineers, Applications
	15-1032	Computer Software Engineers, Systems Software
	15-1041	Computer Support Specialists
	15-1051	Computer Systems Analysts
	15-1071	Network and Computer Systems Administrators
	23-1011	Lawyers
	37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners
	43-1011	First-Line Sup/Mgrs of Office and Administrative Support Workers
Administration (Sales-Related)	13-1051	Cost Estimators
	19-3021	Market Research Analysts
	27-3031	Public Relations Specialists
	41-1012	First-Line Supervisors/Managers of Non-Retail Sales Workers
	41-3099	Sales Representatives, Services, All Other
	41-4011	Sales Reps, Wholesale & Manf., Technical & Scientific Products
	41-4012	Sales Reps, Wholesale & Manf., Exc. Technical & Scientific Products
	41-9011	Demonstrators and Product Promoters
	41-9031	Sales Engineers
	43-4051	Customer Service Representatives
Management (Blue-Collar)	11-3051	Industrial Production Managers
	11-9021	Construction Managers
	11-9041	Engineering Managers
	11-9141	Property, Real Estate, and Community Association Managers
	11-1021	General and Operations Managers
Management (White-Collar)	11-2021	Marketing Managers
	11-2022	Sales Managers
	11-3021	Computer and Information Systems Managers
	11-3031	Financial Managers
	11-3061	Purchasing Managers
	11-9199	Managers, All Other
	11-1011	Chief Executives
		Sustainability Program Coordinators/Managers
	11-3061	Purchasing Managers
	11-9199	Managers, All Other
	11-1011	Chief Executives
		Sustainability Program Coordinators/Managers

Table 3.12 Energy Efficiency Total Direct Job Person-Year Projections Per Year, Medium Scenario, by Occupational Group

Occupational Group	Direct Residential Jobs		Direct Commercial and Public Sector Jobs		Direct Industrial and Agricultural Sector Jobs	
	2015	2020	2015	2020	2015	2020
Mechanical and Electrical Trades	211	470	124	276	48	106
Building Envelope (Construction Trades)	232	312	136	184	53	71
Building Envelope (Performance Trades)	9	19	5	11	2	4
Architecture and Engineering	—	67	—	40	—	15
Administration (General)	50	112	29	66	11	25
Administration (Sales-Related)	74	121	43	71	17	27
Management (Blue-Collar)	43	98	25	57	10	22
Management (White-Collar)	29	55	17	32	7	12
Manufacturing	—	4	—	2	—	1
Occupations Not Requiring Training	277	550	163	323	63	125
Total	909	1,809	534	1,063	206	410

Table 3.13 Energy Efficiency Incremental Worker Training Projections, Medium Scenario, by Occupational Group, Total and Per Year

Occupational Group	Total Direct New Workers (Net of 2009)		Direct New Workers Per Year (Net)	
	2015	2020	2015	2020
Administration	2,205	3,798	104	319
Administration (Sales-Related)	3,110	4,961	195	370
Architecture and Engineering	2,812	4,748	—	387
Building Envelope (Construction Trades)	27,452	37,282	1,145	1,966
Building Envelope (Performance Trades)	1,004	1,487	39	96
Management (Blue-Collar)	5,883	8,395	173	502
Management (White-Collar)	1,096	1,855	62	152
Manufacturing	48	97	—	10
Mechanical and Electrical Trades	8,286	15,582	628	1,459
Total	51,896	78,205	2,301	5,262

3.5 OCCUPATIONAL PROJECTIONS BY METROPOLITAN REGION

Once we developed projections of the number of workers needing training by energy efficiency occupation statewide, we then allocated these jobs to lower geographic levels of analysis. Specifically, we estimate the number of jobs by each IOU service territory and for each of California's 36 metropolitan areas.[50] (Appendix F contains the analysis for all metropolitan areas.) The IOU service territories include PG&E, SDG&E, SCE, and SCG. The job estimates for PG&E and SDG&E are based on their respective electric utility service territories. The SCG service territory overlaps with the PG&E electric utility service territory, the SCE service territory and various other POU service territories. Thus, a portion of the job estimates reported for SCG are also reported for PG&E, SCE and other POU service areas.

There were two steps used to conduct this analysis:

STEP 1. First, we used data from the U.S. Census Bureau's American Community Survey (ACS) to calculate the number of employed workers in each energy efficiency occupation in each county or rural region in California. From this occupational data figure we calculated each county's share of statewide employment in each occupation and then allocated the statewide jobs figures from IMPLAN to each county or region based on this share.

STEP 2. Next, we built a geographic bridge between each county and each IOU service area (note: we grouped all POU service areas together to form a single non-IOU area). With each centroid associated with a particular IOU, we then calculated the share of each county's population that lay in each IOU service territory. This county allocation factor was then used to bridge the county jobs figures to IOU territories. For example, if 40 percent of county X's population fell in PG&E's territory, then 40 percent of that county's jobs were assigned to PG&E.

Table 3.14 provides the projections of workers needing training for the direct energy efficiency related occupations created under the Medium Scenario for the IOU service territories (organized by occupation group). Southern California Gas leads the IOUs in training needs, with a net of 13,502 new workers needing training in 2020. This is explained by the size of its territory. PG&E is second, with 6,113, followed by the combined POUs (4,334), Southern California Edison (4,034), and San Diego Gas & Electric (2,257).

The major metropolitan areas, including Los Angeles, Riverside–San Bernardino, Sacramento, San Diego, San Francisco–Oakland, and San Jose, gain the majority of the workers to be trained in these occupations, with 54 percent anticipated to go to the Los Angeles and San Francisco regions alone. Of these jobs, 45 percent are in construction industries related to the building envelope. Table 3.15 provides the projections for the nine occupation groups for these regions.

[50] Specifically, the analysis allocated the projections to 36 California counties within metropolitan areas, and 6 aggregations of counties outside metropolitan areas (henceforth "rural regions").

Table 3.14 Energy Efficiency Related Total Worker Training Projections Per Year, Medium Scenario, by Occupational Group and IOU/POU Region

Occupations by IOU/POU	Direct New Workers, 2020				
	PGE	SDGE	SCE	SoCalGas	POUs
Administration	57	19	27	96	36
Administration (Sales-Related)	43	19	28	84	25
Architecture and Engineering	113	41	75	197	58
Building Envelope (Construction)	199	72	140	482	147
Building Envelope (Performance)	15	4	10	30	9
Management (Blue-Collar)	85	26	57	161	50
Management (White-Collar)	22	8	14	43	13
Manufacturing	4	1	3	11	4
Mechanical Systems	180	66	109	392	129
	717	257	463	1,498	470
	Total = 3,405				

Note: The IOU totals sum to greater than 100 percent because of the overlap between Southern California Gas and other IOU territories.

3.6 LABOR SUPPLY

Is the California workforce prepared to work in the jobs created by energy efficiency and related policy-driven investment? In order to determine the extent of California's workforce education and training needs, it is necessary to examine the existing and projected workforce in energy efficiency related occupations. Relying on secondary source data from the American Community Survey and the Current Population Survey, this analysis first establishes the characteristics of California workers in energy efficiency related occupations in 2009, and then projects the labor supply (both employed and unemployed workers in these occupations) to 2010, 2015, and 2020. Data on sex and race/ethnicity reveals existing concentrations of different demographic groups in certain occupations, which may create barriers to entry. Educational attainment data suggests the level of preparation expected currently of energy efficiency workers. Data on age distribution suggests occupations where significant numbers of retirements and/or shortages of new workers might be expected. Finally, firm size, wages, and health insurance data demonstrate the quality of jobs in energy efficiency.

Table 3.15 Energy Efficiency Related Total Worker Training Projections, Medium Scenario, by Occupational Group, for the Los Angeles-Long Beach-Santa Ana Metropolitan Region and the Nine-County Bay Area Metropolitan Region

Occupations by Metro Region	Total Direct New Workers in 2020 (Net of 2009)	Direct New Workers in 2020 (Net of All Previous Years)
LA-Long Beach-Santa Ana		1,727
Administration	1,434	118
Administration (Sales-Related)	1,729	131
Architecture and Engineering	1,442	117
Building Envelope (Construction)	12,497	681
Building Envelope (Performance)	505	33
Management (Blue-Collar)	2,795	168
Management (White-Collar)	678	56
Manufacturing	38	4
Mechanical and Electrical Trades	4,464	420
San Francisco Bay Area	16,057	1,109
Administration	962	86
Administration (Sales-Related)	1,084	83
Architecture and Engineering	1,185	99
Building Envelope (Construction)	7,123	386
Building Envelope (Performance)	351	22
Management (Blue-Collar)	1,982	123
Management (white-collar)	522	43
Manufacturing	19	2
Mechanical and Electrical Trades	2,828	265

3.6.1 METHODOLOGY

The analysis of current labor supply encompasses both demographic (sex, age, race and ethnicity, and educational attainment) and employment characteristics (firm size, hourly wages, and access to health insurance) for California's current workforce. The analysis is organized into the nine energy efficiency-related occupational groups, which include the 77 occupations that require some level of job training related to energy efficiency, distributed generation, and demand response. Demographic data come from the US Census 2009 American

Community Survey (ACS).[51] Wage data come from the May 2009 California Employment Development Department (EDD) Wage Estimates, and the 2008 US Census Current Population Survey provides data on benefits and firm size.

To project future labor supply, we first obtained 2009 baseline data on employed and unemployed workers by occupation and by county from the ACS. Projections of employed workers in 2010, 2015, and 2020 were based upon the projected statewide annual growth rates by occupation from the EDD's 2008–2018 Projections of Employment by Occupation. To estimate unemployment by occupation, we first applied a growth factor based upon the overall labor force growth in 2010, 2015, and 2020 (based on the EDD projections). This allowed us to calculate the unemployed as the unemployment rate times the projected number of workers in each year. To calculate 2010 unemployment by occupation and county, we used the ratio of the California 2010 unemployment rate (12.4 percent) to the 2009 unemployment rate (12.1 percent). To project 2015 and 2020 unemployment, we built two scenarios based upon two different views of the rate that the California economy will recover. The first (the Low Unemployment Scenario) assumes, based upon the California Department of Finance 2009 Economic Forecasts, that unemployment will decline to 7.9 percent in 2015 and 4.2 percent in 2020. The second (the High Unemployment Scenario) assumes that unemployment rates will remain at 2010 levels in 2015 and decline to 7.9 percent by 2020.

3.6.2 CURRENT ENERGY EFFICIENCY, DEMAND RESPONSE, AND DISTRIBUTED GENERATION LABOR SUPPLY IN CALIFORNIA

This section describes the demographic, labor and wage characteristics of the nine occupational groups that require some energy efficiency related training, while providing additional data on the top 18 energy efficiency related occupations with significant job creation (over 400 jobs) by 2020. It is important to note that the workforce and demographic figures presented here are for the total California workforce in a given occupation or occupational group. For instance, the analysis shows the demographic characteristics of all plumbers, not just those performing energy efficiency related work, and the projections of the future supply of plumbers includes all plumbers in the state, some of whom work in energy efficiency and some who do not.

Overall, this analysis suggests that energy efficiency jobs differ in several important aspects from California employment overall. First, they disproportionately hire men, while Blacks are underrepresented, particularly in occupations in architecture/engineering, building envelope construction, and management. Second, younger workers are relatively underrepresented in energy efficiency jobs, and older workers dominate certain occupational groups, in particular (e.g., architecture/engineering, building envelope performance, mechanical and electrical trades). Not surprisingly, given the diversity of occupations funded by energy efficiency investment, educational qualifications vary significantly, with concentrations of workers with both very little education (e.g., construction laborers) and university degrees (e.g., engineers). In general, job quality is relatively high, with higher wages and health insurance benefit levels than in the California workforce as a whole, although these conditions may vary considerably both between and within occupational groups.

In 2009, over 4.3 million Californians worked in one of the nine occupation groups, representing about 23 percent of California's 18.5 million workers (Table 3.16). For comparison, we include the total number of workers that are at least in part funded by energy efficiency investment in California in 2009 (14,834). Almost one-half million workers in energy efficiency related occupations were unemployed in 2009. Over 60 percent of these jobs are in administration or management occupations. The largest affected group, general administration occupations,

[51] The ACS uses a different occupational coding system (the Census Occupation Codes (COC) instead of the Standard Occupational Codes (SOC), the 77 SOC occupations correspond to just 63 COC occupations.

includes business operations specialists and first line supervisors of office and administrative support workers. Among the largest occupations in sales-related administration are sales and customer service representatives and cost estimators.

Table 3.16 2009 Employed and Unemployed Workers by Energy Efficiency Related Occupational Group

Energy Efficiency Related Occupational Group	Employed Workers	Workers Partially Funded by Energy Efficiency Related Investment	Unemployed Workers	Unemployment Rate
Administration (General)	1,141,291	1,109	83,458	6.8%
Administration (Sales-Related)	718,383	955	75,406	9.5%
Architecture and Engineering	277,298	1,256	19,513	6.6%
Building Envelope (Construction)	482,872	1,679	119,985	19.9%
Building Envelope (Performance)	13,040	192	1,160	8.2%
Management (Blue-Collar)	346,631	896	30,725	8.1%
Management (White-Collar)	869,246	474	57,027	6.2%
Manufacturing	185,739	405	17,122	8.4%
Mechanical and Electrical Trades	289,067	7,868	55,369	16.1%
Total Energy Efficiency Related Occupational Groups	4,323,567	14,834	459,765	9.6%
Total California Workforce	18,541,318	—	2,086,740	11.3%

Source: American Community Survey, 2009; authors' calculations.

The construction trades are a large component of California's energy efficiency related occupations. In particular, workers in mechanical and electrical trades, as well as building envelope (or building performance) workers, such as energy auditors, are the most likely to be funded by energy efficiency investment: 2.7 percent of mechanical and electrical trades workers and 1.5 percent of building performance workers are funded by energy efficiency. Among the largest energy efficiency occupations in this group are several related to the building envelope: construction laborers, carpenters, drywallers, and first-line supervisors of construction trades workers. Other occupations that employ sizeable numbers of Californian workers are in the mechanical and electrical trades, including sheet metal workers; electricians; pipelayers, plumbers, pipefitters, and steamfitters; construction helpers; and HVAC workers (heating, air conditioning, and refrigeration mechanics and installers). In management, construction managers and general and operations managers employ high numbers of workers. In architecture and engineering, civil engineers stand out as one of the larger occupations.

Overall there is a large gender imbalance in energy efficiency-related occupations (see Table 3.17). Women are much better represented in administration, management, and manufacturing than they are in the building envelope and mechanical and electrical trades. Within building envelope occupations, women are more highly represented in construction supervision. In the mechanical and electrical trades, women stand out most in the fields of elevator installers and repairers, and also compose a disproportionate share of mechanical installation, maintenance, and repair helpers. Within architecture and engineering, women have highest representation among industrial engineers and engineering technicians.

Table 3.17 2009 Employment by Gender for Energy Efficiency Related Occupational Groups

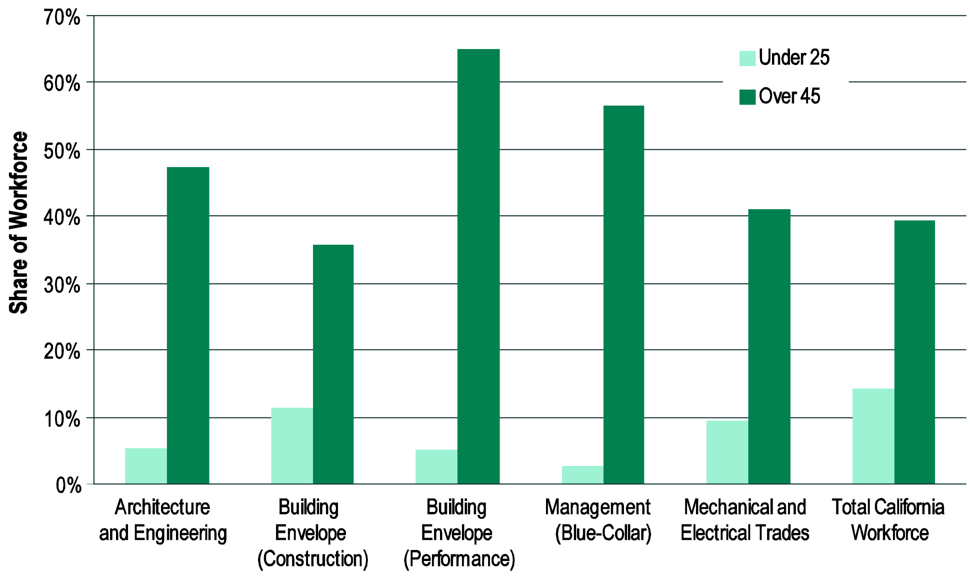
Energy Efficiency Related Occupational Group	Male	Female
Administration (General)	64%	36%
Administration (Sales-Related)	55%	45%
Architecture and Engineering	85%	15%
Building Envelope (Construction)	98%	2%
Building Envelope (Performance)	89%	11%
Management (Blue-Collar)	70%	30%
Management (White-Collar)	62%	38%
Manufacturing	68%	32%
Mechanical and Electrical Trades	97%	3%
Total Energy Efficiency Related Occupational Groups	71%	29%
Total California Workforce	55%	45%

Source: American Community Survey, 2009.

Understanding the age distribution within an occupation helps to identify opportunities for succession; as workers retire, more junior colleagues move up the career ladder and openings occur at the entry-level. Figure 3.10 shows the concentration of workers under 25 and over 45 years of age for the five occupational groups that include most of the significant energy efficiency occupations, as well as for California as a whole. Among the occupations with a higher percentage of people under 25 are low-level administrative positions (receptionists, customer service representatives, and office clerks), construction trades helpers, and construction laborers. HVAC mechanics and installers are also generally younger than workers in other construction occupations like electricians or carpenters. Among the occupations with the highest percentage of workers in the 25 to 44 year age group, are electricians, sheet metal workers, construction laborers, plumbers, carpenters, and drywall and ceiling tile installers. Engineering managers and construction managers are among the occupations with the most disproportionate concentration of workers in the 45 to 64 year age group. For the construction trades, first line supervisors and plumbers had the highest percentages of workers between 45 and 64 years old.

In the energy efficiency occupational groups, Whites and Asians are generally overrepresented, while Blacks and Latinos (Hispanics) are underrepresented (Table 3.18). However, the reader should use caution when interpreting this data, since the ACS may undercount the immigrant, particularly Latino, workforce. Management, administrative, and sales jobs have a high proportion of Whites, relative to their 44 percent of the total state workforce. Whites make up a disproportionate share of cost estimators, management analysts, construction managers, engineering managers, and general and operations managers. The proportion of Hispanics is considerably higher than other racial and ethnic groups in construction occupations. Hispanics are concentrated in the following occupations: drywall and ceiling tile installers, construction laborers, construction helpers, carpenters, plumbers, and HVAC mechanics and installers. In the construction trades, only Whites come close to these numbers, making up a disproportionate share of electricians, first-line construction supervisors, and HVAC workers. Asians are best represented as engineering managers, civil engineers, and business operation specialists. The occupation with the highest percentage of Blacks is customer service representatives; Blacks are generally underrepresented in the construction trades.

Figure 3.10 2009 Share of Workers Under 25 and Over 45 Years Old, Selected Energy Efficiency Occupational Groups



Source: American Community Survey, 2009.

Table 3.18 2009 Employment by Race/Ethnicity for Energy Efficiency Related Occupational Groups

Energy Efficiency Related Occupational Group	Non-Hispanic White	Non-Hispanic Black	Non-Hispanic Asian & Pacific Islander	Non-Hispanic Other	Hispanic
Administration (General)	48%	5%	19%	2%	26%
Administration (Sales-Related)	54%	6%	13%	2%	26%
Architecture and Engineering	50%	3%	31%	3%	13%
Building Envelope (Construction)	38%	3%	4%	2%	54%
Building Envelope (Performance)	77%	4%	7%	1%	11%
Management (Blue-Collar)	66%	3%	10%	2%	19%
Management (White-Collar)	64%	4%	15%	3%	14%
Manufacturing	36%	4%	15%	2%	43%
Mechanical and Electrical Trades	47%	5%	6%	3%	40%
Total Energy Efficiency Related Occupational Groups	52%	4%	14%	2%	28%
California Workforce	44%	6%	13%	2%	35%

Source: American Community Survey, 2009.

Because of the concentration of administrative and management occupations in energy efficiency related occupations, the workers in these occupational groups are generally better educated than the California workforce as a whole (Table 3.19). In terms of specific energy efficiency related occupations, the highest numbers of university degree holders are among civil engineers, general and operations managers, and other business operations specialists. The highest proportions of workers in the top 18 occupations who had not completed high school were among carpenters; construction laborers; construction trades helpers; and drywall and ceiling tile installers.

Table 3.19 2009 Employment by Educational Attainment for Energy Efficiency Related Occupational Groups

Energy Efficiency Related Occupational Group	No High School	High School Diploma	Some College	University Degree
Administration (General)	12%	14%	19%	55%
Administration (Sales-Related)	7%	20%	32%	41%
Architecture and Engineering	2%	6%	17%	76%
Building Envelope (Construction)	36%	33%	22%	9%
Building Envelope (Performance)	3%	18%	34%	46%
Management (Blue-Collar)	6%	17%	28%	49%
Management (White-Collar)	3%	10%	21%	66%
Manufacturing	20%	29%	27%	23%
Mechanical and Electrical Trades	19%	35%	32%	14%
Total Energy Efficiency Related Occupational Groups	12%	19%	24%	45%
Total California Workforce	16%	21%	25%	38%

Source: American Community Survey, 2009.

Energy efficiency related workers are distributed across different firm sizes in similar proportions to California's workforce as a whole (Table 3.20). Among the top energy efficiency occupations, construction laborers and helpers; pipelayers, plumbers, pipefitters, and steamfitters; and heating, air conditioning, and refrigeration mechanics and installers are most likely to be concentrated in small firms (fewer than ten employees). Business operations specialists are the most likely of all energy efficiency occupations to work in a large company with more than 1,000 employees, followed by customer service representatives and office clerks.

Table 3.21 shows the mean hourly wages for the nine occupational groups. Readers should treat these data with caution. Studies have shown that wage data collected as part of the Current Population Survey under report wages for independent contractors and "informal" workers. In addition, mean wages may be distorted by a few highly paid individuals (or outliers). In general, managerial and professional workers in California earn the highest wages among the energy efficiency-related occupations, while the construction occupations have the lowest. Despite enjoying, in general, higher pay rates, some professional occupations such as cost estimators, drafters and other business operations specialists have hourly wages below $30. Among administrative and sales positions, sales representatives are the best paid, followed by first-line supervisors of office and administrative support workers. The least well paid are receptionists and information clerks, office clerks and secretaries. In construction, workers in the residential sector earn just 80 to 90 percent of what their counterparts in the commercial sector earn.

Table 3.20 Employment by Firm Size for Energy Efficiency Related Occupational Groups, 2008

Energy Efficiency Related Occupational Group	Under 10 Employees	10 to 24 Employees	25 to 99 Employees	100 to 499 Employees	500+ Employees
Administration (General)	22%	6%	12%	13%	47%
Administration (Sales-Related)	25%	8%	11%	11%	44%
Architecture and Engineering	10%	5%	15%	13%	58%
Building Envelope (Construction)	36%	19%	16%	12%	17%
Building Envelope (Performance)	16%	12%	13%	0%	59%
Management (Blue-Collar)	30%	11%	17%	13%	28%
Management (White-Collar)	26%	8%	14%	13%	40%
Manufacturing	12%	8%	22%	21%	36%
Mechanical and Electrical Trades	26%	11%	22%	15%	27%
Total Energy Efficiency Related Occupational Groups	25%	9%	15%	13%	38%
Total California Workforce	26%	10%	14%	12%	39%

Source: Current Population Survey, 2008.

Table 3.21 Mean Wages for Energy Efficiency Related Occupational Groups, 2008

Energy Efficiency Related Occupational Group	Mean Hourly Wage
Administration (General)	$31.84
Administration (Sales-Related)	$37.06
Architecture and Engineering	$40.03
Building Envelope (Construction)	$36.54
Building Envelope (Performance)	$21.24
Management (Blue-Collar)	$52.01
Management (White-Collar)	$47.82
Manufacturing	$27.64
Mechanical and Electrical Trades	$21.95
Total Energy Efficiency Related Occupational Groups	$37.46

Source: California Employment Development Department, 2009.

Table 3.22 shows the extent and type of health insurance coverage for energy efficiency-related occupations. Overall, 82 percent of workers have some insurance and 18 percent are uninsured, compared to the 65 percent of California's workforce who have some insurance and 35 percent who are uninsured. However, for all construction occupations, the percentage of people covered by any insurance is considerably less than the California average. The lowest levels of insurance coverage for construction are for construction laborers and drywall and ceiling tile installers. Most likely to be covered in construction positions are HVAC mechanics and installers and electricians. The energy efficiency workers who are most likely to be covered by any kind of insurance are those in management and professional occupations.

Table 3.22 Health Coverage for Energy Efficiency Related Occupational Groups, 2008

Energy Efficiency Related Occupational Group	Not Insured by Employer	Insured by Employer
Administration (General)	24%	76%
Administration (Sales-Related)	27%	73%
Architecture and Engineering	10%	90%
Building Envelope (Construction)	65%	35%
Building Envelope (Performance)	0%	100%
Management (Blue-Collar)	27%	73%
Management (White-Collar)	17%	83%
Manufacturing	22%	78%
Mechanical and Electrical Trades	28%	72%
Total Energy Efficiency Related Occupational Groups	28%	72%
Total California Workforce	35%	65%

Source: Current Population Survey, 2008.

3.6.3 PROJECTING FUTURE ENERGY EFFICIENCY LABOR SUPPLY IN CALIFORNIA

In order to determine the future need for workforce education and training, it is important to understand California's future labor force. Over the next decade, the California labor force is expected to grow about one percent per year. This natural growth includes both new job openings and replacement job openings (due to retirements and turnover), and it will mean about one-half million new workers in energy efficiency related occupations by 2020 (or about one-fourth of the California workforce; see Table 3.23). The labor force in energy efficiency occupations will continue to include a significant number of unemployed workers, although the number is anticipated to decline from current levels under both scenarios. Under the Low Unemployment Scenario (4 percent unemployment in 2020), the number of unemployed drops from 460,000 in 2010 to 177,000. Even under the High Unemployment Scenario (7.9 percent in 2020), the number of unemployed will decrease by over half, to 213,000. However, the unemployment rate in the largest construction trades (building envelope and mechanical and electrical trades) is still anticipated to be significantly higher than that in the state overall. The next section evaluates these labor supply projections in light of the numbers of workers needing training in energy efficiency, demand response, and distributed generation occupations.

Table 3.23 Projections for Employed and Unemployed Workers by Energy Efficiency Related Occupational Group in 2020

Energy Efficiency Related Occupational Group	Employed Workers	Low (4%) Unemployment Scenario, # Unemployed Workers	High (8%) Unemployment Scenario, # Unemployed Workers
Administration (General)	1,304,565	32,232	38,882
Administration (Sales-Related)	812,083	29,866	36,027
Architecture and Engineering	301,736	6,794	8,196
Building Envelope (Construction)	563,331	47,916	57,802
Building Envelope (Performance)	15,232	330	398
Management (Blue-Collar)	370,634	11,633	14,033
Management (White-Collar)	932,371	21,454	25,880
Manufacturing	179,628	5,718	6,897
Mechanical and Electrical Trades	327,734	20,693	24,962
Total Energy Efficiency Related Occupational Groups	4,807,315	176,636	213,079

Source: Calculations by the authors based upon American Community Survey, 2009 and California EDD Occupational Projections, 2008-2018.

3.7 MATCH BETWEEN LABOR DEMAND AND SUPPLY

In the year 2020, the number of job openings partially funded by energy efficiency investment will be significantly lower than the number of unemployed workers. For instance, with 47,816 unemployed workers in the building envelope construction trades, there will be just 1,966 net new energy efficiency positions in that occupational group in 2020. The total from 2010 to 2020 is significantly higher, at 37,282, but unemployed workers in the early years of the decade will quickly absorb those openings. For the purposes of the Needs Assessment, it is assumed that employers will hire these unemployed workers, because they are more experienced, before tapping into the pipeline of newly trained workers. Thus, until the queue of unemployed workers is absorbed, there will be limited opportunities for newly trained workers.

Although the state overall is experiencing a surplus of workers in energy efficiency related occupations—a surplus expected to continue through the next decade—it is possible that individual metropolitan areas with significant energy efficiency and related investment will see shortages in certain occupations. To determine whether any localized shortages will occur, a gap analysis compared future projected labor demand to labor supply by metro and occupation. Specifically, we looked at projected workers needing training in the 77 energy efficiency related occupations in 2020 and compared this number to the projections of new and unemployed workers in these occupations in 2020 (using the Low Unemployment Scenario). In each metropolitan area, for each occupation, there was either a surplus, meaning more new and unemployed workers than workers needing training, or deficit, with more workers needing training than are available from the pool of new and unemployed workers. In the 42 regions (including 36 metropolitan areas or counties and 6 rural regions) and 77 occupations evaluated, there were surpluses in 1,659 occupations and deficits in 411. However, no deficit reached more than 14 workers, not enough to warrant a single training program. Table 3.24 shows the top five occupations in surplus, as well as the top five in deficit, in particular counties in 2020. The top five in surplus, indicating an excess labor supply, are all projected to be in Los Angeles, numbering in the thousands of workers. The top five in deficit in 2020 are from smaller counties, but the deficits are projected to be very low.

Table 3.24 Top Five Occupations in Surplus or Deficit in 2020 by County

County	Occupation	2020 Gap (Surplus/Deficit)
Los Angeles	Construction Laborers	6,418
Los Angeles	Customer Service Representatives	5,379
Los Angeles	Carpenters	3,870
Los Angeles	Janitors and Building Cleaners	2,922
Los Angeles	Managers, All Other	2,726
Orange	Wholesale and Retail Buyers, Except Farm Products	-9
Contra Costa	Sheet Metal Workers	-11
Fresno	First-line Supervisors / Managers of Production and Operating Workers	-12
San Bernardino	Helpers, Construction Trades	-12
Orange	Helpers, Construction Trades	-14

It is likely that the universe of workers needing training related to energy efficiency and related activities will include not only those hired to fill the new jobs generated by energy efficiency and related investment, but also workers in existing positions. For instance, energy efficiency policies and investments will create some new jobs for electricians who need training, mostly those working in some form of construction. But technologies related to energy efficiency will also impact tens of thousands more electricians whose work is not solely in those areas. For instance, some electricians will be funded by energy efficiency investment to install energy-saving devices in supermarkets. Other electricians work in supermarkets that are not participating in energy efficiency incentive programs. Still, these electricians will need re-skilling as well, as energy-saving devices become standard. The aggregate numbers are significant: for instance, the EDD projects that there will be 64,000 electricians in California in 2018, while this study estimates just 4,800 total direct job person-years for electricians by 2020. Future research might estimate workers in these occupations that will undergo some evolution of skills, even if they are not directly related to the specific investments generated by the policies and programs analyzed here.

3.8 CONCLUSION

This chapter provided projections of the need for job training in California's energy efficiency occupations in 2010, 2015, and 2020. These projections rely on a careful seven-step methodology. To review, the analysis first estimates the public and private investment from energy efficiency-related policies and programs (step 1), develops investment scenarios (step 2) and then assigns demand to specific industries (step 3). Next, the E-DRAM model estimates indirect and induced job creation (step 4), while IMPLAN input-output model is used to translate the investment into direct jobs created in California (step 5). These jobs are then converted into numbers of workers that need training (step 6) for different California geographies (step 7).

Readers will want to keep several factors in mind when interpreting the numbers. First, the analysis is limited to energy efficiency and related industries, not only because of the limited scope of the EE Strategic Plan, but also because the WE&T Needs Assessment focuses on job training needs relevant to energy efficiency and related activities. Since these industries comprise just one subsector of the green economy, these numbers are not comparable to those produced by many other studies that look either at the entire green economy or the impacts of clean energy investment on the economy as a whole. Second, these numbers do not simply represent job opportunities; rather, investment will help fund the part of a particular job in a particular occupation that is engaged in energy efficiency activity. Finally, this new labor demand must be assessed in the context of the California labor supply, since existing workers, many of whom have been idled by the recession, will absorb some of the new demand.

To review the highlights of this analysis, we estimate that by 2020 California will spend $11.2 billion on energy efficiency activities, according to the Medium Scenario. This demand will stem from a combination of public expenditures (including ratepayer-funded utility programs), and leveraged investments from private market actors (e.g., residential consumers and businesses). This is the level of demand that we characterize as investment-induced spending, and does not include all forms of private investments in energy efficiency. We project that this level of demand will result in a total impact in 2020 (including 2009) of over 211,000 total job person-years including all indirect and induced jobs (result of multiplier effects). However, this figure includes many jobs in the local service sector that do not relate to energy efficiency and are gained mainly from consumers and businesses devoting fewer dollars to energy use.

For the purposes of this WE&T Needs Assessment, the more important figure is the number of direct jobs in energy efficiency related industries that will require training. Using our unique "hybrid" methodology we estimate that by 2020, policy-driven investments will generate 52,371 total new job-years (38,937 over the 2009 baseline) and will require some level of training for 78,204 workers over the ten-year period, although for the general administrative and management occupation this may be minimal. The training need will fluctuate by year as investment fluctuates, and a large portion of these workers will need training during the ARRA years due to the spike in investment at that time. In any given year, the number of unemployed workers in energy efficiency related occupations will greatly exceed the number of new jobs created. Thus, the need for energy efficiency training is largely for incumbent workers.

This study did not specifically analyze the job creation potential of different investment strategies; further research is necessary to determine the most effective way to leverage energy efficiency and related investment in order to create jobs. However, these findings do suggest several general approaches the state might take. In order to create more energy efficiency and related jobs in California, the state should target programs with a higher yield of jobs per investment dollar (as ARRA did)—while still ensuring job quality, as suggested in Chapter 4. Most of the manufacturing jobs generated by this policy-driven energy efficiency investment will be created outside California unless public policy strategies are implemented to capture them in the state, for instance by requiring that the public sector purchase energy-efficient goods and services made locally. Finally, given the amount of labor market expertise in the energy efficiency and related industries, the state might also work to promote exports in energy efficiency and related industries to create more jobs. However, developing estimates as to how many jobs are likely to result from investment generated outside of California was outside the scope of this study.

CHAPTER FOUR:

4. CASE STUDIES OF THE HVAC, RESIDENTIAL RETROFIT, AND COMMERCIAL LIGHTING CONTROLS SECTORS

"Do it right the first time. Quality comes not from inspection, but from improvement of the process."

~ Dr. W. Edwards Deming

4.1 INTRODUCTION

In the first chapters of this report we examined the changes in labor demand that will result from energy efficiency and related policies and programs. In Part Two, we assess the capacity of our current workforce infrastructure to meet the changing labor demand. The purpose of this chapter—the sector case studies—is to better understand how policy interventions and market dynamics impact the state's ability to achieve both its energy and workforce related policy objectives. Specifically, we bring to light the issues that need to be addressed to ensure that energy efficiency and related work is performed at the standard necessary to achieve energy savings goals. We also examine the workforce impacts of energy efficiency policies and programs and ways to ensure that policy is creating jobs with livable wages, advancement opportunity, and pathways out of poverty for California workers. Building the high road entails developing strategies to meet both energy and workforce goals, and we shed light on the feasibility, trade-offs, and costs associated with strategies to do so.

In order to look closely at business and labor market dynamics, this chapter drills down into three submarkets: (1) the heating, ventilation, and air conditioning (HVAC) market; (2) the residential energy efficiency retrofit market; and (3) the commercial lighting market. These sectors have been selected because of their substantial contribution to total energy consumption and peak energy demand and their potential to lower energy use, and because they are illustrative of many of the workforce issues encountered in other sectors.

4.1.1 WORKFORCE ISSUES AFFECTING ENERGY SAVINGS OUTCOMES

Although workforce issues are not the sole factor affecting energy savings outcomes, there is clearly a connection between the number of trained workers, the quality of work performed, and the level of energy savings that will be achieved. When the California Long Term Energy Efficiency Strategic Plan (EE Strategic Plan) was created, there were serious concerns about an inadequate supply of experienced workers in the key occupations needed for expansion of the energy efficiency sectors. The landscape has since changed dramatically and earlier concerns have been reversed by the recession, since many skilled trades and construction workers are now unemployed. Confirming the quantitative analysis of Chapters 3, our interviews revealed a widespread view that worker shortages do not currently exist and that, at present, there is a surplus, rather than a gap, in training programs.

How long this surplus will continue depends in part on the length of the recession.[1] Although the policymakers, utility program managers, and industry experts that we interviewed are not concerned, at present, about the quantity of available workers, they consistently emphasize the issue of work quality. The term "high quality work" is used here to mean workmanship that results in proper the installation, maintenance, and operation of energy efficient equipment, (e.g., HVAC) and materials (e.g., insulation). The following are some of the most critical and commonly cited issues arising from poor work quality:

- → UNREALIZED ENERGY SAVINGS: In HVAC change-outs and maintenance, insulation work, advanced lighting controls and other energy efficiency work, incorrect installation is commonly reported and has been found to result in significant levels of unrealized energy savings.
- → SAFETY: Poor quality work also leads to safety concerns for occupants and workers.
- → CONSUMER SATISFACTION: Since market expansion is significantly dependent on word-of-mouth advertising and other social marketing, dissatisfaction resulting from inadequate work quality can significantly undermine sector growth.
- → LENDING CONSTRAINTS: Since market expansion is dependent on financing, quality verification and standardization is necessary to assure lending institutions that income from energy savings paybacks will be available to service loans. Investment grade audits are still limited to very large commercial buildings where the payback is sufficient to warrant the high cost of such audits.

4.1.2 WORKFORCE GOALS AND OUTCOMES

Throughout the sectors profiled here, concerns about the workforce outcomes of investments from energy efficiency programs and policies also surfaced. These concerns were voiced particularly by educators and trainers, low-income advocates, union representatives and elected officials. The workforce goals can be characterized by three interrelated components: (1) the quantity of jobs that these public policies generate and leverage; (2) the quality of jobs in terms of wages, benefits, career pathways; and (3) the accessibility of jobs for Californians from low-income, minority and disadvantaged communities.

The availability of jobs for training graduates is clearly on the minds of these stakeholders. Yet the quantity of jobs is not the only concern; job quality, and the existence or lack of career pathways that reward workers as they move up the skill and experience ladder are also critical. Attention to what types of jobs are being supported in these industries will also become more prevalent as the use of taxpayer and ratepayer funds is expanded to subsidize retrofits for middle- and upper-income households. Finally, who gets the available jobs and the extent to which disadvantaged workers have opportunities to obtain them is a key question to be addressed.

Workforce development providers may be reluctant to train for the historically low-wage jobs in the residential construction industry. For example, the Los Angeles Workforce Investment Board (WIB) Executive Director, stated it bluntly:, "We don't fund training for low-wage jobs." Some funders and training organizations will only support training for career tracks that provide workers with a strong wage floor and a wage progression tied to skill acquisition. In addition to these groups' concerns about placing their students/trainees in living-wage jobs, the high turnover rates common in low-wage occupations mean that training investments in those occupations are often squandered as training program graduates leave the field after a short time. Under these circumstances, the workforce development community faces the challenge of how to build career ladders from low-wage, entry-level jobs, and/or to improve conditions in the low-wage jobs themselves.

[1] Part Two addresses questions about the longer-term capacity of the state's workforce infrastructure.

As in many industries, there is a perceived trade-off between ensuring high quality energy efficiency work and providing that work at a price that consumers are willing to pay. Although there certainly are limits to what the market can bear, this trade-off between cost and quality has not been well-documented or studied. The emphasis on the trade-off does not take into account the value that high quality work provides in achieving the energy efficiency goals of the state.[2] In some cases, investing in a better compensated, more highly skilled workforce leads to productivity improvements that offset the higher wage bill. Research in the construction industry that compares public works projects carried out with and without prevailing wages shows similar overall cost, as employers are able to compensate for higher wages through the use of more highly skilled workers.[3] In other cases, investing in a more highly-skilled workforce enables firms to compete in a higher-quality, higher-price market.

The three case studies that follow illustrate these connections and trade-offs, as well as the potential dangers of allowing the development of a low road market in which workers are not compensated for their skills, so investment in training is low, turnover is high, work quality suffers, and we achieve neither our energy savings nor our workforce goals as a result.

4.1.3 METHODOLOGY AND CHAPTER ORGANIZATION

The sector case studies presented in this chapter are based on both quantitative and qualitative data gathered through in-depth interviews with 20 to 30 experts in each sector, a review of the existing research literature and utility and CPUC program documents, and a limited analysis of data from the Quarterly Census of Employment and Wages, the California Employer Survey, and the Current Population Survey.[4] Interviewees included utility program staff, contractors, training providers, technical experts, and policymakers. A partial list of interviewees is included in Appendix M.[5]

This chapter is organized by sector, with HVAC presented first, then residential retrofit and, finally, commercial lighting. Figure 4.1 provides the framework for our analysis of each sector. Program design and policy combine with market dynamics to influence the conditions of the labor market. As discussed above, labor market conditions have an impact on work quality and thus, ultimately, on energy savings. These labor conditions also have an impact on the quantity, quality and accessibility of jobs—that is, on worker outcomes. In order to contextualize the analysis of each sector, each section begins with an overview of the market and policies pertaining to that sector, followed by a description of existing labor conditions. We then assess the impact of these factors on the workforce and energy savings outcomes for each sector, and discuss new policy directions and lessons learned.

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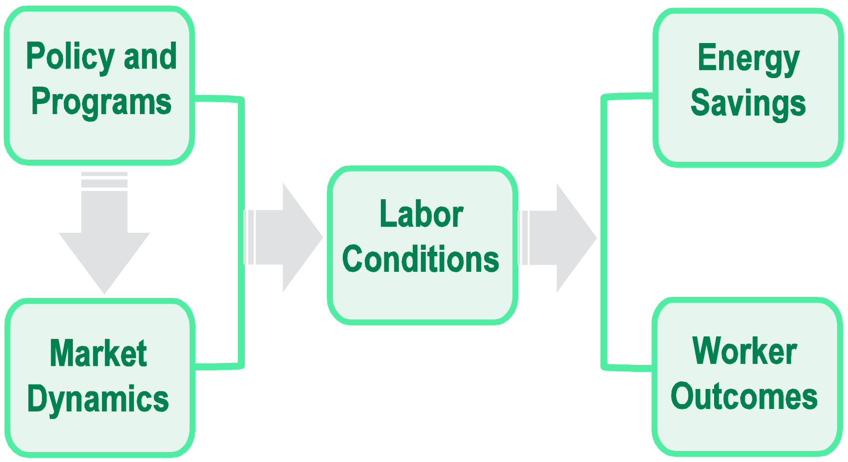
2 There is substantial theoretical and empirical research in the Economics literature asserting the correlation between work quality and job quality. See for example the seminal work: Akerlof, G., & J. Yellen (1986). "Efficiency Wage Models of the Labor Market," *Handbook of Labor Economics*. Cambridge: Cambridge University Press.

3 Mahalie, N. (2008), "Prevailing wages and government Contracting costs A review of the research," EPI Briefing Paper #215. Retrieved from: http://www.epi.org/publications/entry/bp215.

4 Unfortunately, the sample size and/or level of disaggregation of these data sources limited their usefulness for this analysis.

5 The names of the contractors and workers we interviewed are withheld.

Figure 4.1 Framework for Sector Case Studies



Clearly this model is somewhat simplified and there are myriad other factors affecting energy savings and workforce outcomes. However, this framework illustrates the role of energy efficiency policy and programs in determining workforce outcomes, as well as the connection between labor conditions, work quality, and energy savings outcomes. Each case study examines how these dynamics play out in a specific sector, to illustrate some of the ways that policy interventions can and have been used to try to improve both energy and workforce outcomes, and what the trade-offs are of doing so. There are lessons to be learned from each sector, but also lessons to be learned from comparing all three. Thus, the case studies are followed by a set of conclusions and lessons that apply more broadly to other sectors relevant to the WE&T Needs Assessment.

4.2 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

California's EE Strategic Plan identifies the HVAC industry as a key target for major restructuring, for a variety of reasons. First and foremost, heating and cooling buildings is one of the largest electricity end uses in the state and is also the single largest contributor to peak power demand, composing up to 30 percent of total demand in the hot summer months.[6] In addition, HVAC energy use has continued to grow over time, as air conditioning in homes and offices has become more prevalent and housing stock growth shifts to the hotter regions of the state. Second, certain segments of the HVAC industry are beset by issues of poor quality installation and maintenance. In a 2008 report by the California Energy Commission (CEC) estimates that as many as 50 percent of all new HVAC systems and 85 percent of all replacement systems are not installed to a quality specification, resulting in a huge loss of potential energy savings.[7] Finally, as the state seeks to achieve deeper energy savings, the adoption of more sophisticated control technologies, products that cater to California's climate and more integrated whole-building approaches will be key components to achieving energy savings. These changes will require that HVAC system

[6] California Public Utilities Commission (2008b). *Long Term Energy Efficiency Strategic Plan: Achieving Maximum Energy Savings in California for 2009 and Beyond,* page 58. Retrieved from: http://www.cpuc.ca.gov/NR/rdonlyres/D4321448-208C-48F9-9F62-1BBB14A8D717/0/EEStrategicPlan.pdf.

[7] Messenger, M. (2008). *Strategic Plan to Reduce the Energy Impact of Air Conditioners.* California Energy Commission Staff Report (CEC-400-2008-010). p. 30. Retrieved from: http://www.energy.ca.gov/2008publications/CEC-400-2008-010/CEC-400-2008-010.PDF.

designers and technicians develop skills to properly use new technologies and cultivate a more integrated understanding of building systems.

In light of these issues, the EE Strategic Plan has set the goal of improving HVAC performance 50 percent by 2020 and 75 percent by 2030 and identifies the following strategies for transforming the sector:[8]

- → Compliance, enforcement, and verification of existing standards;
- → Mainstreaming of quality installation and maintenance practices;
- → Integration of HVAC systems into whole-building systems design; and
- → Development of climate appropriate HVAC technologies.

4.2.1 MARKET DYNAMICS

As in many areas of the construction industry, there are a number of subsectors or market segments within the larger HVAC sector. Most IOU programs in the HVAC sector target residential and commercial HVAC separately and some programs further distinguish between large commercial and small commercial market segments. These market segments are based partially on the differing technical requirements of the equipment in these different building types and partially on the resources and behavior of the customers in each segment.

For the purposes of this analysis, we have grouped the residential and small commercial market segments together, because, technical considerations aside, these markets share many characteristics. The small commercial and single-family residential market segments are highly competitive and price-driven. Consumers in these segments have difficulty distinguishing contractors on the basis of quality, because many of the attributes that contribute to energy efficiency—such as unit sizing, duct sealing, air flow, and refrigerant charge—cannot be easily appraised by most consumers. Barriers to entry for firms in these market segments are fairly low, but an estimated 25 percent of all HVAC firms go out of business in a given year.[9] This undermines professionalism and regulatory compliance. Since most homeowners and small commercial building owners do not recognize the benefits of quality installations, contractors who are committed to quality installation practices, which can raise costs by as much as 40 percent, are disfavored in the market. The CEC estimates that less than 10 percent of HVAC work is performed under legally required building permits, which trigger compliance with the minimum performance standards required by building codes.[10] Because of these issues of quality and non-compliance, we refer to these as "low-road" market segments, in which competitive advantage is gained primarily through cutting costs rather than through quality services.[11]

In contrast, the larger firms serving the large commercial and institutional markets tend to be more stable, adhere to existing standards, and compete on the basis of quality. The more complex technical requirements and sheer size of larger buildings require that firms have high levels of technical expertise, numerous highly skilled installers and service technicians, and greater capital investment in equipment. These factors make it difficult for firms to start up without a great deal of experience, training investment and initial capital. In many cases, large commercial building owners are also very knowledgeable about the energy consumption in their buildings and they may have dedicated energy management staff. Thus, large commercial and institutional building owners tend to understand the payback benefits of properly installed and maintained equipment, making them more inclined to invest in high

8 CPUC 2008b, p. 58.

9 San Diego Gas & Electric (2006-2008). HVAC Training, Maintenance, and Installation Program Implementation Plan (SDGE3043). Available at http://eega2006.cpuc.ca.gov/DisplayPlans.aspx?ID=9

10 California Energy Commission, 2008, p. 17.

11 See Chapter 1 for a definition of high-road and low-road development.

quality work up front. Table 4.1 shows some characteristics of these segmented markets in the HVAC industry. *This does not imply that all individual firms operating within the low-road markets are low quality, but rather that the market conditions they all face favor low quality.*

Table 4.1 Segmented Markets in HVAC*

	High Road	Low Road
Market Segments	• Large owner-occupied commercial • Public buildings	• Residential • Small commercial
Average Firm Size	Large	Small
Permit Compliance	High	<10%
Firm Turnover	Low	25% annually
Barriers to Entry	High	Low
Reported Quality Problems	Very low	Very high

* This segmentation is our own analysis based on interviews with HVAC experts, U.S. Census County Business Patterns data, and other sources listed in this document.

4.2.2 POLICY INSTRUMENTS AND PROGRAMS

The majority of energy efficiency programs directed at the HVAC sector come from ratepayer-funded programs, administered by utilities. There are also some federal programs of note, as well as statewide policies, regulations and codes, which are discussed below, but we focus primarily on the investor-owned utility programs that make up the bulk of HVAC-related energy efficiency investments in California.

4.2.2.1 REBATES AND INCENTIVES

Until very recently, energy efficiency incentive programs directed at the HVAC sector have focused on equipment replacement rebates. These rebates usually take the form of one of the following:

- DOWNSTREAM CONSUMER REBATES: Consumers apply for a rebate based on their proof of purchase of the eligible piece of equipment, and then hire a contractor to do the installation work.[12] Eligible equipment must meet certain ENERGY STAR-rating requirements. From 2006 to 2009, IOU rebates for HVAC equipment ranged from $50 to $300 per unit, depending on the equipment. These rebates are often referred to as "widget" rebates, as they prescribe particular equipment, which has been rated for energy efficiency.

- UPSTREAM INCENTIVES to manufacturers or distributors of HVAC equipment – Manufacturers or distributors receive incentives to buy down the cost of high efficiency equipment. This ensures that HVAC units sold in the state comply with or exceed Title 20 and Title 24 requirements and that these more efficient units are cost competitive with less efficient models.

[12] In some cases, consumers do the installation themselves, without a contractor.

Recently, there has been a dramatic shift in the strategy behind consumer rebates programs as part of a concerted effort by the CPUC and utilities to address the massive quality shortfalls in this sector. All IOU consumer rebates for HVAC equipment are now part of quality installation and quality maintenance (QI/QM) programs, which impose requirements on contractors up front, to ensure that equipment is installed to a quality specification. Sacramento Municipal Utility District (SMUD) has also recently implemented quality HVAC programs, which require that permits be pulled and HVAC installations be done by participating contractors in order to be eligible for rebates. This shift is not yet statewide; for example the Los Angeles Department of Water and Power (LADWP) still provides "widget" rebates on equipment without upfront requirements on installation quality. Table 4.2 provides an overview of current IOU programs targeting the HVAC sector.

The first residential QI/QM program is now underway at Southern California Edison (SCE) and the other IOUs have submitted program implementation plans for programs that will converge with SCE's in the next year. For the first time, these QI/QM programs provide significant rebates based on installation quality that, when added to state and federal incentives, are large enough to close the gap between a low bid, poor installation job and a high quality job. The programs set rigorous standards for contractor participation, including the requirement that 50 percent of technicians be certified by North American Technician Excellence (NATE).[13] Technicians or other employees are also required to attend mandatory training modules on load calculations and field commissioning. These training modules were added after commencement of the program, because although training in load calculations (Air Conditioning Contractors' Association Manuals J and N) are part of the course offerings at the Energy Training Centers, SCE program managers found that most contractors were unable to properly perform them.

Table 4.2 Statewide IOU Program Budgets for HVAC, 2010 to 2012*

Program	Budget	Description
Quality Installation & Quality Maintenance (QI/QM)	$65,129,148	A set of new programs tying consumer rebates to quality specifications in residential and commercial installation and maintenance. The only program underway is SCE's Residential Installation Program. For that program, new units must be installed to a quality specification by a contractor with at least 50 percent NATE-certified technicians. Also includes training requirements.
Upstream Incentives	$31,943,132	This program provides rebates to manufacturers and distributors (see above).
Workforce Education & Training (WE&T)	$10,185,146	This is a non-resource program dedicated to training at all levels of the HVAC value chain, particularly in the area of QI/QM.
Technology & Diagnostics	$19,510,819	This is a non-resource focusing on advocacy and coordination to promote more efficient HVAC technologies.
Core Umbrella-PIP (SDGE & SoCalGas only)	$101,057	Coordination and administration.
Total HVAC Budget	$126,869,302	

*In addition to the programs described in Table 4.2, Pacific Gas and Electric (PG&E) has added a $1.5 million third-party HVAC program known as Cool Cash, which provides audits and single measure incentives for commercial and industrial facilities. San Diego Gas and Electric (SDG&E) also has third party contracts covering residential HVAC at $5,573,279 and Commercial HVAC at $5,135,116.

The existing SCE program removes contractors that do not meet standards and has thus far only retained 25 percent of the contractors who were initially recruited into the program. According to SCE HVAC staff, the other 75 percent of contractors have been removed from the program because of their inability to meet quality standards or because they were taking advantage of the marketing benefits of the program without participating in

[13] NATE is the nation's largest non-profit offering independent third party certification for technicians in the HVAC industry. The organization tests technicians in basic and specialty areas, but does not offer any training. NATE's certifications are endorsed by most major HVAC industry organizations.

the quality installation work. This is an expensive program that is limited in scale and has yet to be evaluated, but represents a significant commitment to supporting quality contractors and technicians in this industry.

The IOUs are also devoting substantial resources to HVAC training. The budget for IOU training activities in the 2010–2012 for the HVAC sector is about $10 million dollars, and a needs assessment specific to HVAC is being planned. This represents a deepening focus on HVAC, which has already been one of the most prominent topic areas in the IOU Energy Training Centers' class offerings. According to the Opinion Dynamics evaluation of the IOU WE&T Energy Training Center programs for 2006–2008, the number of individuals participating in HVAC classes was about 44 percent of the total number of Californians working in the HVAC industry.[14] Though admittedly imprecise, this is an extremely high penetration rate. However, the effectiveness of this training is not well understood, particularly given the high worker turnover in the residential and small commercial sector. In this program cycle, the IOUs are developing programs to collaborate with other HVAC training organizations, in addition to continuing their class offerings. For a further discussion of training in the low road segments, see Section 4.2.3 and Chapter 13.

4.2.2.2 CODES AND STANDARDS

Contractors doing HVAC work must have a C-20 license issued by the Contractor State Licensing Board (CSLB). In order to get a C-20 license, contractors must pass an exam, covering the topics of planning, engineering and design; fabrication, installation and startup; troubleshooting; repair and maintenance; and safety. Although energy efficiency is integral to these topics, the exam does not explicitly emphasize the importance of efficiency considerations and experts have noted that the exam covers only very basic knowledge in each of the areas.[15] There is widespread agreement that the state's licensing requirements do not adequately test for competence. Moreover, they only cover business owners (contractors), not technicians, unlike in the electrical specialty trade where both electrical contractors and electricians must obtain a license in order to practice in California.

Most HVAC work, whether it is installation of a new system, or retrofitting of an existing one, also requires a local building permit and Title 24 compliance documentation, which must be completed by a licensed contractor. As mentioned above, compliance with building permit requirements is extremely low, particularly in the residential and small commercial HVAC markets. In some cases this is because the contractors doing the work are unlicensed. However, even licensed contractors report that in many cases customers request that permits not be pulled, in order to save costs, or to avoid the inspection of previously unpermitted work.[16] In most cases, city governments have very few resources for enforcing building codes and building inspectors, who are often unfamiliar with HVAC work, are not in a position to verify the quality of installations.[17]

As of 2008, Title 24, California's statewide Energy Efficiency Building Code has been revised to include a number of additional or updated measures intended to improve efficiency. These measures also require that particular testing and verification procedures be performed by a CEC certified Home Energy Rating System (HERS) rater.[18] Some in the industry fear that without strong accompanying enforcement measures, these efforts to tighten regulations could inadvertently bolster the unregulated underground segment of the market. Particularly in the current economy, in which cash is in short supply, property owners are reluctant to spend what they see as unnecessary

[14] Opinion Dynamics Corp. (2010). *PY2006-2008 Indirect Impact Evaluation of the Statewide Education & Information Programs*. Prepared for the California Public Utilities Commission Energy Division.

[15] Interviews with SCE HVAC Staff, 3/9/2010; 10/27/2010.

[16] Interview with CPUC Staff, 9/24/2010; Interviews with HVAC Contractors.

[17] Interview with SCE HVAC Staff, 3/9/2010.

[18] California Energy Commission (2011). 2008 HVAC Change-Out Information. Retrieved from: http://www.energy.ca.gov/title24/2008standards/changeout/.

money on code compliance when their concern is ensuring that their air conditioning works. Even when rebates are tied to permitting requirements, the rebates may be too low to compensate for the much greater cost of complying with codes.[19]

4.2.2.3 FEDERAL INCENTIVES

The federal government provides tax credits for energy efficiency investments, including upgrading to ENERGY STAR-rated HVAC equipment. Homeowners can qualify for a tax credit up to 30 percent of the cost of eligible equipment, up to $1,500. Commercial property owners who invest in HVAC systems that are rated 50 percent higher than American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) standards can receive a tax credit of $0.60 per square foot. These are straight equipment incentives that are not tied to quality installation or maintenance requirements. In order to receive the credit, consumers must show a proof of purchase and a manufacturer's certificate documenting the energy rating of the equipment, but there is no verification of the installation. While the commercial tax credits were recently extended until 2013, tax credits for homeowners are set to expire at the end of 2010.

Another incentive program for homeowners, funded by the 2008 American Recovery and Reinvestment Act (ARRA), but administered through the CEC, is the Cash for Appliances program. This program is based on a one-time fund of $15.6 million to provide cash incentives for consumers who replace their appliances with models that exceed minimum Title 24 requirements.[20] Rebates up to $1,000 are available for qualifying HVAC equipment. Unlike the tax credits, this program requires that the equipment be installed by a licensed contractor, that ducts are tested and sealed, and that the contractor finalize all permitting and Title 24 documentation before the customer can receive a rebate. With over 5,000 applications for HVAC rebates since its inception, this program has been successful in pushing quality for some installations. However, this number still represents only a tiny fraction of all HVAC change-outs done in the state in an average year.[21]

4.2.2.4 JOINT INDUSTRY–GOVERNMENT MARKET TRANSFORMATION INITIATIVE: WESTERN HVAC PERFORMANCE ALLIANCE

Based on recommendations in the EE Strategic Plan, the Western HVAC Performance Alliance (WHPA), an industry stakeholder group, was formed to provide the California IOUs with input from the HVAC industry as implementation of the Plan proceeds. This task force represents an unprecedented collaboration between stakeholders and government agencies, and includes representatives of the major manufacturer, distributor, union and non-union contractor trade associations; all four investor-owned and some public utilities; a number of large individual contractors; the CPUC, CEC and other government agencies; the dominant third-party personnel certification bodies, such as NATE, HVAC Excellence, and United Association (UA) STAR; and multiple other industry stakeholders. It includes individual contractors in the residential and small and large commercial markets who are interested in growing the quality segments of the industry. These stakeholders are working together in committees devoted to implementing the market transformation strategies outlined in the EE Strategic Plan, including a newly convened workforce committee.

The goal of the task force is to upgrade the HVAC industry, transforming it into an industry where quality is recognized and rewarded. In its initial stages, the WHPA is focused on addressing compliance with existing

[19] Interviews with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), 2/5/2010; Institute of Heating and Air-Conditioning Industries (IHACI), 9/1/2010.

[20] Current standards require that equipment have a minimum Seasonal Energy Efficiency Rating (SEER) of 13.

[21] The CEC reports that 346,322 residential central air-conditioning system replacements with energy savings potential occurred in California in 2006: Messenger, M., 2008, p. 31.

standards and mainstreaming quality installation and quality maintenance practices. These strategies involve working with the Contractor State Licensing Board (CSLB) to enforce licensing and permitting requirements, and with the CEC, the IOUs, and the California Building Officials (CALBO) to train Building Inspectors in new Title 24 requirements related to HVAC systems. Other committees and subcommittees are devoted to addressing each of the transformation strategies outlined in the EE Strategic Plan. The HVAC Performance Alliance is a significant emerging venue for addressing industry issues, including workforce planning, and a workforce committee has recently been formed to address training issues.

4.2.3 LABOR MARKET CONDITIONS

As shown in Table 4.3, the market segmentation described above also exists in the labor market. In the "high road" large commercial and institutional market segments, workers are better trained, wages are much higher, and workers are much more likely to make a career commitment to the industry. A greater number of employers in this segment have collective bargaining agreements with labor unions and thus, participate in state-certified apprenticeship programs. The apprenticeship system creates a structure that allows employers who compete using highly skilled labor to jointly fund and direct training so that each business does not have to individually invest in training program design and delivery. Training consists of five-year apprenticeship programs which, according to interviews with industry and workforce experts, are much more comprehensive than community college and private trade school programs. Graduates of apprenticeship programs are better prepared to solve problems in the field and have a stronger background to understand changing work specifications and new technologies. Apprentices also have the opportunity to earn a number of certifications throughout their training, which certify their skill level and provide a baseline knowledge that can be built upon through journey upgrade training. This broad occupational background, continuing education opportunities, and career commitment all make possible the incorporation of new skills and knowledge in a way that sticks.

Contractors in the large commercial and institutional sector articulated the critical importance of training a highly skilled workforce. One commercial HVAC contractor put it like this:

> *"For example, today we're looking at a small three-story building. It's a medical office building. It not only has energy problems, but this July, which is one of the coldest Julys on record, the building consumed more energy than it has ever consumed in its history. So we can send somebody in there to put some meters on it and take some readings, but to assess that building and understand why this building is suddenly using more energy than ever before requires somebody that has a deeper understanding of the systems and how they work. And how the operation of the building demands assistance with the building-timers, settings, economizers, and how that impacts how they use energy. That's not something we can teach someone in two weeks. That's something that takes a couple of years of training, as well as a couple of years of on the job experience.*
>
> *We are union contractors, so we have the benefit of journeyman upgrade training that's provided through our labor partner. Whether we're dealing with the pipe fitters or the sheet metal workers, the specific programs and classes that we need are available to us through our apprenticeship and journeyman upgrade programs. The classes that are very specific to what we need are on air balance, measurement and verification, and specific certifications. When we want to get our technicians certified to work with certain tools or do certain types of measurements—to get somebody NATE certified, TABB (Testing, Adjusting. and*

> *Balancing Bureau) certified or to get somebody with a Home Energy Rating System (HERS) rating, we're able to get that through our training program."*

This contractor and others we spoke with in the commercial sector recognize that quality depends on a well-trained workforce with access to continuing education to keep up with new practices and technologies. They also recognize the link between better wages and benefits, and their capacity to retain a stable and professionalized work force.

Table 4.3 Dual Labor Markets in the HVAC Industry

	High Road	Low Road
Market Segments	• Large owner-occupied commercial • Public buildings	• Residential • Small commercial
Wages	$14 to $22/hr+ entry wage for apprentices Prevailing wage average $37/hr (plus benefits)*	$10 - $15/hr Maximum around $25/hr
Turnover	Low	High
Training	5-year apprenticeship, comprehensive, funded by employer/employee contributions averaging $1.15 per journey hour worked	On the job, skills specific, paid for by worker or public subsidy
Certifications**	*Common* Journey Card NATE UA STAR TABB	*Rare* NATE HVAC Excellence ICE

* Prevailing wages vary by location, ranging from $25 to $55/hr in California. Union wages are higher, on average, as prevailing wage takes into account both union and non-union sectors. Workers in the high road sector are also much more likely to receive health insurance, pension, and other benefits which can greatly increase their total compensation.

**See Appendix H for a more complete list of certifications.

In contrast, in the residential and small commercial markets, where pressures to reduce costs are greater, there is little incentive for contractors to hire and retain workers with a deep knowledge of the craft, or to invest much time or money in training their staff about more advanced installation techniques or new technology for energy efficiency. Our interviews with HVAC experts in California strongly suggest that this "low-road" segment of the HVAC industry is characterized by low wages, and as a consequence, a lack of career commitment among technicians. Although no quantitative data are available to confirm turnover estimates, anecdotal evidence suggests that turnover is close to 30 percent per year in this sector. [22]

Although a minority of residential contractors offer good quality internal training and encourage workers to pursue industry recognized credentials, a large percentage of employers limit educational opportunities to short term, skills-specific training, often at the workers' own expense. Because most of the training that residential HVAC technicians receive is not formalized, or is specific to a given firm, it is not easily transferable to a higher-level position at a different company, or to acquiring further educational credentials in the sector. Several employers stated that though they preferred to hire technicians with certificates, they did not offer them higher wages. Although third-party certification could provide these workers with a more portable credential, most workers are reluctant to pursue certification if it is unlikely to bring them significantly higher wages. [23] High turnover discourages employers from investing in training for workers and low-paid workers have neither time

[22] San Diego Gas & Electric (2006-2008); interviews with HVAC contractors and experts.

[23] See Appendix H for a more complete description of skills certifications in HVAC.

nor money to invest in improving their skills. Despite this piecemeal training, most small firms expect technicians to perform all aspects of the trade, which require substantial skills if work is to be performed correctly. Some medium-sized firms classify workers into lower paid installation jobs, which require only a few weeks to a few months of on-the-job training, and slightly higher paid service technician jobs, which may require up to a year of community college or trade school, but in general, career ladders in the low-road sector are limited.

4.2.4 IMPACT ON ENERGY SAVINGS AND WORKFORCE OUTCOMES

There is very widespread recognition among HVAC industry stakeholders and experts of the installation and maintenance quality issues in the residential and small commercial market segments described above. The impact of these poorly-installed systems has been a significant loss of energy savings.[24] In the 2008 *Strategic Plan to Reduce the Energy Impact of Air Conditioners,* the CEC estimates that potential cumulative savings from higher quality HVAC installation in the residential and small commercial markets could reach 1,216 GWh and 1,096 MW by 2020.[25] This represents roughly two combined-cycle gas-fired power plants of 500 MW each. The report also notes that estimated cumulative savings would be 1,272 MW from "accelerated introduction of more efficient and *properly installed* [emphasis added] cooling technologies," by 2020.[26] The CPUC's Evaluation of the 2006–2008 IOU Energy Efficiency programs reports that for residential HVAC incentive programs, not only were evaluated energy savings consistently lower than predicted, but the data from measured duct leakage in the sample houses indicates that "some of these units never had any work performed."[27] It is possible that service contractors on the site "made some efforts to seal the duct work," but even if this is the case, it was done so poorly as to be equivalent to having no improvements made at all.[28]

The major obstacle to increasing energy savings in the HVAC sector is the poor quality of installation and maintenance in the small commercial and residential markets. Because good quality installations are difficult for the layman to see or measure, residential and small commercial customers overwhelmingly choose the low-priced option. There is consensus that poor quality is the result of this low-bid market, favored when standards are not enforced and the low road is not closed off.

Before the 2010–2012 program cycle IOU rebates had been limited to equipment standards, and had placed no upfront requirements on contractors to hire skilled workers, perform work to quality specifications, or obtain required building permits. The CPUC and some industry leaders are now embarking on an earnest effort to address some of these issues, which are fundamentally workforce issues. And, although training is necessary, it is not sufficient to address the problem of low-quality work. Unless there is a demand to recruit and retain trained workers and support them to use their skills, there will not be an improvement in quality. Thus, the sector itself needs to be transformed so that a thriving market develops for skilled, high-wage work that delivers real energy savings.

Currently, the low-road conditions and lack of quality requirements in residential and small commercial markets provide little reward for investments in training by either workers or employers. Though skills are required for optimal performance, they are not rewarded. In this situation, although public investment in skills training for technicians in the residential and small commercial segments appears, at first glance, to be a good solution for

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[24] California Public Utilities Commission, 2008b, page 58.

[25] Messenger, 2008, p. 36.

[26] Ibid.

[27] California Public Utilities Commission (2010). *2006-2008 Energy Division Scenario Analysis Report*, p. 18. Retrieved from: ftp://ftp.cpuc.ca.gov/gopher-data/energy%20efficiency/Final%20Energy%20Division%20Scenario%20Analysis%20Report_070910.pdf

[28] Ibid.

improving installation and maintenance quality, training is unlikely to have a transformative impact. If estimates of turnover in the HVAC sector are accurate, as much as $3 million or more out of the $10 million invested in HVAC workforce education and training over this three-year funding cycle may be wasted as workers leave the industry. Training will have a much more valuable impact once market conditions have created a more stable and committed workforce. One small commercial HVAC contractor in Southern California summed up the situation:

> *"If we're to get where the state wants us to be with the strategic plan…it's so fundamental at so many levels for us to be able to pay kids what we're going to need to be able to attract them to the industry. We have to be able to charge higher rates—charge our customers more, rather than what the low ball guys are charging."*

This situation obviously affects worker outcomes as well. In the large commercial, more highly unionized HVAC sector, workers who start out with no postsecondary education support themselves through five year apprenticeship programs and end up with journey level wages of $35 to $45 per hour, with health and pension benefits and access to further training. In contrast, residential and small commercial HVAC workers enter at about $14 per hour and top out at $25 per hour after years of work experience, much more meager benefits and fewer opportunities for free skills upgrading. These low-road conditions mean that although being an HVAC technician in the residential and small commercial sector could be a good middle skill career, based on substantial investment in skill development, it currently neither provides the wage floors nor career ladders that could make it so.

4.2.5 FUTURE DIRECTIONS AND LESSONS FROM HVAC

The problems of quality and standards in the residential and small commercial HVAC sector are broadly acknowledged, and have reached such dramatic levels that concerted efforts are now being made to close off the low road and build the high road. In designing future policies to promote energy efficiency in HVAC and other areas, it is critical to keep in mind the lessons that the story of the HVAC industry teaches. Most importantly, although training is necessary, it is insufficient to address the problem of low-quality work. Unless the existing competitive conditions support high quality work, there will not be an improvement in quality. In some sectors, like residential and small commercial HVAC, this requires closing off the low road by setting and enforcing minimum quality standards. Thus, the sector itself needs to be transformed so that a thriving market develops for higher-skilled, high-wage work that delivers real energy savings.

It is also important to recognize that market transformation goes beyond what utility energy efficiency incentives can address. Steering low-road market segments onto the high road will require more than limited incentive programs and training programs. Utilities do not have the authority or the capacity to enforce licensing and code regulations, and incentive programs drive only a portion of the market.

Concerted and coordinated efforts by the many state agencies and regulatory bodies that influence the HVAC sector are necessary. Such efforts include enforcement of existing standards and stronger licensure provisions that cover both contractors and workers and require testing of expertise and ongoing professional development. In addition, the use of prevailing wages and project labor agreements in public and many commercial projects help support a business model built on the demand for highly skilled workers. In this business model contractors balance higher wages with more highly skilled and productive workers and maintain high training standards through bargained contributions to the apprenticeship programs.

Recent work on improving compliance and developing new codes and standards within the CEC, CPUC, Contractor State Licensing Board (CSLB), California Building Officials (CALBO), utilities, and the stakeholders in the WHPA show significant effort toward setting the bar for contractor qualifications and performance higher. These efforts are a start, but key informants at the WHPA admit that there is still a long way to go toward transforming the market.

If these statewide efforts to build the high road and close off the low road in the HVAC sector are successful, they will support the development of a more stable and professionalized workforce. They will also likely drive up the upfront costs of HVAC installation. While further evaluations are warranted, the expectation is that over the long run, higher energy savings, particularly the more valuable peak energy savings from properly installed HVAC systems, along with savings from higher worker retention rates will compensate for the higher costs.

4.3 RESIDENTIAL ENERGY EFFICIENCY RETROFITS

Retrofitting residential buildings represents one of the greatest opportunities and one of the greatest challenges for achieving California's energy efficiency goals. The residential sector represents about one-third of California's current electricity and natural gas consumption.[29] Without major efforts to reduce household consumption, residential electricity demand is expected to increase nearly 25 percent by 2018. Although California is a leader in reducing energy use in homes, there are significant opportunities to achieve deeper energy savings on a greater number of dwellings. Policymakers have responded to this challenge with specific goals in the EE Strategic Plan. These goals are also supported by AB 758, California's Comprehensive Energy Efficiency Program for Existing Residential and Non-residential Buildings law, passed in 2010, as well as by significant channeling of funding from the 2009 ARRA to the residential sector.

The EE Strategic Plan goals for the residential sector are that by the year 2020:[30]

- → All eligible low-income customers will be given the opportunity to participate in low-income energy efficiency programs; and
- → Twenty-five percent of existing homes will achieve a 70 percent decrease in purchased energy from 2008 levels and 75 percent of existing homes will achieve a 30 percent decrease in purchased energy from 2008 levels.

Like the HVAC sector, the emerging residential retrofit sector faces issues of poor quality work which can lead to unrealized energy savings and undermine market expansion.

4.3.1 MARKET DYNAMICS

The home performance market (i.e., the market that specializes in energy efficiency retrofits) is still very underdeveloped. Homeowners are as likely to invest in energy efficiency upgrades during comprehensive remodeling projects and when they replace worn out appliances and other equipment, as they are to invest specifically in energy retrofits. Many barriers to the expansion of the home performance market persist. Frequently identified barriers include payback periods from energy savings that may outpace ownership or tenancy, homeowners' lack of access to capital to cover the upfront costs, split incentives between the building's owner and

[29] Thirty-two percent of electricity consumption and 36 percent of natural gas consumption is in the residential sector. (California Public Utilities Commission, 2008b, p. 9).

[30] California Public Utilities Commission, 2008b, pp. 19, 26.

tenants (who pay the energy bills), a lack of reliable information for consumers to make decisions, and the overall atomization of the work that leads to dispersed returns and increased costs.[31]

The pool of contractors carrying out energy efficiency services includes home performance specialists as well as more general remodeling and specialty trade contractors. Contractors that do not usually specialize in home performance may make particular choices regarding practices or materials in order to take advantage of rebates on projects that would likely occur even without incentives. In addition, some HVAC and other specialty trade contractors are broadening their work into the home performance market, using the opportunity of HVAC change-outs to sell customers on related energy efficiency measures.[32] Because of these blurry boundaries, the retrofit market is embedded within the residential construction industry as a whole and is largely shaped by the competitive dynamics and regulatory framework of this wider market.

The residential construction industry, in which home performance is embedded, is characterized by intense competition between numerous small firms, with upfront costs being the primary consideration for many homeowners. The structure of the residential construction industry is similar to what we have described above as the "low-road" side of the HVAC sector. Much of the market is unregulated, and some contractors operate without proper licenses and/or without the required building permits. Firm size is small and employment relationships are often casual. In 2008, 89 percent of residential remodeling contractors employed fewer than ten workers each.[33] This tally does not include the considerable number of contractors with no permanent employees, those who subcontract for all their labor needs, or those who hire undocumented day laborers to supplement their workforce.[34] It is also relatively easy for contractors to enter the residential retrofit market, as licensing requirements are not stringent, and many homeowners are not aware whether or not their contractor holds a license.

4.3.2 POLICY INSTRUMENTS AND PROGRAMS

The main policy instruments aimed at achieving residential energy efficiency goals in the state are direct-install weatherization programs for low-income households, and incentive programs for homeowners. In addition, Titles 20 and 24 of the California Code of Regulations set minimum standards for appliances and work specifications for home remodels.[35] As mentioned above, these codes were recently updated to require more stringent energy efficiency measures and third-party inspections. However, in many cases remodeling and retrofit work in the residential sector is done without the required permits, so the work is never inspected to ensure it is compliant with these codes.

4.3.2.1 LOW-INCOME PROGRAMS

[31] See for example, Fuller, M., C. Kunkel, M. Zimring, I. Hoffman, K. L. Soroye, and C. Goldman (September 2010). *Driving Demand for Home Energy Improvements*, LBNL-3960E. http://drivingdemand.lbl.gov/.

[32] Interviews with Contractors, 8/2010–11/2010.

[33] Quarterly Census of Employment and Wages and U.S. Census, 2008 County Business Patterns. Retrieved from: http://www.labormarketinfo.edd.ca.gov/.

[34] According to a landmark 2006 survey of day laborers, residential construction contractors and home-owners are the top two employers of casual workers picked up on the street or at day labor sites. See Valenzuela A. et al. (2006). *On the Corner: Day Labor in the United States.* Center for the Study of Urban Poverty, University of California, Los Angeles. Retrieved from: http://www.sscnet.ucla.edu/issr/csup/index.php.

[35] Title 20 pertains to the Public Utilities and Energy Code and Title 24 pertains to Energy Efficiency Building Standards. Title 24, Part 6 applies to residential and nonresidential building envelopes, space-conditioning systems, water-heating systems, and indoor lighting systems of buildings, and outdoor lighting systems and signs located either indoors or outdoors.

Low-income programs provide free energy efficiency retrofits for low-income households. This market is entirely policy driven and is publicly funded from federal, state, and ratepayer sources. These programs have the dual objectives of creating energy savings through improvements to residences that would not otherwise be retrofitted, and of supporting low-income families by reducing their energy bills.

There are two federally funded low-income programs: the Weatherization Assistance Program (WAP), funded by the U.S. Department of Energy (DOE) and the Low Income Home Energy Assistance Program (LIHEAP,) funded by the U.S. Department of Health and Human Services (HHS). In California, these federally funded programs are administered by the California Department of Community Services and Development (CSD). All the investor-owned utilities and some public utilities also run energy efficiency programs for low-income households. In the case of the IOUs, these Low-Income Energy Efficiency (LIEE) programs are overseen by the CPUC and the Low-Income Oversight Board (LIOB).

Low-income programs typically use a "direct install" approach that gives the utilities and state agencies substantial oversight and control over the work that is carried out, including the choice of contractors and training requirements. Retrofit businesses have contracts with the utilities or their subcontractors for the LIEE and public utility programs and with the CSD for the federally funded WAP and LIHEAP. Since these programs aim to provide benefit to low-income households, some of the contractors chosen are "social enterprises," such as community action agencies that provide a variety of services in the community, while others are for profit firms.

Table 4.4 shows how WAP and LIHEAP, which had been fairly stable since 1979, have been given a large but short-term boost through ARRA funding.[36] Funding for the low-income IOU programs has also increased substantially in the latest funding cycle, providing a larger and more stable source of funding. These large increases in funding for low-income weatherization have greatly amplified the workload for contractors participating in these programs. Contractors report higher levels of subcontracting, as well as increased work hours and hiring to meet this demand.[37] Because the ARRA funding for WAP and LIHEAP is only temporary, most contractors have chosen to subcontract this work.

The low income programs focus on a package of prescriptive measures that are installed in every household. This means that emphasis is placed on installing particular equipment or materials, rather than on a whole house building systems approach that uses diagnostic testing to determine the best package of measures. However, the federally funded programs have recently begun requiring some diagnostic testing and have also substantially increased the maximum budget available for each household to cover these increased costs.

Table 4.4 Low-Income Program Summary

Program	Agency	2010 Budget	Assistance Per Unit	Quality Assurance
WAP + LIHEAP	U.S. Department of Energy and U.S. Department of Health & Human Services	Formula, $71 million ARRA, $186 million	Raised from $2,500 to $6,500 under ARRA statute	Diagnostic testing, in-house inspection
Low Income Energy Efficiency (LIEE)	Investor-Owned Utilities & CPUC	$310 million		Field verifications on some installations

In the LIEE programs, implementation contractors for some of the IOUs were reported to subcontract out specific components of the work, such as signing up new customers or carrying out a specific measure, to other firms or independent contractors. Interviews with former employees and experts familiar with the LIEE program suggest

36 Low Income Home Energy Assistance Program Clearinghouse, National Center for Appropriate Technology. Retrieved from: http://liheap.NCAT.org.

37 Interviews with contractors 8/2010–10/2010.

that this piecemeal approach reduces potential energy savings by providing incentives that undercut the ability of the program to address whole house linkages among measures and to leverage all available funding streams.

4.3.2.2 CUSTOMER INCENTIVE PROGRAMS

Customer incentive programs are market driven programs that primarily take the form of rebates that buy down the cost of energy efficiency retrofits, thereby encouraging additional consumer investment. In contrast to the fully subsidized direct-install low-income programs, in rebate programs the consumer chooses and hires the contractor. Historically, these programs have focused rebates on single measures or equipment change-outs. As in the case of HVAC, these "widget" rebates focus on energy efficient equipment and materials, rather than installation quality and rely on back-end inspection rather than upfront contractor or worker standards.

As a result of the EE Strategic Plan goals, AB 758, and significant funding from the ARRA, California's customer incentive programs have recently been rolled into the statewide "Energy Upgrade California" initiative. [38] In contrast to previous approaches, Energy Upgrade California emphasizes: (1) a whole house approach to energy retrofits; (2) an alignment of numerous funding streams along with efforts to expand financing; and (3) greater emphasis on contractor and worker certifications to meet strict test-in and test-out quality standards. Table 4.5 shows the various funding streams that have been aligned under the Energy Upgrade program and gives a basic description of the program incentives and requirements.

Energy Upgrade California acts as a statewide branding mechanism as well as a clearinghouse for financing options and incentives in each locale. The coordination of this statewide program began under the auspices of an ad hoc coordinating body convened by the California Environmental Protection Agency (EPA), known as the California Home Energy Retrofit Coordinating Committee (CA HERCC). This group was originally convened to provide recommendations to local governments that were planning to implement a Property Assessed Clean Energy (PACE) financing program. The committee has included government agencies, the IOUs, and the California Building Performance Contractors Association (CBPCA) in an effort to align agencies and programs relevant to the residential retrofit industry. Although most local PACE programs have now been cancelled or postponed, recommendations drafted by CA HERCC have been instrumental in focusing ARRA funds and utility incentive programs on the whole house retrofit strategy and determining the contractor requirements and quality assurance mechanisms adopted by the Energy Upgrade program.

[38] Energy Upgrade California is also the policy umbrella for ARRA-funded commercial retrofit incentive programs, which have not yet been fully developed.

Table 4.5 Energy Upgrade California Summary*

Program	Agency	2010 Budget
Residential Whole House Programs	IOUs & CPUC	$116 million
Comprehensive Residential Retrofit Program	State Energy Program (ARRA)	$50 million
Statewide Community Development Association	State Energy Program	$33 million
Energy Efficiency and Conservation Block Grants	ARRA funds, administered by local governments	$12.9 million
Clean Energy Workforce Development Program	ARRA funds	$20 million
Better Buildings Program	DOE	$30 million
Workforce Investment Act	California Employment Development Department	$13 million+
Total	Energy Upgrade California	$275 million+

Program Description
• A Basic Package offers $1,000 rebate to customers who implement a prescribed set of energy efficiency measures.
• An Advanced Package offers a maximum rebate of $4,000 for customers who are willing to invest in a more thorough performance-based retrofit.
• All participating contractors must be licensed, complete an orientation course, and sign a participation agreement, and have a BPI-certified Building Analyst conduct safety tests.
• Contractors must be BPI-certified to participate in the Advanced Program or complete a 3-day Basic Path Training for the Basic Program.
• Post-installation inspections must be conducted by CEC certified HERS II raters.

*"Energy Upgrade California Introduction," Slides from All-Party Meeting on October 7, 2010. Retrieved from: http://www.energyupgradecalifornia.com/documents/2010-10-07_presentations/Energy_Upgrade_California_All_Party_Introduction_Final.pdf.

4.3.3 LABOR CONDITIONS

Because rebate programs have, until recently, focused on equipment ratings and not on the quality of work being performed, and because energy retrofits are not yet a market separate from remodeling and equipment change-outs, the residential retrofit market is subject to the labor conditions in the wider residential construction market. As described above, the residential construction industry in California is highly competitive and largely unregulated. Workers in this industry are often subject to poor wages, high injury rates, poor working conditions, and a lack of career pathways.[39] A large percentage of workers are immigrants, many of whom are undocumented.[40] Many workers are hired as independent contractors or as casual day laborers, rather than as employees. Although it is technically illegal, it is common practice for residential contractors to misclassify employees as independent contractors, enabling employers to save money on insurance, payroll taxes, and other costs. While workers in this industry may be skilled, they frequently face low wages and employment law violations due to their legal status, language barriers, and lack of other options. These conditions are not captured in government wage data, but the only available large scale survey of residential construction and other low-wage workers in Los Angeles, 17 percent of surveyed workers in the residential construction industry reported experiencing minimum wage violations, 64

[39] Wilson, C. (2009). *Construction Apprenticeship Programs*. Center on Policy Initiatives; Baxamuza (2009). *Construction: Working without a Healthcare Net*. Center on Policy Initiatives.

[40] Valenzuela A. et al. (2006). *On the Corner: Day Labor in the United States.* Center for the Study of Urban Poverty, University of California - Los Angeles. Retrieved from: http://www.sscnet.ucla.edu/issr/csup/index.php.

percent reported being forced to work off the clock with no pay, and 79 percent reported being denied a standard meal break.[41]

A number of home performance contractors, focusing on whole-home performance that requires extensive diagnostics and testing, are attempting to carve out a quality niche in this market. These contractors are committed to high quality services and in interviews stated their desire to employ long-term well-trained employees. However, they are forced to compete in the wider residential remodeling market where competitive conditions favor the low road. LIEE and WAP contractors are more shielded from the wider residential construction market because they enter into long-term contracts with the IOUs or state agencies, so competitive pressures are determined by program budgets and bidding mechanisms.

Wages for workers in the residential retrofit market are inevitably influenced by these labor market conditions. The largest job category in residential energy efficiency retrofit work is the installer/technician category, comprising an estimated 68 percent of all non-administrative work, according to the Los Angeles County Energy Plan. These workers perform basic insulation, caulking, weather stripping, sealing, and related tasks. In some cases crews are also responsible for mechanical and glazing work, and even installation of solar panels. Although no reliable quantitative wage data is available, our interviews revealed entry-level technician installer wages as low as $8.00 per hour and as high as $15 per hour in home performance. Notably, higher wage contractors described how hard it is to maintain a viable business when their competitors commonly pay lower wages, and cut corners in other ways, such as subcontracting out asbestos work to unlicensed contractors.

Though LIEE contractors are shielded from the competitive dynamics of the customer driven retrofit market, there seems to be great variation in the wages paid in this segment as well. Some LIEE subcontractors pay piece rates for each item installed or customer enrolled, and anecdotal evidence suggests pay can be as low as $50 to $70 per day in these cases. Some LIEE and WAP contractors that are community-based organizations with economic development missions pay higher starting wages, in the range of $13 to $14 per hour. For WAP work funded through the ARRA, Davis–Bacon Act prevailing wages apply, which for weatherization installers range from $11 to $15 per hour, depending on location.

Higher-wage and higher-skills jobs in the residential retrofit industry include crew chiefs, home performance analysts or auditors and raters and quality inspectors, but these jobs are much less numerous that the basic installer job. Though no certifications have been adopted on an industry-wide basis, a number of them now exist for home energy auditors and home energy raters, including those offered by the Building Performance Institute (BPI). In the 1990s the CEC developed the HERS for new homes and is now rolling out the HERS II certifications for raters and inspectors for home retrofits. The DOE has also developed voluntary skill standards for four main field jobs in residential retrofit, discussed below. At this time, there are no training or certification requirements for the bulk of workers employed by contractors participating in the newly launched Energy Upgrade California, though there are contractor requirements for all incentive packages. For the advanced upgrade package (based on test-in and test-out performance), contractors or one of their staff must have a BPI Building Analyst (BA) certification, and raters must have a whole house HERS II certification.[42]

In contrast, WAP and most LIEE workers, including installation workers, are required to attend short-term trainings at approved training facilities (such as PG&E's Energy Training Center in Stockton) before starting work. These training programs provide certificates of completion to workers, which are the only certificates that were

[41] See Milkman et al. (2010). *Wage Theft and Workplace Violations in Los Angeles: The failure of employment and labor law for low-wage workers.* Institute for Research on Labor and Employment, University of California - Los Angeles. Retrieved from: http://www.irle.ucla.edu/publications/pdf/LAwagetheft.pdf.

[42] California Energy Commission (2010). Energy Upgrade California: Becoming a Participating Contractor. Retrieved from: https://energyupgradeca.org/statewide_for_contractors.

identified for the weatherization installer job category in California. PG&E and SCE have established specific training standards and courses; these courses follow a specific set of training standards established by the utilities. However, the other two IOUs do not require their contractors to follow specific standards.

Though the WAP and LIEE programs are very similar, the training requirements differ, so that a worker trained for a WAP contractor is required to undergo new training to be eligible to work for a LIEE contractor. The DOE is now funding efforts to align all the major trainings and link them as much as possible to their new voluntary guidelines for skill standards and training, discussed below.

4.3.4 IMPACT ON ENERGY SAVINGS AND WORKFORCE OUTCOMES

Concerns about quality work in residential retrofit were commonly expressed in interviews conducted for this study. In addition, quality concerns have been a central focus of program design in all the new policy efforts to expand funding for residential retrofits in California and nationally.

In residential retrofit, the quality issues that surfaced in our interviews included concerns about safety, loss of immediate potential energy savings, and slowing down the expansion of the market for retrofits. Safety concerns were focused mostly sharply on the necessity of testing for appliance combustion safety in order to avoid dangerous buildup of toxic gases inside the building as a consequence of envelope sealing. In terms of immediate energy savings, interviewees identified both single measure quality issues, such as improper installation of insulation, and the more sophisticated diagnostics and workmanship needed for whole house retrofits. Finally, interviewees also emphasized the importance of consumer satisfaction for market expansion. Since growing the market for homeowner investments in energy efficiency retrofits depends in large measure on word-of-mouth advertising and other social marketing, consumer dissatisfaction resulting from inadequate work quality can significantly undermine sector growth.

Traditionally IOU incentive programs and low-income weatherization programs have relied primarily on post-installation inspections of a sample of dwellings. This method only captures a fraction of the work that is done, and when poor quality is found, often requires expensive reworking. Though certainly part of any quality assurance package, back-end inspections have not rid programs of quality concerns.

Energy Upgrade California has continued to use back-end verification, but is also addressing quality concerns through upfront contractor requirements, including licensure, permitting, a standard agreement, and a mandated orientation course. The program currently has determined that HERS II and BPI certifications will be required for building raters and auditors; certification requirements and quality work specifications for specialty trade technicians (such as HVAC) are now under consideration for inclusion. However, at this time there are no specific training or certification requirements for weatherization installers who perform the majority of energy efficiency installations. The LIEE programs carry out both upfront training of workers and back end inspections, but their single measure approach (and possibly program design incentive structures) limits overall potential energy savings. The LIEE programs are being evaluated at this time and may undergo changes in the next funding cycle.

In terms of worker outcomes, the residential retrofit sector seems to provide low wages and few benefits, though the lack of basic jobs and workforce data frustrated our attempts to quantify this. As in many low-wage industries, career ladders are currently very limited in the residential retrofit industry. Research on career ladders has shown that large firms with internal labor markets are much more likely to provide promotion opportunities internally.[43] In sectors, such as residential construction, characterized by small firms and multiple subcontracting levels, career

[43] Fitzgerald, J. (2006) *Moving Up in the New Economy: Career Ladders for U.S. Workers*. Ithaca: Cornell University Press.

advancement opportunities are much more difficult to find. As discussed above, the residential and commercial construction markets are highly segmented in terms of wages, skill levels, and contractor type, making movement up from the low-wage residential to the much higher-wage, higher-skills commercial market segment difficult.[44]

4.3.5 NEW POLICY DIRECTIONS

California, a number of other states, and the federal government are all engaged in enormous efforts to ramp up residential retrofits. The current period is one of great experimentation in program design for many residential retrofit programs. A number of approaches are being tried—and debated—to achieve the objective of improved work quality. In some cases, policymakers and program designers have also attempted to build in job quality and job access requirements. Below, we discuss some of the promising approaches to the workforce issue that are being undertaken and promoted nationally and in some other states.

The "Recovery through Retrofit Workforce Working Group," convened by the Obama administration to scale up the residential retrofit market, identified the lack of a skilled and credentialed workforce as a key obstacle to the industry's growth. As a result, the U.S. Department of Energy (DOE) has developed a set of industry guidelines for worker certifications and training program accreditation for the four main field job categories: Installer/ Technician, Crew Chief, Energy Auditor, and Quality Assurance Inspector.[45] These guidelines were created through rigorous technical analyses of job tasks and minimum technical requirements, standard work specifications, and essential knowledge and skills for workers in each job category. The development of these guidelines followed well-known protocols that included substantive feedback from industry and educators. They provide the first standard for the entry level job category of weatherization installer/technician, which can be used to ensure workers are prepared to do quality work. Now, BPI, WAP, and training programs around the country are working with DOE to align their standards with these basic guidelines. Los Angeles Trade–Technical College (LATTC) is one of the training centers funded by DOE and is working to align the WAP, LIEE, and other curricula. The DOE is encouraging these voluntary standards, and it remains to be seen whether these guidelines will be adopted as mandatory certification requirements by any major state or local retrofit program.

Certifications can contribute to improvements in quality, and they can also help improve workforce outcomes.[46] LATTC's involvement in the alignment of curricula for certifications is motivated by wanting to provide students with portable and stackable certifications that can facilitate career mobility. The college has also been working to establish a number of career pathways in the industry. The challenge LATTC articulates is that in order for certification to actually lead to strong career pathways with higher skills and higher wages, there must be adequate floors on wages and wide acceptance of the value of certification within the industry, so that employers are willing to pay certified workers more. It is not clear yet whether the residential market can offer these conditions.

One model to incorporate certification has been proposed by Efficiency First, a national trade association for the home performance industry.[47] They propose a "training within industry" (TWI) model that would use public funding for on-the-job training, tied to worker certification. Training within industry has the advantage of targeting

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[44] Wilson, C. (2009). *Construction Apprenticeship Programs*. Center on Policy Initiatives, Center on Policy Initiatives; Baxamuza (2009). *Construction: Working without a Healthcare Net*. Center on Policy Initiatives.

[45] U.S. Department of Energy (2011). *Energy Efficiency & Renewable Energy: Weatherization & Intergovernmental Program*. Retrieved from: http://www1.eere.energy.gov/wip/retrofit_guidelines.html.

[46] See Chapter 5 for an in-depth discussion of certifications.

[47] Redman, E. (2010). Green Jobs in the Residential Energy Efficiency Industry: The Home Performance Industry Perspective on Training and Workforce Development. Home Performance Resource Center. Retrieved from: www.hprcenter.org/.../green_jobs_in_the_residential_energy_efficiency_ industry.pdf.

training to workers who are already hired and have been screened by employers to make sure that they can physically perform the work (for example move through small crawl spaces). In addition, it provides trainees with hands-on work experience, not just classroom or online learning, which is insufficient in this hands-on profession. This approach is very similar to apprenticeship but proposes using public rather than industry funding. Workforce development funding from state and federal sources for on-the-job training has been quite limited because of the concern that employers might pay for this type of training without a public subsidy. However, if there were systems in place to track participants, clear agreements on wage progressions tied to certifications and other accountability measures, this could be a viable way to achieve both higher work quality and better workforce outcomes.

Attempts to integrate apprenticeship and unionized contractors into residential retrofit projects are also occurring, though not without challenges. In the residential sector, particularly, the rigid craft lines of the unionized sector do not make sense for small jobs, and unions have only begun to address the possibility of new job classifications that entail doing work that combines the traditional jurisdiction of more than one craft and have wage scales that correspond to the lower skills needed for residential work. For example, the Los Angeles Department of Water and Power (LADWP) is considering a model for energy efficiency retrofit of low-income residences and non-profit buildings where utility employees carry out retrofit work under a new "pre-craft trainee" job classification in the International Brotherhood of Electrical Workers (IBEW) Local 18–LADWP collective bargaining agreement. These trainees would have a starting wage of $16 per hour plus benefits and participate in an 18 month training program that will prepare them for jobs at the LADWP and to take the civil service exam, assuring a solid career ladder. While this model has not been launched or even approved, we bring it up here as an example of the ways to make energy efficiency work a good job with a career ladder.

An alternative approach to creating career paths for residential retrofit workers and trainees is to help them use their training and experience to move out of residential into commercial construction where wages are higher. LATTC and other colleges, community organizations like MAAC (Metropolitan Area Advisory Committee on Anti-Poverty, the WAP agency in San Diego), and city programs such as Richmond BUILD in the Bay Area, is to develop working relationships with local apprenticeship programs, and provide pathways for their graduates into apprenticeship in the commercial construction industry.[48]

Another approach to achieving workforce goals is to directly institute labor standards, in addition to contractor requirements and worker certification. This method directly addresses the quality of the jobs that are created through publicly funded or subsidized programs. The White House Recovery through Retrofit Working Group is encouraging this approach and the DOE Better Buildings grant program has funded a number of initiatives that use it—all outside California. Green for All, a national nonprofit, has worked with retrofit program managers to refine and implement this strategy, including in Portland, discussed below. In addition, a national coalition of low-income and minority advocacy groups and organized labor has formed to advocate for this strategy under the Emerald Cities Collaborative project, which recently held a briefing at the White House.[49] It has funded project start-ups in ten cities, including Oakland and San Francisco, which are just now being organized.

Key components of these initiatives are:

- Job quality standards that include living wages or other wage standards, health and other benefits;
- Local hire and targeted hire policies to enable job seekers from historically disadvantaged minority and low-income communities to access new job opportunities;

[48] See Chapter 7 and Chapter 13.

[49] Emerald Cities Collaborative (2011). http://emeraldcities.org/.

- → Stringent contractor qualifications, to eliminate labor violations, ensure high-quality work, and "close off the low road;"
- → Provision of high-quality training with industry recognized certification that enables workers to advance in the field, and in some cases use of apprenticeship; and
- → Efforts to increase demand and lower costs for contractors through neighborhood and other bundling approaches that enable contractors to bid on multiple jobs and achieve scale.

A notable example of this approach is the "Clean Energy Works" residential retrofit program in Portland, Oregon. This comprehensive retrofit program is a DOE Better Buildings grantee and includes many innovative components such as on-bill repayment of third party financing.[50] In partnership with Green for All, this program requires contractors to comply with the provisions established in a high-road agreement. This agreement, developed through a multi-stakeholder process, establishes workforce goals and minimum labor standards for participants, including a wage floor and targeted and local hiring quotas.

In addition, the program establishes a rating system for contractors, based on a number of factors set forth in the high-road agreement, including labor standards, contractor standards, local and targeted hire, and inclusion of minority and women subcontractors. These and other factors are used to rank contractors and work is awarded preferentially based on these rankings. Although some of these factors do not tie directly in to improving work quality, the overall goal of the program is to "level the playing field" for high-road contractors and to disfavor those whose business model is based exclusively on cutting costs and hiring low-wage labor.

The Portland experience provides a successful example that illustrates the ability of contractors to comply with the requirements embedded in high-road agreements, albeit at a small scale and in a much less complex environment than a California-wide program. When the Portland program began there were six partner contractors participating in the high-road program; over the last year that number has grown to 17 participating contractors. The program has met or exceeded all of its workforce goals, including paying family supporting wages; employment of underrepresented or disadvantaged workers, who have worked 30 percent of total project work hours; and inclusion of women- and minority-owned businesses, who have received 20 percent of contract dollars. The pilot phase of the program has also been very successful in achieving its energy goals and has been awarded a $20 million ARRA grant to expand the program statewide.

The Portland program is too new to evaluate the potential cost increases associated with the high-road labor standards. While there is a general acknowledgment of the importance of work quality in energy efficiency projects, some stakeholders worry that imposing too many requirements on an emerging industry could raise costs prohibitively, hinder the industry's growth, and slow down job creation as well as energy savings. Increasing demand is certainly a concern in the currently depressed residential market. To date, there is insufficient information to evaluate whether or not imposing higher skill standards and/or labor standards significantly affects the costs of saving energy. In large-scale construction projects, research suggests that higher wage and benefit costs are offset by higher skills, quality, and productivity.[51] In small-scale residential retrofit projects that require lower skill levels, raising skill levels of installers may not compensate for higher training and wage costs. If this is the case, policymakers will have to weigh the competing priorities of cost-effective energy efficiency and good jobs for Californians.

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[50] Clean Energy Works Portland (2011). http://www.cleanenergyworksportland.org/index.php; Green for All (2010). *Clean Energy Works Portland: A National Model for Energy-Efficiency Retrofits*. Retrieved from: http://www.greenforall.org/resources/clean-energy-works-portland-report.

[51] Mahalie, N. (2008), "Prevailing Wages and Government Contracting Costs: A Review of the Research," EPI Briefing Paper #215. http://www.epi.org/publications/entry/b p. 215.

In California, Energy Upgrade California has largely proceeded without incorporating these high-road agreement strategies, due to fears about layering too many workforce goals on top of a new program that is trying to stand up an underdeveloped residential retrofit industry. The County of Santa Clara passed high road language for its PACE program (now held up), which was met by strong objections from the CBPCA, due to their perception that the burdens on their contractors—who are overwhelmingly very small—would be too great.

One of the key challenges in the approaches built on high road agreements is the issue of scale. Very small residential or building performance contractors usually cannot meet either the wage or the reporting requirements of high-road agreements. At the same time, it is difficult for program implementers to attract larger contractors, such as unionized commercial sector contractors, whose business models are based on more highly skilled, highly paid workers and who have the administrative structures and efficiencies to meet accountability requirements of these publicly subsidized programs. Attracting such contractors would also mean negotiating new agreements with unions that include residential wage levels commensurate with residential skill levels, and that allow workers to cross craft boundaries to perform multi-craft work.

Bundling work at a larger scale is an essential strategy for building a program that attracts higher road contractors and that can overcome the barriers just described. There are a number of initiatives around the country that are attempting to create scale, for example, by instituting a competitive bidding process for a group of homes, rather than requiring each consumer to find its own contractor. Because of the strong voice of the CBPCA and the absence of the voice of stakeholder coalitions such as Green for All and the Emerald Cities Collaborative in the design of Energy Upgrade California thus far, there is little experimentation in this kind of scaling strategy in California.

4.3.6 LESSONS FROM RESIDENTIAL RETROFIT

Major new efforts to expand the residential retrofit sector in California have been launched, most importantly Energy Upgrade California and large funding increases for the IOU LIEE programs (as well as the temporary increase in funding for the WAP program from ARRA). These efforts are attempting to carve out and grow a quality residential retrofit sector in California. The initiatives face an important workforce challenge because market conditions in the broader residential construction industry, in which residential retrofit is embedded, are unlikely to support the work quality that is needed to create real energy savings, or the job quality that is needed to provide opportunities for California's workers.

In order to carve out a quality residential energy efficiency market, a number of complementary solutions are needed. These include standardized training and certification requirements for workers and contractors, enforcement of contractor licensing requirements, and other incentives and standards that encourage contractors to engage in high road practices. In addition, if policy priorities include workforce goals in addition to energy efficiency goals, then labor standards and job access provisions, like those embedded in high-road agreements, need support. At a minimum, there is a critical need for more information on wages, turnover and other basic labor market conditions to inform the design of future policies and programs. This information is important to verify if poor labor conditions are, in fact, widespread, and if so, to assess their impact on achieving energy savings and growing the retrofit market. This is needed to be able to analyze the cost effectiveness of alternative program designs and their impact on both energy efficiency and worker outcomes.

4.4 COMMERCIAL LIGHTING CONTROLS

Lighting has long been one of the most cost effective ways to achieve energy savings. Many of the least expensive lighting upgrades, such as bulb change-outs, have already been implemented. However, the EE Strategic Plan estimates that lighting still accounts for approximately 25 percent of California's total energy use and more than 35 percent in the commercial sector.[52] Table 4.6 gives an overview of approved IOU Lighting Program budgets for the 2010–2012 funding cycle.

Table 4.6 IOU Lighting Program Budget 2010–2012

Utility	CFL Program	Advanced Lighting	Lighting Market Transformation
PG&E	$30 million	$33 million	Statewide non-resource program focused on research, coordination, and outreach
SCE	$32 million	$45 million	
SDG&E	$16 million	$11 million	
Total	$78 million	$89 million	$1.5 million

California has been a leader in policies to reduce energy use from lighting. In 2007, AB 1109, the California Lighting Efficiency and Toxics Reduction Act was signed into law. Known as the Huffman bill, this law prohibits the manufacturing for sale or the sale of certain general purpose lights that contain hazardous substances. In addition, the bill requires the CEC to adopt energy efficiency standards for all general-purpose lights. The CPUC has also taken strong action on lighting and in September 2010 voted to adopt a chapter on lighting as an addition to the EE Strategic Plan. The goal for the lighting sector in the EE Strategic Plan is the reduction of lighting energy use by 60 to 80 percent statewide by 2020.[53] While this seems ambitious, newly emerging technologies and practices, including task lighting, advanced lighting controls, and light-emitting diode (LED) lamps can already save about 60 percent over standard practices. Lighting controls, in particular, offer great potential, not only for reducing energy use in lighting, but for moving towards integration of energy efficiency retrofits across lighting and mechanical building systems.

4.4.1 MARKET DYNAMICS

Like the residential construction and HVAC industries, the electrical contracting industry, which installs lighting, is a highly fragmented industry with many small firms and self-employed contractors. In 2007, 79 percent of electrical contracting establishments in the state had fewer than ten employees.[54] However, many electrical contractors in the commercial sector in California belong to the National Electrical Contractors Association (NECA), are unionized, and fund and participate in apprenticeship programs. Thus, though small, these contractors are organized into a broader infrastructure that facilitates proactive response to adopting emerging technologies and upgrading workforce skills.

4.4.2 POLICY INSTRUMENTS AND PROGRAMS

52 California Public Utilities Commission, 2008b, Section 13.

53 Ibid.

54 Quarterly Census of Employment and Wages and U.S. Census, 2008 County Business Patterns. Retrieved from: http://www.labormarketinfo.edd.ca.gov/.

Until recently, the utilities have relied almost exclusively on "widget" incentives for lighting, particularly upstream incentives to reduce the price of efficient light bulbs. Much of this "low-hanging fruit" has now been exploited, the market has largely been transformed, and the incentives are no longer needed. In order to obtain more savings out of the lighting sector, the CPUC has directed utilities to shift the focus of incentives to advanced lighting technologies and lighting systems, particularly in the commercial sector. The CPUC's decision approving the latest Portfolio of IOU Energy Efficiency Programs shifted funding from the Basic Compact Fluorescent Lamp (CFL) Program to the Advanced Lighting Program, which is consistent with the EE Strategic Plan's vision that utilities will phase out "traditional mass market CFL bulb promotions and giveaways" in favor of new technologies and programs.[55]

Both the CFL and Advanced Lighting systems provide upstream incentives for lighting products, but the Advanced Lighting Controls Program targets newer technologies with greater savings potential and less existing market penetration. The Advanced Lighting Controls Program also provides midstream rebates to contractors for certain products.

The IOUs are, thus, now shifting away from widget based programs towards systems approaches and approaches that focus on quality installation. Advanced lighting systems and controls involve new technologies and new ways of planning, procuring, installing and commissioning lighting. These technologies are considered emerging, and many established contractors and highly trained electricians are still unfamiliar with them. The IOUs have an important role in testing and carrying out demonstration projects with these emerging technologies, developing the performance standards that are needed to yield expected energy savings, and finally pushing them to market by developing incentive programs. In initiating this process for advanced lighting controls, installation issues surfaced as a major market barrier. An experienced lighting program staff person at SCE described the installation issues as follows:

> *"We've done a number of demonstration projects where we've been putting in advanced lighting systems to see how the technology interface works—does it work? In the process of doing this…one of the things that I knew, but didn't really pay attention to is that, typically, controls are never installed properly. They're too complicated; there aren't good instructions. We did one of our own facilities. It was a half million dollar test where we tested three pretty advanced systems with all new fixtures, ballasts, controls, interfaces, etc. Lo and behold, every single one of those was installed improperly by the manufacturers' own installers. That's when we realized that this is a huge problem."*[56]

Improper installation often leads to customer dissatisfaction and override of control systems, resulting in a loss of estimated energy savings. It also leads consumers to have a negative perception of the technology, which slows market expansion and implementation.

4.4.2.1 CALCTP PROGRAM

In order to develop solutions to address the installation quality issues in the Advanced Lighting Controls sector, SCE embarked on a cutting edge effort that is now known as the California Advanced Lighting Controls Training Program (CALCTP). CALCTP is a high-level training program for licensed electricians that will be tied to a new incentive program providing an additional rebate to customers who hire an electrician with CALCTP training and

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55 Gruenich, D. and A. Gamson (2009). CPUC Decision Approving 2010 to 2012 Energy Efficiency Portfolios and Budgets(D0909047). Retrieved from: http://docs.cpuc.ca.gov/PUBLISHED/Graphics/107829.PDF.

56 Interview with program staff, Southern California Edison, 10/2010.

certification. Though still in development, the incentive program will reward certified contractors whose workforce has been trained and certified by the CALCTP.

CALCTP has become a nationally recognized model for improving work quality in a key energy efficiency sector and provides a guide for workforce planning for other emerging technologies and measures such as retro-commissioning, new energy storage technologies, and other integrated demand-side management initiatives. This program also illustrates the benefits of collaboration between the IOUs, the University of California, and networks of licensed contractors who have a proven commitment to investing in comprehensive skills training. It has drawn on the existing strengths of each of the partners, taking advantage of the technical expertise of California Lighting Technology Center at UC Davis (CLTC) and the existing training infrastructure at the International Brotherhood of Electrical Workers and National Electrical Contractors Association (IBEW–NECA), as well as the Design and Engineering Services Group at SCE which promotes emerging technologies.

In the language of the workforce development world, CALCTP represents a quintessential example of a successful "sector strategy."[57] It started with an industry partnership that identified workforce issues and skill shortages as a major barrier to market competitiveness and growth. Industry partners then formed a collaborative to plan and implemented training, including convening training partners, creating a curriculum, developing a training delivery system, and seeking public and private funding.

SCE took the lead on developing the curriculum and continues to own its intellectual property rights, which it licenses to others. Although the majority of training is currently offered through the IBEW–NECA's 23 joint apprenticeship and training centers (JATCs), the program is also being rolled out at community college Advanced Transportation Technology and Energy campuses and IOU Energy Training Centers, making it widely available to all state certified General Electricians. Due to the advanced level of the skills taught, CALCTP is technical upgrade training that requires significant technical expertise and mandated online prerequisites provided by lighting controls manufacturers.

In conjunction with the roll-out of CALCTP, new incentives are focusing on installation as well as equipment performance standards. Now that several hundred electricians have gone through the training program, the utilities are planning to offer an extra incentive for installation meeting CALCTP-certified project requirements, that is projects installed by CALCTP-certified electricians working for a CALCTP-certified contractor on a utility approved project. As in HVAC and other construction trades, there is a low bid process for commercial lighting contractors, but shifting incentives towards certified technical workers creates a value proposition for investing in quality installations with verified energy savings.

4.4.3 LABOR CONDITIONS

Commercial electrical contracting is primarily a high-road industry. Unlike other trades, where only contractors must be licensed, California requires that all practicing electricians be licensed. In addition to the substantial initial training, on-the-job experience, and testing requirements that is needed for licensure, electricians must complete 32 hours of continuing education and training every three years in order to maintain their license. These requirements mean that nearly all electricians in the state have completed an apprenticeship or extensive training program. For this reason, prevailing wages for commercial sector electricians are higher than for most other trades.

[57] See Chapter 5 for an in-depth explanation of sector strategies and their role in the workforce development world.

Nationally, about 32 percent of licensed electricians belong to a labor union, mostly IBEW.[58] In the commercial sector, union representation is even higher. These conditions also provide a lifelong career for workers, starting with paid on the job training through apprenticeship, high journey level wages, and health and retirement benefits. Life-long learning through journey upgrade training is also available and since license renewal requires continuing education, skills upgrading is embedded in the career.

In addition to providing benefits to workers choosing a career as an electrician, high union density creates a stable and professional workforce. Apprenticeship coordinators reported very high retention rates as workers who finish five year apprenticeship programs have made an enormous investment in their career. The forty-hour CALCTP program, though rigorous, is a small addition to this broad occupational training. The apprenticeship infrastructure facilitates ongoing learning through free journey upgrade training. The simultaneous training of both contractors and workers means that as contractors are able to gain business in advanced lighting controls in new construction and retrofits, their workforce will be ready and able to carry out the work.

4.4.4 LESSONS FROM LIGHTING

The commercial lighting sector is more successful in achieving work quality goals with new technologies and programs than either the HVAC or residential sectors. This success is due to: (1) the existing high-road conditions of the market, which provided an already well-trained, stable, and professional work force that could quickly gain the advanced skills; (2) the foresight and flexibility which enabled the utilities to collaborate successfully with NECA–IBEW and the UC Davis CLTC to create the CALCTP training program; and (3) the development of strong skill certification standards that will be tied to incentive programs to help drive quality in the market. This collaboration leveraged the existing training infrastructure of NECA–IBEW with the technical expertise and funding capacity of the utilities, enabling the rapid development and implementation of a rigorous training program and associated incentive program.

4.5 CONCLUSIONS AND RECOMMENDATIONS

The case studies presented in this chapter illustrate the workforce related possibilities and pitfalls of energy efficiency programming. The issues of work quality highlighted here pertain particularly to the sectors studied, but can arise in any unchecked low-road industry. Across all sectors, it is clear that energy efficiency program designers and administrators have an active role to play in ensuring quality energy savings outcomes *and* that work quality and job quality outcomes are closely linked. The examples in this chapter also present a range of solutions for addressing quality, some of which have been tested and proven, and others that are relatively new.

The CALCTP project provides an example of a sector strategy leading to the successful development of advanced level training to address specific industry needs—in a context in which training investments are likely to stick because the workforce is already stable and professionalized and employers are already committed to investing in training for their current and future employees through their contributions to the apprenticeship trust funds. The CALCTP utility–industry–labor partnership enabled planning for workforce training and new utility programming to be done simultaneously and in a complementary fashion, rather than addressing workforce issues after the fact. This enables policymakers and energy program designers to build in upfront quality assurance mechanisms that get to the root of market related issues and training gaps.

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[58] Bureau of Labor Statistics (2010-2011). Occupational Outlook Handbook: Electricians. http://www.bls.gov/oco/ocos206.htm.

We suggest that this type of sector strategy is a model that should be expanded and replicated throughout energy efficiency programming. Such training oriented strategies are likely to have the most immediate success in programs and technologies targeted at the large commercial sector, such as retro-commissioning and a variety of integrated demand-side measures. As discussed above, the large commercial construction sector is largely a high-road industry with an existing trained workforce and workforce infrastructure in place to support skills upgrade training as new technologies and systems are developed and deployed.

In low-road sectors, such as residential construction and residential and small commercial HVAC, the solutions are less straightforward, although a number of approaches are being tried. Sector strategies are needed in these industries, not only to address training gaps, but to initiate transformations in the market that will support quality work and improve workforce outcomes. The beginnings of these industry partnerships are already in place in emerging organizations, such as the WHPA and the networks formed around Energy Upgrade California. However these initiatives can be informed by the best practices that have been developed for sector strategies, which include the development of stackable and portable industry-recognized certifications, along with robust multi-employer agreements to train the existing workforce and/or hire newly trained job seekers. Ultimately, skills upgrading and certification must be linked to wage progressions to stabilize and professionalize the workforce, so that training investments are not wasted, but instead lead to changes in practice in the field.[59]

The ongoing and growing investment of public and ratepayer funds in residential retrofits provides an important opportunity to build high-road energy efficiency and related industries that are based on high-quality work as well as living wage jobs with career ladders. A number of initiatives attempting to scale up this sector have taken different approaches to addressing quality:

4.5.1 SKILL STANDARDS AND CERTIFICATIONS

Skill certifications have the potential for improving quality, making workforce investments more efficient, and creating greater certainty for contractors. The DOE has developed skills standards for the major job categories in residential retrofit, which could be adopted in California to guide training and certification. Incentive programs that are tied to a particular training or certification standard, like the residential HVAC Quality Installation program, have the most potential for influencing the market, although they are not guaranteed to transform it without further measures. Third party accredited certifications, at the very least, guarantee a minimum training investment that ensures workers are prepared to do work to a quality specification. More in-depth discussion of certifications can be found in Chapter 5 and Chapter13 of this report.

4.5.2 HIGH-ROAD AGREEMENTS AND LABOR STANDARDS

When—as we have seen in HVAC and the residential sector—training is not sufficient to ensure quality work, other strategies have been employed to attempt to transform labor market conditions. Some approaches include building permit and code enforcement, best-value contracting, and labor standards, all of which favor high-road contractors. High-road agreements that govern some retrofit programs directly address workforce considerations such as wages and benefits, and they often include local and targeted hiring agreements that improve access to jobs for disadvantaged workers. Policies that mandate or incentivize quality may increase the cost of residential energy retrofit or HVAC work, but higher-quality work and lower turnover may offset some costs.

[59] See Chapter 5 of this report for a more thorough discussion of sector strategies.

In sum, our research and others' indicate that policies such as skill standards, contractor requirements, worker certifications, labor standards, local hire policies, and other quality assurance mechanisms enhance workforce outcomes *and* may increase energy savings enough to improve or at least not reduce overall cost-effectiveness. Because the application of these strategies to energy efficiency sectors is relatively new, however, it is difficult to accurately anticipate the magnitude of long-term cost-effectiveness and energy savings. The impact of workforce conditions such as wages, benefits, turnover and retention rates on the quality and cost of energy retrofit programs has been an overlooked area of analysis. As a result, policymakers who share both workforce and energy goals are not yet able to evaluate potential trade-offs in policy design. All programs should be rigorously reviewed along these lines, focusing on energy savings, workforce outcomes and cost effectiveness. Thus, Dr. W. Edwards Deming's refrain to "do it right the first time" doesn't just apply to the energy efficiency installation work itself; it also refers to the need to improve our processes of policy development in order to produce higher-quality outcomes.

PART TWO:

CALIFORNIA'S WORKFORCE EDUCATION AND TRAINING INFRASTRUCTURE

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CHAPTER FIVE:

5. CALIFORNIA'S WORKFORCE DEVELOPMENT INFRASTRUCTURE

California's workforce development infrastructure is made up of a complex web of institutions providing skills development, job matching and other workforce development activities. These institutions are funded by a variety of state and federal programs and sources, including, but not limited to, private employers, student fees, and charitable contributions. Part Two of this report analyzes the institutions and training programs in California that are most relevant to the economic sectors and occupations impacted by energy efficiency policies and programs.

The purpose of Part Two is to understand the role of each type of institution, document how they collectively fit together, and surface any gaps, redundancies, or other problems that need to be addressed. Ultimately the objectives of this analysis are to assess the extent to which these programs:

- → help employers recruit qualified workers or upgrade the skills of incumbent workers in furtherance of our energy policy goals, and
- → help workers, including those from low income and disadvantaged backgrounds, develop good careers in energy efficiency.

Though this study is not able to evaluate the effectiveness of each program, nor identify the specific skill needs of each employer, it can paint a broad brush picture of the way training, education, and other workforce strategies are currently functioning, the challenges of the current situation, and the opportunities for improvement.

This chapter provides an introductory context and framework for the analysis of our survey and interviews on the workforce development infrastructure that is directly relevant to the sectors and occupations under the scope of this study. It first gives an overview of California's workforce development system and its parts and then talks about the sector approach to training for middle skill jobs, which is endorsed both at the state level and by the Obama administration as a major thrust of reform for workforce training and education. It then addresses the importance of credentialing and certification, and discusses the major venues for workforce coordination and planning in the energy efficiency arena. Finally, we summarize the methodology used in the survey of training and education programs, to set the stage for the documentation of our findings on the seven main education and training institutions that are included in the survey, as well as separate analyses of K-12 programs, employment information systems, and pathways into good jobs for disadvantaged workers.

5.1 CALIFORNIA'S WORKFORCE SYSTEM

Before turning to a discussion of the specific institutions and programs that are relevant here, it is useful to first present an overview of California's workforce development system for all sectors and occupations.

California's workforce system is composed of many parts, but the key components are the state's workforce investment act (WIA) programs—funded by the federal Department of Labor—and California's post-secondary education system, which consists of universities, colleges, community colleges and the state department of education. These latter institutions are funded largely by the state, with specific funding streams from the federal Department of Education.

The WIA system is composed of 49 local workforce investment boards (WIBs) and 259 One-Stop Centers, as well as a state WIB that administers the Governor's 15 percent WIA discretionary funds. The national WIA system is a "work first" system, geared to helping individuals get jobs by providing job matching services through its One-Stop system. The system also funds training for workers who are unemployed, dislocated, or have barriers to employment, through limited individual training vouchers.

California's post-secondary education system includes 112 community colleges, 285 adult schools, and 74 Regional Occupational Centers and Programs, as well as the 23 campuses of the California State University System and the 10 campuses of the University of California. The post-secondary system also includes private colleges and universities, as well as some for-profit training institutions. Unlike the WIA system, which is geared towards rapid job acquisition, the education system is built on the premise that students will forgo earnings for significant periods of education, in the expectation of future returns. As shown in Chapter 2, the returns to a four-year degree are substantial, due to both a significant wage premium and much lower unemployment rates for college graduates, compared to those with lower educational levels. Another significant workforce development program is the Employment Training Panel (ETP), California's incumbent worker training program, funded by the payroll training tax, whose main purpose is to bolster California businesses that face out of state competition. Finally, although less prominent in many other sectors, the California state-certified apprenticeship program is by far the largest state-regulated—but mostly privately funded—training program for construction.

For the higher educational institutions, the California Master Plan for Higher Education, set up in 1960, continues to provide a coherent system for post-secondary education. This plan defined specific roles for the UC, CSU, and the California Community Colleges systems. No such coordination exists for the "middle skills occupations," that is jobs which require more than a high school degree but less than a four-year degree. Yet it is in the middle skills occupations, and the training and education programs that target them, where the real problems lie. Fewer than half of all Californians age 25 or older have a post-secondary degree. More than 70 percent of California's community college students have below-college level math skills and more than 40 percent require remedial English classes.[1] This basic skills crisis, combined with the state's severe fiscal woes, puts tremendous constraints on California's ability to prepare workers for good jobs and careers in our changing economy. To quote a recent California Budget Projects report, "Currently, goals are largely uncoordinated across programs, and use of the state's discretionary funds rarely reflects an overarching strategy.… The state will fail to maximize the effectiveness of its resource unless it takes a systematic and statewide approach."[2]

At the same time, there are important efforts to use our limited resources more efficiently. There is considerable support for stronger alignment of the various tools in our workforce development tool chest, and the new Brown administration, at the time of this writing, is deliberating various strategies to move toward this goal. Changing regulations and direction from the US DOL are encouraging new directions in the use of federal workforce dollars that flow to the state and local WIBs, including support for sector initiatives, and a stronger emphasis on requiring training programs to result in educational credentials and/or industry recognized certifications, as described in Section 5.3. Breaking from the previous emphasis on "work first" job matching services and individual training accounts, the DOL is encouraging collaboration between the WIA system and the community college and apprenticeship systems. This change in direction is likely to be greatly strengthened if the WIA is reauthorized, as expected. In addition, President Obama's efforts to promote career technical education and to encourage the development of portable and stackable credentials are in concert with WIA reform.

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[1] California Budget Projects (2009). *Mapping California's Workforce Development System*. Retrieved from: http://cbp.org/pdfs/2009/090401_Workforce_Presentation.pdf.

[2] California Budget Projects, 2009.

5.2 SECTOR STRATEGIES

Over the past two decades, innovative approaches to workforce development known as *sectoral employment strategies* (or *sector strategies*) have emerged as the most effective method for training, placing, retaining, and creating career ladders for workers in middle skills jobs, as well as for meeting the needs of employers for skilled workers.[3] Sector strategies are,

> *"…regional partnerships of employers, educators, workforce developers and other stakeholders that address the skills needs of critical industries in a region. They are focused on a single industry; led by a strategic partner who coordinates dialogue and action; and result in customized solutions to the workforce needs of employers in the industry."*[4]

Their dual customer focus emphasizes both the needs of workers for good jobs and the needs of employers for skilled workers. Because of their emphasis on partnering with a variety of organizations to coordinate recruitment, training and services, sector strategies have also been successful in creating pipelines for disadvantaged workers to move into skilled employment.

Around the country, sectoral programs are being implemented by an array of institutions, including community colleges, WIBs, state agencies, employer associations, and labor–management partnerships, with funding from both public and private sources.[5] As Maureen Conway and her colleagues at the Aspen institute describe in their 2007 report, the approaches that fall under the name sectoral employment can vary widely, but usually include:

- → Skills training programs that provide participants with the skills to enter a particular industry sector or occupation;
- → Industry partnerships that identify training needs of incumbent workers in specific industries; and
- → Organizations focused on systems change, such as efforts to improve wages and working conditions for target industries or occupations.

A key feature of sectoral programs is their designation of a workforce intermediary to function as a coordinating body. Successful intermediaries are quite varied and can include community colleges, labor–management partnerships, city economic development departments, employer consortiums, and community-based organizations. The intermediary organization brings together the partners necessary to address both employer and worker needs. An organization serving in this intermediary role facilitates, coordinates, organizes, and drives the work being done by all the other organizations involved, including those representing training and education, workforce development, industry, employers, unions, and community-based organizations.

In any sector strategy, business must be at the table to identify specific skill and training needs, and to commit to training their incumbent workers or new hires. For pre-employment training, employers commit to giving specific consideration to training graduates as job openings occur. Sector intermediaries develop close relationships with employers in a particular sector to help negotiate the exact nature of the commitments by employers, particularly around sharing the costs of training, wage ladders or promotion opportunities for workers with upgraded skills,

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[3] Conway, M. et al. (2009). *Job Training That Works: Findings from the Sectoral Employment Impact Study.* Public/Private Ventures. Retrieved from: http://www.ppv.org/ppv/publications/assets/294_publication.pdf.

[4] State Sector Strategies (2008). Accelerating the Adoption of State Sector Strategies Knowledge Exchange. Retrieved from: http://sectorstrategies.org.

[5] Conway, M., A. Kays Blair, S. L. Dawson, L. Dworak-Munoz (2007). *Sectoral Strategies for Low-Income Workers: Lessons from the Field.* Washington, DC: Aspen Institute.

and other key mechanisms to assure sustainability and benefits for both employers and workers. These relationships also serve to identify skill shortages and workforce and training needs, develop agreements on appropriate certifications and credentials, and design or modify occupation specific skills trainings to meet employer needs. A critical function of sector intermediaries is developing funding proposals for public training funds, so that WIA and other state and federal resources for workforce development can be brought into play. They also serve to connect job seekers with employers and with additional services that might increase their success in the labor market.

These relationships sometimes provide opportunities for programs to influence the quality of jobs within the sector, by engaging with employers directly to improve working conditions, access, career ladders and wages in the target occupation. A 2006 report by MDRC found that employers have responded positively to efforts by workforce development organizations to collaborate on identifying advancement opportunities in high-demand occupations and new routes to participation in career advancement activities.[6]

In addition to direct engagement with employers and workers, sector program intermediaries also facilitate partnerships with other organizations to supplement the services they provide. For instance, a program may engage a local community college to provide technical skills training, a community-based organization to assist in recruiting applicants for training, or a human services provider to enhance the supportive services available to participants.[7] Sector programs often partner with relevant pre-apprenticeship and apprenticeship programs to open opportunities for the job seekers they serve. Recent research from the Aspen Institute has shown that programs that prepare workers to enter apprenticeships can significantly increase their participants' success in the labor market, particularly programs that train workers to enter the construction trades. Programs partner with union apprenticeships to design training that is specifically geared towards enhancing participants' skills to improve their chances of successfully completing often rigorous apprenticeship programs.

Though sector strategies take different forms depending on the sector and the region of the country where they are implemented, they are all industry-specific initiatives designed to help ensure a smooth progression from recruiting participants with inadequate skills to assuring their placement and retention in living wage jobs with career advancement opportunities. They all require industry-specific expertise and deep engagement with multiple employers in a given sector and they usually involve multiple partners with a lead intermediary that brings together stakeholders and coordinates all the various elements, activities, and funding. This gathering of expertise and employer input allows sector strategies to develop training programs that make business sense, create clear pipelines into employment or advancement for trained workers, and link economic development to workforce development. At the same time, sector initiatives require deep engagement with job seekers, workers, and organizations.

5.3 CREDENTIALING AND CERTIFICATIONS

A means to signal individual mastery of desired skills and competencies is an essential component of a well-functioning workforce education and training system. As stated by White, Dresser, and Rogers,

> *"most advanced economies have far more elaborate, nationally recognized skill standards and credentialing systems than the United States…To reintroduce regular upward mobility*

[6] Anderson, J., L. Yuriko Kato, J. A. Riccio, S. Blank (2006). A New Approach to Low-Wage Workers and Employers: Launching the Work Advancement and Support Center Demonstration. New York: MDRC.

[7] Conway et al. 2007.

> *paths, connect disadvantaged workers to the labor market and get them reward within it, reduce per capita training costs, show effects of training (particularly among cash strapped public training providers), or, most ambitiously, drive skills-based upgrading among firms, some standard way of measuring what workers know, that is accepted and used by employers, is now generally seen as a social good."*[8]

A credentialing system helps employers reduce search and transaction costs in hiring and promotions, helps government regulators and program implementers guarantee a standard quality of work, helps training institutions know what skills to train for, helps trainees gain clear signposts that can help guide their decisions, and benefits workers who often receive higher compensation as a reward for their proven skills and education and gain greater mobility within the labor market. It is important that credentials be *portable*, meaning they are equally valuable in another firm or another location and *stackable*, meaning they can be built upon through further training and more advanced credentials.

However, not all credentials are created equal. Both post-secondary educational degrees and industry-recognized certifications have internationally recognized best practices and standards. Educational institutions must be accredited by appropriate bodies, and specific programs that confer degrees must be accredited by the state. For industry-recognized certifications, the ANSI Standard for Personnel Certification, approved by the federal government, delineates a process for developing certifications. This process starts from a technical standards reference guide to develop a job task analysis, which helps identify the essential knowledge, skills and abilities that workers must have. These essential skills are the basis for the ultimate development of a skills certification and associated training. Such a certification must, in turn, be issued by an accredited third-party certification entity to individuals trained in accredited training programs.

In California, at this time, training programs for traditional and emerging energy efficiency related occupations offer an incredible variety of types of credentials (and words to describe them), not all of which are of equal value. Although they are frequently confounded or conflated in the marketplace, it is particularly important to distinguish between ***certifications*** that are industry-recognized, test for competency, and are verified by a third party, versus ***certificates*** that do not make an assessment of competency, but rather show completion of a particular training program.[9] Because certifications verify that a worker's skills meet an industry standard, they are more valuable to workers, employers, and to government agencies concerned with work quality, although for slightly different reasons.

Based on the data collected from training institutions, we have categorized worker credentials into the following types:

5.3.1 PROFESSIONAL LICENSES

Professional licenses are legally required to practice particular occupations. These are based on general professional competency and are usually issued by a third party, such as a state agency or state-sanctioned professional association. Licenses are advanced credentials and often have a significant education and work experience requirements, rigorous competency examinations, and continuing education and relicensing requirements, which ensure that licensed workers are continually maintaining and upgrading their skills. Examples

[8] White, S., L. Dresser, J. Rogers (2010). *Greener Skills: How Credentials Create Value in the Clean Energy Economy*. Center on Wisconsin Strategies. (p.4)

[9] American National Standards Institute. (2011). Accreditation Services: Frequently Asked Questions. Retrieved from: https://www.ansica.org/wwwversion2/outside/PERfaq.asp?menuID=2.

of mandatory licenses include the Professional Engineer (P.E.), the Registered Architect (R.A.) and the Electrician license. In the building trades, Electricians are unique in their licensing requirements. In other trades, only contractors must be licensed, which does not ensure worker competency. Because professional licenses are held to a high standard and are legally required, the return on investment for earning a professional degree and license is usually high in terms of compensation and employment opportunities.

5.3.2 OCCUPATIONAL CERTIFICATION

Occupational certification indicates broad occupational competency in a particular trade, but unlike licensure, is voluntary. These certifications are based on nationally recognized skills standards and, whether offered by a trade association, government agency, or a non-profit certifying body, the certification is accredited by a third party organization, such as the American National Standards Institute (ANSI) or the International Organization for Standardization (ISO). Such third party accreditation helps a certification to gain wide recognition and value in the industry, making it highly portable for workers moving between jobs or between regions. Like licensure, these certifications are usually not entry level credentials, but may require multiple years of experience and advanced knowledge of the trade. Certifications, such as those offered by North American Technician Excellence (NATE) in HVAC, and the North American Board of Certified Energy Practitioners (NABCEP) for solar installers are most commonly earned after at least a year of work experience. Some certifying bodies, such as NABCEP, have developed entry level examinations. However, these carry much less weight than full certification.

5.3.3 JOURNEY CARD

A journey card is a credential that is specific to apprenticeship training, but it combines features of both occupational certification and a post-secondary educational degree. A journey card takes three to five years to complete and is issued by the state to certify completion of an apprenticeship training program. Because apprenticeship training is standardized and regulated by the state, a journey card is also recognized by employers as certifying the achievement of broad occupational competency and advanced technical skills in a particular trade. Journey level workers receive considerably higher compensation than un-credentialed workers in the same trade. In addition, completion of an apprenticeship program entitles workers to continual upgrade training throughout their career, which allows them to continue to advance their skills, earn further credentials, and stay up to date with the latest technologies.

5.3.4 EDUCATIONAL DEGREES

An educational degree indicates fulfillment of the requirements of an accredited educational program. These can range from high school diplomas to doctoral degrees. Because degrees and educational programs are standardized, the difference between them is well understood by employers. Some professions, such as engineering and architecture, require a four-year university degree, or higher. For most middle skill jobs an associate's degree from a community college may be helpful when seeking employment, but is rarely required. In general, workers with bachelor's degrees and higher receive higher compensation and experience less unemployment that their less educated counterparts.

5.3.5 EDUCATIONAL CERTIFICATES

An educational certificate certifies the completion of an accredited educational program that does not lead to a degree. These programs are most commonly offered by community colleges as an alternative to traditional degree programs or sometimes by four-year colleges as supplemental programs. The community college certificate system suits incumbent or entry-level workers who are seeking skills training but do not care to fulfill general education requirements. Usually completed in a single year, an educational certificate program still provides college credit that can be transferred or built upon through further education and training. In some cases certificate programs are developed as trial programs for emerging occupations or technologies. Some educational certificate programs also prepare students to take competency exams to earn skills or occupational certifications.

5.3.6 SKILLS CERTIFICATES

Skills certificates indicate knowledge of specific technical skills or safety practices, such as welding or driving a forklift. Specific skills certificates may be issued by a training provider, a third party, or a manufacturer of particular equipment. In fact, many skills certificates are nested within more comprehensive training programs, such as apprenticeships. In the case of new technology, however, a manufacturer may be the only available provider of training and certification. As in the case of occupational certification, third party accreditation to ensure that the credential meets a national or international standard makes it more valuable and more widely recognized. The skills category encompasses a number of safety and environmental hazard certificates that are required by law for some occupations. For example, the U.S. Environmental Protection Agency requires verification that HVAC workers have been trained in handling refrigerants. Carpenters or others working with paint must complete training in Lead Abatement practices. These safety and environmental certificates, which are required by law, are by far the most commonly trained-for skills certificates in the respective trades.

5.3.7 SELF-DEFINED CERTIFICATES

Most training programs offer a certificate of completion, whether the training lasts one day or one year. Thus, the value of such a certificate depends on how well-recognized the training program is. This may vary depending on the perspective of an individual employer, but there are not usually clear signals for workers to indicate which certificates are the most valuable. Examples of self-defined certificates include certificates of completion from CBOs or private training institutions as well as skills certificates that are not tied to a national standard or do not require a competency test. These un-standardized certificates may not signal competency to an employer and are, therefore, much less valuable for workers, irrespective of the quality of training received.

As described in Chapter 13, which focuses on how training institutions fit together, this bewildering array of credentials makes alignment of training programs difficult and reflects a lack of statewide agreement on skill standards needed to accomplish the work related to achieving our energy efficiency goals.

5.4 THE SPECIFIC VENUES FOR WORKFORCE PLANNING AND SECTOR STRATEGIES IN THE ENERGY EFFICIENCY SECTORS

There is general recognition of the importance of collaboration within the state's workforce agencies and in the agencies driving energy efficiency investments and many efforts to promote it. However, the rush towards green as the state's new economic driver has not allowed the planning and coordination needed to economize on resources and avoid redundancy and competition. Deep funding cuts to the community colleges have undermined long-term program development, undermined collaboration with apprenticeship programs and led colleges to seek short-term grants as a major funding source.[10] The speed at which ARRA funds were dispersed has exacerbated this tendency to chase dollars.

Despite these significant challenges, there are also forces that create the opportunity for system reform leading to more effective workforce development. In fact, the opportunity of green, including but not limited to the infusion of ARRA funds, has propelled experimentation, collaboration and significant success in overcoming silos.

The propitious creation of the Green Collar Jobs Council (GCJC), authored by then-Speaker Nuñez, occurred before ARRA. As part of the California WIB, the major economic development and workforce development agencies sit on it, along with representatives from industry and labor, and agencies with environmental and energy responsibilities, including the CPUC, CEC, and CARB. The Council is tasked with "understanding the current and future workforce needs of the Green/Clean economy, developing a comprehensive strategy to prepare California's workforce to meet the needs of businesses and to ensure that efforts aimed at improving worker's skills are coordinated and effective."[11] While it has no legislative mandate to align funding streams, the GCJC has spawned cross-agency collaborations to a much greater degree than occurred in the past, and its vision is to "serve as a catalyst for the creation of sustainable regional sector strategies."

The GCJC became an important coordinating body for the expenditure of ARRA funds. The California Energy Commission was the agency receiving the ARRA investments in the clean energy arena and partnered with the CWIB and the ETP to create the Clean Energy Workforce Training Partnership program (CEWTP), which dispersed over 31 million dollars to 48 training programs, as well as the state and local WIBs. Forty of these training programs are serving the sectors under study here, and intend to deliver short-term trainings to approximately 7,780 workers for green building, solar, water efficiency, and wind.[12] The competitive solicitations incorporated some of the best practices in workforce development, starting, of course, from the sector approach, but also encouraging the use of certifications and the development of partnerships between the WIBs and the community colleges. The end results of these programs are not in, and it will be critical to evaluate their effectiveness in the very near future. An evaluation of these CEC administered programs is currently underway, although it is focusing primarily on the energy savings produced, with less emphasis on the workforce outcomes. Other grant programs also tried to encourage data-driven planning and industry partnerships; these also should be evaluated to assess their effectiveness

Since the ARRA funds were allocated, and with the change in administration, the mission of the GCJC is unclear. It could potentially be a convening body for a series of sector partnerships in the clean energy sectors. The skills panels in Washington State or the industry councils in Pennsylvania provide models for how this could work. In

[10] The Montoya funds, which were the state's dedicated funding stream to community colleges for the support of supplemental and related instruction tied to apprenticeship programs, were recently changed so that they can now be used as discretionary funds. This has dealt a severe blow to collaboration between apprenticeship programs and the community colleges.

[11] California Workforce Investment Board (2007). Green Collar Jobs Council. Retrieved from: http://www.cwib.ca.gov/special_committees/green_collar_jobs_council.

[12] California Energy Commission (2011). Clean Energy Workforce Organizations. Retrieved from: http://www.energy.ca.gov/cleanenergyjobs/resources.html.

both those states, the workforce agency convened business and labor within narrow sectors (e.g., the utility sector, or the long-term care sector); chose and funded an intermediary to lead a sector planning process, which included building industry consensus around skills certification; and funded the training initiatives that emerged from that process. In Washington State, the community college Centers of Excellence play the intermediary role for the utility and energy efficiency sectors, and have helped both create new certifications (e.g., wind) and choose between competing ones when needed.

At the present time, there are a number of relevant initiatives that closely resemble sector strategies, in the sense that they are linking economic development planning with workforce development in a specific sector. Several of these are described in Chapter 4, in our case study analysis. The first is Energy Upgrade California, the state's major residential retrofit program. The CEC and the CPUC are now coordinating this program statewide, though the process is also being planned and implemented by local planning bodies such as ABAG, the utilities, and their implementation subcontractors. Though mostly oriented towards the economic development and investment side of the initiative, important workforce strategy decisions are being made, warranting coordination of workforce training dollars and programs. The CEC is working with its CEWTP grantees, who have received both CEC and WIA funds, to do this coordination.

The Western Performance HVAC alliance is also a de facto economic development sector initiative, which includes a newly formed workforce committee. This is a broad industry, utility, CEC and CPUC effort to upgrade the HVAC industry and close off the low road through enforcement of laws and regulations. Embedding the workforce planning within this process is essential to ensure training investments are geared towards supporting the high road segments of the industry. Setting standards and certifications is likely to be the subject of some of the work of this alliance and the challenge may be to get a wide range of employers to commit to agreed upon standards. Coordination with the state WIB could potentially help secure WIA funds as training plans develop.

The CALCTP program is also a sector initiative. This industry partnership identified workforce issues as a key impediment to industry expansion in the advanced lighting controls sector. This effort led to a new certificate, structured as advanced training for licensed electricians, and workforce planning to coordinate among apprenticeship, community colleges, and the utility training program. Its narrow focus cleared the way for quick development of strategic partnerships, building on the current state infrastructure that supports long-term pipelines into highly skilled work. As this industry expands, it can open up new apprenticeship slots for entry level electricians, connecting with pre-apprenticeship programs that can prepare people from low-income communities who are not college bound.

Though they would not name themselves sector strategies, these are all examples of types of sector-based initiatives because they are efforts—in various stages of development and some too new to evaluate—to organize economic development, address workforce and skill issues, and coordinate among training institutions within a specific industry sector. The only one tapping into WIA funds (through the more flexible ARRA WIA funds) is Energy Upgrade California, due to the key coordinating role of the GCJC around ARRA funds.

The variety of initiatives shows that a "one-size-fits-all" solution is not realistic. However, it does point to the key role of the CPUC, the CEC, and the utilities in helping to drive sector initiatives. It suggests that the initiatives should be analyzed to see if they are incorporating the best practices of sector initiatives, such as building industry consensus to promote widespread adoption of specific skill certifications, creating an intermediary to coordinate among the state's main workforce and education institutions, filling in gaps before creating new programs, and getting employer commitments to hire workers meeting skills and certification standards. In addition, it suggests tapping into all the funding sources—particularly from WIA and from DOE—that might be available to support them.[13] Finally, it suggests a common framework for assessment of effectiveness, which includes impacts on both energy savings and workforce outcomes.

5.5 SURVEY OF TRAINING AND EDUCATION PROGRAMS

The following chapters in Part Two describe what we learned about California's workforce development infrastructure relevant to the energy efficiency sectors. Much of this is based on our inventory and survey of training programs in the seven main institutions and includes our analysis of this data to explain how they all fit together. In addition, we separately analyze the utility programs, K-12 programs, employment information systems, and strategies for the inclusion of low-income, minority and disadvantaged Californians. When possible we include more detailed data from the utility programs.

The detailed inventory and survey methodology is presented in Appendix G; here we present a brief summary as an introduction to the following chapters. The institutions included in the inventory and survey are:

- → Four-year colleges and universities
- → Community colleges
- → Apprenticeships
- → Private industry training programs
- → Community-based organizations (CBOs)
- → Regional Occupational Programs (ROPs)
- → Utility training programs (although these must be treated differently)

There were two criteria for inclusion in the inventory (and the sample we drew from it): First, we include training and education programs that train for the most prominent occupations from our job projections, eliminating the general occupations (e.g., accountant). Second, we include training programs that self-identify as training for skills in these sectors. Therefore, we capture both the traditional occupations that are involved in implementing energy efficiency work, as well as the new "specialty" occupations focusing solely on a particular set of energy-related skills. The inventory compiled basic information on training programs, such as the location, length, and skills emphasis of each program, gathered from administrative data and web searches, while the survey entailed in-depth interviews with a sample of training providers across the state.

We were able to identify about 1,080 training programs in California, among four-year, community colleges, apprenticeships, CBOs, private training organizations, and ROPs. A training program refers to a department at a particular college or ROP, an apprenticeship committee, [14] an IOU Energy Center, or a distinct community-based or private organization. Quite a few of these training programs have multiple degree tracks or occupational tracks (in particular colleges and apprenticeships). Therefore, the total number of distinct program tracks is quite a bit higher, around 1,545.[15] These individual tracks are the relevant unit of analysis for Part Two because they lead to

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13 The US DOE is also making major investments in workforce preparation for the clean energy economy. It is funding credentialing and accreditation in energy efficiency and self-generation, and is engaged in efforts to encourage the adoption of skills standards with robust third-party verification in these sectors as a way to assure appropriate quality of work in order to successfully develop these industries. It is using a variety of funding opportunities, such as the E-RIC process, to link development of the clean energy economy with workforce development. DOE's recognition of the importance of skill standards converges well with the interests of the workforce training and education leaders at the state and federal level, because industry recognition of stackable and portable credentials is critical.

14 Some committees are highly consolidated and have multiple locations that are overseen by one labor-management committee, most notably laborers and carpenters.

15 This total is slightly higher than the counts reported later in t

different career pathways and employment outcomes. For example, someone with a master's degree in engineering typically will be eligible for different jobs than someone with bachelor's degree in engineering.

Of these program tracks we interviewed 492. We used a cluster-sampling method to produce a random sample of programs to interview by phone, and we oversampled the ones that trained in the most prevalent occupations in our job projections.[16] The sampling strategy focused on established institutions rather than new grant-funded initiatives such as the ARRA-funded programs. Table 5.1 shows the number of program tracks interviewed for each type of institution, and the total number of tracks identified (all of which is listed in the inventory).[17] Each track leads to a specific type of credential or outcome.

Table 5.1 Number of Program Tracks Interviewed

Institution	Program Tracks Interviewed	Total Number of Program Tracks[15]
4-Year Colleges and Universities	38	212
Apprenticeships (Joint)	89	218
Apprenticeships (Unilateral)	5	47
Community Colleges	102	607
Community-Based Organizations	31	39
Private Training Organizations	147	204
Regional Occupational Programs	73	211
IOU Energy Training Centers	7	7
Total	492	1,545

The in-depth phone survey was designed to achieve our main objective of analyzing the workforce development infrastructure in California as a whole, considering the linkages and overlap between major types of training institutions. The interview protocol was based on our combined knowledge of workforce development best practices, and energy efficiency related job skills and training types. It includes both qualitative and quantitative questions. Each type of institution had a tailored version of the protocol, but all interview formats collected information on program structure, content, and connection to career pathways, as well as data on enrollment, graduation, participant demographics and other characteristics.

[16] As a result, programs that train for a specific energy efficiency skill but do not train for a high-demand occupation based on the job projections were not over-sampled as "priority." While it may seem counter-intuitive to not consider a specific "solar" training program as high-priority in a study like this, our intent here was to study training programs based on the labor demand analysis and not hand-pick occupations to study that seem like they would be in high demand because of energy efficiency policy, because they are targeted on specific skills in those areas.

[17] 11 program tracks in adult education are also included in the inventory, although we did not include these in our survey sample.

CHAPTER SIX:

6. FOUR-YEAR COLLEGES AND UNIVERSITIES

6.1 OVERVIEW

Professionals and managers constitute about 20 percent of the national, direct energy efficiency services workforce and about 17 percent of our study group. Workers in these occupations, which include architecture, engineering, and construction management professions, play a critical role in designing buildings, understanding energy use in buildings, and in crafting the policies that support energy efficiency and renewable energy.[1] These efforts provide the framework within which the remaining 80 percent of the workforce for the energy efficiency and related sectors operate.

Typically, these workers have at least an associate's degree, or more commonly a bachelor's or graduate-level degree from a university or college. In addition, some of these professions, particularly those involved in systems design and specification, require specialized licenses in order to practice in a position of responsibility. This chapter describes the type of degrees available and the most relevant degree programs, discusses certification and licenses for energy efficiency related professional occupations, and concludes with a discussion about equity and access to the degree programs leading to these types of jobs.

6.2 DESCRIPTION OF PROGRAMS AND INCORPORATION OF ENERGY EFFICIENCY

Most energy efficiency oriented professionals have a bachelor's, master's, or a Ph.D. degree. A bachelor's degree curriculum generally takes about four years to complete and includes foundational knowledge that prepares students for entry into a professional occupation. Foundational knowledge includes general writing and communication skills as well as topical knowledge in a specific area such as engineering or business. A bachelor's degree demonstrates the minimum skill set needed to attain a professional occupation. With a bachelor's degree an individual may further their education with a master's, Ph.D., or, combined with practical experience, pursue professional certification or licensure. Graduate degrees offer students the opportunity to achieve mastery of their field and pursue more in-depth research or professional training.[2]

There are four primary types of university programs associated with the major professional occupations for energy efficiency related sectors: (1) multidisciplinary programs with an energy emphasis; (2) engineering (civil and mechanical); (3) architecture; and (4) construction management. Table 6.1 provides an overview of the number of these programs in California colleges and universities.

[1] Confirmed by this study, and Goldman, C., M. Fuller, E. Stuart, J. Peters, M. McRae, N. Albers, S. Lutzenhiser, M. Spahic (2010, Sept.) *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*. Lawrence Berkeley National Laboratories; Research Into Action, Inc.

[2] A master's degree generally takes two to three years to complete, during which time students often complete small independent research projects relevant to their field. The Ph.D. is typically a longer-term degree program (five to seven years) in which students focus on independent research, demonstrating an ability to synthesize complex topics and contribute to the body of knowledge of their discipline. Graduate students usually pay for the degree using their own funds, university assistantships, fellowships, or employer contributions.

Table 6.1 Relevant University Programs in California and Representatives Interviewed, by Type

Departments and Programs	Number of Programs[1]	Number Interviewed	Average Number of Graduates Per Year Per Program	Number of Graduates, 2009
Multidisciplinary Energy and Energy Efficiency Specific Programs	16	11	37	592
Engineering Programs[2]				
Civil Engineering	45	8	49	2,212
Mechanical Engineering	58	3	46	2,651
Electrical Engineering	54	0	56	3,049
Architecture[3]	24	7	58	1,402
Construction Management	15	9	22	330
Total	212	38	45	10,236

[1] Note that B.A.s, M.A.s, Ph.D.s, and certificates are counted as separate program tracks, because they lead to different employment outcomes.

[2] American Society for Engineering Education (2009). College Profiles. Retrieved from: http://www.asee.org/papers-and-publications/publications/college-profiles.

[3] National Center for Education Statistics, U.S. Dept of Education - Institute of Education Sciences. Retrieved from: http://nces.ed.gov/collegenavigator/?s=CA&p=04.0201&l=5&ic=1.

6.2.1 MULTIDISCIPLINARY ENERGY AND ENERGY-EFFICIENCY SPECIFIC PROGRAMS

A few multidisciplinary programs provide an academic home to students with a specific interest in energy efficiency and related studies. Although their origins and funding vary substantially, most of these programs are fairly new, with five of them emerging after 2004. Table 6.2 provides an overview of the seven multidisciplinary programs in California that focus on energy topics. Only one of these programs, the Energy Management and Design program at Sonoma State, focuses on undergraduate students, while the remaining programs are associated with graduate-level degrees or research centers.

In addition to being limited in number, these programs tend to train a very small number of students, producing fewer than 100 graduates per year. However, most of these programs are planning for increased enrollment and expanded offerings in the coming years. For instance, the Energy Efficiency Center at University of California–Davis (UC Davis) has a five- to ten-year plan to expand from a few targeted energy efficiency classes to offering a master's degree or certificate for master's students. As of 2010, the two oldest programs are the only ones offering degrees: a bachelor's program at Sonoma State, and both a master's and Ph.D. program at University of California–Berkeley's (UC Berkeley) Energy and Resources Group.

Table 6.2 Universities with Energy Efficiency and/or Renewable Energy Focus

University	Center / Department	Inception Date	Program Type	Description
Stanford	Precourt Center on Energy Efficiency	2006	Research	Engineering students and faculty conduct research associated with energy efficiency technologies.
UC Berkeley	Energy and Resources Group	1973	Graduate	Approximately half the students enrolled in this program take classes and conduct research pertinent to energy policy and the use of renewable energy.
UC Davis	Energy Efficiency Center	2006	Graduate	Students from disciplines such as engineering and business take classes specific to energy efficiency technologies, measures, and policies.
Sonoma State	Energy Management and Design	c.1985	Bachelor's	Students learn about energy efficiency and renewable energy technologies in addition to the policies and procedures that support energy efficiency and renewable energy in California.
UC Berkeley	School of Law – Center for Law, Energy and the Environment	2005	Graduate	Law students can take energy specific course(s) and earn a certificate in Energy and Clean Technology Law. Students from other programs such as business can also take earn this certificate.
University of San Diego	School of Law – Energy Policy Initiatives Center	2005	Graduate	Law students can take energy law and policy courses and clinics that teach students about California specific energy laws and policies.
UC Los Angeles	School of Law – Emmet Center on Climate Change and the Environment	2008	Graduate	The Center conducts and promotes research on climate change policies in California.

One obstacle to the expansion of these energy-specific programs is the lack of qualified teaching professionals. All respondents reported some difficulties in finding qualified instructors for their programs. The programs currently rely on existing or retired industry professionals as instructors, but most report that they lack a sufficient number of people with industry experience and a willingness to teach.

6.2.2 ENGINEERING PROGRAMS

Engineering encompasses a variety of sub-fields that are relevant to energy efficiency related work, including mechanical, electrical, and civil engineering. In 2009, engineering programs in California graduated over 15,000 engineers, a little over half of them in the civil, mechanical, or electrical engineering.

Across all engineering disciplines about 80 percent of the curriculum is designed to follow the approved curriculum criteria established by the Accreditation Board for Engineering and Technology (ABET). ABET approves of programs that supply students with foundational knowledge in physics, math, chemistry and the basic concepts needed in engineering's subdisciplines. Table 6.3 displays ABET's description of what constitutes an approved curriculum in civil and mechanical engineering.

Professor, student, or departmental interest in a topic defines the remaining 20 percent of the curriculum. Currently, energy efficiency and renewable energy-specific topics are not part of the ABET defined curriculum and will only become part of the curriculum if student, faculty, or departmental interest pushes in that direction. This can occur in the portion of the curriculum dealing with application, but energy efficiency-related topics compete with all other potential topics a student, professor, or department may devise, including such as topics as microelectronics, nanotechnologies, aeronautics, etc.

Table 6.3 BET Approved Curriculum Definitions

Degree	ABET Approved Curriculum*
Civil Engineering	"The program must demonstrate that graduates can: apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives; apply knowledge of four technical areas appropriate to civil engineering: conduct civil engineering experiments and analyze and interpret the resulting data; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure."
Mechanical Engineering	"The program must demonstrate that graduates have the ability to: apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems, components or processes; and work professionally in both thermal and mechanical systems areas."
Electrical Engineering	"The program must demonstrate that graduates have: knowledge of probability and statistics, including applications appropriate to the program name and objectives; and knowledge of mathematics through differential and integral calculus, basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives. Programs … must also demonstrate that graduates have knowledge of advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics."

* Accreditation Board for Engineering and Technology (2009). Criteria for Accrediting Engineering Programs: Effective for Evaluations During the 2010-2011 Accreditation Cycle. Retrieved from: http://www.abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/E001%2010-11%20EAC%20Criteria%201-27-10.pdf .

We identified a total of 75 bachelor's degree, 57 master's degree, and 25 Ph.D. programs in civil, mechanical, and electrical engineering statewide. However, we were able to interview only a small sample of these programs. The following sections describe the findings from these interviews for each sub-field.

6.2.2.1 CIVIL ENGINEERING

Civil engineers design, construct, and maintain physical and natural structures, including dams, transportation infrastructure, and, most relevant to this report, buildings and the physical site on which buildings are built. We contacted 18 civil engineering departments, representing over 35 degree programs. However, representatives from at least nine of these programs declined the opportunity to participate in the study because they did not think the description of our research applied to their program. Five more representatives declined without reason or did not respond to our query, leaving us with the opportunity to interview only four departments (eight programs in total). Although it is difficult to draw conclusions from non-respondents, this lack of interest in participating in the study may indicate that a majority of civil engineering programs do not see a relationship between civil engineering and energy efficiency related industries.

Respondents from both University of Southern California (USC) and the University of Santa Clara suggested that the emergence of energy efficiency in their curriculums has been due largely to an interest in multidisciplinary topics across all the engineering subdisciplines. For instance, the study of systems design moves beyond traditional disciplinary boundaries to incorporate elements of different engineering and science fields. One respondent described how energy efficiency is starting to become part of the civil engineering curriculum this way:

> *"Traditionally the energy use concentration [in engineering] has been in HVAC and that has had its home in mechanical engineering and architecture. Civil engineering [focuses on the] building of structure, [but now] we have to think about the energy efficiency of buildings in addition to things like seismic strength if we want the system to use minimum levels of energy and have minimum impact on the environment."*

At times, energy topics may be integrated into the civil engineering curriculum serendipitously. At USC, for example, energy efficiency entered the curriculum in part because of a chance encounter between a civil engineering professor and an architecture professor who became interested in each other's work and began collaborating on research on earthquake resistant and energy efficient structures. In other cases, universities or individual departments are intentionally seeking out opportunities to incorporate energy efficiency or other green practices across disciplines. Santa Clara University emphasizes sustainability across campus with a variety of initiatives, including a collaboration of civil engineering students and other disciplines to design a home for the U.S. Department of Energy's Solar Decathlon competition.

Civil engineering programs select faculty to complement the focus of the degrees offered. For instance, at the undergraduate level, civil engineering schools largely employ tenure-track faculty to teach courses. At the master's level with a professional focus, departments rely more on industry professionals for instruction. A typical civil engineering program prepares students already employed in the construction field for careers as construction engineering managers. An expansion into energy efficiency will likely depend on access to instructors with professional experience in these areas.

Figure 6.1 shows all civil engineering schools in California by the number of graduates in 2009.

6.2.2.2 MECHANICAL ENGINEERING

Mechanical engineers apply the principles of physics to help design, manufacture and maintain mechanical systems such as heating, ventilation, and air conditioning (HVAC) units. As noted above, the national workforce needs assessment found strong demand for mechanical engineers in the energy efficiency services workforce. Figure 6.2 displays the total number of 2009 graduates from mechanical engineering departments in California.

We spoke with one representative from a mechanical engineering department at California State University (CSU)–Chico. He reported that his department does address energy issues and is currently working on reviving a course, initially offered in the 1980s and early 1990s, which lay dormant during a low-point in funding for energy efficiency between 1995 and 2005. This course will directly addresses energy efficiency and mechanical engineering issues.

Engineering programs at San Diego State (SDSU) and San Francisco State Universities (SFSU) host Industrial Assessment Centers (IACs), funded by the U.S. Department of Energy since 1976.[3] The IACs throughout the U.S. provide the opportunity for engineering students to conduct free energy assessments for medium-sized manufacturers, which helps manufacturers identify energy savings while providing students with valuable practical experience under the tutelage of an experienced professional. Until 2007, in addition to those at SDSU and SFSU, a third IAC was operated at Loyola University in Los Angeles but this center closed after repeated budget cuts. The directors of the two remaining California-based IACs are mechanical engineers, and while they draw students from all engineering disciplines, the majority of students involved in IAC activities are from mechanical engineering.

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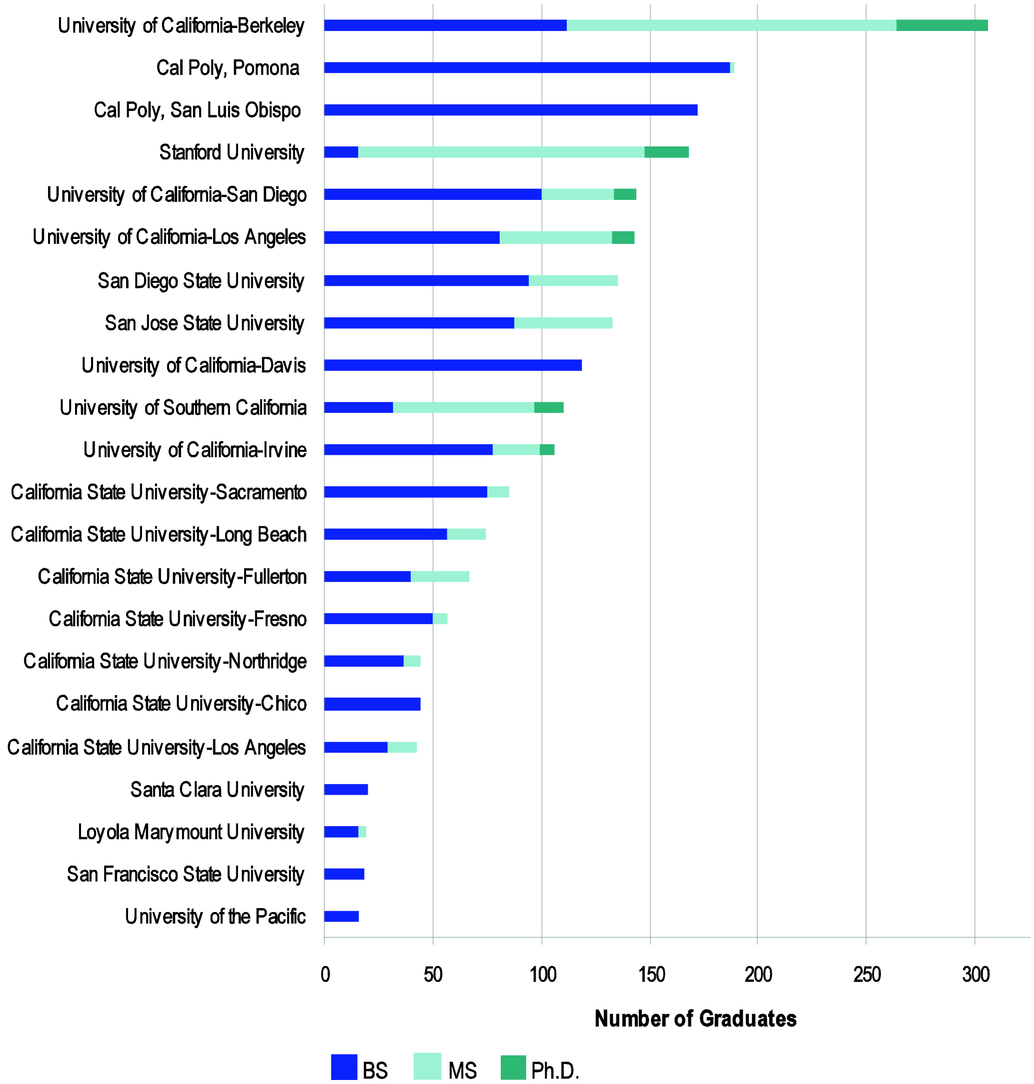
[3] Goldman, C., J. Peters, N. Albers, E. Stuart, M. Fuller (2010, March). *Energy Efficiency Services Sector: Workforce Education and Training Needs.* Lawrence Berkeley National Laboratories; Research Into Action, Inc.

Figure 6.1 Civil Engineering Programs by Degree Type Graduates, 2009



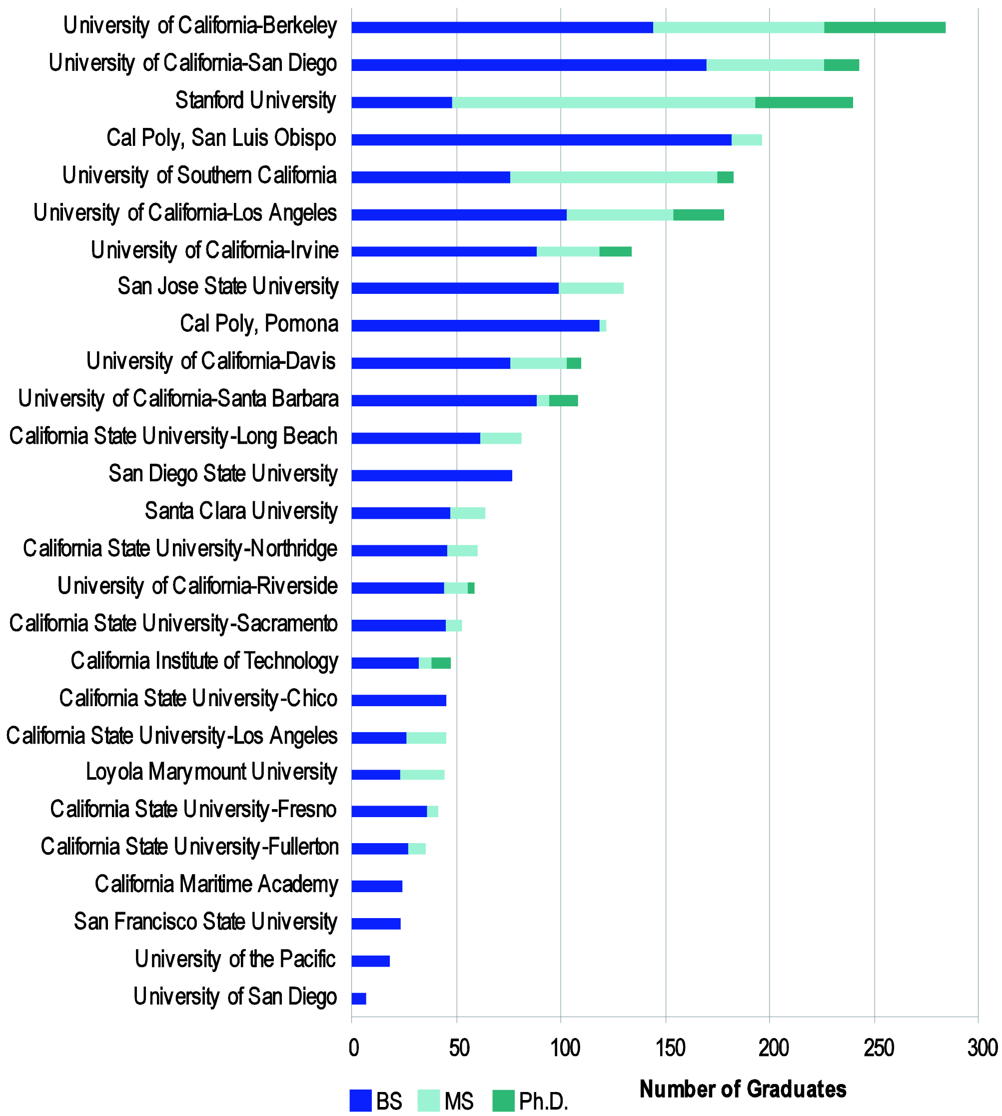
6.2.3 ARCHITECTURE

Architecture is the art and science of designing and erecting buildings and other physical structures. There are ten architecture programs in California. These programs graduated 885 bachelor's students, 500 master's students, and 12 Ph.D. students in 2009 (Figure 6.3).

Unlike engineering departments, architecture departments report embracing "green" topics, including energy efficiency and building-integrated distributed generation. For example, the Southern California Institute of Architecture and the California College of the Arts (CCA) integrate topics such as energy efficiency and sustainable design into their curriculum. They aim to showcase the most recent energy efficiency technologies, sustainable materials, and relevant policies throughout their curriculum. Southern California Institute of

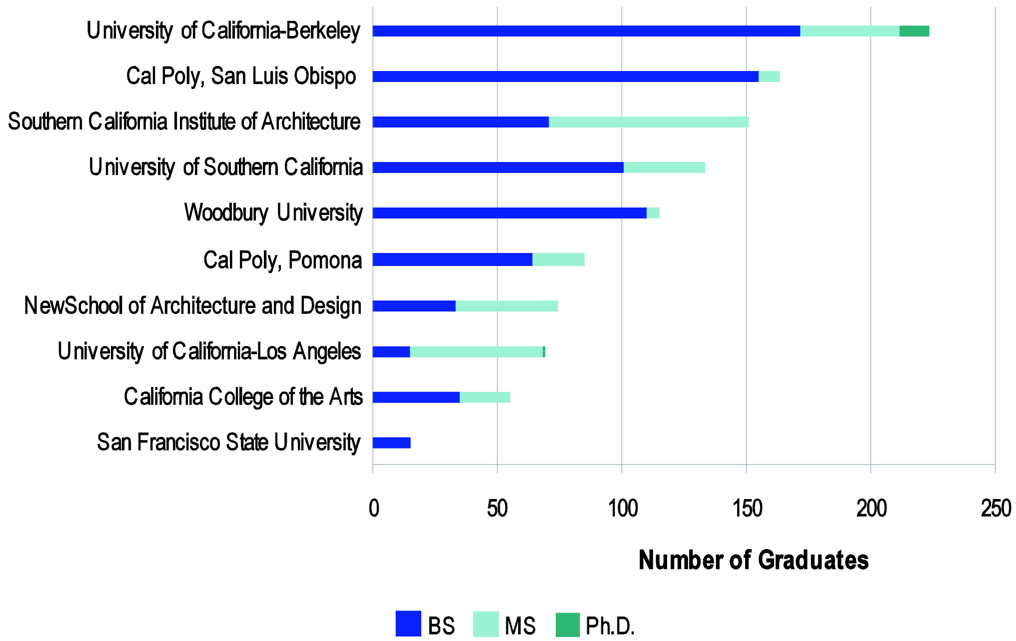
Architecture participates in the National Solar Decathlon where students compete against other universities to design an energy efficient and solar powered house that uses little to no energy. Additionally, Southern California Institute of Architecture offers coursework about designing buildings that do not require traditional air conditioning systems for cooling.

Figure 6.2 Mechanical Engineering Programs by Degree Type Graduate, 2009



CCA offers classes such as Building Energy and Green Building that stress "an integrated approach to sustainable development through the design of higher performance buildings that are regenerative, healthy, durable, and cost-effective over the long term." These architecture programs report also integrating energy efficiency topics into the curriculum organically by examining related topics such as day-lighting, sustainable building design, ventilation, and building modeling. An examination of the largest architecture program websites also tells us that energy topics are at a minimum part of the standard bachelor's degree curriculum.[4] For instance the two largest architecture programs in California, UC Berkeley and California State Polytechnic University (Cal Poly)–San Luis Obispo, offer coursework and minors that cover energy topics. Additionally, USC requires students to take a course related to passive solar systems and mechanical systems.

Figure 6.3 California Architecture Program Graduates by Degree Type, 2009



Architecture programs largely rely on industry professionals as instructors. For instance, about 75 percent of CCA teachers are industry professionals, who teach part time, while the remaining 25 percent are full-time instructors. Architecture programs also emphasize the practical application of the principles they teach. Therefore, architecture instructors are expected to be specialists within their sub-field and are expected to be implementing what they teach in their own practice. Architecture students are also expected to put their knowledge into practice through studio classes and design-build workshops.

While students do receive exposure to energy efficiency, we received feedback from one professional involved in continuing education to architects that architecture schools do not adequately prepare students in fields such as energy efficiency and distributed generation. Architecture students do not receive the deep practical experience in these topics comparable to the experience students obtain through design studio classes. He stated that "their exposure to these topics is episodic and occurs outside of design studio. Students emerge from architecture programs with a vague awareness that energy efficiency matters, but with very little idea of how to actually achieve it in their careers and incorporate it into the firm's projects." Furthermore, since this addition of "green" topics to architecture curriculums is relatively recent, many practicing architects have not been exposed sufficiently to energy efficiency related advances. To respond to this lack of concrete skills and practical experience, this respondent suggests the CPUC partner with the California Architects Board, the licensing board for this field, to require continuing education for architects on energy efficiency and renewable energy topics as part of their

[4] The four largest architecture programs in California based on number of 2009 graduates are 1) University of California – Berkeley, 2) California Polytechnic State University – San Luis Obispo, 3) Southern California Institute of Architecture, and 4) the University of Southern California.

license renewal. American Institute of Architects (AIA) California Council supports such a requirement. In addition, this respondent suggests that the CPUC should also work to institute an energy efficiency and renewable energy component in the licensing exam for architects. Currently the licensing exam does not require proficiency on these topics. Such a requirement could stimulate architecture schools to more deeply address and integrate energy efficiency and renewable energy into their curricula.

6.2.4 CONSTRUCTION MANAGEMENT

Construction managers provide the overall planning, coordination and controls of construction projects, focusing on key engineering and business principles. While some construction managers obtain degrees, others obtain certification through their professional association and professional experience. Ten colleges or universities offer construction management programs in California. Only one of these offers a master's degree, while the rest offer bachelor's degree programs.

We spoke with representatives of four of these construction management programs:

- → University of Southern California
- → California State University–Fresno
- → Westwood College
- → Cal Poly–San Luis Obispo

The representative from USC represented the only master's degree program in the state, and the remaining respondents represented bachelor's degree programs.

Westwood College's program is a stand-alone program focused largely on the business of construction. This program relies mostly on industry professionals that teach part time to implement the curriculum. The programs at Cal Poly and CSU, Fresno have a more technical focus and rely on tenure-track faculty for the majority of instruction. The master's program at USC caters to students currently working in the construction field who are interested in management positions.

In addition to their primary focus, these programs also offer courses that specifically cover some energy efficiency related topics. For instance CSU–Fresno offers courses such as electrical and mechanical systems, Leadership in Energy and Environmental Design (LEED) applications, and residential green building. Furthermore, because students have expressed an interest, next year this program will start offering instruction on how to conduct an energy audit.

The USC respondent also indicated that energy topics are becoming more common in the construction management curriculum as energy becomes a greater focus in the construction marketplace. This respondent noted that every grant he had recently applied for had an energy efficiency component. At Cal Poly–San Luis Obispo, mechanical, electrical, and plumbing classes all incorporate efficiency into the coursework. They are also launching a new sustainable topics class that will incorporate instruction on what a construction manager should know about LEED certification.

6.3 OUTCOMES

In 2009, California engineering programs graduated almost 8,000 civil, mechanical, and electrical engineers. These three fields represent a little over half of all graduating engineers in 2009, as shown in Table 6.4.

Table 6.4 Engineering Programs in California

Engineering Type	Bachelor's		Master's		Ph.D.		Total
	Count of Programs	2009 Graduates	Count of Programs	2009 Graduates	Count of Programs	2009 Graduates	2009 Graduates
Civil Engineer	22	1,481	16	564	6	102	2,147
Mechanical Engineer	27	1,777	21	673	10	201	2,651
Electrical Engineer	26	1,336	19	1,459	9	254	3,049
Other Engineering Programs	31	3,826	21	2,797	11	671	7,294
Total		8,420		5,558		1,228	15,206

Source: American Society for Engineering Education (2009). College Profiles. Retrieved from: http://www.asee.org/papers-and-publications/publications/college-profiles.

These new engineers, and the 77,500 incumbent engineers in California's workforce, work in a variety of fields from computer programming to designing roads.[5] Approximately 1,500, or two percent of all engineers in California, work in the energy efficiency field.[6] Assuming that two percent of all graduating engineers go to work in the energy efficiency field in California, approximately 300 new engineers enter the energy efficiency workforce each year.

The four civil engineering programs interviewed represent eight civil engineering degree programs, each with approximately 50 graduates per year. Upon graduation, these students primarily go to work for construction, engineering, and architecture firms. Graduates from bachelor's degree programs get jobs as entry-level engineers. Master's students often enroll in the degree program while already employed, in hopes that the extra education will enable them to move into a management position. Respondents did not know how many students from their programs went to work for organizations that focus on energy efficiency. One respondent from the USC estimated that more master's students were likely to work in energy efficiency than bachelor's students, but he expects that will change as the undergraduate program shifts to focusing on energy topics.

Civil engineers are the largest engineering field in the emerging energy efficiency workforce. However, engineers of all types successfully work in the energy efficiency industry, and the national assessment of the energy efficiency services industry found that mechanical engineers and electrical engineers are in particular demand among energy efficiency firms.[7] Nevertheless, because of the reluctance of many engineering programs to actively incorporate energy efficiency related topics into their regular curricula, many of these engineers receive the majority of their energy efficiency training on the job.

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[5] Bureau of Labor Statistics (2010). Occupational Employment Statistics. Retrieved from: http://www.bls.gov/oes/

[6] These 1,500 engineers work for utilities in energy efficiency departments, program implementation contractors, and Energy Service Companies (ESCOs). Goldman, C., et al. (2010, Sept.) *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*. Lawrence Berkeley National Laboratories; Research Into Action, Inc.

[7] Ibid.

Data for employment outcomes in the other professional fields are less abundant. In the architecture field, the top five programs—the CCA, Southern California Institute of Architecture, USC, UC Berkeley, and Cal Poly–San Luis Obispo—produced more than two-thirds of California's architecture graduates in 2009. Assuming the curriculum of these programs is similar to the remaining California architecture programs, the approximately 1,100 architecture students that graduate each year in the state receive exposure to energy efficiency and related design topics. Although programs neither collect nor maintain detailed employment data on graduates, it is likely that most of these graduates go to work for architecture firms, bringing their energy efficiency related knowledge with them.

Construction management programs have a curriculum that prepares students to work for general contractors, primarily in large residential, commercial, or industrial projects. One respondent estimated that 75 to 80 percent of his undergraduate students go to work for general contractors.

Finally, respondents from multidisciplinary programs report that graduates are typically successful in finding positions to design and implement the technologies and policies that support energy efficiency related investments. These positions are with utilities, municipal governments, law firms, renewable energy companies, and implementation firms that specialize in energy efficiency and other demand-side management activities. However, none of the respondents for these professional programs maintain any records of their graduates' achievements, nor do they know how many of their graduating students stay in California.

Table 6.5 displays 2009 California wage data for these key professional categories. There is substantial competition for entry-level professionals, which affects the ability of demand-side energy management sectors to recruit workers.[8] Wage data for graduates of multidisciplinary programs is not available as these graduates go on to work in a wide variety of occupations.

Table 6.5 Wage Data for Professional Fields

Occupational Category	Number Employed in CA May 2009	Hourly Wages in 2010 Dollars	
		First 10th Percentile (Entry Level)	Median Wage
Civil Engineer	38,430	$28.51	$43.49
Mechanical Engineer	21,420	$25.62	$41.53
Electrical Engineer	17,650	$28.60	$45.49
Architect	11,260	$24.82	$39.04
Construction Manager	20,850	$32.77	$49.88

Source: Bureau of Labor Statistics (2010). Occupational Employment Statistics. Retrieved from: http://www.bls.gov/oes/.

8 Ibid.

6.4 LICENSES AND CERTIFICATION IN THE PROFESSIONAL ENERGY EFFICIENCY WORKFORCE

A bachelor's degree is an entry-level credential in the architecture and engineering fields. Graduates of such programs can move into the workforce directly, or they may choose to pursue additional education in the form of continuing education courses or a graduate degree. An architect or engineer must earn a professional license before moving into a responsible position, in which they can make decisions without the supervision of another licensed professional. In addition, workers with a bachelor's or master's degree in any of these fields may choose to pursue voluntary third-party certifications or additional professional training, in order to provide evidence to employers that their skills and knowledge are up to date. This section describes the steps needed to become a licensed engineer or architect, as well as presenting some key energy-related certifications available to professionals.

6.4.1 ENGINEERS

In order to become a licensed engineer in California, a candidate must take the following steps:

- Earn a degree from an ABET accredited engineering program.
- Pass the Fundamentals in Engineering (F.E.) exam provided by the National Council of Examiners for Engineering and Surveying (NCEES). This test is usually taken around the time of bachelor's degree completion and is offered in all 50 states.
- Meet a work experience requirement. This usually takes four years and is done under the supervision of a Professional Engineer (P.E.). During this time the candidate may be referred to as an Engineer in Training (EIT).
- Pass the P.E. exam provided by NCEES in an appropriate engineering discipline (for instance, Civil Engineering: Construction or Mechanical Engineering: HVAC and refrigeration).
- Register their license with the California Board for Professional Engineers and Land Surveyors.
- Licensed engineers must also renew their license biannually by paying a $125 renewal fee.[9] In most states renewal is also contingent upon completing a mandated quota of continuing education courses, although California currently does not have this requirement.[10]

A P.E. designation allows an engineer to approve of engineering drawings, be in charge of a private engineering practice, and serve as an expert witness. While a P.E. is not required to work in the engineering field, it is a mark of distinction and it provides professional opportunities because it is sought after in the marketplace and required for some engineering activities.

In addition to professional licensure, professional engineers in the energy efficiency field can pursue certification to enhance their credentials. Two of the primary organizations that offer certification are the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) and the Association of Energy Engineers (AEE). These certifications usually require a P.E. license and two years of relevant experience, or some equivalent combination of education and experience.

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[9] National Council of Examiners for Engineering and Surveying (2010). Licensure for engineers. Retrieved from: http://www.ncees.org/Licensure/Licensure_for_engineers.php.

[10] Professional Associations in California have considered pushing for legislation to change this. See Al-Kazily, J. (2010, July) *Concept Paper for Legislation to Require Continuing Education for Re-licensing as a Professional Engineer*. American Society of Civil Engineers Region 9.

6.4.1.1 AEE CERTIFICATIONS

The most widely-earned certification AEE offers is The Certified Energy Manger (CEM).[11] The CEM accounts for about half of all AEE certifications in California and is used by government agencies and energy service companies to distinguish people knowledgeable about energy management. Table 6.6 shows the five AEE certifications with the largest number of certified professionals in California.

Table 6.6 AEE Certifications Relevant to Energy Efficiency

Certification	AEE Description	Certified Professionals in California, December 2010
Certified Energy Manager (CEM)	The CEM is used as a measure of professional accomplishment within the energy management field. It has gained industry-wide use as the standard for qualifying energy professionals both in the United States and abroad. It is recognized by the U.S. Department of Energy, the Office of Federal Energy Management Programs (FEMP), and the U.S. Agency for International Development, as well as by numerous state energy offices, major utilities, corporations and energy service companies.	718
Certified Energy Auditor (CEA)	The CEA certification identifies professionals as having the required knowledge and experience needed to succeed in the field of energy auditing.	100
Green Building Engineer (GBE)	The Green Building Engineer (GBE™) program awards special recognition to those green building, design and construction engineering professionals who have demonstrated a high level of competence and ethical fitness for green building related disciplines, as well as laws governing and affecting green building professionals.	60
Certified Sustainable Development Professional (CSDP)	The designation CSDP identifies individuals who have demonstrated high levels of technical expertise in energy management and environmental practices.	59
Certified Building Commissioning Professional (CBCP)	The CBCP is available to licensed engineers and architects, or facilities management professionals with significant experience in building science. The examination is offered in conjunction with two short-term trainings on commissioning and covers "concepts and experiences basic to the building commissioning process."	51

Source: Association of Energy Engineers. Certifications. Retrieved from: https://www.aeecenter.org/i4a/pages/index.cfm?pageID=3330.

6.4.1.2 ASHRAE

ASHRAE offers five certifications relevant to energy efficiency and related skills. Table 6.7 shows each certification, a brief description of the certification, and how many certified engineers exist in California. The relatively low numbers of ASHRAE certified engineers is due in part to the recent development and specificity of the certifications. Currently, only 52 California-based engineers are certified.

[11] Goldman, C., J. Peters, N. Albers, E. Stuart, M. Fuller (2010, March). *Energy Efficiency Services Sector: Workforce Education and Training Needs.* Lawrence Berkeley National Laboratories; Research Into Action, Inc.

Table 6.7 ASHRAE Certifications Relevant to Energy Efficiency

Certification	Description	Certification Start Date	Certified Engineers in California, December 2010
Building Energy Modeling Professional (BEMP)	The purpose of this program is to certify individuals' ability to evaluate, choose, use, calibrate, and interpret the results of energy modeling software when applied to building and systems energy performance and economics and to certify individuals' competence to model new and existing buildings and systems with their full range of physics.	2010	14
Commissioning Process Management Professional (CPMP)	The CPMP is designed to train professionals to oversee and coordinate the whole building commissioning process, by acting as an intermediary between the building owner and commissioning provider.	2009	24
High Performance Building Design Professional (HBDP)	Candidates who earn the HBDP certification will have demonstrated a well-rounded understanding and knowledge of how HVAC&R design is integrated into high performing buildings to achieve the overall goal of producing a sustainable HVAC/R design.	2008	13
Operations & Performance Management Professional (OPMP)	OPMP certification requires demonstration a well-rounded understanding and knowledge of the management of facility operations and maintenance and their impact on HVAC/R systems' performance.	2009	1
Building Energy Assessment Professional (BEAP)	The purpose of this program is to certify individuals' ability to audit and analyze residential, commercial, and industrial buildings including determining project scope, collecting data, analyzing building performance, interpreting results, evaluating alternatives, submitting recommendations for energy conservation measures, and assisting with the implementation of these recommendations.	2011	0

Source: American Society of Heating, Refrigeration and Air Conditioning Engineers. Certification. Retrieved from: http://www.ashrae.org/certification/.

6.4.2 ARCHITECTS

Becoming a licensed architect requires the following steps in California:

- Complete eight years of post-secondary education and/or work experience, as evaluated by the California Architects Board (including at least one year of work experience under the direct supervision of an architect licensed in the U.S.).
- Complete the Comprehensive Intern Development Program (CIDP) and the Intern Development Program (IDP). The CIDP and IDP are programs that document a student's experience mastering the field of architecture.

- Pass the Architect Registration Examination (ARE). This national exam tests the candidate's knowledge, skills and ability to design and construct buildings.
- Pass the California Supplemental Examination (CSE). The CSE tests the candidate's knowledge and skills of California-specific building requirements including building codes and standards.[12]

Once licensed by the California Architects Board, an architect must renew their license biannually by completing five hours of continuing education coursework on disability access requirements, completing the renewal application, and paying the $300 renewal fee. Specific energy efficiency related knowledge is not currently part of the licensure process.

While not required as part of initial licensure, the AIA offers continuing education credits on a variety of topics including the following:

- → Building science and performance
- → Design and design services
- → Legal issues in architecture
- → Methods and materials
- → Practice
- → Project management
- → Project types
- → Sustainable design

A review of the California Council of the AIA shows only three online courses about energy efficiency.[13] Other entities such as the Pacific Energy Center in San Francisco also offer energy related continuing education credits for architects but these courses do not appear on the California Council's website and are voluntary on the part of the architect.

6.4.2.1 LEED AP BUILDING DESIGN AND CONSTRUCTION

The most well-known certification relevant to architects in energy efficiency is the LEED Accredited Professional in Building Design and Construction (LEED AP–BDC) offered by the Green Building Certification Institute (GBCI). The LEED AP–BDC is designed for architects and other professionals (including construction managers and engineers) that participate in the design and construction of high performance buildings that can qualify for the United Stated Green Building Council's (USGBC) LEED rating.[14] Currently, there are 1,321 LEED AP–BDC architects in California registered with GBCI.

6.4.3 CONSTRUCTION MANAGERS

While construction managers do not need a license like architects and engineers, they can attain a certification in the field through the Construction Management Association of America (CMAA). To be certified, one must fulfill the following requirements:

[12] California Architects Board (2011). License Requirements Process. Retrieved from: http://www.cab.ca.gov/candidates/license_requirements.shtml

[13] These courses are about CalGreen (Title 24) building code.

[14] Only about half of the LEED rating system pertains to energy use. The other parts of the LEED system pertain to topics such as water conservation and using sustainable building materials.

- Have one of the following combinations of education and experience:
  - → Possess an undergraduate or graduate degree in construction management, construction science, architecture, or engineering;
  - → Possess an associate's degree or certification in construction management, construction science, architecture, or engineering and four years experience in general design and construction; OR
  - → Do not have a degree but have eight years experience in general design or construction; AND
- Have four years experience as a construction manager and complete an application documenting that experience;
- Pay $275 to take the certification exam.[15]

Upon successful completion, the construction manager becomes a Certified Construction Manager. Additionally, the CMAA offers webinars, conferences, and courses. A review of upcoming courses includes a webinar pertinent to LEED projects. As mentioned above, construction managers can also attain LEED AP-BDC certification which demonstrates the manager's knowledge of the LEED rating system.

6.5 EQUITY AND ACCESS IN THE PROFESSIONAL OCCUPATIONS

A small fraction of people entering professional fields such as engineering and architecture will go on to focus on energy efficiency and renewable energy in their careers. Historically, an even smaller number of these professionals will come from underrepresented groups. With data only available for engineering programs, we estimate that African Americans and Latinos make up only about five to six percent (respectively) of all engineers currently employed by utilities, energy efficiency program implementers, and ESCOs nationwide.[16] Previous research shows that demand for engineers in the energy efficiency sector is growing, though again this is tempered by the fact that California has lost about 10 percent of its architect and engineer jobs during the 2008–2010 recession.[17] Over time, the demand for entry-level architects, engineers and other professional will create an opportunity to increase the ranks of underrepresented groups such as African Americans and Latinos in the energy efficiency field.

The Maximizing Engineering Potential (MEP) program at Cal Poly–Pomona is one example of a program designed to increase the diversity of the engineering field. This program, the largest of its kind in California, provides support to underrepresented students who express interest in engineering by offering assistance with class scheduling, orientation courses, summer programs, peer mentoring, and other services. While programs such as MEP do not encourage energy efficiency specifically, they do expand the population of engineers from underrepresented groups. This can indirectly lead to an expansion of underrepresented groups in the professional sector of the energy efficiency field. There are numerous programs of this nature at California's four-year colleges, though many are not specific to one field of study such as engineering. These programs provide critical but limited support, as they cannot address the larger socioeconomic issues that impact the achievement gap and high school dropout rates, the increasing costs of college, and the decline in financial aid that continue to impede broad college access and college success overall for students from disadvantaged communities.

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[15] Construction Management Association of America. Certification Process. Retrieved from: http://www.cmaanet.org/certification-process-0.

[16] Gibbons, M. (2009). *Engineering by the Numbers.* American Society of Engineering Education.. We estimate about 1,250 engineers work in the energy efficiency field as program administrators, implementation contractors, or for ESCOs in California (Goldman, C., et al. 2010).

[17] Goldman, C., M. Fuller, E. Stuart, J. Peters, M. McRae, N. Albers, S. Lutzenhiser, M. Spahic (2010, Sept.) *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*. Lawrence Berkeley National Laboratories; Research Into Action, Inc,

6.6 CONCLUSIONS

At their core, university programs provide students with foundational knowledge upon which employers in the energy efficiency and renewable energy fields can build upon through on-the-job training. Architecture departments have started to incorporate energy efficiency into their curricula, and construction management programs have recently begun to do the same. Thus far, other than mechanical engineering, engineering departments appear to incorporate energy efficiency topics into the curriculum less frequently. This difference may stem from the fact that as building designers, architects are closer to issues of energy use in buildings. Architecture students also have more opportunities to put their knowledge into practical application.

Construction management programs focus more on business practices, while civil engineering focuses on engineering principles and direct application to construction, rather than to systems. Civil engineering and construction management graduates also go into a range of fields from building roads and bridges to constructing wastewater systems, many of which have not been perceived as related to energy efficiency. Energy efficiency issues are more widely acknowledged as fundamental knowledge for new architects.

Multidisciplinary programs that focus on energy topics are the only programs that prepare students specifically for energy efficiency or renewable energy careers, with Sonoma State's program being the lone undergraduate program in the state. The other multidisciplinary programs teach and train post-baccalaureate students that have a specific interest in energy topics and are predominantly interested in energy careers.

There are only two professional energy efficiency related certifications that have over 100 California professionals associated with them: (1) The CEM for engineers and (2) The LEED AP–BDC for architects, construction managers, and engineers. The other certifications are specific to a small audience of professionals. However, there does appear to be room for integrating energy efficiency topics into the professional licensure process similar to the way disability access coursework is now required of California architects. Similar continuing education courses on energy efficiency topics could be required of professional architects and engineers as part of their biannual licensing or as part of the CMAA construction manager certification process.

Engineering programs graduate relatively small numbers of historically underrepresented groups resulting in small numbers of African American and Hispanic engineers working in California in energy efficiency related fields. However, as these sectors grow there may be an opportunity to provide good paying, professional sector jobs to these historically underrepresented groups.

CHAPTER SEVEN:

7. CERTIFIED APPRENTICESHIP PROGRAMS

7.1 OVERVIEW

Apprenticeship is a long-established "learn-while-you-earn" training model designed to provide industry with a highly skilled workforce. Apprentices usually take five years to complete their training, while working full time for an employer who pays their wages and benefits. Training combines on-the-job experience, under the supervision of a journeyman or skilled tradesperson, with highly technical classroom instruction. In many cases, classroom training is accredited by a local community college partner. The model is distinctive for being demand-driven and self-financing; for having strong partnerships between employers, government, educational institutions, and organized labor; and for providing broad-based occupational training that prepares workers for a life-long career in their trade, with wage increases as they move up the skill ladder. This long-term comprehensive training is tailored to the needs of industry and produces highly skilled workers with a broad occupational foundation. The system also enables workers to earn a number of educational and industry-recognized certificates throughout the course of their training, as well as the state-issued journey card, which is a portable, industry-recognized certification.

Although apprenticeship training dates back centuries, the system was formalized in the United States through the 1937 National Apprenticeship Act. Currently, all certified apprenticeship programs are regulated by the Employment and Training Administration Office of Apprenticeship in the U.S. Department of Labor (DOL), and/or, in California, by the state Division of Apprenticeship Standards (DAS). These agencies establish and enforce apprenticeship standards for wages, hours, working conditions, and the specific skills required for state certification as a journeyperson. DAS also consults with program sponsors and monitors programs to ensure high standards for on-the-job training and supplemental classroom instruction through each program's local educational agency (LEA). This regulatory oversight ensures consistency between programs and holds apprenticeship training to a high standard of quality.

Although a single employer or trade association can sponsor an apprenticeship program under a *Plant Standard,* or *Unilateral Apprenticeship Committee* (UAC), close to 80 percent of apprenticeships in California are sponsored by a collaborative arrangement between an employer association and a labor union, known as a *Joint Apprenticeship Committee* (JAC) or *Joint Apprenticeship and Training Committee* (JAC).[1] In the case of JAC programs, apprenticeships are self-financed through employer–worker contributions into a training trust fund. Among the programs interviewed for this study, employer–worker contributions range from $0.15 to $1.75 per hour worked by each journey-level employee. In some cases there are also contributions to the trust fund from apprentice compensation packages. This considerable investment provides financing for the next generation of tradespeople with little public funding. Unilateral and Plant Standard Programs, on the other hand, must collect testing fees and tuition from students or individual employers in order to maintain their programs. All state-registered program sponsors are also eligible for state-provided related supplemental instruction (RSI) funds to offset the cost of classroom instruction. Until recently, the state provided Montoya funds to pay for 20 percent of apprenticeship training, by funding each program's LEA, but these funds were largely cut in 2010.

[1] California Department of Industrial Relations, Division of Apprenticeship Standards (2010). Program Sponsor Survey Results 2010. Retrieved from: http://www.dir.ca.gov/das/DASSurveySummary2010.pdf.

7.2 DESCRIPTION OF PROGRAMS

The DOL Office of Apprenticeship (OA) has a list of over 1,000 apprenticeable occupations, from which apprenticeship programs can be developed. Apprenticeship training can be found in numerous industries including aerospace, automotive, childcare, construction, cosmetology, manufacturing, and utilities. [2] This report focuses on apprenticeship programs that train for occupations in the energy efficiency and related sectors. These occupations are found primarily in the building trades, including electrical, sheet metal, plumbing and pipefitting, carpentry, and laborers. There are 135 relevant apprenticeship committees in the state of California and we were able to interview a sample of 43 of those committees for this study.

Table 7.1 shows the total number of apprenticeship programs interviewed in each trade and the key occupational tracks that each trade offers. Not all tracks within each trade are relevant to this study, but are listed here to accurately document the occupations trained for by these programs.

Table 7.1 Apprenticeship Programs and Training Tracks

Trade	Committees Interviewed	Occupational Tracks
Carpenter	2	Carpenter, Floorlayer, Cabinet Maker, Acoustical Installer, Plasterer, Terrazzo Worker/Finisher, Furnishing Installer, Shingler, Insulation Installer, Pile Driver, Drywall/Lather, Millwright
Cement Mason	1	Cement Mason
Electrician	12	Inside Wireman, Residential, Intelligent Transportation Systems
HVAC Service Tech & Mechanic	2	HVAC/R Mechanic, HVAC/R Service Technician
Heat and Frost Insulator	1	Heat & Frost Insulator
Laborer	1	Carpenter, Laborer, Equipment Operator
Stationary / Operating Engineer	2	Equipment Operator, Heavy Duty Repair Mechanic, Stationary Engineer
Plumber / Pipefitter / Steamfitter	8	Plumber, Pipefitter, Steamfitter
Roofer / Waterproofer	1	Roofer/Waterproofer
Sheet Metal Worker	7	Sheet Metal Worker—building trades and residential, A/C Service Tech—commercial and residential, Air Balance & Testing—commercial and residential
Sprinkler Fitter	1	Sprinkler Fitter

Although we contacted both JAC and UAC programs, we were only able to obtain interviews with three UACs, representing five apprenticeship programs.[3] This includes two plumbers committees, and one program offering tracks for laborers, operating engineers, and carpenters. This insufficient sample makes it difficult to draw conclusions about UAC-sponsored programs, based on the interview data. Therefore, the majority of information provided in this report is specific to the much more numerically significant JAC programs.

Apprentices work under a collective bargaining contract that stipulates working conditions, a graduated wage scale tied to skill increases, the total number of training hours, and the technical competencies that they must master to earn recognition as a journey-level tradesperson. Total training hours vary depending on the trade, but DAS

[2] An apprenticeable occupation is defined as a skilled occupation that is: 1) customarily learned in a practical way, through a structured, systematic program of on-the-job supervised training; 2) is clearly identified and commonly recognized throughout an industry; 3) involves manual, mechanical or technical skills and knowledge that require a minimum of 2000 hours of on-the-job work experience; and 4) requires related instruction to supplement the on-the-job-training.

[3] Fifteen percent of UAC apprenticeship programs and 67 percent of JAC programs contacted agreed to be included in the study.

standards require two to six years of training, with a yearly minimum of 2,000 hours of on-the-job training and 144 hours of RSI. Wages usually start at 40 percent of a journey worker's wages and increase incrementally every six months, based on training hours and testing. Table 7.2 shows the average number of required on-the-job and classroom (RSI) training hours required by trade, as well as the average starting journey wage for each trade, which is what apprentices can expect to earn immediately upon completion of their training. Most journey tradespeople continue working for the same employer after completing their apprenticeship, and their wages continue to increase along a predetermined pay scale.

Table 7.2 Average Required Training Hours and Starting Wages

Trade	Average Training Hours				Starting Hourly Wages (not including benefits)			
	JAC		UAC		JAC		UAC	
	OTJ	RSI	OTJ	RSI	Apprentice	Journey	Apprentice	Journey
Carpenter	4,386	548	5,000	504	$16.52	$32.57	$16.72	$37.15
Cement Mason	4,200	432	—	—	$18.62	$28.65	—	—
Electrician	6,711	827	—	—	$16.90	$37.64	—	—
HVAC Service Tech & Mechanic	9,000	1,080	—	—	$18.61	$38.61	—	—
Heat and Frost Insulator	6,000	576	—	—	$17.35	$46.11	—	—
Maintenance Mechanic	6,640	640	—	—	$15.00	$30.00	—	—
Stationary / Operating Engineer	7,600	477	6,000	504	$20.58	$37.16	$16.72	$36.83
Plumber / Steamfitter / Pipefitter	7,730	1,080	7,200	688	$18.86	$40.54	$10.63	$40.00
Roofer / Waterproofer	4,000	400	—	—	$12.97	$30.12	—	—
Sheet Metal Worker	5,242	679	—	—	$14.81	$40.81	—	—
Laborer	—	—	3,000	336	—	—	$13.71	$25.22

Note: Missing data indicated" with "—".

Apprentices are trained through a combination of on-the-job learning and classroom lecture and hands-on lab instruction, which gives workers the ability to immediately apply the theory they are learning in the classroom to their work. Apprentices emerge from training with knowledge of safety and environmental regulations, CPR and first aid, mathematics, drafting, blueprint reading, and other technical skills connected with the trade. In addition, programs often include training related to diversity, sexual harassment issues, personal development, environmental mediation, and job site management.[4]

Upon completion of an apprenticeship program, participants receive a journey card or certificate of completion issued by the State of California or the federal Department of Labor. Throughout their training, apprentices also have the opportunity to earn a number of other industry-recognized certificates.[5] These certificates indicate mastery of such competencies as safety, equipment operation, welding, and other trade-specific skills. Some certifications are required for completion of the program. For example, sheet metal apprentices are required to pass at least one North American Technician Excellence (NATE) certification in order to earn their journey card.[6]

[4] California Department of Industrial Relations, Division of Apprenticeship Standards (2011). Minimum Industry Training Criteria. Retrieved from: http://www.dir.ca.gov/das/mitc.htm.

[5] See Appendix H for a more complete listing of the certifications that apprentices can earn in key trades.

[6] NATE is the nation's largest non-profit offering independent third-party certification for technicians in the HVAC industry. The organization tests technicians in basic and specialty areas, but does not offer any training. NATE's certifications are endorsed by most major HVAC industry organizations.

Other certifications are optional, but provide workers with industry-recognized evidence of their advanced skills. Most JACs also offer free journey upgrade trainings to teach specialized skills and introduce workers to new best practices or technologies throughout their career.

7.3 INFORMATION ON OUTCOMES

Because apprenticeship is a pathway into well-paid, middle-skill employment opportunities and the number of training slots is limited, entry into programs is highly competitive. Apprenticeship is demand-driven, with the number of program openings determined by economic projections of industry and employer need. The construction industry has been impacted profoundly by the recent economic recession, to the extent that a number of building trades apprenticeship programs have stopped accepting applications until the economy recovers. As one apprenticeship coordinator stated, “We don’t train if there’s no job.” This system guarantees that apprentices are fully employed while in training, but it means that many programs have long waiting lists.

Table 7.3 shows the annual average number of indentured apprentices in California in each trade between 2006 and 2010. The averages represent the total number of apprentices indentured in a trade in a particular year regardless what year of the apprenticeship they are in. Each indentured apprentice represents an individual who is not only enrolled in training, but also has a full-time job. Peak indentures were approximately 50 percent higher than the averages.

Despite the length and intensity of apprenticeship training, 88 percent of apprentices in the programs sampled successfully complete their training and earn a journey card within three to five years. The right-hand columns of Table 7.3 show the average number of apprentices in each trade that completed the program and obtained their journey card each year between 2005 and 2009.

The comprehensive training and certifications provided through apprenticeship programs have significant value in the marketplace. After completing their apprenticeship, most journey tradespersons continue their employment in large commercial, industrial, or infrastructure construction industries. These sectors are more highly paid and demand greater worker productivity than the residential or small commercial sectors. Net earnings gains for apprenticeship participants are far more than gains for other types of non-university training. A national study estimates that an individual who completes an apprenticeship program can expect to increase their annual earnings by approximately $16,000, and their lifetime earnings by over $220,000 by the time they reach 65 years of age.[7] These earnings differentials continue to increase with additional work experience and journey upgrade training. Over the course of a career this amounts to a significant increase in earning power, as well as a high-road career path with benefits such as health care and a pension. In addition, graduates of apprenticeship programs frequently have the opportunity to continue upgrading their skills through journey upgrade training offered by JACs. These trainings are also paid for through the training trust fund and employers are reimbursed for the time workers spend in the classroom.

[7] Lerman, R. (2010). “Expanding Apprenticeship in the U.S.” Presentation to the Ray Marshall Center, University of Texas – Austin, October 2010. Retrieved from: http://www.utexas.edu/research/cshr/pubs/pdf/Robert%20Lerman%20-%20Expanding%20Apprenticeship%20in%20the%20US.pdf.

Table 7.3 Annual Indentures and Journey Completions from 2005 – 2010 by Trade*

Trade	Average Indentures		Peak Indentures		Journey Completions	
	JAC	UAC	JAC	UAC	JAC	UAC
Carpenter	6,535	277	9,926	407	1,814	59
Cement Mason	139	53	223	63	39	8
Electrician	1,002	546	1,981	1038	884	230
HVAC Service Tech & Mechanic	57		83		32	
Heat and Frost Insulator	82	1	142	5	31	29
Maintenance Mechanic	25		33		12	
Stationary / Operating Engineer	266		627		245	
Plumber / Steamfitter / Pipefitter	1,040	189	1,930	272	490	52
Roofer / Waterproofer	1,247	197	1,902	261	110	20
Sheet Metal Worker	460	55	877	85	311	13
Sprinkler Fitter	87		166		40	
Laborer	1,014		1,581		424	
Total	11,955	1,317	19,471	2,131	4,433	410

* Data obtained from the DAS. Average indentures from 2006-2010, average journey completions from 2005-2009. Peak indentures are the totals from the single year with the highest reported indentures during the five year time period.

7.4 EMPLOYER INVOLVEMENT

Apprenticeship is an employer-driven system. In addition to funding the programs, employers are deeply engaged in the governance of apprenticeship programs at all levels. They serve on joint or unilateral apprenticeship committees, which are responsible for developing and making changes to curricula and determining the application process and number of training slots available each year. Employers also serve on oral interview panels during the application process; hire, train, and evaluate apprentices on the job; and introduce new products, technology, and equipment to the program. In addition, employers are often appointed to serve on State Apprenticeship Councils that establish policies, regulations, and standards for apprenticeship training.

7.5 PARTNERSHIPS

In addition to the collaboration between labor unions and employer associations that form the basis of JACs, apprenticeship programs have developed partnerships with a variety of organizations. These include educational institutions, military and government agencies, community based organizations, and other apprenticeship programs. These partnerships are primarily formed for the purposes of providing or supplementing training for apprentices and prospective applicants, or for the recruitment and support of targeted groups, such as veterans, minorities, or high school students.

7.5.1 EDUCATION AND RECRUITMENT

In order to receive RSI funds, state-certified apprenticeship programs must have a partnership with a LEA. This is usually a community college or an adult education program that provides the classroom portion of the training. The RSI funding goes directly to the LEA and is used to:

- → Employ and pay training instructors;
- → Approve the curriculum developed by the program sponsor or provide a pre-approved curriculum;
- → Schedule classes at the discretion of the program sponsor, based on the needs of apprentices and their employers; and
- → Teach classes at the program sponsor's training facility at no cost to them.

The program sponsor pays for the equipment, space, facilities, and materials used for the training. Over the years, the amount of RSI funding provided to LEAs has decreased substantially and program sponsors are now responsible for more of the cost of providing classroom instruction.

The depth of collaboration between apprenticeship programs and their LEAs varies between programs. In the best cases, it is a strategic partnership that proactively seeks external funding opportunities and collaboratively develops pre-apprenticeship and journey upgrade training, while in other cases it is little more than a nominal partnership. In some cases, articulation agreements have been developed allowing apprentices to receive college credit for RSI training hours. Motivated apprentices can build on this training by earning an associate's degree, if they are willing to fulfill the additional general education requirements. Program sponsors have developed these agreements with local colleges and also at the national level through their national training centers, as in the case of the sheet metal and electrician apprenticeship programs.

7.5.1.1 RECRUITMENT

Apprenticeship program sponsors have formal and informal working relationships for the recruitment of applicants with a large number of organizations. These include military organizations, community and faith based organizations, job training organizations, high school and community colleges and One-Stop Centers. In many instances these are long-term working relationships that span many years.

Many veterans learn mechanical, electrical, or construction skills during their tours of duty, which are applicable to the building trades when they return to civilian life. Services, such as Helmets to Hardhats (H2H), run by the Center for Military Recruitment, Assessment and Veterans' Employment, specifically help retired and transitioning active-duty members of the armed forces, and National Guard Reserve to connect with "quality career training and employment opportunities in the construction industry,"[8] usually apprenticeship and JACs. Joint apprenticeship programs have agreed to directly accept individuals referred by H2H as long as they meet the minimum qualifications.

The United Association of Plumbers, Pipefitters and Sprinkler Fitters (UA) has developed the UA Veterans in Piping (VIP) partnership, which provides returning Marine Corps veterans with 16 weeks of accelerated welding training. Trainees are also guaranteed placement into a job or an apprenticeship program anywhere in the U.S. Efforts are currently being made to expand this partnership to include veterans of the U.S. Navy as well.

For high school graduates who are not interested in attending college, apprenticeship training in the building trades offers a pathway into middle-wage employment. However, many high school students are not familiar with the

[8] Helmets to Hardhats (2010). Frequently Asked Questions. Retrieved from: http://info.helmetstohardhats.org/content/faq/

options available to them and may not associate construction jobs with renewable energy or green careers. For this reason, apprenticeship program sponsors often partner with local schools to expose students to career options in the building trades. For example, the electrical and sheet metal JACs in San Diego have developed the Renewable Energy Leadership Institute, a two hour class offered to students in three local high schools during the regular school year. The program exposes students to careers in these two trades through both lecture and lab work focusing on the solar photovoltaic (PV) sector. Classes are taught by apprenticeship program instructors and prepare students for entry into apprenticeship programs or further technical training. Three construction charter schools in San Diego have also partnered with apprenticeship programs around curriculum development and recruitment of graduates.

Career fairs are another way that apprenticeship programs get the word out to high school students. State and Regional Apprenticeship Coordinators Associations—partnerships between apprenticeship programs—often work together to sponsor career fairs. For the past six years, the San Joaquin Area Apprenticeship Coordinators Association has partnered with 15 local high schools to promote construction apprenticeship programs to high school junior and seniors, teachers, and career counselors through the Construction Career Fair–Apprenticeship Pathway.

7.6 PIPELINES INTO APPRENTICESHIP

Because apprenticeships lead into living wage jobs, but do not require advanced education, they are often identified as a potential opportunity for building pathways out of poverty for individuals from low-income, minority, or disadvantaged backgrounds. The basic requirements for most apprenticeship programs are that applicants must be over the age of 18, have a high school diploma or equivalent level of education, and have a valid driver's license. However, employers (not the JAC) may also impose additional conditions or requirements that can create barriers for those with a criminal history or other disadvantages. For example, most employers usually require a drug test and, in some cases, a criminal background check. No post-secondary education or trade experience is technically required, but the application process usually involves a written and/or oral examination to determine aptitude, so at the very least, basic math and reading skills are necessary to pass entrance exams. Some trades, particularly electricians, sheet metal workers, plumbers/pipefitters/steamfitters, and other mechanical trades require applicants to have high school level math proficiency. In fact, many of the barriers that prevent people from finding a good job, such as former incarceration or low educational attainment, are also barriers to entering an apprenticeship program.[9]

Many of the apprenticeship coordinators interviewed also point out that apprenticeship is "still the best kept secret" in workforce development. Information about apprenticeship programs is hard to find unless you know what you're looking for. Traditionally this information has been handed down from a tradesman to his son, brother, or nephew, and "word of mouth" is still the predominant method for finding out about apprenticeship programs. Although apprenticeship programs have recently made efforts to recruit women and underrepresented minorities, as of December 2009 only 7.1 percent of active apprentices in the state were women. Although historically minorities have experienced discrimination and been underrepresented in the trades, the proportion of African Americans in apprenticeships in 2009 (6.6 percent) was roughly equivalent to their representation in the workforce as a whole (5.8 percent), and Latinos are slightly overrepresented.[10] However, there are higher percentages of people of color in the lower-paid trades, such as laborers, than in higher paid trades, such as electricians.

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[9] See Chapter 16 for more information on pipelines for disadvantaged workers.

[10] California Department of Industrial Relations, Division of Apprenticeship Standards (2009). *Exhibit 6: DAS Program Statistics 2009*. Statistical Report to the Legislature.

In response to the need for greater preparation in order to be accepted into and successful in an apprenticeship program, pre-apprenticeship programs have been developed to assist interested individuals in improving basic and soft skills while gaining some hands-on experience and familiarity with the skilled trades. Many pre-apprenticeship programs target low-income or minority individuals who may find it difficult to enter an apprenticeship program directly, and help these applicants improve their chances of getting into and succeeding in an apprenticeship program. Most programs of this type also provide outreach efforts and a variety of wrap-around support services.

Pre-apprenticeship programs originate in a variety of institutions, including apprenticeship program sponsors, community-based organizations, and educational institutions, such as community colleges. These organizations are primarily funded through the Workforce Investment Act (WIA) and private foundations. Cypress Mandela, Asian Neighborhood Design, Northern California Construction and Training, Prison Industry Authority, RichmondBUILD, Women In Non-Traditional Employment Roles (WINTER), American River College, and Los Angeles Trade–Technical College are just a few of the organizations that offer pre-apprenticeship training programs in California.

Although unregulated, and varying in quality, the DAS has published a list of ten best practices to guide the development of pre-apprenticeship programs.[11] These guidelines indicate the appropriate length, content, and teaching methods for pre-apprenticeship programs, underscoring that it is essential for a successful pre-apprenticeship program to have “an active relationship with apprenticeship programs.” These apprenticeship partners can advise pre-apprenticeship programs on how to best prepare participants for entry into apprenticeships. In some cases apprenticeship programs also have agreements guaranteeing entry to completers of particular pre-apprenticeship programs. However, this is not necessarily the norm. Although many pre-apprenticeships are focused on a single trade, the DAS recommends that programs introduce participants to multiple trades. The National Building Trades Council has recently developed a “Multi-Craft Core Curriculum,” which combines courses common to all trades and provides a general introduction to apprenticeship in the building trades. This curriculum is now being adopted in a number of states in high schools and other pre-apprenticeship programs, although it does not appear to have gained traction yet in California.

One example of a robust pre-apprenticeship program partnership is the Sacramento Region Green Building Pre-Apprenticeship Training Partnership, which is funded by the Sacramento Employment and Training Agency. American River College, Cosumnes River College, International Brotherhood of Electrical Workers–National Electrical Contractors Association (IBEW–NECA) Sacramento Area Electrical Training Center, and the Sacramento Municipal Utility District’s (SMUD) Energy and Technology Center collaborate to provide training that leads to a Certified Green Building Professional credential. The program allows students to explore careers as electricians, plumbers, sheet metal workers, and laborers in green construction, and prepares them for entry into commercial, industrial, and infrastructure construction apprenticeships in the green building industry.

7.7 INCORPORATION OF ENERGY EFFICIENCY AND RELATED SKILLS

The majority of program coordinators indicate that their apprenticeships have been teaching energy efficiency since their inception, to the extent that their training curriculum reflects changes in the industry as regulatory codes change, and new products, technologies, and equipment come into the marketplace. In the case of most JACs, national organizations develop curriculum guidelines based on industry specifications. Joint labor–

[11] California Department of Industrial Relations, Division of Apprenticeship Standards. “Best Practices: Preparation for Apprenticeship Training.” Retrieved from: http://www.dir.ca.gov/das/BP-Pre-Apprenticeship.pdf and California Employment Development Department, Labor Market Information Division. “EEO Occupational Groups by Race/Ethnicity and Sex.” Retrieved from: http://www.calmis.ca.gov/file/demoaa/cal$EEO.xls.

management committees adapt these guidelines to the local context in consideration of state and local codes and employer needs. Thus, apprenticeship curricula tend to be up-to-date in terms of regulations and the incorporation of green technologies and best practices that exceed code is driven primarily by employer demand.

When asked how energy efficiency is incorporated into apprenticeship training, most program coordinators indicated that this knowledge is integrated into program offerings, rather than being taught as a specialized skill set. For example, since early in the decade, all electrical apprenticeship programs have provided solar PV training to fifth-year apprentices. In addition, some trades are now applying for DAS approval for green-specific occupational tracks, such as the newly developed Home Performance Laborer Apprenticeship, and the recently approved Carpenters' Weatherization Installer/Technician Apprenticeship program.

In January of 2010 the California Apprenticeship Council (CAC) voted to require all crafts to add green components to their Minimum Industry Training Criteria (MITC).[12] In response, many apprenticeship programs have upgraded their training curricula to include new "green" training material provided through their national training institutes or statewide JACs. Other programs have more explicitly identified the "green" elements of the existing materials currently used in their apprenticeship training. Table 7.4 provides a brief description of the specific ways that key trades have been incorporating energy-efficiency related materials into their training programs.

7.8 CONCLUSIONS

- Apprenticeship is a workforce development model that has been proven to produce positive outcomes for both employers and workers. Training prepares workers to meet industry needs, but also provides them with a solid foundation in a particular trade, which can be built upon throughout their career.
- Apprentices earn industry-recognized certifications, including a journey card, which acknowledge their mastery of a variety of general and trade-specific skills.
- Apprenticeship programs continue to upgrade, refine, and enhance their foundational training based on feedback from employers and instructors. This has allowed the curriculum to develop over time to address the technological and regulatory changes in each industry.
- The main limitation the apprenticeship system encounters, in terms of incorporating energy efficiency practices, is that change must be led by the contractor community. If the contractors in a particular JAC are green innovators, the training programs will respond and integrate those innovations into their programs. However, if the contractors are only building to code, training is also less likely to go beyond this standard. In the case of IBEW–NECA, the statewide labor management partnership has led the way in educating contractors, as well as workers, in green practices. Even when national JACs introduce new curricula, California is often ahead of the nation in terms of using emerging energy technologies and practices, making contractor leadership in the state essential.
- Although the number of apprenticeships is limited by market demand, making the application process extremely selective, a number of pre-apprenticeship programs are making strides toward preparing workers from low-income, minority, and disadvantaged backgrounds to participate in these programs.

[12] California Department of Industrial Relations, Division of Apprenticeship Standards (2011). Minimum Industry Training Criteria. Retrieved from: http://www.dir.ca.gov/das/mitc.htm

Table 7.4 Green Innovation in Building Trades Apprenticeship Programs

Trade	Program Description
Carpenter	The Southwest Carpenters Training Fund has trained eight instructors in the Building Performance Institute (BPI) Technical Standards for the Envelope Professional and Building Analyst Professional and is in the process of becoming a BPI affiliate trainer. A Weatherization Installer/Technician Apprenticeship track has recently been approved by DAS. Additionally they are negotiating with the solar industry to become certified solar installers and getting apprenticeship standards approved to train apprentices in this occupation. The Carpenter's International Union's Green Awareness training manual has been recognized by the U.S. Green Building Council (USGBC) and has been incorporated into the first levels of their apprenticeship training.
Electrician	IBEW-NECA has been particularly proactive in advancing best practices for energy efficiency. Electrical JACs have invested funds from their Labor Management Cooperation Committee (LMCC) to target emerging energy efficiency technologies and help their contractor members understand the new market opportunities. Newly developed training offerings include energy auditing, energy efficiency, solar PV and renewable electricity generation, smart grid infrastructure, and electric vehicle infrastructure. Journey upgrade trainings and contractor trainings are also used to incorporate new knowledge and build capacity to enter new markets. All California IBEW-NECA program sponsors are now participating in the California Advanced Lighting Controls Training Program (CALCTP),* a journey upgrade training funded by the investor-owned utilities (IOUs), the U.S. DOL and the State of California. CALCTP was developed in response to recognized quality installation issues and promises to result in major energy savings.
Plumber/ Pipefitter/ Steamfitter	The UA has developed the UA Green Systems Awareness program, which trains and certifies plumbers, pipefitters, sprinkler fitters, HVACR mechanics, and service technicians in green building education that aligns with the USGBC's Leadership in Energy and Environmental Design (LEED) training. This program has been recognized by the USGBC 's Educational Provider Program. The UA Green Systems Awareness program is also being used by several unilateral plumbers committees as a journey worker upgrade training.
Sheet Metal Worker	The Sheet Metal Workers International Association (SMWIA) and the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) have developed a Green Awareness Curriculum that has been incorporated into apprenticeship training in 161 training facilities nationally, since 2009. They also train for a variety of rigorous industry-sponsored certifications including NATE, which incorporates best practice installation techniques for HVAC. The local sheet metal training programs we interviewed also offer training to building inspectors on the latest updates to Title 24, Part 6 of the California Code of Regulations, which sets energy efficiency standards in California's buildings. The northern California sheet metal workers have collaborated with the PG&E Energy Centers to integrate best practice duct sealing into the JAC curriculum.
Stationary/ Operating Engineers	The Northern California Stationary Engineers apprenticeship training has developed a LEED training curriculum in collaboration with the USGBC. This training prepares apprentices to take the examinations for obtaining LEED certification. This curriculum has also been recognized by the USGBC Educational Provider Program, meaning the courses are peer-reviewed and program attendees with an existing LEED certification can use program hours as continuing education credits to maintain their credential.
Construction Laborer	The Laborers' International Union of North America (LiUNA) has developed a residential energy efficiency training program that trains workers in weatherization and home performance. They have partnered with BPI to harmonize training with certification standards and requirements for energy efficiency professionals nationwide. The President's Economic Recovery Advisory Board and the proposed HOME STAR legislation both cite LiUNA's weatherization training as a national standard. The Laborers' Training and Retraining Trust of Southern California has submitted apprenticeship standards to DAS to provide this training to laborer apprentices.

*See Chapter 4 for more information on CALTCP.

CHAPTER EIGHT:

8. COMMUNITY COLLEGES

8.1 OVERVIEW

The California Community College System is tasked with four main objectives: supporting transfer to four-year colleges, providing basic technical skills education, aiding economic development by responding to labor market needs, and offering continuing education for incumbent workers. Sixty percent of California State University (CSU) and 30 percent of University of California (UC) graduates are community college transfers. Community colleges in California serve a wide variety of populations, ranging from recent high school graduates wishing to obtain first two years of their postsecondary education at a low cost to mid-career professionals coming back to take a few courses to upgrade their skills and knowledge within their field, or to gain skills for a career change.[1]

There are 72 Community College districts in California, 112 colleges and more than 2.9 million students enrolled annually. The current budget is over $6.5 billion.[2] Unlike other states where there are both technical colleges and comprehensive community colleges, each of the 112 institutions in California is a comprehensive community college that offers both academic preparation for transferring into a four-year university and career education. Roughly 1.4 million of the students are enrolled annually in career technical education (CTE) certificate and degree programs. The State Chancellor is responsible for developing and implementing policy for as well as allocating state funding to the colleges and districts.[3] Additionally, each of the 72 community college districts in the state has a locally elected Board of Trustees, responsive to local community needs and charged with guiding operations of the local colleges.

8.2 DESCRIPTION OF PROGRAMS

The community colleges prepare students both for jobs in the building and construction trades, as well as in the professional and managerial occupations. Furthermore, they train for traditional occupations related to energy efficiency, distributed generation, and demand response, as well as having programs specifically targeted at specialized jobs in these sectors. Over 600 community college programs in California fall into one of these categories.[4] Traditional programs training in energy efficiency related skills include the building and construction

[1] Because of such diversity in student population and a significant number of “returning” and part-time students, “enrollment” in a community college is not always captured based on the completion of a degree or certificate, or the transfer to a four-year institution. This affects the data that community colleges are able to collect. For example, a student may enroll only in one course within a program to update knowledge of changing regulations or new technologies. Other students may attend a degree program and almost achieve the necessary units to earn a degree, but never actually graduate because of a transfer to a four-year institution.

[2] The colleges are serving roughly 200,000 students for which they are receiving no State remuneration, according to the Office of the Chancellor (about seven percent of the total served). Although the 2010-11 augmentation of $126 million for growth will fund around 60,000 of these students, $189 million of the funding has been deferred until fiscal year 2011-12.

[3] The State Chancellor is selected by the Board of Governors. The Board members are appointed by the California Governor.

[4] The majority of these programs are for-credit. Certificate and associate’s degree tracks counted as separate programs. Since (1) there is no uniform standard for where emerging green courses and programs are placed within the State’s Taxonomy of Programs and (2) not-for-credit and non-credit green courses are not captured there, maintaining the current inventory of such programs is a challenge. The Taxonomy of Programs (TOP) is a system of codes used by community colleges at the state level to classify, collect, and report information on credit

trades, environmental sciences, architecture, and engineering. Specialized training programs include "green" construction, wind energy, and solar installation, among others.[5]

We therefore group the programs studied into two categories:

→ TRADITIONAL COMMUNITY COLLEGE PROGRAMS. These programs provide education and training for so-called traditional occupations where skills and knowledge are relevant to energy efficiency-related industries.

→ EMERGING COMMUNITY COLLEGE PROGRAMS. These programs provide education and training for so-called new and emerging occupations that are specific to energy efficiency related industries.

8.2.1 TRADITIONAL COMMUNITY COLLEGE PROGRAMS

These programs offer either (1) career preparation certificate and degree tracks, where securing employment is the targeted outcome, (2) transfer tracks aimed at providing students with the first two years of post-secondary education credits for a transfer to a four-year university, (3) apprenticeship tracks, in which colleges act as local educational agencies (LEAs) providing related supplemental (classroom) instruction for union apprenticeship programs, or (4) pre-apprenticeship programs designed to lead into a union apprenticeship. Out of 569 traditional, non-apprenticeship programs identified, the majority (roughly 60 percent) are employment-oriented programs, while the rest (27 percent) are transfer focused. A small number of the employment-oriented programs function as pre-apprenticeships as well. Additionally, 41 apprenticeship programs operate at community colleges in California to prepare skilled labor in a myriad of trades.

Table 8.1 identifies job training clusters of traditional community college programs (excluding apprenticeship programs). We identified these six clusters by grouping individual community college programs with a similar occupational focus.[6] Table 8.1 also includes information on the number of certificate and associate's degree programs in each cluster, the number of those programs that we interviewed, the average units required to earn an associate's degree or certificate, and the total number of degrees and certificates awarded for all programs in each cluster in one year. Note that associate's degrees and certificates are counted as separate program tracks, because they lead to different employment outcomes. The certificate programs identified include "certificate of achievement" programs that require the completion of at least 18 units and have been approved by the State Chancellor's Office as well as those called "departmental certificates," which vary according to the individual college.[7]

The following brief descriptions provide an overview of the training tracks available within each cluster as well as the specific types of programs offered.

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programs and courses by college that have similar outcomes. Emerging occupations or unique programs are classified within one code until that occupation is widely enough recognized for its own occupational code.

[5] Many of the programs that are specialized in new and emerging technology have not yet been approved as certificate or degree tracks, and therefore data on these programs is limited.

[6] This is an idiosyncratic grouping for Community Colleges that does not match precisely with the occupational groups discussed in Chapter 13.

[7] Certificates of achievement require at least 18 units of instruction. Similar to associate's degree, they are developed in coordination with other regional community colleges and approved by the State's Chancellor's Office. As accredited institutions, community colleges may also offer "departmental certificates" that require less than 18 units for an award. Both types of certificates are offered in response to local employer needs and therefore recognized by local employers. Most of the certificate programs identified in Table 8.1 are certificate of achievement offerings, with only a few departmental certificate programs.

Table 8.1 Traditional Community College Programs for Energy Efficiency Related Sectors

Occupational Group/ Program Focus	Total Programs	Programs Interviewed	Average Associate Degree Units*	Total # of Degrees Awarded (08-09)**	Average Certificate Units	Total # of Certificates Awarded (08-09)**
Architecture, Architectural Technology, and Architectural Drafting	98	5	31	251	33	195
Engineering Technology and Drafting, including Civil, Mechanical, and Electrical	193	22	32	190	33	316
Engineering, General	69	7	42	208	27	26
Construction Trades (Construction Management, Construction Crafts Technology, Carpentry, Electrical, Public Works, Plumbing, and other)	138	44	30	189	36	546
Environmental Control Technology (HVAC)	71	17	37	46	37	402
Total	569	95	34.4	884	33.2	1,485

Source: California Community Colleges Chancellor's Office.

* Listed in the table are specialty unit requirements. In order to receive an associate's degree, a student will also need to obtain general education units. Total number of units (both specialty and general education) required for an associate's degree is 60.Generally, 1 unit equals 18 hours of instruction.

**The degree and certificate award data for all programs identified, not just for those interviewed.

8.2.1.1 ARCHITECTURE AND ARCHITECTURAL TECHNOLOGY CLUSTER

There are 98 community college programs identified in this cluster, including architecture, architectural technology, architectural drafting, and other architectural design certificate and degree offerings. These programs often provide both vocational and transfer tracks. As a rule, they incorporate an industry-endorsed curriculum of building fundamentals, design, drafting, computer-aided design (CAD), technical research, and model-building coursework. Most certificate programs can be completed within one year and provide enough skills for a graduate to obtain entry-level employment as an architectural drafter or drafting assistant. Students that pursue transfer tracks typically further their education at four-year universities to become architects.

8.2.1.2 ENGINEERING TECHNOLOGY AND DRAFTING CLUSTER

This is a very diverse cluster of community college offerings, with a total of 193 programs that range from general engineering and drafting technology programs to specialized drafting options, including mechanical drafting, civil drafting, and electrical drafting. The majority of these programs have a vocational focus. These programs are normally placed within a CTE division or department. A typical program in this cluster prepares individuals to apply basic engineering principles and technical skills in support of engineers engaged in a wide variety of projects and industries. The programs usually include instruction in engineering drawing, 3D modeling, geometric dimensioning, machine shop basics, drafting software (AutoCAD) and other fundamentals of engineering, coupled with some basic math and physics coursework. Most classes incorporate laboratory exercises and other hands-on components.

8.2.1.3 GENERAL ENGINEERING CLUSTER

Unlike the engineering technology cluster, the general engineering cluster is primarily transfer oriented and is usually offered through academic departments within community colleges, such as math and science departments. With a total of 69 general engineering programs identified in the state, at least one out of two community colleges offers programs in this cluster. Only eight colleges offer a certificate option in these programs, and students rarely choose it. Thus, there were only seven certificates awarded statewide in the 2008–2009 school year. A typical general engineering program is a sequence of theoretical courses aimed at providing students with foundational knowledge in engineering. It normally incorporates coursework in math, applied calculus, general physics, and introductory engineering, including engineering basics, engineering graphics, and an understanding of materials.

8.2.1.4 CONSTRUCTION TRADES CLUSTER

The construction trades cluster includes offerings that range from an overview program in construction crafts to specialized certificate and degree options in electrical, building inspection, carpentry, public works, and plumbing, to transfer-level construction management programs. We identified 138 programs in the construction trade cluster. These programs provide preparation for a wide variety of positions in the construction field as a contractor, supervisor, building inspector, or tradesperson. Some community colleges offer pre-apprenticeship programs, as well, but they are not always clearly identified as such, so it is difficult to determine the exact number of programs. Most courses are geared toward employment, with the exception of the construction management, which provides a transfer option for those seeking four-year degrees. The majority of graduates from these programs leave holding certificates in a specialized trade. However, community college construction programs also attract large numbers of individuals who work in the industry and enroll into a program in order to upgrade their skills and learn about new technologies, practices and regulations. These students are typically less interested in receiving a certificate of completion, and more interested in taking courses in the specific skills they are seeking.

8.2.1.5 HEATING, VENTILATION, AIR CONDITIONING, AND REFRIGERATION (HVAC/R)

This occupational cluster is also known in community colleges as Environmental Controls Technology. There are 71 programs total in the state. Twenty-five colleges offer certificate and/or degree programs in this cluster. As reported in Table 8.1, the programs in this cluster serve a number of students, with 402 certificates awarded in 2008–2009 (only 46 associate's degrees in HVAC/R were awarded that year). Both certificate and degree options are designed for students who wish to obtain employment in heating and air conditioning at a technician level. As a rule, courses offered prepare students for the Environmental Protection Agency (EPA) refrigerants exam, which is required in the industry. The skills taught in a typical program include installation, troubleshooting, repair, equipment maintenance, operation monitoring, operation and control, quality control analysis, as well as critical thinking, and judgment and decision making. Many HVAC/R programs also incorporate renewable energy and energy efficiency knowledge and skill areas. Basics of solar energy (PV and thermal) and energy conservation courses are the most common.

8.2.2 APPRENTICESHIP TRAINING COMMUNITY COLLEGE PROGRAMS

Community colleges work collaboratively with unions to offer classroom instruction for apprenticeship programs. This type of partnership allows apprentices to earn credits for the related supplemental instruction (RSI) courses taken at the community college, which are then applicable toward a certificate or associate's degree. Table 8.2 lists apprenticeship programs related to the scope of this study that work with community colleges for their RSI component. We identified these programs using data available from the community colleges.[8] The majority of apprenticeship programs offered through community colleges are those for construction trades, such as electrical, carpentry, plumbing, and drywall.[9]

Table 8.2 Some Apprenticeship Programs in Community Colleges

Apprenticeship Track	Community College
Electronics	Chabot College; Imperial Valley College
Utilities	San Diego City College; Santiago Canyon College
Maintenance Mechanics	Santiago Canyon College
HVAC	Chabot College; College of San Mateo
Operating Engineer	Bakersfield College; Rio Hondo College; Santiago Canyon College
Carpentry	American River College; Bakersfield College; Chabot College; Gavilan Hills College; Palomar College; Rio Hondo College; Santiago Canyon College
Electrical	Allan Hancock College; American River College; Bakersfield College; Chabot College; Hartnell College; Palomar College
Plumbing	Allan Hancock College; Bakersfield College; Chabot College; Foothill College; Rio Hondo College; College of San Mateo
Glazing	San Jose City College
Drywall	American River College; Chabot College; Palomar College; Santiago Canyon College
Roofing	Chabot College
Sheet Metal	American River College; Bakersfield College; Chabot College; Foothill College; Palomar College
Solar Turbines	San Diego City College

Source: California Community Colleges Chancellor's Office

8.2.3 EMERGING GREEN COMMUNITY COLLEGE PROGRAMS

In general, community college programs that are training for specific new and emerging occupations in the energy efficiency and related sectors are clustered around the following topic areas:

- GREEN BUILDING AND CONSTRUCTION: focuses on architectural design and construction of "green" and energy efficient buildings.
- ENERGY SYSTEMS TECHNOLOGY/RENEWABLE ENERGY: solar energy is the most common area of specialization, followed by wind energy.
- ENERGY EFFICIENCY: includes energy auditing, smart meters, building controls technology, and energy regulation.

[8] This list cannot be considered complete because community colleges do not consistently report the data about their apprenticeship programs.

[9] For more information on apprenticeship programs in California see Chapter 7of this report.

- OTHER ENVIRONMENTAL TECHNOLOGY AND GENERAL SUSTAINABILITY: includes some combination of the above three areas or other related topics.

These emerging programs offer both certificate and associate's degree options. They are designed to prepare students for joining the renewable energy or energy efficiency workforce as technicians, energy specialists, installers or other entry-level occupations. In some cases, these programs also prepare students for industry-recognized, third-party certification. Some of the third-party certifications mentioned include:

→ North American Board of Certified Energy Practitioners (NABCEP) for solar PV and solar thermal
→ EPA Certification for building trades
→ Building Performance Institute (BPI) Certifications
→ Home Energy Rating System (HERS) Certification
→ Partnership for Air-Conditioning, Heating, Refrigeration Accreditation (PAHRA) Certificate
→ Drafting Essential Skills Certificate

Table 8.3 features information about four clusters of new community college programs. It outlines the number of certificate and associate's degree programs identified, the number of programs covered by interviews, the average units required to earn certificates or associate's degrees, and the total number of awards for all certificate and degree programs in the 2008–09 academic year.

Table 8.3 New / Emerging Community College Programs Specific to Energy Efficiency Sectors

Occupational Group / Program Focus	Total Programs*	Programs Interviewed	Total # of Degrees Awarded (08-09)	Total # of Certificates Awarded (08-09)
Green Building and Construction Technology	9	0	0	0
Energy Systems Technology / Renewable Energy	9	3	0	0
Energy Efficiency	16	2	3	8
Other Environmental Technology / Sustainability	2	0	0	0
Total	36	5	3	8

Source: California Community Colleges Chancellor's Office.

*The programs identified include many that are under development. These programs do not have degree/certificate awards data. Therefore, the completion data for each occupational track might seem small compared to the number of programs.

Additionally, because many programs are also in their first or second year of operation, completion data for the 2008–09 year are not available in all cases. Note that the energy systems technology/renewable energy cluster is not limited to distributed generation programs and includes some utility-scale energy training offerings. This is primarily due to the fact that community colleges rarely distinguish between utility-scale and distributed generation renewables in their curricula, and prefer teaching both. For example, wind energy programs generally cover both utility-scale and small wind in order to provide students with a broader array of employment options upon graduation.

8.3 INFORMATION ON OUTCOMES

A total of 1,493 certificates and 887 associate's degrees were awarded to students of the identified community college programs in the 2008–2009 school year. Of the 1,493 certificates, all but eight were for traditional programs (versus emerging programs). Of the 887 associate's degrees, only 3 were awarded in emerging programs.

As shown in Table 8.1, the most certificates awarded were in construction trades programs, followed by environmental controls technology (HVAC/R). The architecture and architectural technology cluster was the leading program in the number of associate's degrees awarded statewide. General engineering was the second largest. This is hardly surprising considering that a large part of the student body in these two programs is comprised of transfer-oriented individuals who are more likely to finish credits necessary for an associate's degree than career and technical education students.

Although the number of certificates and degrees awarded in emerging programs is very small, these data do not accurately reflect the total number of individuals that community colleges train for the occupations covered by these clusters. More specifically, the certificate and degree data capture neither the incumbent workers, who enroll to upgrade or maintain specific skills and are not interested in receiving a certificate or degree, nor the students who pursue the transfer track and transfer to a four-year program before receiving an associate's degree.

Many of the programs in the emerging area that are preparing students for specific energy-efficiency and renewable energy careers do not yet have data on completion rates, as many of them have been created and approved in the last two years. For the 2008–2009 year, only eight certificates and three degrees were awarded to students in the emerging clusters (see Table 8.3). However, enrollment in these programs has grown exponentially in the last two years. This growth is due to the recent availability of American Recovery and Reinvestment Act (ARRA) funding and general interest among community colleges in green and clean technology training, rather than as a clear result of increased demand for a "green" labor pool.

8.4 EMPLOYER INVOLVEMENT

In interviews, program administrators reported that programs have strong links with employers and that partnerships between colleges and employers have been instrumental in many aspects of program planning and delivery, and connecting students to jobs. However, this information is difficult to verify and quantify. Because community colleges do not track job placement, we cannot assess how successful these programs are at helping their graduates get jobs, what the average wage levels of graduates are, or other key outcomes.

The areas of reported industry involvement range from employer participation on formal industry advisory boards to equipment donations and curriculum upgrades. Based on our interviews, the following are the most common ways in which colleges utilize their partnerships with employers:

ADVISORY BOARDS: All college CTE programs included in the survey reported utilizing the expertise and resources of advisory boards made up of industry experts. However, the level of engagement between college programs and those industry partners varies widely. Some program administrators convene advisory boards only once or twice a year, while others regularly involve their board members in field trips, curriculum development, class lectures, procurement of equipment, and other activities. Eighty-seven percent of programs interviewed reported involving employers as advisory board members. Generally, the 13 percent that do not have advisory boards are the transfer-oriented programs.

CURRICULUM DEVELOPMENT AND UPGRADE: About 70 percent of community college programs interviewed consulted employers for curriculum development and upgrading. Colleges that offer energy efficiency and renewable energy programs often work with industry associations to stay current with technology changes and new knowledge and skills requirements. Specifically, such industry groups as the American Wind Energy Association and the Solar Energy Industries Association were mentioned as partners that contribute to the curriculum development needs of certain college programs.

INSTRUCTORS FROM THE INDUSTRY: The majority of CTE programs at community colleges are taught by industry professionals. These instructors are employed in the industry and teach classes part-time. This is beneficial to the programs, as these instructors infuse industry perspective into the classroom, keep their courses up-to-date with the latest technology, and sometimes even offer employment to some students.

WORK EXPERIENCE AND JOB PLACEMENT: Partnering with local businesses to provide work experience for students is another way of engaging employers. However, these efforts are typically sporadic and not well coordinated. Colleges do not have resources dedicated to these functions, and are not charged with the task of securing or supporting students' job placement. In place of formal job placement services, instructors utilize relationships with local businesses to make students aware of potential jobs in the field. For example, an administrator from Palomar College reported that "if a firm/business requests an intern, the position is announced in class." The instructors of the Drafting/CAD program at San Barbara Community College provide job leads to students, as do some of the other programs that were interviewed.

8.5 PARTNERSHIPS

Community colleges often link their offerings and services to other important actors in the workforce training and education arena, including local businesses, workforce investment boards, community-based organizations, four-year universities, other community colleges, and middle and high schools. Some of the areas for which community colleges partner with other institutions include:

TRAINING DELIVERY: Almost one-third of all college programs reported partnerships with other organizations on training. In most cases, partnering organizations are other community colleges and universities. The ability to offer cross-training with other educational institutions can expand the course offerings without additional funding or new program development. Some community colleges are also expanding their reach to K-12 education by offering training for high school students and teachers. Training partnerships also materialize through collaborative efforts with local Workforce Investment Boards (WIBs) and non-profit organizations, with the college acting as the training partner.

STUDENT RECRUITMENT: Colleges utilize a variety of local partners to recruit students, including local high schools, WIBs, One-Stop Centers, and industry organizations. Recruitment, however, has been a low priority for the colleges recently, as most programs have far more applicants than their resources can support.

FUNDING: Over 25 percent of colleges interviewed reported partnership around funding. The majority of such partnerships are driven by state or federal grant projects that often require collaboration with other local agencies in delivering training, recruiting participants, developing curriculum, and providing case management. However, some colleges also reported receiving funding from foundations to support student achievement through scholarships.

JOB PLACEMENT: The most prominent placement partnerships involve WIBs, One-Stop Centers, businesses, industry associations, and local workforce agencies. One in five college programs is connecting with these organizations for post-training job placement.

ARTICULATION AGREEMENTS: Articulation agreements are a formalized way to allow student to receive college credit for high school courses taken and/or university credit for community college units completed. These agreements are critical in providing students with an opportunity to follow educational pathways from high school to an advanced degree. Most common articulation agreements that community colleges have are with (1) local high school CTE programs, and (2) local four-year educational institutions, primarily those that belong to CSU and UC systems.

SUPPORT SERVICES: Most community colleges offer some supportive services, such as extended opportunity programs and services (EOPS),[10] childcare, and financial aid in addition to instruction, but there is no coordinated case management unless those services are through a third-party arrangement such as a WIB. The ability of students to access such services is highly reliant on the knowledge and outreach efforts of instructors and counselors. The most frequently reported form of supportive services offered was access to self-directed job search resources including up-to-date job postings on bulletin boards, access to college-wide career centers, announcements of employment opportunities in class, and assistance with computerized searches. Over 70 percent of programs interviewed indicate that they provide these types of basic job search services.

8.6 INCORPORATION OF ENERGY EFFICIENCY AND RELATED SKILLS

Among the traditional and the emerging training programs related to energy efficiency, distributed generation and demand response, community colleges are integrating new "green" skills into their training in one of three ways:

- ADAPTING EXISTING CERTIFICATE/DEGREE PROGRAMS to incorporate "green" components. Nearly every community college in the state has been incorporating green skills into an array of existing job training programs including construction, skilled trades, environmental sciences, engineering, and architecture. This may include improved practices or new technologies, and/or updating the curriculum so that it teaches to the standards set by state building code for energy efficiency.

- DEVELOPING NEW CERTIFICATE/DEGREE PROGRAMS that prepare students for specific "green" careers. Training programs have already been developed in energy efficiency, wind energy, and solar installation, among others. Many programs are aligning their curricula with industry certification requirements, such as NABCEP certification for solar.

- OFFERING NON-CREDIT, SHORT-TERM WORKFORCE TRAINING in energy efficiency and renewable energy topics. Many colleges have received funding from ARRA to provide training for displaced workers in new green careers. These types of programs are often driven by funding opportunities and are short term in nature.

Almost all of the 63 programs interviewed (about 94 percent) reported that they have integrated energy efficiency into their programs in some way. Most college programs (63 percent) incorporate energy efficiency throughout their existing courses in traditional engineering, architecture, construction, and other skilled trades programs,

[10] EOPS program is designed to increase academic success of students from disadvantaged populations. It usually involves a mutual responsibility contract that generally states that students receive such assistance as textbooks, tutoring, counseling, and other in exchange for commitment to pursue their education.

while a few of them (14 percent) provide energy efficiency education as a separate module of instruction. Due to the budget cut backs in the 2008–09 and 2009–10 years, it has been difficult for community colleges to develop and launch entirely new programs. Additionally, most instructors in the programs interviewed are part-time faculty. This presents a challenge as the development of new curricula is typically initiated and led by faculty members. Part-time faculty often do not have hours devoted to these functions.

Developing new, stand-alone programs that self-identify as specific to energy efficiency related jobs may seem like the most obvious way of tracking and promoting training in these skills. However, our research indicates that this is not necessarily most effective approach, and in some cases may be counterproductive for putting these skills into practice. Indeed, several interviewees expressed concern that community colleges and other training organizations may be focusing too narrowly on renewable energy, because of the apparent "hype" and excitement surrounding these sectors. Others noted that graduates of specific training programs lacking foundational knowledge of the field may have difficulty finding employment, while those with a traditional occupational background will likely be more successful, especially if they have supplemental skills related to energy efficiency.

8.7 CONCLUSIONS

Community colleges have several different roles within the state's system of workforce training and education, including preparing students for entry-level jobs, providing experienced workers with opportunities to improve their skills in their existing profession or in a new profession, and preparing students to enter four-year degree programs in engineering and other technical disciplines like architecture and construction management.

Unfortunately, most colleges do not emphasize employment outcomes as program success metrics, and therefore there is little data on job placement, wages, and career pathways for community college students. Existing data on certificate and degree completion do not reflect the scope of how students use community college services to advance in their careers, and data on students' labor market outcomes are lacking as well.

Community colleges train for energy efficiency and related skills both with specialized training for new/emerging occupations, and by integrating new or upgraded skills into traditional curriculum. State budget cuts to community colleges have adversely affected the schools' ability to develop curricula, particularly in the areas of emerging technologies and new occupations. However, integrating coursework on energy efficiency and related skills into traditional programs, rather than launching entirely new programs, may be a more effective way of preparing students for "green" work and meeting the changing needs of the labor market.

There are many examples of partnerships between community colleges and employers or other training organizations to provide curriculum development, support services, and job placement, although these are frequently idiosyncratic. Articulation agreements with high schools and four-year colleges, and partnerships with apprenticeships on RSI represent good models for how to systematize relationships to build career pathways. While some pre-apprenticeships exist at community colleges, this type of partnership has potential for expansion.

CHAPTER NINE:

9. PRIVATE TRAINING PROGRAMS

9.1 OVERVIEW

Private training providers are a highly heterogeneous group of programs that consists of both for-profit and non-profit organizations. The non-profit training providers that we have included in this category (instead of in the community-based training provider category) are closely associated with private industry, usually a trade association. We identified 55 unique private for-profit and non-profit organizations with one or more training locations in California. Each organization offers at least one energy efficiency or renewable energy training course or course series.[1] We interviewed 15 of these programs, which altogether offer 60 separate courses or series of courses in energy efficiency and renewable energy. This heterogeneity of the programs means that our sample is unlikely to be representative of the whole category. However, there are several broad ways of grouping these programs to examine trends in the training that they do and do not offer.

9.2 DESCRIPTION OF PROGRAMS

Private training providers prepare people to become energy raters, building analysts, weatherization technicians, solar panel installers, heating, ventilation, and air conditioning (HVAC) technicians, or similar professionals. All organizations claim to prepare students for careers or to enhance their existing careers in the energy efficiency, renewable energy, or the building trades. In most cases they provide training relevant to multiple occupations. Table 9.1 describes the organizations we interviewed and lists key occupations that they train for.

The private training programs we identified are mostly short term and target specific levels in a career pathway. Most of the programs offer short-term, basic job skills training for entry-level positions. This category of training may also include some soft skills or work readiness training, however this is less common than in community based organizations (see Chapter 10 on CBOs). Typically these programs are completed in less than a year, and are often only a few days in length. This is the most common training type in our sample.

Many of the programs provide incumbent worker technical skills upgrade, which is typically short-term training designed to help skilled workers advance their knowledge and keep abreast of new technological developments. These trainings may be optional for career advancement, or required for licensure renewal or particular kinds of jobs.

Only one of the programs we interviewed provided intermediate technical training, which prepares workers for jobs as entry-level skilled technicians. This program trains HVAC mechanics and installers, and is a six-month program providing a basic foundation in a skilled trade. This is much longer than the majority of private training programs.

[1] Note that this is a narrower definition than we used in searching for other types of programs. Specific courses in energy efficiency or renewable energy were only necessary criteria for inclusion in the case of private programs. Therefore, we do not fully capture the scope of private training programs that train for occupations related (but not specific) to energy efficiency and renewable energy.

Private training programs as a whole are not regulated by any central body. The widely variant program types within this group are a result of this; there is little accountability among these programs other than their ability to continue to attract new students.

Table 9.1 Description of Interviewed Organizations

Organization	Began	Training Type	Key Occupations
Advanced Vocational Institute (AVI)	2009	Entry Level	Energy Auditors, Insulation Workers, Cost Estimators, Construction Laborers, Solar Photovoltaic (PV) Installers, Construction And Building Inspectors
Airstreams Renewables	2003	Entry Level	Wind Turbine Service Technicians
California Building Performance Contractors Association (CBPCA)	2002	Entry Level Incumbent Worker	Construction Managers, Cost Estimators, Energy Auditors
California Home Energy Efficiency Rating Services (CHEERS)	1995	Entry Level Incumbent Worker	Construction Managers, Cost Estimators, Energy Auditors
Clean Edison	2008	Entry Level Incumbent Worker	Architects, Construction Managers, Cost Estimators, Energy Auditors, Insulation Workers, Carpenters, Electricians
Community Business College (CBC)	2004	Entry Level	HVAC/R Mechanics And Installers, Solar PV Installers, Electricians
Construction Craft Training (CCT)	2010	Entry Level	Solar PV Installers, Electricians
Everblue Energy	2007	Entry Level Incumbent Worker	Architects, Construction Managers, Cost Estimators, Energy Auditors, Insulation Workers, Carpenters, Electricians
Green Career Institute (GCI)	2008	Entry Level	Solar PV Installers, Electricians
National Association of Home Builders (NAHB)	2007	Incumbent Worker	Construction Managers, Cost Estimators, Carpenters
National Association of the Remodeling Industry (NARI)	2007	Incumbent Worker	Construction Managers, Cost Estimators, Carpenters
Refrigeration Services Engineering Society (RSES) – CARSES (Southern California Association of RSES members)	Unknown	Incumbent Worker	HVAC/R Mechanics And Installers
Specialty HVAC Products Institute	2000	Intermediate Technical Training	HVAC/R Mechanics And Installers
Train to Sustain Los Angeles (TSLA)	2010	Entry Level	Energy Auditors, Insulation Workers, Cost Estimators, Construction Laborers, Solar PV Installers, Construction And Building Inspectors
United States Green Building Council (USGBC) – Northern California Chapter	2005	Incumbent Worker	Architects, Construction Managers, Cost Estimators, Energy Auditors, Civil Engineers

As indicated in Table 9.1, most of the organizations we interviewed started offering training after 2002, with two-thirds starting their programs after 2007. All but one program formed in the past decade. The relative youth of these programs can be attributed to the recent increase in public spending to support energy efficiency related sectors. Utility incentive programs and statewide energy efficiency policies have been expanding since 2002, and the passage of the federal American Recovery and Reinvestment Act (ARRA) in 2009 has further stimulated the demand for training.

9.3 CERTIFICATIONS

Most of the training courses and series we identified are structured to prepare students for examinations for skill certifications in the building and/or energy efficiency industries.[2] While the pursuit of certification is often a reason for attending training, the level of industry recognition of these credentials varies. Some of the training organizations we spoke with are accredited by the most highly recognized energy efficiency and renewable energy third party certification organizations, while others lead to less recognized certifications or are merely associated with an internal certificate or exam process, which is not accredited by a third party. The organizations that accredit training programs in our sample include:

- Certifying organizations focused specifically on "green" industries, such as residential energy efficiency and solar. These include:
  - → BUILDING PERFORMANCE INSTITUTE (BPI)
  - → RESIDENTIAL ENERGY SERVICES NETWORK (RESNET)
  - → NORTH AMERICAN BOARD OF CERTIFIED ENERGY PROFESSIONALS (NABCEP)
  - → LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED)

- Certifying organizations that focus on traditional trades, such as HVAC, but have added energy efficiency to their curricula, to provide third party certification for energy efficiency and renewable energy occupations.[3] Such organizations include:
  - → NORTH AMERICAN TECHNICIAN EXCELLENCE (NATE)
  - → REFRIGERATION SERVICES ENGINEERS SOCIETY (RSES)

Not all the training organizations in our sample offer preparation for these recognized industry certifications, nor are all that offer training for a particular exam accredited by the certifying organization. For some skills and occupations, no certification currently exists. For instance, NABCEP is currently working on a curriculum and certification for small wind, but until that is completed there is no national certification for the small wind sector. Table 9.2 displays the certifications targeted by the organizations we interviewed and whether the organization is accredited to offer these courses.

9.4 INFORMATION ON OUTCOMES

Each of the private organizations identified in this study prepares students for an occupation or provides new skills for someone in a related occupation, presumably in hopes that this training will increase their earnings potential. However, only a few respondents were able to report on the starting wages of individuals completing these training programs. Table 9.3 shows the estimated starting wages for the four occupations for which contacts provided wage estimates.

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[2] Requiring third-party certification is considered a best practice in order to maintain neutrality between the training efforts and the certification efforts. See Chapter 5.

[3] See Chapters 5 and 13 for a more complete discussion of certifications and accreditation.

Table 9.2 Certifications Offered by Private Training Organizations

Organization	Total Certifications	Certification Types	National Accreditation
Advanced Vocational Institute (AVI)	11	BPI, RESNET, Solar, Wind, Energy Efficiency	
Airstreams Renewables	1	Wind	X
California Building Performance Contractors Association (CBPCA)	2	BPI, RESNET	X
California Home Energy Efficiency Rating Services (CHEERS)	7	BPI, RESNET, Solar, Wind	X
Clean Edison	12	BPI, LEED, Solar	X
Community Business College (CBC)	3	EPA, Solar	
Construction Craft Training (CCT)	2	Solar, Wind	
Everblue Energy	10	BPI, RESNET, LEED	X
Green Career Institute (GCI)	4	Solar, Energy Efficiency	
National Association of Home Builders (NAHB)	3	Energy Efficiency	
National Association of the Remodeling Industry (NARI)	1	Energy Efficiency	
Refrigeration Services Engineering Society (RSES) – CARSES (Southern California Association of RSES members)	1	Energy Efficiency	X
Specialty HVAC Products Institute	1	EPA	
Train to Sustain Los Angeles (TSLA)	2	BPI, LEED	X
United States Green Buildings Council (USGBC) – Northern California Chapter	2	LEED	X

Table 9.3 Estimated Starting Hourly Wage, 2010 Dollars

Occupation	Career Pathways Level	Estimated Starting Wage
Auditor / Performance Analyst (n=2)	Incumbent Worker	$20.00
Heating Ventilation and Air Conditioning Technician (n=3)	Entry Level	$15.00
Solar Photovoltaic Installer (n=5)	Entry Level	$18.00
Wind Turbine Technician (n=2)	Entry Level	$20.00

9.4.1 ENTRY-LEVEL OCCUPATIONAL TRAININGS

The entry level training programs interviewed run from one to 60 days in length and cost students from $345 to $10,000 per class, with the majority of programs costing students $1,200 or more for less than one week of training. Based on average course sizes and the average number of courses offered, we estimate that these organizations will train approximately 3,000 people in 2010.

The majority of organizations providing entry-level training began within the past decade. These organizations report that they have recently started up or expanded training in response to what they perceive as an increased demand for this type of training. All these organizations report that they are able to quickly scale up or down to meet demand for courses. If training courses fill up quickly, they offer that same training again to meet demand. If they offer a course that does not meet the minimum number of enrollments, they cancel the course or combine it with another course offering. This demand is generated by *students* who pay for the training programs, rather than by employers who are trying to fill jobs. In most cases, decisions to offer particular courses are not based on consultation with employers or labor market research.

The California Employment Development Department (EDD) lists only six out of all entry-level private training organizations as eligible providers for WIA individual training accounts. This means students of these six organizations can qualify to use Workforce Investment Act (WIB) Title I-B funds to pay for all or some of the training costs. Additionally, all these organizations report offering some assistance to students looking for a job by offering online job resources, mock interview assistance, and/or resume review. However, agencies were able to provide data on neither the number of graduates who earned industry recognized certifications nor on those who found job placements upon completion of the training programs.

In summary:

- → Private organizations that provide entry-level training are relatively new organizations.
- → These organizations are capitalizing on a perceived market opportunity to provide training for energy efficiency and renewable energy professionals.
- → They can quickly scale up or down to meet student demand, but do not calibrate their training slots to the number of job openings.
- → They are publicly subsidized to the extent that their students tap into WIA funded individual training accounts.

9.4.2 INTERMEDIATE TECHNICAL TRAINING

The Specialty HVAC Products Institute training is the only privately-run, intermediate-level training program we interviewed. This program provides 6 months of training at a tuition cost of $6,000 and trains about 40 students per year. The training does not lead towards a specific energy efficiency certification, but instead provides foundational knowledge to enter the residential and light commercial HVAC sector. Students of this program also take the Environmental Protection Agency (EPA)–Section 608 certification exam, which certifies students to responsibly handle refrigerants. This certification is required for most HVAC technicians.

Students are required to pay all fees, but WIB money is available for students that qualify. Students that attend with WIB funds also receive a caseworker and job search resources. All students, including those that attend using their own funds, can receive informal job search assistance such as alerts from school staff that are aware of job openings, or more formal assistance such as mock interviews.

The limited number of private programs providing intermediate-level training hindered our ability to draw generalizations about this type of training. However, the program we interviewed provides a relatively basic level of occupational training at a relatively high cost when compared with community college or apprenticeship programs in the same field.

9.4.3 INCUMBENT WORKER TECHNICAL SKILLS UPGRADE

Organizations in this category offer training to upgrade the skills of workers currently employed in the building and construction trades. For the organizations interviewed an estimated 1,000 to 1,600 workers have attended this type of training in the past year. These trainings are usually very short term, lasting between one and twelve days, and focus on a particular skill or certification. For example, CHEERS is authorized by the California Energy Commission to offer Home Energy Rating System (HERS) training and certification for California and targets professionals who want to focus their career on rating and assessment services consistent with Title 24. A number of organizations that specialize in energy efficiency training for entry-level workers, such as CBPCA, Everblue, and Clean Edison, also offer training targeting incumbent workers who want to achieve BPI certification.

Many incumbent worker trainings are offered by trade associations or other non-profit industry organizations. For example, RSES is a national organization that offers training to members on a variety of HVAC/R-related topics, including training that can help prepare a professional for NATE certification. Similarly, the national NAHB and NARI trade associations offer "green" training designed to help existing construction professionals learn how to make buildings more efficient and use sustainable materials. The Northern California Chapter also offers LEED training for professionals in the building field who are interested in distinguishing themselves as experts on "green" building.

Unlike the entry-level training programs we spoke with, energy efficiency and renewable energy are only one of a broader set of topics in the trainings offered by trade associations for their members. RSES trains people in quality installation of HVACR products and prepares people to sit for NATE certification. In 2010, there is one NATE Knowledge Area of Expertise certification specific to efficiency, the NATE Senior Efficiency Analyst, with only 52 people in the United States certified. None of the sites we interviewed currently offers training specific to this certification. Similarly, the NAHB, NARI, and USGBC trainings cover efficiency practice, but they also cover topics such as sustainable materials and relevant energy policies.

In summary:

- → Incumbent worker training is readily available, is usually short term, and is geared towards certifications.
- → Traditional construction contractor trade associations offer some limited energy efficiency training for their incumbent workers, but this has reached a limited number of workers.
- → Tracking of graduation and certification is poor for these organizations.
- → Assistance with career growth is poor or non-existent with most of these organizations.

9.5 CONCLUSIONS

In the last decade and, in particular, within the last three years there appears to have been a steady growth in the number of organizations offering entry-level and incumbent worker energy efficiency and renewable energy training. This growth appears to be driven by government energy efficiency investment policies such as ratepayer-funded programs, ARRA, and similar policy initiatives. However, there is a lack of measurement of worker outcomes based on this training. Most of the programs we spoke with were unable to tell us if the training had resulted in workers getting jobs or increasing their wages.

Private programs are typically costly for students, and the value of the training for workers in the labor market is not consistent. Some programs do train for industry-recognized certifications, but many do not. In general, these programs are un-standardized and unregulated and, therefore, vary widely in terms of quality and overall benefit to students. For trainees attempting to get entry-level job training but who have little knowledge of the job market, these programs are risky because they are expensive and their value for jobs seekers is very difficult to verify.

It is not clear that trade associations or other traditional programs providing intermediate technical and incumbent worker training are successfully informing their students about energy efficiency and renewable energy. The organizations appear to understand that there is an emerging market in energy efficiency and "green" building and have begun offering specialty certifications, but uptake of these courses and certifications appears to be small. Furthermore, it is not clear how important energy efficiency training is considered to be within technical trades training.

While there are a great number of private organizations providing entry-level energy efficiency and/or renewable energy specific training, there is very little to prepare workers with a longer-term occupational foundation leading to marketable technical skills. Currently, the emphasis appears to be on attracting new people to energy efficiency specific careers such as energy auditors, rather than training HVAC installers to emphasize efficiency into their work. Ultimately, in order to realize large energy savings, energy efficiency training must be incorporated into the standard operating procedures of builders, HVAC installers, and other trades professionals.

Finally, while third-party certification is present in this market place, it is still nascent and is thus having a limited effect on training differentiation and quality assurance. Clearer requirements from policymakers regarding third party certification and training accreditation would enhance training quality.

CHAPTER TEN:

10. COMMUNITY-BASED ORGANIZATIONS

10.1 OVERVIEW

Most community-based training organizations (CBO) provide pre-employment or pre-apprenticeship training, and serve disadvantaged populations with limited occupational skills and work experience. For the most part, CBOs run the only training programs that exclusively target low-income, minority, and disadvantaged job seekers and low-wage workers. Typically, over 75 percent of participants are people of color, most being Latino or African American. These programs represent the front end of the career pipeline, enabling participants to achieve work readiness through acquisition of the "soft" and "basic" skills needed to successfully enter employment or the next level of education or training.[1] Pre-employment and pre-apprenticeship programs typically integrate both work readiness and occupational skills training into their curricula, while also providing a range of support services for participants, such as child care and flexible scheduling. Over two thirds of the CBOs we interviewed offer either entry-level pre-employment or pre-apprenticeship programs. Most of these programs are very short term.

Incumbent worker training for low-wage workers makes up a much smaller proportion of CBO programs. Approximately 20 percent of the programs interviewed offer training to workers who are already employed, and most of these also offer pre-employment training. Incumbent worker programs provide skills enhancement or retraining opportunities for workers who are employed in low-wage jobs and wish to advance into better paid positions. Improving existing skills or gaining new skills can enable workers to move up a career ladder into a job with higher skills requirements and higher wages. Most incumbent worker programs also provide support services. Many participants in CBO training programs have other work or family obligations, and support services help accommodate their needs.

Community-based organizations are non-profit entities that obtain funding from a variety of sources. They usually do not charge clients directly for their services because they serve low-income participants. Funding for these programs typically comes from foundation grants or government contracts, either from Workforce Investment Boards (WIBs) or, recently, from a variety of initiatives funded by the American Recovery and Reinvestment Act (ARRA). Most of these programs assemble financial support from several sources, in order to ensure a sustainable funding stream.

10.2 DESCRIPTION OF PROGRAMS

Categorizing CBO programs into occupational groups helps illustrate the training niches that these programs are filling. The occupational tracks identified through analysis of interview data include:

→ TRADITIONAL skilled trades, including carpenters, electricians, and HVAC technicians; and

[1] "Soft skills" include such things as time management, interpersonal communication, punctuality, self-confidence, resume writing, interviewing, and problem solving, while "basic skills" refer to academic and foundational trades skills such as high school level math and reading. Both these skills sets are generally included in "work readiness."

→ EMERGING green occupations, such as solar installers, weatherization technicians and installers, and energy auditors.

As indicated in Table 10.1, a majority of programs we interviewed train participants for occupations in the traditional skilled trades and emerging occupations.[2] Because we were able to interview a high percentage of the relevant CBO training programs throughout the state (about 80 percent), we can assume that this information is fairly representative.[3] Traditional skilled trade training programs are far more likely to be pre-apprenticeship rather than pre-employment. They tend not to teach trade-specific skills (such as training only for electrical work). Instead, they teach general construction skills that are foundational for a variety of trades and therefore prepare participants to enter any of a number of different apprenticeships. Many pre-apprenticeship programs use the "Multi-Craft Core Curriculum," which is endorsed by the AFL-CIO Building and Construction Trades and is specifically aligned with these apprenticeships.[4]

Table 10.1 CBO Programs by Occupational Group

Occupational Group	Count	% of Total
Not specified	5	16
Administrative*	6	19
Traditional Skilled Trades	19	60
Emerging Occupations	23	72
Weatherization Installers / Technicians	14	61
Weatherization, Green Construction	1	4
Solar Photovoltaic Installers	13	57
Energy Auditors	11	48
Energy Engineers	1	4
Solar Thermal Installers / Technicians	5	22
Solar Energy Installation Managers	4	17
Solar Energy Systems Engineers	1	4
Solar Sales Reps & Assessors	3	13
Energy Specialists	1	4

*We recorded administrative tracks but only when they were within the energy efficiency related programs.

Within the emerging occupations category, training is more often occupation-specific because the programs are designed to prepare students for immediate entry-level employment, rather than for apprenticeship or another stage of training. The top three jobs that these CBOs train for are weatherization, solar installation and energy auditing.

A number of CBOs offer training in both traditional trades and emerging occupations. For example, RichmondBUILD offers pre-apprenticeship training in traditional skilled trades, but also partners with Solar Richmond to train for solar installation and with Rising Sun Energy Center for weatherization and energy auditor

[2] We were not specifically seeking information on training for administrative occupations because they do not have a direct impact on energy efficiency; however we did capture this information where it appeared in our sample alongside energy-related training.

[3] For more information on the complete list of programs we were able to identify and the sources for this information please see Appendix I.

[4] The Building and Construction Trades Department, AFL-CIO. Building Trades Multi-Craft Core curriculum. Retrieved from: http://www.efficiencycities.org/wp-content/uploads/062309/BCTD%20TriFold_v6.pdf.

training. This provides graduates with skills for direct employment and also prepares them to pursue apprenticeship training if desired.

10.3 INFORMATION ON OUTCOMES

Completion and job placement outcomes for participants vary depending on the occupational focus and whether the program is intended to prepare for entry-level employment or the next level of training.

As shown in Table 10.2, post-training placement rates are quite low for the emerging occupations programs we interviewed, compared to those training for traditional skilled trades. Approximately 74 percent of graduates from traditional construction programs are hired for a job or enter a paid apprenticeship each year, but only 19 percent of those from energy efficiency oriented programs are. Average starting wages for participants successfully placed in jobs are about a dollar higher per hour for traditional trades training than for emerging occupation programs, $14 versus $13 per hour.

Table 10.2 Estimated Statewide Enrollment, Completion, Placement, and Wage Data*

	Traditional Trades	Emerging Occupations	Total
Average Statewide Enrollment, 2006 – 2010	575	1,829	2,404
Average Statewide Graduates, 2006 – 2009	452 (79%)	1,392 (76%)	1,844 (77%)
Average Number of Participants Hired, 2006 – 2010	335	264	559
Average Starting Wages	$14/hr.	$13/hr.	

* These are estimated statewide totals based on the information from our sample.

These differences indicate a surplus of programs focusing specifically on green occupations compared with the number of available jobs, and for some, perhaps a lack of attention to career pathways and participant outcomes in the labor market as a metric of success. In contrast, CBOs offering pre-apprenticeships in the traditional skilled trades are well-connected to career pathways and emphasize the placement of students in apprenticeships. As a result, participants of these programs have better outcomes in the labor market in terms of employment, skill development and wage increases.

10.4 EMPLOYER INVOLVEMENT

The lack of attention to job placement and employer needs among CBOs training for emerging occupations indicates a lack of effective employer involvement in this type of training. This is detrimental to workers who still cannot get a job even after completing training.

Pre-apprenticeship programs in the traditional trades are often better connected to employers as a result of their ties with apprenticeship programs, which are run by joint labor–management committees and emphasize on-the-job training. Because apprenticeship is so strongly driven and shaped by labor demand, so too are most pre-apprenticeships—at least those that are effectively articulated with apprenticeship programs.[5] However, unlike apprenticeships, pre-apprenticeship programs are not regulated by the state Division of Apprenticeship Standards (DAS), so the degree to which these relationships are aligned and articulated can vary substantially.

In general, there are a number of ways that CBOs can involve employers in their training. Of the CBOs we interviewed, 70 percent reported that they involve employers in curriculum development and also offer opportunities for trainees to interact with employers via site visits and in-class speakers. Other ways that employers are involved in CBO programs include:

- → Serving on an advisory board (48 percent)
- → Serving as instructors (48 percent)
- → Donating supplies and equipment (48 percent)
- → Conducting mock interviews with trainees (39 percent)
- → Offering mentorships or internships (30 percent)

Industry input is also essential for incorporating green technological advances to CBO programs (in both traditional and emerging occupations). Over half of the organizations that train for emerging occupations rely on industry experts to provide advice on the selection and development of new programs, or to serve as program instructors.

Even though most programs involved employers, our research shows that employer involvement does not always lead to successful job placement outcomes in good jobs with career paths. Job outcomes are a far better metric by which to judge the effectiveness of employer involvement.

10.5 PARTNERSHIPS

Community-based organizations can link with other organizations at every step of a program, beginning with recruitment, followed by training, work experience, job search assistance, job placement, and post-placement services after completion of the program. The depth and scale of these partnerships varies, but most interviewees reported partnerships in all or some of these areas.

Partner organizations most commonly include other CBOs, labor unions, trade associations, community colleges, government agencies, WIBs and One-Stop Centers, and faith-based organizations. These organizations provide a variety of supplemental services, including outreach and recruitment, training and curriculum development, supportive services, job placement, and career counseling. Although some CBOs may also partner with utilities or other private industry organizations, none of the interview respondents mentioned these organizations as primary partners for any of their major activities.

In some cases, CBOs are also part of a network that is affiliated with a national organization. For example, several of the programs interviewed for this study are affiliates of YouthBuild USA. YouthBuild programs compete for federal grants to train low-income 16- to 24-year-olds in construction skills. Participants build affordable housing in their community, while simultaneously working to earn a high school diploma or General Educational Development diploma (GED), and learning basic occupational skills. These programs are typically designed to be pre-apprenticeships.

[5] See Chapter 7 for more information on apprenticeship.

10.6 CONCLUSIONS

Most CBO training programs specifically serve individuals from disadvantaged, low-income and minority communities, who have with limited occupational skills and work experience, at the front end of the career pipeline. Some also help low-income workers who are already employed to improve their skills and wages. These programs can be broadly defined as two types: those training for traditional skilled trades, often through pre-apprenticeship programs that offer foundational training for a number of trades; and those training for emerging occupations, such as solar installation or weatherization. Some programs provide a combination of these two types of training, and most also offer a range of work readiness training and support services.

Based on self-reported job placement estimates, programs that train exclusively for emerging occupations are not well-connected to employers and do not emphasize the labor market outcomes of their participants. Job placement rates and starting wages for graduates of these programs are typically extremely low, much worse than those for programs training for traditional skills and occupations. This is partially due to a disconnect between the policy goals of program funders and the realities of the labor market.

Pre-apprenticeship programs are an especially important type of training that can be run by CBOs or other types of organizations. Many of these programs are specifically intended to support the entry of underrepresented or disadvantaged populations into skilled trade apprenticeships, helping participants move directly into an established career pathway. Although the DAS has established a list of best practices for pre-apprenticeship programs, these programs vary in quality as they are un-standardized and are not regulated or accredited by the DAS or by any third party or government agency.

Community-based organizations are typically well-rooted in their communities, and are acutely aware of the needs of the populations they serve. One strength of CBOs is their ability to connect with underserved populations and help remove barriers to their employment. Given this rootedness, CBOs are performing a critical function for the inclusion of disadvantaged populations. However, unless they partner or perform the other functions of a sector strategy, particularly effective connections with jobs and employers, they are unlikely to help their clientele get good jobs with career pathways.

CHAPTER ELEVEN:

11. REGIONAL OCCUPATIONAL PROGRAMS

11.1 OVERVIEW

Operating through high schools across the state, Regional Occupational Centers and Programs (or Regional Occupational Programs—ROPs) offer career technical courses for high school students and some adult learners. Established in 1967, the programs "are designed to serve the state's interests in providing quality career preparation and technical education." [1] ROPs offer training for entry-level jobs, preparation for entry into apprenticeship, or a foundation for further training.

Regional Occupational Programs are located in school districts throughout the state. They all belong to the California Association of Regional Occupational Centers and Programs (CAROP). [2] In remote areas with low population density, such as the northernmost region of the state, one ROP may serve high schools from two or three counties, while more populated counties usually have multiple ROPs. For example, 13 ROPs work with high schools in Los Angeles County alone. ROPs are currently scaling back on the number of courses in each program due to state budget cuts.

Regional Occupational Program participants must be at least 16 years of age and be working to complete a high school diploma. Individual ROPs can adjust their requirements to allow younger students to register, or they may have additional enrollment conditions. Some ROPs also cater to high school graduates seeking adult education. Most students start in the Career Technical Education (CTE) track within their high school, and take the ROP courses as a capstone to their program, defining their area of interest. Students take courses at their home high school or at another school, within the area that the ROP serves, that offers the desired course.

Regional Occupational Programs train at the front end of a career pathway, attempting to provide students with the fundamental skills necessary to succeed upon entry into the workforce, higher education, or additional training programs. These programs teach both "soft" and "basic" skills. [3] While soft skills, such as resume writing and interviewing, are often common across programs, the programs also integrate introductory training in the core competencies of particular occupations.

11.2 DESCRIPTION OF PROGRAMS

Training at ROPs related to energy efficiency, distributed generation, or demand-response sectors falls into the following general program tracks (each of which includes a number of specialties):

[1] California Association of Regional Occupational Centers and Programs (2010). Retrieved from: http://www.carocp.org/

[2] Overall, the majority of the ROPs have been accredited by the Western Association of Schools and Colleges (WASC). However, the ROP itself does not need to be accredited as long as the schools in which they operate have been accredited. Among those ROPs covered through interviews, 58 of the 77 have been accredited, all of which by WASC.

[3] "Soft skills" include such things as time management, interpersonal communication, punctuality, self-confidence, and problem solving, while "basic skills" refer to academic and foundational trades skills such as high school level math and reading. Both these skills sets are generally included in "work readiness."

- → Architectural Design and Drafting
- → Building Trades and Construction
- → Building Trades and Construction–Green Construction
- → Engineering Design/Technology
- → Renewable Energy/Green Technology

Table 11.1 shows how the spread of program tracks included in our sample closely matches the distribution of all ROPs training in these areas in the state. Note that individual ROP programs plan and organize courses at their own discretion. There is little uniformity in the naming or content of occupational tracks, so the above groupings are approximate based on the available data.

Table 11.1 ROP Occupational Tracks Related to Energy Efficiency and Distributed Generation

ROP Occupational Tracks	Total Programs	% of Total Programs	Programs Interviewed	% of Interviewed Programs
Architectural Design and Drafting	18	9%	5	6%
Building Trades and Construction	77	37%	29	38%
Building Trades and Construction – Green Construction	6	3%	4	5%
Engineering Design / Technology	51	24%	17	22%
Renewable Energy / Green Technology	12	6%	7	9%
Total	210		77	

The following list describes several key program tracks in detail, and Table 11.2 shows some specific examples of core competency skills taught at ROPs. [4]

BUILDING TRADES AND CONSTRUCTION: This ROP track has the greatest number of program offerings. With 77 programs, it makes up over one-third of the total programs of interest to this study. Specialty offerings in this track include residential and commercial construction, and construction technology. These programs typically focus on basic construction skills, such as plumbing, HVAC, roofing and carpentry. This track comprised 38 percent of the programs in the sample. Some of these programs lead to entry-level employment, while others are preparatory for entrance into apprenticeship in one of the skilled trades.

ENGINEERING DESIGN / TECHNOLOGY: The second largest track, engineering design/technology, includes programs such as computer-aided drafting and design (CAD) and robotics and electronics technology. As such, core competencies in this track include basic skills for CAD and engineering. These programs typically prepare for entry into a post-secondary program in engineering or drafting.

[4] We do not emphasize agricultural construction here, as it is less relevant for energy efficiency, distributed generation, and demand response.

ARCHITECTURAL DESIGN AND DRAFTING: Programs categorized in this track include those focusing on architectural design and some CAD programs that place the emphasis on drafting skills applicable in architecture, rather than engineering. The core competencies of these programs include basic drafting and visualization skills. These programs typically prepare for entry into a post-secondary program in architecture or architectural drafting.

RENEWABLE ENERGY/GREEN TECHNOLOGY: Programs in this track are some of the newest at ROPs. Among the 12 programs in the sample, most focus on an overview of available clean and "green" technologies, such as energy and environmental technology offerings. However, some specialized programs in solar installation and wind turbine technology are also available. Core competencies for this track include basic knowledge of energy technologies, in general, as well as specific occupational skills. These programs are intended to lead to entry-level employment in an energy-specific occupation.

BUILDING TRADES AND CONSTRUCTION–GREEN CONSTRUCTION: This is the smallest of the ROP tracks, with only six green construction programs in California. These programs apply "green" technology to established construction core competencies. Some of them also emphasize energy auditing skills and techniques. These programs are designed to provide students with sufficient skills for entry-level employment in energy-specific occupations, such as weatherization installer/technician, or energy auditor.

Table 11.2 Examples of Core Competencies for ROP Occupational Tracks

ROP Occupational Tracks	Examples of Core Competencies
Architectural Design & Drafting	Basic drafting and visualization
Building Trades & Construction	Carpentry, plumbing, roofing
Building Trades & Construction – Green Construction	Energy audit skills, applying green perspectives to established construction skills
Engineering Design / Technology	Drafting, CAD
Renewable Energy / Green Technology	Solar photovoltaic cells, knowledge of energy sources

11.3 INFORMATION ON OUTCOMES

Individuals who complete ROP programs gain knowledge of entry-level skills in their chosen vocation. Graduates can then choose either (1) to enter the workforce in entry-level jobs, (2) to pursue two- or four-year college, or (3) to enter into an apprenticeship or another type of post-secondary vocational training.

Students enroll in their selected track and then take related courses to earn certificates of completion signifying their competency in particular skill areas. Based on our interviews, a typical ROP will enroll around 800 students per year in the relevant occupational training programs.[5] The average number of graduates each year is around 600, indicating that a quarter of students typically do not complete ROP training. Table 11.3 provides an overview of the average enrollment and graduation rates across programs for each occupational track. [6]

[5] Here we include the agricultural construction trades and manufacturing training programs at ROPs. We omitted these programs from the comparative analysis in Chapter 13 because we did not collect information on these programs at other institutions.

[6] There is very limited data available on completions of ROP programs to verify our sample data. ROPs operate within individual high schools and information of that nature is not typically stored in one place or database. In order to accurately assess the number of students that complete ROP courses, it is necessary to speak with individual schools or teachers and aggregate the numbers to find the total.

Table 11.3 Average Enrollees and Graduates, by Occupational Track

ROP Occupational Tracks	Average Enrollees Per Year from 2006-2010 (n=77)	Average Completers Per Year from 2006-2011 (n=77)	Average Completion Rates
Architectural Design and Drafting	184	147	79.9%
Building Trades and Construction	910	628	69.0%
Building Trades and Construction – Green Construction	200	90	45.0%
Engineering Design / Technology	765	620	81.0%
Renewable Energy / Green Technology	271	148	54.6%
Total	3,517	2,656	75.5%

Most students complete ROP programs within 1 to 2 years, while a few programs are designed to take less than one year. However, Completion in ROPs is defined, not by a number of hours, units or courses completed or attended (as it is for many other training programs), but rather by whether or not a student can master a certain set of skills as measured through competency testing. Therefore, a student who already possesses some basic knowledge or skills in their field of choice can complete the program more quickly than a student who does not.

The engineering design and technology track has the highest completion rate, approximately 80 percent. The tracks with the lowest graduation rates are those directly related to energy occupations, including building trades and construction–green construction, and renewable energy technology. These low graduation rates may be attributable to the infancy of these programs, or a variety of other factors such as lack of demand in the labor market for these specific skill sets.

11.4 EMPLOYER INVOLVEMENT

Regional Occupational Programs work with local businesses and industries to design and deliver training that caters to the labor market demand in the region. They are required to have an advisory board consisting of employers in a particular sector. The following are some of the ways that ROPs engage employers with their training programs:

CURRICULUM DEVELOPMENT AND UPDATES: Forty-seven out of 77 programs responded that "feedback from employers" was a key contributor to curriculum development. Similarly, many interviewees mentioned the importance of advisory boards. Interviewees also suggested that informal conversations with industry professionals/experts are another key way for ROPs to link with employers for curriculum development.

INFLUENCING PROGRAM PLANNING: In addition to curriculum development, employers play a critical role in influencing ROP decisions about the broader question of program tracks and sectors in which they ought to provide training. Over 88 percent of respondents said that employers' input was the leading factor in this decision-making process.

PRACTICE INTERVIEWS: Over 60 percent of ROP administrators noted employer participation in conducting practice interviews with students. Many mock interviews occur during career fair events at the high schools that host ROPs.

FIELD TRIPS/INDUSTRY SPEAKERS: Regional Occupational Program instructors are predominantly high school teachers, rather than industry professionals. Many of them invite industry speakers into their classrooms or take students on field trips to employer sites to infuse "real life" or practical application elements to their instruction. Over half of ROP programs interviewed engage employers by organizing visits to businesses and inviting industry speakers.

WORK EXPERIENCE: Some ROPs work with the industry to provide internship opportunities for students. However, our assessment of the data indicates that this effort is neither systematic nor a key objective of the ROPs at this point. Only 18 out of 77 programs reported having an internship component in their programs.

OTHER EMPLOYER INVOLVEMENT: Additional support from industry partners includes providing funding for the program, helping with the recruitment of students, and assisting with delivery of training.

11.5 PARTNERSHIPS

In addition to collaborating with employers, interviewees reported a number of other types of partnerships. Student recruitment, training delivery, and curriculum development are the three most common areas of collaboration for ROPs. Typical partners in these pursuits are local community colleges and One-Stop Centers. Community colleges and ROPs often share funding on training grant projects, which helps expand and strengthen their ties. In some instances, they also share training facilities and laboratories on a cost-recovery basis. A number of ROPs also reported establishing articulation agreements with community colleges and local four-year institutions.[7]

Many ROPs are pre-apprenticeships as well. These programs typically have a close relationship with the nearby apprenticeship committee for a particular trade. These relationships may result in collaboration on recruitment and placement, as well as curriculum development.

One-Stop Career Centers offer support services to ROP students in a variety of capacities, including job placement, case management, and assistance with their job search.[8] The two most frequently reported forms of student support services include (1) Access to self-directed job search resources (84 percent), and (2) Job Readiness Training (71 percent). These are important services for students enrolled in these programs, as many intend to enter the workforce upon completion of ROP programs. However, the job search and placement services provided by ROPs are very minimal. In many cases, they are limited to supplying students with letters of recommendation and providing resources that require students to take initiative in their own job search.

[7] An articulation agreement is a formal mechanism that allows student to receive college/university credit for high school courses taken and/or university credit for community college units completed. These agreements are critical in providing students with an opportunity to follow educational pathways from high school to an advanced degree.

[8] Funded by the U.S. Department of Labor through the Workforce Investment Act of 1998 (WIA), One-Stop centers were developed to bring together employment and training services that work with all people into one place and make it easier for job seekers and employers to use these services. One-stop centers are operating in every county in California, with many counties having multiple centers. WorkWorld (2011). "One-Stop Centers - Overview." Employment Support Institute, Virginia Commonwealth University School of Business. Retrieved from: http://www.workworld.org/wwwebhelp/one_stop_centers_overview.htm.

11.6 INCORPORATION OF ENERGY EFFICIENCY AND RELATED SKILLS

The response to the growing importance of energy-efficiency related occupations has been inconsistent across ROPs. Some programs have integrated energy efficiency or added separate modules into energy related courses, such as those on construction and design. A less common approach is to offer courses that specifically address energy and environmental technologies, primarily targeting the energy and utilities industry sector. Although two out of the five relevant occupational tracks were identified as specific to green technology, including building trades and construction–green construction and renewable energy/green technology, programs in these two tracks make up only 14 percent of the total programs interviewed. However, data from interviews suggest that more ROPs are planning to add courses specifically addressing green and energy efficiency related fields.

Of the programs interviewed, the most common way of incorporating energy efficiency into a program is to integrate it throughout classes (88 percent). Few ROPs indicated that they emphasize energy efficiency as the main topic of learning. The least frequent way of incorporating energy efficiency into programs is through offering a separate module of instruction (3 percent). Since ROPs are subject to the timeframes and restrictions of the high schools' course planning, including an extra module on energy efficiency or renewable energy is not usually possible. Integrating energy efficiency concepts throughout the program represents a more practical approach, because it overcomes these administrative barriers and contextualizes energy efficiency training in a broader occupational skill set.

In order to integrate energy topics into their traditional offerings, ROPs will need to continue to reform and adapt their curricula. A majority (59 percent) of the respondents indicate that they have changed or are planning to change curricula in order to incorporate energy related topics. Specifically, ROPs report that they are working with their advisory committees on curriculum revisions, and purchasing new pieces of energy efficient equipment to stay relevant and up to date with the current trends and technologies.

11.7 CONCLUSIONS

Regional Occupational Programs provide students with soft skills and basic skills training designed for pathways into entry-level employment in the building and construction trades, apprenticeship programs, and two- and four-year colleges. They offer basic skill competency testing and certification applicable to a variety of occupations and career tracks, including building and construction trades, architecture, and engineering. These appear to be valuable programs to provide career awareness and basic skills training for high school students. However, data on job placement, wages, and retention or entry into further education is minimal or non-existent, so it is difficult to fully assess the effectiveness of these programs.

In general, integration of energy efficiency related training in ROP programs has been inconsistent. Regional Occupational Programs have recently begun to develop a small number of new "green" programs, while over half of the traditional programs have also been incorporating energy efficiency related topics of instruction. According to interviewees, the main reason for adding new programs was the deteriorating employment conditions in the construction and manufacturing industries, and the perception that there are more jobs available in green sectors of the economy. Based on the findings of this report, this may be a misguided perception.

CHAPTER TWELVE:

12. INVESTOR-OWNED UTILITY PROGRAMS

12.1 INTRODUCTION

This chapter examines the investor-owned utility (IOU) Workforce Education and Training (WE&T) programs, which include the Energy Training Centers (ETC), which are the largest part of the recently labeled *Centergies* programs, and the *Connections* programs, which are collaborations with educational institutions. This chapter also looks at other selected IOU investments in training and education in energy efficiency and related sectors, focusing on how the IOU WE&T programs fit within the larger network of institutions and workforce development programs that are engaged in the energy efficiency, demand response, and distributed generation sectors in California. Our analysis addresses the current role that the IOU programs are playing and their core competencies and specific assets within this larger workforce system. We also suggest avenues for deeper collaboration with other workforce funding agencies and training and education institutions.

Our recommendations are based on an assessment of how well current IOU programs match these strengths to the needs of the overall workforce development system in the energy efficiency and related sectors. Since one of the purposes of this WE&T Needs Assessment is to provide recommendations on possible changes in direction or emphasis for the IOU-funded training initiatives, we examine the utility programs in greater depth than the other training institutions. However, this assessment is not designed to replace the evaluations of the specific programs.

For the *Centergies* programs, this analysis builds on the recent impact evaluation by Opinion Dynamics.[1] As described in the final report, this evaluation analyzed the impact of the *Centergies* program on knowledge transfer and actual energy savings. The Opinion Dynamics evaluation is an extremely valuable resource and we use the large amount of data they collected whenever possible, since our data collection process was much less intensive.

For the *Connections* programs, we consulted the process evaluation conducted by Research Into Action for the 2006–2008 EARTH Education and Training Program.[2] This Program included three of the components of the current *Connections* programs—Green Schools, LivingWise, and Green Campus. An impact evaluation was not completed for these programs for the 2006–2008 cycle.

In addition to these two program evaluations, we interviewed key WE&T staff at each utility and analyzed WE&T documents including Program Implementation Plans (PIPs), and collaboration plans. We reviewed data supplied by utility training staff such as number of trainings, attendees, and attendee types. We interviewed a number of IOU WE&T partners to the *Centergies* and *Connections* programs. Finally, we bring to bear the knowledge we gained through our survey of community colleges, apprenticeship programs, 4 year colleges, community based and industry based training programs, and ROP and other high school programs, which helped us situate the IOU WE&T training investments in the whole workforce development universe for these sectors in California.

[1] Opinion Dynamics Corporation (2010, March). Indirect Impact Evaluation of the Statewide Energy Efficiency Education and Training Program. Volume I of IV: Final Report, Study ID: CPU0014.01. Prepared for the California Public Utilities Commission Energy Division.

[2] McRae, M.; N. Harris, J. Van Clock, and T.L. Hanson (2009, August). Process Evaluation of the 2006-2008 EARTH Education & Training Program. Research Into Action and Educational Consulting Services. Study ID: SCE0276.01 / CPUC ID: SCE 2504.

12.2 KEY WE&T PROGRAMS

The key WE&T programs operated by the IOUs of California include the Energy Training Centers and educational programs for K-12 schools, community colleges, and four-year colleges and universities. The Energy Training Centers, the key program category under the *Centergies* program, are the largest set of programs in terms of funding. They provide classes, seminars and similar activities in eight centers located throughout California, as well as some mobile training. Educational programs, currently referred to as *Connections* programs, are collaborative efforts to support education and training on energy efficiency and related activities in K-12 schools, community colleges, and four-year colleges and universities.

We also identified to the extent possible other educational and training activities that are administered by the utilities but are not part of either of these WE&T programs. Our interviews with IOU program staff identified several instances in which specific trainings were provided by the IOUs as part of specific programs and were not funded under the *Centergies* or *Connections* programs. The three cases that we identified, all at SCE, were the development of what later become known as the California Advanced Lighting Controls Training Program (CALCTP), in which SCE funded the development of the first curriculum from the emerging technology lighting program initiative; the training of building inspectors funded by the Codes and Standards program, and the training for contractor participants in the HVAC Quality Installation and Quality Maintenance (QI/QM) program. Other training programs fell outside our scope, including internal utility training programs for their own employees and scholarship and internship programs not restricted to energy efficiency. In summary, we focused our attention on the *Centergies* and *Connections* programs; our analysis does not represent a comprehensive review of all utility-funded training programs dealing with energy efficiency, demand response, and distributed generation. While needed to fully appreciate the contribution of the IOUs to workforce education and training, that more comprehensive analysis was determined to be outside the scope of this project.

This chapter first describes the eight Energy Training Centers that are part of the *Centergies* program. For each Center, we identify the primary audiences, number of trainings offered, budget, and number of attendees in 2009. We then describe the role of each Center, the direction provided by the CPUC, and the collaborations they maintain. Second, we describe and analyze the programs that constitute the *Connections* initiatives. Finally, we provide suggestions for how the training centers and the *Connections* initiatives could better position themselves to support energy efficiency and renewable energy career pathways.

12.3 CENTERGIES (ENERGY TRAINING CENTERS)

The Energy Training Centers operated by California's IOUs are designed to educate both market actors and customers on energy efficiency and related technologies and measures. Market actors include firms and employees installing energy efficiency related measures, while customers include the building owners and homeowners who pay for, maintain and operate these measures.

All of the *Centergies* programs are provided to participants at no cost. As articulated by ETC directors, classes are created to fill gaps and "prime the market" with a portfolio of programs and services that complements the services offered by other educational and training institutions. Gaps are identified through information gathered from utility staff members who manage resource programs, trade association staff members who also provide training, class participants, and other sources in the field. This flexibility to respond to need, and withdraw when the need no longer exists, is an important aspect of the programs.

The Energy Training Centers offer a variety of programs—classes, information dissemination, customized demonstrations and consultations, and equipment lending libraries. By far the most predominant activities are very short classes on specific topics related to energy efficiency and related demand-side management activities. Most classes are three to four hours in length and are designed to be self-contained "one-off" classes. In the great majority of cases, enrollment is open, there is no screening, and access is on a first-come, first-served basis. This open enrollment is not mandated by CPUC policy but is deeply ingrained in the structure and practices of the ETCs and is part of the overall strategy of maximizing the number of people taking classes. Table 12.1 summarizes key features of the seven IOU Energy Training Centers.

Table 12.1 Summary of Energy Training Centers in California

Utility	Training Center	Location	Primary Audience	Number of Sessions Offered [1]	2010-2012 Budget	Number of Attendees 2009
Pacific Gas & Electric (PG&E)	Pacific Energy Center (PEC)	San Francisco	Commercial and Industrial Professionals	164	$34 million	7,716
	Energy Training Center (ETC)	Stockton	Residential Sector Professionals	90		8,662
	Food Service Technology Center (FSTC)[2]	San Ramon	Commercial and Industrial Professionals	—		—
Southern California Edison (SCE)	Customer Technology Application Center (CTAC)	Irwindale	Commercial and Industrial Professionals	211	$21 million	8,634
	Agricultural Technology Application Center (AgTAC)	Tulare	Agricultural and Industrial Sector Professionals	146		2,272
Southern California Gas (SCG)	Energy Resource Center (ERC) [3]	Downey	Commercial and Industrial Professionals	140	$8.8 million	9,485
San Diego Gas and Electric (SDG&E)	Energy Resource Center (ERC) [4]	San Diego	Commercial and Industrial Professionals	84	$12 million	6,385
	California Center for Sustainable Energy (CCSE)**	San Diego	Residential Sector Professionals	195		9,194
Total					$75.8 million	42,863

[1] Sessions are the total number of unique sessions offered; some sessions may be repeats of the same classes.

[2] The FSTC operates out of San Ramon but conducts seminars at locations throughout California, including other IOU Centers.

[3] The SDG&E ERC shares space with the CCSE.

[4] The CCSE also receives funding from sources other than SDG&E and they offer training in areas outside of building efficiency such as transportation. The dollar figures referenced here are only SDG&E funds.

Most training at the ETCs is geared towards teaching existing professionals from various segments of the building and energy sectors about efficient equipment, technologies, measures, and systems. According to the 2010 Opinion Dynamics Report on the 2006–2008 program period, about 55 percent of training attendees were market actors, 30 percent were commercial end users (building owners and managers), and 15 percent were residential end users.[3]

Table 12.2 shows the training by end use for 2009 and for the three-year cycle for 2006–2008. The greatest emphasis has been on HVAC training, an industry that has been beset by installation and maintenance quality shortfalls. It was hoped that improved training would increase the number of installations that are done correctly, thereby reducing energy use during the summer when load reductions are of greatest value to the state.

Table 12.2 Energy Center Training by End Use

End Use	2009 Classification of End Use		2006-2008 (3 years) Classification of End Use	
	Training Sessions	Percent Training Sessions	Training Sessions	Percent Training Sessions
HVAC	272	24%	663	26%
Other	232	20%	323	13%
Renewables	157	14%	211	8%
Green Building / Envelope	146	13%	224	9%
Lighting	101	9%	310	12%
Controls / Energy Management Systems	45	4%	74	3%
Commercial Cooking / Food Service / Refrigeration	42	4%	127	5%
Title 24	39	3%	187	7%
Motors/Pumps	32	3%	97	4%
Water	23	2%	8	0%
Commissioning	17	1%	74	3%
Financial Incentives	9	1%	101	4%
Gas	8	1%	5	0%
Compressed	7	1%	31	1%
Boilers / Furnaces / Water Heating	5	0%	119	5%
Pool	4	0%	24	1%
Total	1,139		2,578	

Source: Opinion Dynamics (2010) for 2006-2008; authors' calculations from utility data for 2009.

We examined all classes offered by the training centers in 2009 and then categorized the class by occupational skills category. We found that over 70 percent of classes offered did not match easily with any one occupation type. While the centers do promote certain skill standards for some occupation, such as the Building Operator Certification (BOC) for building managers and NATE certification for HVAC mechanics and installers, most trainings are not geared towards a specific certification or standard. The classes are open to people from a broad array of building-related occupations.

[3] Opinion Dynamics, 2010.

The fact that the Energy Training Centers do not focus classes on specific occupations in part reflects the multidisciplinary systems-oriented focus of energy efficiency work. Attaining energy savings is less about training an HVAC technician to install certain types of equipment and more about training them to look at building elements traditionally not covered in their training. Furthermore, the ETCs train market actors to identify new markets that their traditional building field can serve. For instance, an architect may want to offer distributed generation services as part of their design portfolio and may therefore take the Pacific Energy Center's "Integrating Energy Efficiency and Renewables in Home Retrofits" class. However, this class is similarly relevant to construction managers, engineers, tradespeople, and others.

This lack of occupational focus also reflects the fact that these classes are mostly very short, self-contained courses and are not designed to fit into longer-term occupational trainings. Unlike workforce development organizations, the Energy Training Centers do not design their courses as part of a longer-term career development program. As a result, the Centers do not focus on issues of scope and sequencing or the development of a set of portable and stackable credential that can move a worker along a career path of increasing skills over time.

Table 12.3 shows the reach of the Energy Training Centers for various industry segments. Opinion Dynamics estimates that 43 percent of Californians working in the HVAC industry have taken at least one class at the Energy Training Centers, a substantial number that reflects a concerted effort by the utilities to improve the quality of HVAC installation and maintenance, which is a key goal of California's EE Strategic Plan. Though the data collected do not distinguish between professional workers, managers, and business owners on the one hand, and construction workers and technicians on the other, Energy Training Center staff impressions suggest that most of the participants are in the former category, i.e., HVAC industry contractors, rather than technicians.

Table 12.3 Market Actors Reached by Industry Area

Industry Area	Market Actors (Statewide)	Estimated Reach by Centers	Percent Reached (Statewide)
HVAC and Refrigeration	19,700	9,427	44%
Government Agency/Regulatory/Inspector	12,500	3,263	26%
Engineering/Architectural Design	58,200	13,053	22%
Lighting	68,300	8,339	12%
Construction	161,200	9,064	6%
Boilers/Water Heating Sales	56,000	3,263	6%
Other	55,800	2,901	5%
Motors	49,400	2,538	5%
Facility Operations and Maintenance	163,000	3,263	2%
Energy Technology Research/Consulting	N/A	5,801	N/A
Pumping/Hydraulic Equipment	N/A	2,175	N/A
Renewables	N/A	5,076	N/A
Don't know/Refused	N/A	2,175	N/A

Source, Opinion Dynamics (2010) p. 58.

12.3.1 ENERGY CENTER COLLABORATIONS

The Energy Training Centers are actively engaging in collaborations with professional and trade associations. These collaborations expand the reach of their classes, support the development of contractor pools that can participate in utility resource programs, and bring in expertise not available within the utilities. When possible, the Energy Training Centers structure their classes to qualify for continuing education credits in relevant professional organizations such as the Association of Energy Engineers (AEE) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), so that class participants gain professional and industry recognition for skills acquisition.

Notably, the Energy Training Centers have worked most closely with trade and professional associations that are specialized in energy efficiency. The PG&E Centers have even helped form associations. A noteworthy example is the California Building Performance Contractors Association (CBPCA), a trade association which has gone on to be a key player in the attempts to create a specific and separate market for energy efficiency retrofits in the residential sector. The Energy Training Centers also work with some of the industry certification bodies, such as the Building Performance Institute (BPI), and although they are neither officially accredited trainers, nor issuers of certifications, the Energy Training Centers try to develop their classes to be useful to those seeking certification. In a minority of cases, the Energy Training Centers will implement a course series for a specific group of incumbent workers that does lead to a certification, such as in the case of the Building Operators and Maintenance sequence. Table 12.4 gives an overview of the various collaborations between the IOU Energy Training Centers and their many partners.

Another example of a successful collaboration is the Building Operators Certification (BOC) program licensed by the California IOUs from the Northwest Energy Efficiency Council (NEEC), who is also contracted to implement the program. The BOC training is a multi-session course series that combines classroom training, in-facility project assignments and exams to train operators of commercial and industrial buildings. This differs from most Energy Center offerings in that it is longer, has a clear occupational focus, and is based on actual projects that the students, who are building operators, bring to the class. Students may then take certification exams from NEEC for Level I and Level II certifications. A process evaluation of the BOC for 2006–2008 for the SCE territory reported that 131 courses were offered and 748 students enrolled in at least one course. Of these, 416 received Level I certification and 226 received Level II certification.[4] The Opinion Dynamics evaluation showed higher energy savings results from this program compared with the average for all Energy Training Center classes.[5]

While the utilities clearly have many enduring and successful collaborations, there are other, yet to be developed, collaborations that would further energy savings and promote energy efficiency careers. Thus far, the existing collaborations focus heavily on early adopter organizations, professionals and business owners rather than the actual workforce, and on the non-unionized side of the building and construction industry. While appropriate when energy efficiency was a less prominent public policy objective and the state's goals were not so ambitious, this approach is no longer sufficient because it will only touch a slice of those that need to be reached. Now it is imperative to reach into the mainstream building and construction trades industry. As the utility WE&T training efforts move beyond short-term training to providing expert knowledge that can be integrated into longer-term career technical training programs, it is essential that the utilities choose partner organizations that are sustainable, of sufficient depth and breadth, and are part of the higher-road segments of their industry. High-road approaches

[4] McLain ID Consulting and KVDR Inc. (2010) Southern California Edison PY 2006-08 ETO Process Evaluation. Study Number SCE0285. March 31, 2010.

[5] Opinion Dynamics, 2010.

Table 12.4 IOU Energy Training Centers and Their Collaborations*

Organization	Description of Collaboration	Relevant Utility Territory	Degree of Collaboration (Developed or In Process)
Training Providers			
California Home Energy Efficiency Rating Services (CHEERS)	CHEERS is one of three organizations approved by the California Energy Commission. This non-profit organization offers training to people interested in Home Energy Rating System certification (HERS).	All	Developed
California Building Performance Contractors Association (CBPCA)	CBPCA is one of three organizations approved by the California Energy Commission. This non-profit organization offers training to people interested in Home Energy Rating System certification (HERS).	All	Developed
California Certified Energy Rating & Testing Services (CalCERTS)	CalCERTS is one of three organizations approved by the California Energy Commission. This non-profit organization offers training to people interested in Home Energy Rating System Certification (HERS).	All	Developed
Build It Green	Utilities offer their facilities to host Build it Green trainings such as Green Point Rater and BPI Building Analyst.	All	Developed
Building Industry Institute (BII)	PG&E offers their facilities to host BII trainings. BII and their subcontractor Consol offer trainings related to building energy codes in the PG&E service territory.	PG&E	Developed
Affordable Comfort	ID new trends/technologies in the field.	PG&E	Developed
Trade Associations			
Air Conditioning Contractors of America (ACCA)	All utilities adopted the standards set by ACCA for quality installation and sizing of air conditioners.	All	Developed
Institute of Heating and Air Conditioning Industries (IHACI)	IHACI provides training at the three southern California utilities that prepare students for NATE certification. This training adheres to ACCA and other standards. IHACI also connects utilities to HVAC companies.	SCE, SCG, SDG&E	Developed
American Institute of Architects (AIA)	All utilities offer training that architects can use to receive continuing education units from AIA. This collaboration enables utilities to access architects.	All	Developed
Association of Energy Engineers (AEE)	SCG offers a five-day training series in conjunction with AEE that enables participants to sit for the Certified Energy Manager (CEM) exam.	SCG	Developed
Higher Education			
Community Colleges (CC)	All utilities training centers partner with community colleges. Examples of collaboration include Laney CC students currently using PG&E's Energy Training Centers in their curriculum, to SCE partnering with College of the Canyons to pilot a program aimed at training students in energy management, retrofitting, and green design. Additionally, there is a pilot underway with San Francisco City College and Los Angeles Trade Technical College to offer weatherization training.	All	Limited in the past but expanding
Colleges/Universities	Collaboration with colleges includes the Energy Training Centers hiring university instructors to teach classes.	All	Limited

Table 12.4 (continued) Utility Training Centers and their Collaborations

Organization	Description of Collaboration	Relevant Utility Territory	Degree of Collaboration (Developed or in process)
Certification Organizations			
North American Technician Excellence (NATE)	All utilities offer training that partially prepares participants to take NATE certification exams. NATE is seen as the HVAC/R industry standard for certification.	All	Developed
National Council on Qualifications for the Lighting Professions (NCQLP)	PG&E offers training that satisfies NCQLP's re-certification demands. Certified lighting professionals can get credit for taking applicable courses offered by PG&E.	PG&E	Developed
Building Performance Institute (BPI)	All utilities work with training organizations such as Build It Green or CBPCA that offer training that prepares attendees to take BPI certification exams.	All	Developed and Expanding
Builder Operator Certification (BOC)	All utilities offer this series of training that helps prepare building operators to run their facilities efficiently.	All	Developed
Government Agencies			
California Energy Commission	Utilities work with the CEC to offer trainings to market actors about Title 24 policies.	All	Developed
California Community Services and Development (CSD)	PG&E has worked with CSD to provide weatherization training for CSD's low-income weatherization program since the inception of the Energy Training Center in Stockton in 1978.	PG&E	Developed
California Workforce Investment Boards (WIBs)	Southern California Gas has recently started to offer training for people served by their local WIBs.	SCG	In Development
Los Angeles Steam Operators Certification	SCG offers steam operators in the Los Angeles area this training.	SCG	Developed
Union			
Apprenticeship Programs	PG&E instructors have trained JAC members in the Bay Area regarding duct sealing and PG&E lends tools such as duct blasters to Bay Area JACs.	PG&E	Limited
Other			
California Advanced Lighting Controls Training Program (CALCTP)	Utilities will offer training aimed at supporting the CALCTP initiative. The CALCTP aims to expand the use of lighting controls in commercial/industrial facilities.	All	In Development (roll out spring 2011)

* Utility Training Center staff identified these collaborations in our interviews.

focus on quality and are linked to jobs with living wages, health benefits, substantial training investment and long-term career ladders. (See Chapter 1 for additional discussion of the high-road approach.)

Our analysis of workforce education and training programs in the construction industry shows that the main broad occupational training programs for tradespeople are the state-certified apprenticeship programs. Yet the utilities' collaborations with apprenticeship programs are minimal, despite the reported need for construction trades workers, not just professionals or business owners, to be more aware of efficiency and renewable energy technologies, measures, and systems.[6] Only one utility reported any collaboration with union programs and that relationship was described as "limited."

Deepening and broadening relationships with union apprenticeship programs and unionized contractor associations presents a critical opportunity for the state of California to promote a professionalized workforce that is able to incorporate best practices related to energy efficiency. As we have shown elsewhere, the advantage of working with unionized building and construction trades contractors is that these are the businesses that have developed a high-road business model based on an ongoing commitment to training a professionalized workforce. Since they pay higher wages and contribute to a training trust for each hour their employees work, they are very conscious of the investment they are making in their professional work force. Thus public or ratepayer funding would be matched by significant private funding. This high-road investment would reduce the turnover rates that appear to diminish the value of other public and ratepayer investments in training in low-wage and limited opportunity segments of the industry.

Recent experience shows the high potential of building relationships with the union programs. One of the most highly acclaimed examples of utility workforce training initiatives is the California Advanced Lighting Controls Training Program (CALCTP), described in more detail in Chapter 4, and in the next section. This type of collaboration should be fostered with all the union apprenticeship programs that work in trades that can impact energy efficiency. The utilities have reached out to the Sheet Metal Workers International Association (SMWIA), for example, PG&E sent an instructor to train apprenticeship instructors in the sheet metal apprenticeship programs in the Bay Area on advanced duct testing and sealing protocols and appropriate equipment use. However, thus far, this collaboration has not developed to the same degree as that with the International Brotherhood of Electrical Workers and National Electrical Contractors Association (IBEW–NECA). Currently, PG&E and SMWIA are working together to create a new certification for retro-commissioning. This is an important opportunity for advancing retro-commissioning in small to medium sized commercial buildings, and will hopefully follow the model of the CALCTP by creating a certification that can be used as a requirement for utility incentives in this area. Southern California Edison has also reached out to SMWIA as part of the HVAC WE&T activities, although the collaboration has not yet been fully developed.

As with any new institutional relationship, there is a learning process on both sides. The utilities need to be careful to reach out to multiple components of the unionized construction world, including both the signatory contractors associations, and the apprenticeship programs in order to reach both the contractors who may not be aware of new markets and utility incentive programs, as well as the actual training program directors. This is an opportune time to build the relationships because the down economy is forcing the unionized sectors to consider smaller markets than during the construction boom.

12.3.2 SECTOR STRATEGIES—THE CALCTP MODEL

Although not initially under the rubric of the *Centergies* programs, the ETCs are now one of the CALCTP partners. The CALCTP program is designed to overcome the poor installation of advanced lighting systems, which caused users to override them and undermined the widespread adoption of this significant energy saving technology. Collaboration between the utilities, the UC Davis Lighting Center, and the Labor–Management Cooperation Committee (LMCC) of IBEW–NECA produced a journey level upgrade training that can be taken by licensed electricians. This upgrade certification is now being integrated into the utility incentive programs that are being rolled out to encourage adoption of advanced lighting controls.

[6] Goldman, C., J. Peters, N. Albers, E. Stuart, M. Fuller (2010, March). Energy Efficiency Services Sector: Workforce Education and Training Needs. Retrieved from: http://eetd.lbl.gov/ea/ems/reports/lbnl-3163e.pdf.

The CALCTP project is, in the nomenclature of the workforce development world, a sector strategy. As we have described in Chapter 5, sector strategies have been shown to be the most successful approach to workforce development in middle skill jobs. Sector strategies are based on bringing together multiple employers, labor, potential educational partners and workforce funders to develop a strategy to address workforce issues within a particular sector. Business has to be at the table to identify specific skill and training needs, and to commit to training their incumbent workers or new hires, or to consider training graduates as job openings occur. Sector strategies usually require an intermediary or task force of partners to coordinate the planning and implementation of the projects, develop agreements on skill standards and appropriate certifications, contract with training providers (such as community colleges, apprenticeship programs or others), develop or update curricula, and write and carry out other implementation tasks. The intermediary also generally helps negotiate the exact nature of the commitments by the partners, particularly around sharing the costs of training, wage ladders or promotion opportunities for workers with upgraded skills, and other key mechanisms to assure sustainability and benefits for both employers and workers. A critical function of sector intermediaries is developing funding proposals for public training funds, so that WIA and other state and federal resources for workforce development can be brought into play. In the case of the CALCTP, IBEW–NECA carried out many of the tasks of an intermediary, with very deep involvement and some funding by Southern California Edison.

12.3.3 ENTRY LEVEL TRAINING AND INCLUSION OF LOW-INCOME AND DISADVANTAGED WORKERS

In the past, there has been very little emphasis on helping unskilled or entry-level participants gain career skills at the Energy Training Centers. Utility staff members estimate that about 15 to 20 percent of all classes are entry level courses that serve as introductions to subject matter and are meant to expose both customers and prospective workers to energy efficiency and related fields. These kinds of classes should not be confused with training for entry level employment or with programs that successfully include low-income and disadvantaged workers. Recently, the Energy Training Centers have been encouraged to expand the number of classes offered at off-site locations in an effort to improve access of minority, low-income and disadvantaged communities to these classes. However, the only metrics developed so far focus on the number and location of the classes and not on the characteristics of the participants.

The PG&E Stockton Energy Training Center new-hire training for Low Income Energy Efficiency program (LIEE) contractor employees and the California Weatherization Assistance Program (WAP) contractor employees is the only program that was identified that provides training for entry-level workers. This training, which is required for new employees after they have been hired, is designed to ensure that employees can meet the quality assurance standards for LIEE and WAP programs. The program is not structured to provide the support, components and structured scope and sequencing necessary for successful career development programs.[7] Since the 1980s, these trainings have been conducted for workers after they have been hired by participating contractors.

In the 2006–2008 funding cycle, the CPUC issued an RFP with the express purpose of creating a stronger pipeline into LIEE jobs from underserved and disadvantaged populations. This resulted in two pilot projects: one fielded between PG&E and CityBuild (a joint collaboration of San Francisco Office of Economic and Workforce Development and City College of San Francisco), and the other between Southern California Gas and Los Angeles Trade–Technical College (LATTC). Both pilot projects include collaboration with LIEE contractors in the

[7] See the residential retrofit case study for a more complete discussion of LIEE training programs and new efforts to include greater supports for low-income trainees.

respective local areas. This RFP represents an important change in direction and its lessons are critical for designing future programs.

According to the RFP, this program was initiated in order to make sure that there were enough training opportunities for LIEE workers to meet the increased low-income retrofit goals called for in the latest utility program cycle. At the same time, the RFP explicitly referenced the goal of including workers from low-income, minority, and disadvantaged communities. LATTC and the San Francisco Office of Economic and Workforce Development applied for and were chosen to create the pilots. The amount of funding for LATTC's program was ($175,000) and 90 percent of it was directed at wage subsidies for trainees for the first month of employment. In San Francisco, CityBuild received $100,000 and has integrated more than half of this funding into upgrading their existing construction curriculum to establish a CCSF-designed new Residential Energy Efficiency Measure module for its students. The pilots are still in process, and evaluation reports will be written at the conclusion of each project, providing guidelines for successful LIEE training partnerships and best practices.

The pilot programs' objectives are:

- → To develop a replicable model training program for low-income residents for training in weatherization, energy efficiency and LIEE program implementation;
- → To train over 100 low-income residents in weatherization, outreach, and LIEE Program implementation;
- → For 75 percent of students to complete the program and earn at least one of the listed certifications;
- → For 60 percent of students who complete the program and on the job/field training to be employed in the weatherization/energy efficiency or related fields within six months of program completion; and
- → For 40 percent of students who complete the program to enter a career ladder pathway and enroll in a related post-secondary training program.

To this end, LATTC and CityBuild have created weatherization training programs based on both the curriculum materials supplied by Richard Heath and Associates, Inc. (RHA), the contractor whose curriculum is used in the PG&E service area for LIEE new hire workers, and the colleges' own competency framework, which is used for all program development. Thus far, the two programs have trained over 300 students, far exceeding their initial goals. For LATTC, after a student has completed the course and been tested, the college gives a skill analysis of each graduate to the employer, who then conducts interviews, and chooses who to hire. The contractor receives a one month full wage subsidy for each trainee, after which the employer can choose whether or not to hire the graduate. Thus far, the contractor has offered ongoing employment to only a small percentage of trainees, perhaps as few as one in ten. The reason for this low permanent hire rate is still being explored and should be a subject of the evaluation.

Discussions with LATTC have surfaced important issues that should be explored further in the evaluation. Most importantly, developing compatibility between LATTC's mission of serving its low-income student base and the utilities' mission of expanding its LIEE workforce in a cost effective manner is challenging for a number of reasons:

First, LIEE contractors have traditionally been able to screen applicants, choosing those who already have the skills and experience necessary to do LIEE work, lacking only the very specific knowledge provided in the five- to eight-day RHA curriculum, a significant amount of which is very specific to the particular documentation needs of the utilities' programs, rather than more general weatherization skills. In contrast, LATTC and CityBuild's mission is to serve their respective communities, meaning that they seek to prepare a much broader group of students. Their use of a competency framework is meant to provide students with a solid, broad base of knowledge, skills and competencies that are needed to work in entry level jobs, but also provide a foundation for building skills to enter into one of a number of longer-term career pathways.[8] Because of this, LATTC and CityBuild also worked hard to

[8] See http://college.lattc.edu/wed/files/2010/05/LATTC_LIEE.pdf for a description of LATTC's competency framework.

integrate this training into the regular course work of the college, and all courses are taught by regular faculty. This provides a framework for sustainability, in contrast to the contract education model where all costs are paid by the employer or grants, and training is customized solely to the needs of employers. However, this approach also makes the training take longer, as it is less focused on the narrow needs of a specific employer and aims to prepare a wider variety of students. As the LATTC Dean articulated, the CPUC and utilities "need to talk a different language if they want to engage disadvantaged populations, because it's not just about building a workforce for a specific IOU. We are not going to cream. We have to serve the population that comes through our doors." As a result of this need to serve their student base, LATTC developed a four-week program, over twice the length of the PG&E new hire program.

Second, while some may argue that any employment is a chance to escape poverty, there is considerable evidence in the workforce literature that true pathways out of poverty require the existence of attainable opportunities for advancement, meaning a clear career path, with skills development linked to increasing wages. The career path model and its importance is presented in more detail in Chapters 13 and 16 of this report.[9] The lack of clear career ladders leading up from the entry level weatherization installer job is problematic for training providers that aim to provide pathways out of poverty for their students.[10] Within the industry there are few crew chief job openings, and these max out at $14 to $16 dollars an hour. Los Angeles Trade–Technical College is seeking ways to build a career training pathway into auditing and HVAC occupations, but they have not yet found a way to do so within the LIEE program parameters. Though the utilities have experience creating internal career ladders in their own businesses through their apprenticeship programs, they have not worked with their contractors on this issue. As argued elsewhere in this report, creating career ladders that are meaningful pathways out of poverty requires seeking real job rungs in the labor market, and if they are not there, working at the policy level or with employers to create them. Training and education institutions and funders dedicated to providing their students with better opportunities upon completion of training programs will not sustain collaborations with the utilities unless these issues are addressed.

Given that this is the first time that the CPUC has funded a program with an explicit focus on inclusion of low-income, minority and disadvantaged workers in their WE&T activities, this pilot is very important and should be watched closely; an evaluation is now being conducted. It is important to underscore that, to date, inclusion of disadvantaged, minority and low-income workers for the purposes of career development has not been an explicit goal for the utility WE&T funding. If it should become a goal, it would require substantial reorientation of funding and program design.

This project has some of the elements of a sector strategy, with LATTC and CityBuild playing the role of sector intermediary by convening employers, developing curricula, etc. LATTC has also been specifically designated by the City of Los Angeles and the Los Angeles WIB as the workforce intermediary for the energy and utility sector, and has substantial experience that could be harnessed in a broader sector strategy framework. However, the limitations of the funding, the constraints of the contract with the CPUC, and the market conditions that have limited demand for new weatherization workers have discouraged a more robust sector strategy that could convene more employers and funders. Moreover, the projects have not taken full advantage of the convening power and relationships that the utilities have with LIEE contractors.

12.3.4 HVAC

[9] See also Fitzgerald, J. (2006). *Moving up in the New Economy: Career Ladders for U.S. Workers*. Ithaca, NY: Cornell University Press.

[10] Installation work pays about $13.00 per hour for the employers that LA Trade Tech is working with; we have no wage information for employers connected to the City Build work.

Building off the call in the EE Strategic Plan for a restructuring of the HVAC industry, the CPUC approved approximately 10 million dollars for HVAC WE&T activities in the 2010–2012 cycle. This is a subprogram that includes conducting a comprehensive training needs assessment and delivering a dedicated, industry-specific effort to offer education and training opportunities targeted at all levels of the HVAC value chain.[11] This effort is to be coordinated with the utilities WE&T activities, but is under the management of the HVAC programs at each utility. As part of the Residential and Commercial HVAC program, utilities in California have plans to spend approximately $700,000 per year providing training targeted across the HVAC industry for the 2010–2012 program cycle. Part of this funding is expected to be used to provide a training needs assessment to identify skill gaps in the HVAC industry as well as implement trainings to close those gaps. The goal of this program is to help contractors, installers, and technicians deliver high quality efficient HVAC service to all their customers all the time.

The linking of the WE&T activities to the overall strategy to upgrade HVAC work, build the high road, and close off the low road is an extremely positive development for achieving the state's energy and workforce goals. As noted in our analysis of the HVAC sector, training alone cannot solve the problem of endemic poor quality installation and maintenance in this sector.

The HVAC WE&T program is still in development. In addition to the needs assessment that has not yet been completed, the program is targeting training for contractors, technicians, apprentices, salespeople (who are critical because they need to properly size systems), building officials (who are critical because they inspect work to see if it meets codes) and students. The program also appears to endorse a contractor accreditation program that would promote quality contractors (for example "Gold Star Contractors" who maintain a minimum percentage of NATE-certified technicians and other quality indicators. This broad view of who should be trained (not just contractors, as most of the residential programs emphasize, but also workers) as well as the clear distinction regarding what are considered minimum quality standards for contractor participation in utility training programs is critical to transforming the industry, and fits in to our recommendations about how the utilities can help promote the high road.

The implementation process for investing in training for multiple categories of workers will be critical to the success of such an initiative. As the utilities invest in collaborations with industry groups and schools that are currently training for various HVAC job categories, they should gather information about the specific outcomes of the training programs in order to ensure wise investment of funds. For incumbent worker training programs, information about employers and their labor practices (such as wages, worker retention and turnover, and other indicators of high- or low-road competitive strategies) should be gathered so that investments are not made in training for workers who leave the industry at high rates. For pre-employment training programs, information about the placement rates and type of jobs that graduates obtain should be gathered and analyzed. To support the holistic set of policies to build the high road and close off the low road in HVAC, a quality lens needs to be used, even for WE&T investments. Though it makes sense at first analysis to invest in any and all training institutions in the market place, it is critical to avoid using public resources to support training in the low-road segments of the industry, in the vain hope that they will become high-road. The emphasis on working with union apprenticeship programs in the Southern California Edison plan is an important step forward because of their documented ongoing commitment to training among unionized HVAC contractors.

The investment in HVAC training also has some of the elements of a sector strategy but these are not yet well developed. However, it is missing a critical piece: the convening of a multi-employer consortium and, specifically, the commitment of these employers to train incumbent or new hire workers, or to consider a pool of applicants who have undergone pre-employment training. This commitment, and issues of scale, cost-sharing, rewards for

[11] CPUC D.09-09-047; Southern California Education 2009-2011 Energy efficiency plans March 2, 2009, p. 643.

trained workers and other implementation issues must be negotiated, but there is significant expertise and technical assistance available in California that could be brought to bear on this issue.[12] Funding training without employer commitment to use trained workers is likely not to produce intended results.

12.4 CONNECTIONS (ENERGY EFFICIENCY EDUCATIONAL PROGRAMS)

The second component of the IOU WE&T programs are the *Connections* initiatives. The *Connections* initiatives include five programs targeting K-12, college, and university student populations. These educational programs were funded at approximately $7 million dollars in 2010 and the utilities chose in which of the five programs they want to participate (Table 12.5).

Table 12.5 *Connections* Programs by Participating Utility and Budget*

Utility	2010-2012 Program Budget	Green Campus	Living Wise	PEAK	Green Schools	Energenius Program
SCE	$9,003,792 * *	X	X	X	X	X
SCG	$1,281,871 * *		X	X		
PG&E	$4,110,424 * *	X		X		X
SDG&E	$1,620,652 * *	X		X		
Total	$16,016,739					

* Programs previously included in EARTH.

* * CPUC Energy Efficiency Groupware Application, 2010-12 Program Cycle (2010). 2010-2012 Monthly Energy Efficiency Program Report, December 2010. SCE.MN.201011.1.xls. Retrieved from: http://eega.cpuc.ca.gov/.

Unlike the *Centergies* programs that train construction and buildings professionals, *Connections* programs encourage conservation and energy efficiency among end users, primarily students (K-12, community college, and four-year colleges), yet also among students' schools, families, and communities. *Connections* initiatives aim to foster collaborations between utilities and educational institutions with the objectives of:

- → Promoting "green" careers to K-12, community college, and university students through energy-related curricula, internships, and tie-in to relevant degrees (e.g., engineering);
- → Encouraging energy efficiency and conservation behavior among students with the intention of influencing their (and their families') daily energy-related decisions; and
- → Educating school, school district, college, and university staff about the benefits of adopting energy efficiency measures and policies.

The specific programs that comprise the *Connections* initiative for the 2010–2012 program cycle are summarized in Table 14.1 in Chapter 14, where K-12 programs are described in more detail. These programs relate directly to two of the state's main workforce education institutions, the community colleges and high schools.

[12] See for example the California Edge Campaign at www.californiaedgecampaign.org, the Bay Area Workforce Funding Collaborative at http://www.sff.org/programs/community-development/bawfc, and the National Network of Sector Partners at http://www.insightcced.org/communities/nnsp.html.

Of the five current *Connections* programs, only Green Campus has a career development focus in which the dollars in the program directly support interns interested in energy efficiency and/or renewable energy careers. The Green Campus program's goals are fourfold:

- → Build pathways to green careers for students by offering training, mentoring, and hands-on experience doing energy efficiency work;
- → Realize measureable energy savings on campuses by helping campus faculty, staff, and students identify technologies or practices that can result in savings;
- → Infuse energy efficiency concepts in current curricula; and
- → Educate the campus community about energy efficiency and conservation through advertising, social media, and other venues.

Green Campus interns express an interest in energy topics and receive training and financial support to conduct efficiency projects on their campus. Examples of intern projects include:

- → Coordinating dorm energy saving competitions;
- → Encouraging campus staff to install efficient lighting by demonstrating savings; and
- → Organizing and teaching energy efficiency classes and workshops (usually non-credit).

The remaining *Connections* programs have a broader focus of educating students and their families about conservation and energy efficiency. Living Wise, PEAK, Energenius, and Green Schools all help students learn about conservation, energy, and energy efficiency with the intention of increasing awareness of these topics and changing behaviors at home. The programs also seek to tap into and increases students' interest in the energy efficiency and the environment. According to utility staff, career exploration modules have recently been added to the PEAK program, but the effectiveness and usefulness of these modules have yet to be evaluated.

12.4.1 PILOT PROGRAMS

In addition to the current *Connections* programs, there were two pilots underway in 2010; The Green Pathways program in PG&E service territory and the Green Training Collaborative in SCG territory. Both of these programs focus on career development.

12.4.1.1 GREEN PATHWAYS

This program was piloted in the PG&E service area in 2009/2010 with full implementation scheduled statewide for 2012. This is a career development program for high school students throughout California with the objective of cultivating the next generation of "green" professional and vocational careers. Under the pilot, students will work with teachers and career counselors to identify steps they need to take to attain a green career. Teachers will receive curricular and electronic resources designed to help them guide students that express an interest in a green career. Furthermore, through web-based dialogues and other network-based communications students and teachers will be able to connect with practicing and retired professionals in business and industry, professors and researchers in higher education, and local and state government. Green Pathways incorporates the fundamentals of career development planning and strategy in the context of energy and environmental education.

This program is integrated with the California Department of Education's Partnership Academies, which are three-year programs for students in grades 10 through12 that creates a school within a school and focuses on a career theme. The goal of the New Energy Academy is to take this school-within-a-school approach and provide participating students with an integrated academic and technical STEM-based education[13] focused on energy and environment. Each school will receive cash grants, customized professional development workshops and webcasts, and access to education, industry and government experts. Teachers participating in the curriculum development phase will also create a plan to integrate the new curriculum into academic and career technical education courses.

The pilot schools in PG&E's territory are:

- Berkeley High School (Berkeley)—Berkeley Unified School District
- Foothill High School (Sacramento)—Twin Rivers School District
- Edison High School (Fresno)—Fresno Unified School District
- Independence High School (Bakersfield)—Kern County School District
- Venture Academy (Stockton)—San Joaquin County Office of Education; GreenIT

12.4.1.2 GREEN TRAINING COLLABORATIVE

This is a pilot program designed to involve local community education institutions and training programs in energy related career development strategy sessions. SCG will coordinate with regional implementers of such career programs to discuss projects that allow students and other potential green workforce candidates to explore energy efficiency, integrated demand-side management technologies and resource management techniques.

12.5 OTHER PROGRAMS

Other education and training programs, besides the WE&T *Centergies* and *Connections* programs that were the focus of this study, include programs designed for utility staff and training associated with specific programs.

12.5.2 POWER PATHWAYS

Power Pathways is a PG&E program that focuses on training for current utility employees and others interested in utility careers, which initially focused on pre-apprenticeship training for power line workers. Power Pathways seeks to increase the pool of workers with the engineering and craft skills needed to provide power to utility customers. PG&E does this by partnering with educational institutions, industry associations, and labor groups.

Some recent examples of Power Pathways programs are PG&E's work with California State University, East Bay to design a Power Engineering Certificate and an Integrated Energy Solutions Certificate. These stackable certificates provide skill upgrade training for electrical engineers, electrical design drafters, or other technical design workers that would like to become design engineers or work in integrated demand-side management. The certificates require completion of four courses and take about a year to complete. As this is training for incumbent workers, students often receive tuition reimbursement from an employer.

The relationships built through the Power Pathways are being used to initiate new collaborations in the energy efficiency arena as well, where the employer is not PG&E but rather contractors who may participate in PG&E utility programs.

[13] STEM is the acronym for science, technology, engineering and mathematics.

12.6 ANALYSIS OF UTILITY WE&T PROGRAMS

The *Centergies* and *Connections* programs serve many purposes, not all of which are relevant to this analysis. Our task was to assess their role in the wider energy-efficiency related workforce development infrastructure, identify core competencies and resources, and make recommendations on how best to leverage these programs. The IOUs provide substantial, dedicated resources for workforce education and training in energy efficiency, distributed generation, and demand-side management. These resources are, in fact, the only dedicated public resources for these sectors. The majority of WE&T funding and programming consists of short-term classes for incumbent workers, mostly professional workers and business owners or managers in the Energy Training Centers. These classes are designed to provide technical knowledge that can (1) change practices for market actors doing work that impacts energy efficiency and (2) encourage the end users to make more informed decisions about investments in energy efficiency. These two goals are consistent with the objectives of the EE Strategic Plan and have been the de facto mission of the Energy Training Centers.

For the first time, the CPUC has developed specific program performance metrics that attempt to capture outcomes, rather than quantities of classes, by which to measure the effectiveness of utility WE&T programs. Below, we list the performance metrics of the 2010–2012 cycle,[14] and review them (in italics) in light of the results of this needs assessment.

- Change in the percentage of *Centergy* program participants stating an interest in pursuing green careers as a result of program participation, relative to baseline.

Since our needs assessment shows a limited number of new jobs and a very large queue of unemployed experienced workers in the occupations most prominent in the energy efficiency sectors, this may not be an appropriate goal.

- Change in the percentage of *Centergy* program participants reporting utilization of knowledge and skills received from the program, relative to baseline.

This is a valuable metric to address the critical need of skills upgrading for workers already in the industries and occupations related to energy efficiency.

- Percentage of past *Centergy* participants that attribute the program as a significant reason they are currently working in a clean energy job (identify figures for low-income participants).

This has the same weakness as the first metric.

- Percentage of prior program cycle participating schools that have continued the WET *Connection* training activities without program support.

Sustainability is an important measure, but is not a measure of the success of the programs. Desired outcomes need to be clearly stated, whether they are change in behavior, career preparation, or other outcomes, and performance metrics developed to measure achievement of these outcomes.

- Percentage of California HVAC-training institutions offering courses using Quality Installation and Quality Maintenance standards.

[14] Provided by CPUC staff on 10/24/2010.

As per our discussion of the HVAC training subprograms, we suggest that a more targeted metric that measures success in collaborating with training organizations, like apprenticeship programs, that have been targeted due to their position as training institutions for the high road segments of the HVAC industry.

The evidence from the Opinion Dynamics evaluation shows that the WE&T programs offered by the ETCs result in significant energy savings, comparable to many incentive programs that directly fund energy efficiency work.[15] For end users who take classes, Opinion Dynamics was able to trace behavior change and extrapolate energy savings. The study found that there was significant energy savings attributable to the classes, with almost 99 percent of it due to changes made by commercial end users, and less than 1 percent from residential end users.[16] For market actors, the Opinion Dynamics study was not able to quantify overall savings due to constraints on the evaluation, but given their impact on multiple buildings, it is likely to be large as well.

Until very recently, the utilities have not been explicitly directed to support career development goals for Californians interested in or involved in green careers, or to focus the resources of the ETCs on ensuring full participation of low-income, minority, and disadvantaged communities. This change in direction requires rethinking of goals, strategies and programs. Metrics of success for workforce and career development generally focus on positive outcomes for students and workers, in terms of skill acquisition leading to job placement, movement along a career path, and wage progression as skills and experience increase. The *Centergies* program is not structured to address these goals and would have to be changed significantly to do so.

The *Connections* program is developing initiatives that may better meet workforce development goals. These new programs are linked to vocational/technical training in high school and community colleges which are key components of California's workforce training and education infrastructure. This is an expansion of—and a shift in direction from—earlier programs that centered on pre-career education for students not yet in high school and was more oriented towards consumer, as opposed to career, education. If the *Connections* program is selected as the vehicle for addressing an explicit goal of improving workforce outcomes in the energy efficiency sectors for disadvantaged workers, deepening and broadening its collaboration with the career academy partnerships is the most obvious opportunity.

Until recently, CPUC performance metrics for the WE&T programs have been based on quantitative measures, such as the number of classes held and the number of attendees. In this cycle, new performance metrics have been developed that begin to address ways to capture the impact on behavior change leading to energy savings and workforce development outcomes. In addition, evaluations will take place in the 2010–2012 program cycle that seek to quantify potential energy savings as a result of both *Centergies* and *Connections* investments.

12.7 RECOMMENDATIONS

The WE&T programs are a very valuable state asset with a proven track record for contributing to energy savings. Our recommendations are meant to acknowledge and build upon those contributions. We recommend that specific objectives and metrics of success be developed for both energy savings and workforce development, building on the particular strengths and resources that the WE&T initiatives can provide. The CPUC needs to assess the competing priorities of these policy goals and be explicit about the relative weight each should have. We divide our recommendations into those that can impact energy savings and those that can contribute to the state's workforce development goals, including goals of inclusion of low-income workers. We believe these overlap

[15] Opinion Dynamics, 2010, p. 96.

[16] Opinion Dynamics, 2010, p. 90.

significantly, and the best workforce development meets both goals, but it is important to analytically distinguish the two policy goals in order to clarify the metrics that could measure success.

12.7.1 ENERGY CENTER RECOMMENDATIONS

Achieving energy efficiency goals is the main mission of the WE&T programs and there is widespread agreement, as well as evidence from the 2006–08 evaluation, that the Energy Training Centers are achieving these goals. Our recommendations include:

- EXPAND CONTRACTOR AND CONTRACTOR ASSOCIATION COLLABORATIONS to building and construction trades associations that have demonstrated a commitment to investments in ongoing workforce training, such as contributions to apprenticeship programs.

One of the functions of the Energy Training Centers is to expose market actors to new business opportunities in energy efficiency markets and to inform them of the resources available through utility incentive programs. As stated earlier, the majority of collaborations with contractor associations have thus far been with those who are focused on and already see the value of energy efficiency and integrated demand-side management. This strategy made sense when energy efficiency concerns were limited to pioneers and first adopters. However, as these issues become more mainstream, collaborations with traditional building and construction trades associations present an opportunity to integrate new practices more broadly. New criteria for selecting contractor collaborations should emphasize employer commitment to investing in a stable and trained workforce, so that the Energy Training Centers are supporting the higher quality contractors within a subsector, and ratepayer training investments are not lost due to high turnover.

- MODIFY COURSE OFFERINGS to expand targeted cohort-based series of classes that are longer in length, focus on a specific occupation, have a workplace-based hands-on component, clear learning objectives, and lead towards a certification.

The Building Operators Certification program, funded by the IOUs, follows this model and had higher impact on energy savings according to the 2006–08 evaluation. In addition, the Energy Training Centers' programs should continue to make sure that their classes "count" for continuing education credits or renewal of certifications for all relevant disciplines, so that the classes produce value for participants within their professions. Open enrollment should not be required for all programs because this requirement limits the ability to target course offerings.

- ACTIVELY PARTICIPATE in supporting curriculum review and updating, instructor professional development, and continuing education requirements associated with license renewal for the main "home institutions" that train building and construction professionals and tradespeople, including four-year colleges and graduate programs, apprenticeships and community colleges.

Many professionals, business owners, and building and construction trades workers who are in a position to promote energy efficiency through their work have established educational and training "home" institutions that provide the fundamental training for these workers. To ensure that these training programs provide accurate and up-to-date information, by utilizing the Energy Training Centers, the IOUs should continue to seek opportunities to contribute to curriculum development and update instructor professional development within these "home" institutions. As the utility WE&T training efforts move beyond one-off short workshops for early-adopter professionals to providing expert knowledge that can be integrated into longer-term career technical training programs, the utilities should select partner organizations that are sustainable, of sufficient depth and breadth, and are part of the higher road segments of their industry. The most important opportunities for expanding this work are with the community colleges, four-year engineering programs and the state-certified apprenticeship programs. In these institutions, the programs have their own instructors and ways of incorporating curricula. The utilities need to work on developing relationships to ascertain if and how IOU expertise could contribute.

Rather than teaching technical skills to those already sold on the importance of saving energy, this new approach requires expanding outreach and education to leadership in the main home institutions who may be less interested or converted. Though this process undoubtedly would differ by specific field or trade, it requires finding arenas in which to present information both about the state's mandates to save energy and the resources available to help do so. This entails developing ways to help these organizations see their own self-interest in changing and updating curricula to integrate the most advanced skills and knowledge about energy savings.

- STRENGTHENING TRACKING OF PARTICIPANTS AND OUTCOMES: The Opinion Dynamics evaluation makes a number of suggestions for tracking participants in the Energy Centers programs. We endorse these and add the following:
  - → The current job held by participant, including occupation and industry (based on SOC and NAICS), as well as sector (residential, commercial, etc.)
  - → Demographic data of participants including gender, age, race/ethnicity, educational attainment, household income. This is important for several reasons, including, to assess to what degree the programs serve disadvantaged, low-income and minority communities, to better grasp what jobs these skill upgrades can influence, and what role the programs play in the career development of participants.

12.7.2 CONNECTIONS PROGRAM RECOMMENDATIONS

- STRENGTHEN AND EXPAND COLLABORATIONS with career Academies, Regional Occupational Programs (ROPs) and community colleges.

Career development is a very new area for WE&T programming, and efforts both to set goals and develop strategies are only now emerging. The Energy Training Centers are not set up for this purpose, though some individual participants cobble together many classes for their career development. The *Connections* programs thus far have been more oriented towards collaborations with educational institutions on consumer awareness and institutional energy savings. Since they have a set of relationships with educational institutions, these may be leveraged to focus on partnerships with career technical programs at high school and community colleges. The key assets the IOUs bring are deep knowledge of new technologies (and associated skills needs) that are likely to be deployed in the market place, and financial resources. Focusing on high school and community college career technical education, apprenticeships, and four-year colleges has the benefit of leading to more targeted career development results.

- Continue to SUPPORT AND EXPAND CAREER AWARENESS AND EXPLORATION in K-12 programs.

As indicated in our K-12 key findings report, the IOUs have recently added career awareness and career exploration modules to the K-8 programs: Living Wise, PEAK, Green Schools, and Energenius. In this way, the K-8 programs, which, until recently, have mostly focused on how students and their families can save energy, will also contribute to the career development policy goal. These career development modules should be evaluated using appropriate performance metrics.

12.7.3 GENERAL RECOMMENDATIONS FOR WE&T PROGRAMS

- SUPPORT SECTOR STRATEGIES

Using the CALCTP as a model, utilities should initiate, help fund, or partner with other organizations to develop robust sector strategies in key sectors such as HVAC, building operators, , and other emerging sectors such as new energy storage, integrated demand-side management and commercial building benchmarking (as well as LIEE, described in the next bullet). Sector strategies based on industry partnerships are a more effective way of making sure skills upgrading is actually used in the marketplace, compared to training that are not tied directly to employers. Sector strategies also allow the utilities to bring their greatest asset—the role as hubs of best practices and emerging technologies and their associated skill standards—to support larger partnerships with the major training and education institutions in the state. Finally, they allow co-funding arrangements so that the sector strategies can tap into public training dollars through the WIA system, the California Employment Training Panel, and other private and public sources.

- SERVE LOW-INCOME COMMUNITIES through a Sector Strategy Approach to LIEE Programs

The IOUs have the opportunity to reshape the LIEE training and investment programs to contribute to career development for members of low-income communities who can be hired by LIEE contractors. Such an effort should align training requirements with the DOE weatherization skills standards that are being developed (see residential case study in Chapter 4) and build on the lessons being learned from the current pilots between LATTC and Southern California Gas LIEE contractors and CityBuild and PG&E contactors. Given the lack of information about job quality in LIEE employment and anecdotal evidence about low wages and lack of career ladders, we caution that revisions to the LIEE program, not just the training activities, are probably also necessary to achieve positive outcomes for LIEE contractor employees. Unless LIEE jobs have a decent starting wage and a career ladder, investments in training will be insufficient to create pathways out of poverty for members of disadvantaged communities. Careful consideration must be taken to balance policy goals in these programs. Changing the direction of LIEE programs to focus on serving the needs of low income communities through workforce development, as well as home energy savings, may require a shift in budget priorities.

However, improving job quality can also result in a more stable work force with the skills needed to move from a widget based approach to a whole house approach that can deepen energy savings. Given that current practices of subcontracting in some of the IOU LIEE programs do not seem to result in optimal energy savings, it may be possible to better meet both energy savings and workforce goals. At the very least, information should be collected on wages, turnover, and workforce characteristics to determine relationships between workforce practices and energy savings. Pilots that test alternative program design elements regarding the workforce, including sector strategies that incorporate the new DOE skill certifications and programs that are built on high road agreements, should be funded (see Chapter 4).

CHAPTER THIRTEEN:

13. ANALYSIS OF WORKFORCE EDUCATION AND TRAINING SURVEY

This chapter synthesizes the information gathered about all the training and education programs described in depth in the preceding chapters, allowing us to better understand the component parts of California's workforce development infrastructure, their role in the workforce development system, and how they fit together. The purpose of this analysis is to identify strengths and weaknesses in this infrastructure, as well as opportunities for more effective leveraging of its component parts.

This analysis has revealed a robust and complex workforce training infrastructure that is delivering training at many levels, and in a variety of occupational specialties. In fact, our investigation identified over 1,500 distinct programs providing training relevant to energy efficiency, renewable energy and related occupations. Clearly there is no shortage of training opportunities available, but the value and effectiveness of this training, the coordination between training institutions, the credentials provided or trained for, and, ultimately, the outcomes for workers and for the achievement of California's energy policy goals vary widely.

Although we are unable to evaluate the effectiveness of individual training programs in preparing workers for energy efficiency related jobs, we use a variety of program characteristics that enable us to generalize based on institutional type. This helps create a picture of how different types of institutions prepare new and incumbent workers, and how they approach skill development for energy efficiency and related sectors.

Specifically, the chapter analyzes the following characteristics:

- → The relative length and depth of the training;
- → The main occupations and skills each institution trains for, including whether they focus on traditional occupations or specialized energy efficiency related training;
- → The kinds of certifications and credentials programs train for;
- → Training program completion data;
- → The role each program plays along the continuum of pre-employment to incumbent worker training, and the range of skills from basic, to skilled trades, to professional; and
- → The training pathways and articulation between institutions in key sectors.

In-depth occupational training leads to industry-recognized credentials, has effective mechanisms to connect workers with jobs, and is linked to an ongoing system of continuing education and skills upgrade training. The established workforce development literature, as well as our own analysis, makes it clear that this is the most effective way of ensuring that workers will be well prepared to do high quality, professional work, and will be linked in to a long-term career pathway that provides a level of compensation consistent with training investment. Of the institutions surveyed, four-year colleges and state-certified apprenticeship programs are the key institutions providing this type of training, and these institutions focus primarily on traditional occupational categories. Other institutions serve important functions, but these result in the best outcomes for workers when they are articulated with apprenticeship training or four-year college. There are also one to two-year certificate and degree programs in community colleges in specialty occupations, such as heating, ventilation, and air conditioning (HVAC) and building inspection, which prepare workers for entry-level technician jobs. However, it is not unusual for shorter and often narrower programs to be disconnected from more comprehensive training, which limits their capacity to help students, workers, and job seekers to obtain jobs with adequate wage floors and career paths.

The reader should be aware that the lack of data on job placements and job trajectories after graduation impedes rigorous analysis of training outcomes. We use a variety of indicators and information to infer the effectiveness of training institutions and programs.

13.1 OVERVIEW OF WORKFORCE TRAINING AND EDUCATION INSTITUTIONS

Table 13.1 provides a brief overview of the main characteristics of each institution.[1] These seven institutional types differ widely in their purpose, function, and organization, even when training in the same field. Some programs, including most community colleges, apprenticeships, and four-year universities, are standardized and regulated by the state, or are accredited by a recognized national organization. These institutions provide students with credentials and certifications that are widely recognized by employers. Others, particularly those run by community-based organizations (CBOs) and private training organizations, are more heterogeneous and do not necessarily conform to any specific standards.

As Table 13.1 illustrates, the length and depth of the training programs and scope of skills taught vary substantially between these institutions, ranging from a few hours to several years. Universities and apprenticeships offer the longest, most in-depth training programs, serving to bring workers from a novice level to competence and mastery of their field. Individuals who complete apprenticeship programs are also tied into a system of ongoing incumbent worker training, which is available throughout a tradesperson's career. Other training programs provide much shorter-term training for both entry-level workers and incumbent workers. Very short-term training, particularly that offered by the Energy Training Centers at the utilities, focuses on incumbent workers and is often one day or less.

13.2 OCCUPATIONAL PROFILE AND SCOPE OF TRAINING INSTITUTIONS

Each training program is designed to impart a set of skills to a worker or student that are useful for one or more occupations. Table 13.2 provides a summary of the occupational specialties of the programs identified in the Inventory (Appendix I). This shows the number of programs training for each major occupation, within each institutional type.

Identifying the primary occupation associated with a program is complex because of the variation in the breadth and depth of skills taught and the different ways training programs are organized. The intermediate- and long-term training institutions, such as apprenticeship or educational degree programs, use the federal government's standard occupational codes to categorize their programs, but in other training programs, this is not done.

[1] More detailed information on each type of institution is presented in Chapters 6-12. Appendix I is the complete inventory of California WE&T Programs in the energy efficiency sectors, and includes information from the survey as well as additional research. Chapter 5 presents a brief description of the data used in this analysis and Appendix G describes our inventory and survey methodology in greater detail.

Table 13.1 Institutional Overview

Institution	Description	Average Length of Training
Four-Year Colleges and Universities	• Training for qualified high school graduates and community-college transfer students • Long-term pre-employment education for professional or managerial jobs that are linked to professional licenses and continuing education	4 years
Apprenticeships	• Long-term training in the building and mechanical trades • Apprentices typically start with little or no experience, and learn to be experts in their trade while working full-time for an employer and receiving classroom instruction • Wages increase with skill level • Most joint apprenticeships offer skills upgrade training for journey workers to update or enhance their skills*	3 to 5 years
Community Colleges	• Post-secondary education that is open to those with limited resources and low basic skill levels • Students may obtain an associate's degree after two full-time years of study, and/or receive a vocational certificate in a shorter amount of time, usually one year • There are multiple pathways, including into apprenticeship, transfer to four-year, or stand-alone training for entry-level, semi-skilled jobs* * • Incumbent workers also access community college classes, primarily for re-skilling or skills upgrade training	6 months to 2 years (some custom programs as short as 4 weeks)
Community-Based Training Organizations (CBOs)	• Serve disadvantaged, minority, and low-income populations with limited occupational skills and work experience at the front end of the career pathway • Most provide work readiness and pre-employment skills training, and may offer pre-apprenticeship • Typically short-term	3 days to 3 months
Private Industry Training Organizations	• Can be private for-profit organizations, non-profits, or trade associations • Offer pre-employment or incumbent worker training in the energy efficiency, renewable energy, or the building trades • Training is typically very short-term with longer programs for some specialty trades • Programs are often costly compared to other institutions, but receive some public Workforce Investment Act (WIA) funds when trainees can use WIA individual training accounts to pay for training	1 day to 6 months
Regional Occupational Programs (ROPs)	• Offer career and technical education courses at high schools • Help provide students with the skills needed for entry-level positions within the career track of their choice, or for entry into additional vocational or post-secondary training	6 months to 2 years
IOU Energy Training Centers	• Energy Training Centers primarily provide short-term classes and seminars • Although open to anyone, many classes are targeted toward experienced incumbent contractors and professionals looking to acquire specific skills in energy efficiency and related topics • Main goal is to provide knowledge that will help save energy	1 to 5 days

* We did not capture complete information on journey upgrade courses in our inventory of training programs, although they are a critical part of continuing education for journeypersons which were mentioned in almost all apprenticeship interviews.

** We did not capture complete information on contract education in our analysis because we were focused on community college programs that lead to a certificate or a degree.

Table 13.2 Number of Program Tracks by Primary Occupation, 2010

Main Trade Or Skill Set	Four-Year and Graduate	Community College	Private	Appren-ticeship—Joint	Appren-ticeship—Unilateral	ROP	CBO	TOTAL
Professional / Managerial								
Architecture	24	70	1					95
Civil Engineering	45	5						50
Construction Management	11	31	17					59
Electrical Engineering								0
Engineering, General	54	123	3			26		206
Engineering and Architecture (Drafting / Design)		162				44		206
Law/Policy	2	1						3
Management	3							3
Mechanical Engineering	63							63
Total for Professional / Managerial	202	392	21	0	0	70	0	685
Traditional Trades								
Boilermaker				1				1
Bricklayer				3	1			4
Carpenter		13		20	5			38
Cement Mason				1	1			2
Construction Inspector		41	5					46
Electrician		24	4	42	13			83
Elevator Constructor				2	1			3
General Construction Worker		29				117	17	163
Glazier				3				3
Heat and Frost Insulator				2	1			3
HVAC/R Worker[1]	2	64	11	15	4			96
Laborer				10	3			13
Operating Engineer[2]				9	3			12
Plasterer				5				5
Plumber, Pipefitter, and Steamfitter		2		58	7			67
Roofer / Waterproofer				8	2			10
Sheet Metal Worker [1]		5		33	4			42
Sprinkler Fitter				5	3			8
Total for Traditional Trades	2	178	20	217	48	117	17	599
New and Emerging Trades								
Auditing and/or Inspection		11	107					118
Renewable Energy and Energy-Efficiency Specific[3]		25	56		2	24	22	129
Total for New and Emerging Trades	0	36	163	0	2	24	22	247
Total	204	606	204	217	50	211	39	1,531

Note: We did not include information for utility Energy Training Centers here because data by occupation is not collected according to primary occupation. See Chapter 12 for information on training areas.

Table 13.2 (continued) Number of Program Tracks by Primary Occupation, 2010

[1] Most HVAC/R training tracks for apprenticeship are incorporated in the committees for plumbers, pipefitters, and steamfitters. Others are refrigeration-specific committees. Sheet metal workers work with HVAC systems as well.

[2] Including stationary engineers as well.

[3] Many emerging occupational training programs teach a variety of skills for energy efficiency and renewable energy so we use a broad category here. Auditing and/or inspection refers to programs specializing only in audit and/or inspection. Some renewable energy and energy-specific programs may also teach some aspects of auditing or inspection in addition to other skills.

In Table 13.2, the department name for four-year and community colleges indicates the main occupation, while in apprenticeship occupation is indicated by the trade. Short-term, entry-level programs are classified within a broad category (e.g., "general construction"), because they train in very basic and general occupational skills. Short-term, advanced incumbent training programs are classified according to the category of the specialty skill (e.g., "architecture" for Leadership in Energy and Environmental Design courses), but the reader should note that the participants might be employed in a variety of occupations.[2]

As expected, four-year universities train almost exclusively for professional or managerial jobs, while apprenticeship training is entirely focused on the traditional construction trades. Relevant trades include both the basic crafts that mostly focus on building envelopes, and the electrical and mechanical crafts, that focus on building systems. Community colleges span both professional/managerial and trades occupations, as they offer transfer programs to four-year universities, as well as pre-apprenticeship and certificates in HVAC, construction inspection and some new specialized categories like renewable energy and energy efficiency. ROPs and CBOs focus on basic, introductory job skills for more general job categories, although there are a significant number of recently developed CBO programs that focus specifically on renewable energy and energy efficiency related occupations. Private industry programs provide some entry-level training and also specific technical upgrade skills for a variety of occupations. Utility programs offer the greatest number of short-term skills and knowledge upgrade courses, mostly geared towards contractors, distributors, engineers, and other professionals.

The greatest degree of occupational overlap is in the construction trades. For these occupations, different institutions offer training for the same occupations, but at different levels and with varying skill sets. Consider a carpenter—such a worker may have received any of the following levels of training:

- → Four to five years of an apprenticeship program, possibly with an additional pre-apprenticeship;
- → One or two years of instruction at a community college program in construction crafts;
- → Less than one year of entry-level training in general construction at a CBO, ROP, or private training organization; or
- → Only work experience, with no formal training.

Often, training programs are geared to either the residential or the commercial/public sector. For example, workers who have been through a certified apprenticeship program are more likely to work in the commercial sector, while those graduating from shorter training programs are more likely to work in the residential sector. However, in some cases workers with vastly different preparation compete directly for the same set of jobs. For example, some non-union construction firms in the commercial sector do not hire journey-level tradespeople. In

[2] The occupational variable shown in table 13.2 is an aggregation of the idiosyncratic classifications that are listed, along with each individual program, in the inventory. The inventory also includes the broader skills category (such as electrical systems or building envelope) for each program.

this case, if training for the non-union sector is publicly subsidized, but of less breadth and depth than apprenticeship training (which is paid for by employers and workers), public investment in training can actually exacerbate cost-oriented competition, devalue long-term training, and lead to lower skill standards and wages throughout the industry.

13.2.1 EMERGING VS. TRADITIONAL OCCUPATIONS

Many training programs teach skills that are applicable to several occupations, in addition to their primary focus. This is particularly true for the traditional trades that have incorporated (or upgraded) energy efficiency skills into their training. Our labor demand forecast in Chapter 3 suggests that these traditional jobs with expanded skill sets will be in much greater demand than emerging occupations that specialize in energy efficiency. Demand for the latter type could still grow, however; this will partly depend on policy decisions that encourage specific skill certifications and/or invest in either incorporating energy efficiency into existing traditional occupations or in narrower energy-efficiency skills training.

In an effort to capture the range of skills taught, we asked interviewees to identify additional skills and occupations that they include their training, and also to specifically describe how energy efficiency knowledge and skills have been included. We used this self-reported information to determine to what extent training programs for "traditional" occupations are incorporating new energy efficiency-specific skills and which skills are prioritized. For programs that have an energy efficiency or renewable energy focus, we were able to determine which specialties are included in the curriculum and what other skills they may teach.[3]

The incorporation of emerging skills into existing training programs has been intentional and widespread in some institutions or programs, but not in others. Apprenticeships and many community college programs report upgrading their curriculum regularly to keep pace with changes in building code related to energy efficiency (Title 24). Beginning in 2011, the Division of Apprenticeship Standards (DAS) requires all building trade apprenticeships to explicitly identify energy efficiency and green construction practices in their Minimum Industry Training Criteria.[4] Beyond code, apprenticeship programs that are linked to employers who are at the cutting edge of energy efficiency practices have an immediate mechanism to update curricula regularly, through the joint labor–management apprenticeship committees (JACs), though if the employers in the committee are not aware of best practices, updating curricula may not occur. In contrast, at other institutions like ROPs or four-year universities, the incorporation of enhanced energy efficiency skills training in traditional occupational training has not been coordinated or consistent. Some individual programs have made significant advances in this area, usually due to faculty interest, while others have made no changes at all.

Long-term intermediate and advanced training programs frequently teach energy efficiency, among other skills that could be taught as stand-alone training for less-skilled occupations, as components nested within broader traditional occupational training programs. For example, apprenticeship training for electricians also includes solar photovoltaic (PV) installation, but in other institutions, it is taught as a narrow skill set existing as stand-alone job training. Training for energy auditing also exists as both short-term courses at private organizations that prepare workers for employment as energy auditors, and as a unit within sheet metal apprenticeship and journey upgrade

[3] Appendix I shows the skills emphases that we were able to identify among training programs. We note traditional skills categories (i.e., engineering, building envelope, mechanical systems, etc.), as well as specialty energy efficiency skills.

[4] California Department of Industrial Relations, Division of Apprenticeship Standards (2011). Minimum Industry Training Criteria. Retrieved from: http://www.dir.ca.gov/das/mitc.htm.

courses, so that sheet metal journey-persons are prepared to do energy audits in addition to their traditional tasks.[5]

When it comes to training specifically for energy efficiency or renewable energy occupations, the majority of programs are offered by private organizations and the utilities. In many cases these are skills upgrade training courses that are undertaken by professional workers in more traditional occupational classifications who have already undergone long-term occupational training. Skills upgrade training offered by utility energy centers is generally focused on a particular end use and provides supplemental skill or knowledge for experienced professionals or contractors, who may be employed in a variety of related (but distinct) occupations.

There are also entry-level courses that prepare workers for a specific energy efficiency-related task, such as solar PV installation, without the broad occupational background of a traditional trade. Private organizations, CBOs, and community colleges have all developed new training programs specifically targeted at one skill (or set of skills) related to energy efficiency. While we did not specifically interview American Recovery and Reinvestment Act (ARRA)-funded training programs, short-term training in narrowly-focused, energy efficiency-specific occupations was the norm here as well.

Although some entry-level, energy efficiency-specific training programs may perceive themselves (or be perceived) as the only trainers responding to new market demand, in fact many of the skills for these "new" occupations already exist, or are being incorporated into comprehensive training in traditional trades and professions.[6] This is one reason for the low projected demand for energy efficiency-specific training in Chapter 3. One community college program in the area of energy efficiency and renewable energy expressed concern is that there is a lot of "hype" around renewable energy, and that they may be oversupplying the market with people who lack "solid training in the main field." For example, the program representative reported that "we don't see many solar hot water installer jobs out there, but there are jobs for electricians with solar systems knowledge." In response to these circumstances, they have downplayed the solar certificate in their program. The trainer indicated that there are other programs with stronger training in electrical work, and that these programs should be the ones integrating the solar certificates.

Job placement rates reported by CBOs also support the conclusion that employers prefer workers with broader skills training, as programs training for energy efficiency specific occupations have very low job placement rates compared with those training in more traditional skills. The programs we interviewed reported that approximately 74 percent of graduates from traditional construction programs are hired for a job or enter a paid apprenticeship each year, but only 19 percent of those from energy-efficiency oriented programs are. The lack of job placement data in other private, ROP, and community college programs training in these same skills means that comparisons are not possible.

Narrowly-focused training in energy efficiency skills plays an important role in skills upgrading for incumbent workers in the residential sector, where most workers learn on the job because there is very little long-term advanced skills training. Short-term, narrow training in energy efficiency skills for entry-level work is problematic, however, and policymakers should be wary of supporting or promoting this type of training in the cases where another option exists. Our research and interviews indicate strongly that the outcomes in terms of placement rates, quality of work, worker safety, compensation, and career advancement are better in the cases where energy efficiency skills are integrated into long-term, comprehensive training for a traditional occupation. Not only is the

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[5] Other examples of emerging occupations that we found included in the curriculum for one or more apprenticeable trades included solar installer, energy raters and inspectors, weatherization installers and technicians, and wind technicians.

[6] Dierdorff, E., J. Norton, D. Drewes, C. Kroustalis, D. Rivkin, P. Lewis (February 2009).
Greening the World of Work: Implications for O*NET-SOC and New and Emerging Occupations. North Carolina State University and the National Center for O*NET Development. Retrieved from: http://www.onetcenter.org/reports/Green.html

training linked to related skills, but the worker obtains more broadly applicable skills and is linked in to a more established career pathway. We project that these types of jobs will be in greater demand into the future as well, due to their more dynamic and comprehensive skill set.

13.3 SKILLS AND CREDENTIALS

Because of the great number of training programs in the state and the lack of clearly recognized skills standards in many sectors, this study is unable to make a thorough evaluation of the quality of skills training provided by any given training program or institution. However, one of the best available indicators for assessing training quality is the list of certifications and credentials that a program offers or trains for.

As described in Chapter 5, industry-recognized worker credentials are a critical tool for ensuring both work quality and job quality by verifying that a worker's skills meet a particular standard. In some industries and occupations, such as engineering, training standards and credentialing requirements are clear. However, in general, training programs for traditional and emerging energy efficiency related occupations offer a bewildering array of credentials. In sectors such as residential construction, there is a great deal of confusion about what the basic standard for training should be and which credentials workers should be aiming for in order to improve their standing in the job market. A number of instructors in community colleges and CBOs who train for residential work, expressed this common sentiment: "just tell me the standard so I know what to train for."

In order to get a handle on the credentialing landscape in energy efficiency sectors, we gathered information from each of the training programs interviewed about what credentials their students typically earn. We also used information from key informant interviews and our qualitative research for the sector case studies (chapter 4), to help us get a sense of which certifications have real value in the industry from the perspective of employers, and also which certifications are being favored in policy design and implementation related to energy efficiency. Appendix H provides a list of the credentials mentioned by the training programs we interviewed within each type of institution. The list is organized by building system, including electrical, HVAC, and building envelope-related credentials, in order to give a sense of the most prominent credentials within each area of energy efficiency, as well as which types of institutions are best preparing workers to do the energy efficiency related work in these fields. In the HVAC sector, for example, North American Technician Excellence (NATE) is an American National Standards Institute (ANSI)-approved, industry-recognized certification that signifies competency in critical skills for systems installation that ensures efficiency and safety. NATE certification is typically obtained as part of a sheet metal worker apprenticeship, and is now required in the investor-owned utilities (IOU) incentive programs for HVAC.

The transparency of specific credentials' value varies by sector and by type of occupation. Credentialing pathways are well-established in the universe of professional occupations. Engineers and architects, for example, are expected to earn both educational degrees, which indicate a particular level of training, and licenses, which certify competency. Licenses are mandated by the state, and an individual must earn one in order to be allowed, under state law, to practice in a particular profession. In most cases, professional licenses require a four-year degree, several years of work experience, and the successful completion of a series of rigorous examinations. Thus, the educational degree is an entry-level credential that opens the door to employment and advancement in these fields. In addition, licensing maintenance requirements tie professionals in to a system of continuing education and professional development.

In the commercial sector building trades, apprenticeship training and state-issued journey cards are widely accepted as the industry-recognized occupational certification. Within the electrical field, there are also state licensing requirements, with continuing education and relicensing components that are very similar to professional licensing requirements. Other specialty trades do not require a license for workers, and licenses for contractors do not always rigorously test for competency, as is the case in HVAC.

In the residential side of the construction industry, and within training programs that are less comprehensive than apprenticeship, credentialing is much less clearly defined. A number of certifications in HVAC and home performance, in particular, compete for top recognition. Although nearly every program offering HVAC training mentioned that students earn the required Environmental Protection Agency (EPA) certifications for handling refrigerants, in terms of occupational certification, some programs train for NATE, while others use the standard set by HVAC Excellence. In the specialized home performance industry, Building Performance Institute (BPI) certifications have recently been gaining traction, but some argue that these are competing with the Home Energy Rating System (HERS) certifications developed by the California Energy Commission (CEC), which are specifically tailored to California's building codes. In these industries, utility incentive programs and government requirements have a role to play in determining what the training standard will be. The recent adoption of BPI as the certification standard for Energy Upgrade California, and NATE as the standard for participation in IOU quality HVAC installation incentive programs has given a boost to those certifications and may induce more employers or workers to invest in them.

Significant on-the-job training or work experience is a central element of many licenses and professional certifications, as well as apprenticeships. This is not the case with some of the new specialized energy efficiency certificates, such as BPI. Several program implementers, employers, and trainers that we interviewed see this as a weakness because while certified building analysts, for example, could pinpoint envelope leakage, those without sufficient construction experience would not understand the underlying construction work that caused the problem or what was needed to fix it.

This analysis also shows that some types of institutions offer a larger number and greater variety of certifications than others. This corresponds, as might be expected, to the length and comprehensiveness of the training programs offered within a particular institution. As mentioned above, apprenticeship programs train workers in core occupational knowledge, as well as in a wide array of technical and safety skills. Thus, in addition to leaving with a journey card that is a state-certification, apprentices have the opportunity to earn a large number of trade-relevant, industry-recognized skills certifications. Private organizations, on the other hand, tend to offer only self-defined certificates, or one key certification, around which the entire training is focused.

Community colleges, in keeping with their educational mission, offer primarily two-year educational degrees that enable students to transfer credits to a four-year program, or one-year certificates designed to help workers enter directly into employment. Our research suggests that these community college certificates often are not linked to the main industry-based certificates in the corresponding occupation, thus limiting their economic power. This is in contrast to community college programs in the health professions, where licensing and certification requirements are more common even at the lower skill levels, and community college training programs are much more geared towards preparing students to acquire them.

Community-based organizations almost all offer self-defined certificates, including "Certificate of Completion," "Work Readiness" and "Environmental Literacy." However, some programs, particularly pre-apprenticeship programs, use industry-recognized curricula such as the multi-craft core curriculum, which enable students to get portable skills and occupational certifications. Private organizations are more heterogeneous—some were created to offer state-approved certificates like HERS, while other self-certify. Since few gather data on the outcomes for their trainees, we were not able to assess the value of these certificates.

13.3.1 TRAINING INSTITUTION GRADUATION LEVELS

To evaluate outcomes for these training programs, it is necessary to analyze enrollment, graduation, and job placement rates. Many programs do not gather reliable data on enrollment and graduation, and, with the exception of CBOs, data on job placement is mostly non-existent, making it difficult to monitor the real outcomes of any program. However, based on interviews and available administrative data, we have developed statewide estimates for the average number of students completing training programs per year at each institution.[7] When interpreting these numbers, keep in mind the difference between long-term occupational training and short-term training discussed above. Table 13.3 shows these completion estimates broken down by the primary occupation of the training.

These estimates underline several key points about the scale of the training institutions and their main types of training:

- Joint apprenticeship programs train the majority of students in the traditional construction trades, providing long-term comprehensive training.[8]
- Community colleges have a multifaceted role in the construction trades occupations, but they produce relatively small numbers of graduates, especially given their very large number of training programs. For sheet metal, plumbing and electrical occupations, they mostly serve as a pipeline into apprenticeship. In other cases, like the construction inspection occupation, they train for the more white-collar parts of the field. HVAC is more varied—at Laney College there is a one-year residential HVAC program, and a two-year commercial HVAC program. In the latter, some graduates are able to join apprenticeship programs at a more advanced level that gives them credit for their community college work.
- Community-based organizations and ROPs each train several hundred people per year in basic skills for general construction, some of which is pre-apprenticeship training and some of which is entry-level, mostly into the residential sector.
- Community colleges, ROPs, private organizations and CBOs have all developed short-term, energy-specific programs that train for direct employment in jobs such as building performance inspector or renewable energy technician/installer, whereas this is not the case in either the four-year college or the apprenticeship programs.
- A very small number of people complete energy-specific training at community colleges, in spite of efforts to expand programming in this area. This point is reinforced in Appendix I, which shows a number of existing programs in this area with zero graduates in the last year. While this may change in the future since many programs are new, it does indicate slow uptake and a lack of calibration of these programs with industry demand.
- Private organizations and CBOs appear to have developed a niche in new programs for energy-specific trades or skills.[9]

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[7] These figures are weighted estimates based on the responses from our sample or supplemental data gathered on the completion rates for the programs interviewed. In some cases our sample size for a particular occupation was very small, so these statewide estimates have a large margin of error. These numbers differ from those in Appendix I, because they are institutional averages. Appendix I only reports verified data from interviews or administrative sources.

[8] Unilateral apprenticeship programs are excluded here because the high non-response rate means that our sample size was too small to draw reliable conclusions.

[9] Note that the programs counted as "architecture," for example, include LEED training, which is open to many different occupations.

- Private organizations and utilities train a very high volume of people each year, typically in short-term sessions that are either very introductory or specialized in supplemental skills for incumbent workers. A small percentage of private training is entry or intermediate skill level in the trades, and is occasionally up to six months in length.

13.4 CAREER PATHWAYS AND TRAINING

We have already introduced the idea that training programs and institutions train people at different levels, from entry-level training at ROPs and CBOs, to long-term advanced training at apprenticeships and four-year universities, to incumbent worker skills upgrade training. The training completion rates just described are better understood within training pathways, because they represent different training levels and possible links between one level and the next.

In this section we describe these levels in greater detail, and discuss the ways in which they can coordinate to build stronger career pathways. As it has become clear that "green" work may be done more effectively and efficiently by "greening" traditional occupations rather than developing new ones, it follows that traditional career pathways in these sectors can be "greened" as well. There is a significant body of work describing best practices for career pathways, and how to integrate and emphasize "green" skills.[10] One of the important lessons of these studies is not to "reinvent the wheel" of good workforce development, and instead try to build and strengthen traditional career pathways in ways that incorporate training for energy efficiency and related skills.

Along a career pathway, an individual can advance to higher skill and wage levels through additional education and training, through work experience, or through a combination of the two. A well-developed pathway, such as those in the professional/managerial occupations or the commercial construction sector, has a clear progression for advancement from entry-level to advanced skills, and is supported by industry-recognized credentials at each level of training.

The following series of diagrams (Figures 13.1–13.3) illustrate three distinct career pathways within the scope of our study. It is important to note that these show potential levels of training and typical options for how to progress from one level to the next. In reality, people's career trajectories take on many idiosyncratic variations. However, these diagrams do represent the major levels and progressions for the occupations and sectors within the scope of our study. We also include the estimated annual graduates by institution and occupation (also in Table 13.3), in order to illustrate the scale of each type of training within the state.

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[10] White, S. & J. Walsh (2008). *Greener Pathways: Jobs and Workforce Development in the Clean Energy Economy.* Center on Wisconsin Strategy, The Workforce Alliance, The Apollo Alliance. Retrieved from: http://www.cows.org/pdf/rp-greenerpathways.pdf
See also: White, S. and K. Gordon (2009, Jan.). *Mapping Green Career Pathways*. San Francisco, CA: The Apollo Alliance. Retrieved from: http://apolloalliance.org/reports/.

Table 13.3 Estimated Annual Program Completions by Primary Trade Statewide, 2005-2010

Main Trade Or Skill Set	Long-Term Intermediate Or Advanced				Short-Term Entry Level		Short-Term Incumbent Worker		Total
	Appren-ticeship —Joint[1]	Appren-ticeship—Unilateral[1]	4-Year and Graduate[2]	Community college[3]	ROP[4]	CBO[4]	Utility Energy Centers[5]	Private[6]	
Professional / Managerial									
Architecture			1,402	301				* * *	1,703
Civil Engineering			2,212	1					2,213
Construction Management			330	86				* * *	416
Electrical Engineering			3,049	52					3,101
Engineering, General				247	620			* * *	867
Engineering and Architecture (Drafting / Design)				571	147				718
Law / Policy			78	* *					78
Management			60						60
Mechanical Engineering			2,729	10					2,739
Total for Professional / Managerial	0	0	9,860	1,268	767	0	42,863	* * *	54,758
Traditional Trades									
Boilermaker	11								11
Bricklayer	37	4							41
Carpenter	1,814	47		58					1,919
Cement Mason	39	8							47
Construction Inspector				205				* * *	205
Electrical	886	230		271				* * *	1,387
Elevator Constructor	146								146
General Construction Worker				115	799	452			1,366
Glazier	65								65
Heat and Frost Insulator	31	29							60
HVAC/R Worker[7]	84	10		413				* * *	507
Laborer	424	38							462
Operating Engineer[8]	245	5							250
Plasterer	48								48
Plumber, Pipefitter and Steamfitter	403	29		23					455
Roofer/Waterproofer	110	19							129
Sheet Metal Worker[7]	311	13		12					336
Sprinkler Fitter	75	13							88
Total for Traditional Trades	4,729	445	0	1,097	799	452	0	* * *	7,522
New and Emerging Trades									
Auditing and/or Inspection				11				1,628	1,639
Renewable Energy and Energy-Efficiency Specific[9]			356	* *	238	1,392		3,256	5,242
Total for New and Emerging Trades	0	0	356	11	238	1,392	0	4,884	6,881
Total	4,729	445	10,216	2,376	1,804	1,844	42,863	4,884	69,161

Table 13.3 (continued) Estimated Annual Program Completions by Primary Trade Statewide, 2005-2010

** Data unavailable; new program.

*** Missing data.

[1] Apprenticeship: completion for apprenticeship refers to journeying out. Data is from the Division of Apprenticeship Standards and is an annual average from 2005-2009.

[2] Four-year college: graduation information for engineering programs is from the American Society for Engineering Education and the architecture program data is from National Center for Education Statistics. Reported data represents 2009.

[3] Community college: completion data is from 2009, and represents both transfer programs and terminal certificates for intermediate-skill positions. We estimate that approximately half of completions are of each type. Data is from the California Community Colleges Chancellor's Office.

[4] ROP and CBO: Because of very small sample size, we based these figures on our average responses weighed by the number of tracks we estimate to be in the population.

[5] Utilities: data represents attendees at the Energy Training Centers in 2009. The centers do not track the occupations of their attendees, but our interviews confirmed that the majority are architects, engineers, and contractors. See chapter 12 for more information.

[6] Private: some private training is short-term, entry-level as well. We only collected completion data from the training for new and emerging occupations.

[7] Most HVAC/R training tracks for apprenticeship are incorporated in the committees for plumbers, pipefitters, and steamfitters. Others are refrigeration-specific committees. Sheet metal workers work with HVAC systems as well.

[8] Including stationary engineers as well.

[9] Many emerging occupational training programs teach a variety of skills for energy efficiency and renewable energy so we use a broad category here. Auditing and/or inspection refers to programs specializing only in audit and/or inspection. Some renewable energy and energy-specific programs may also teach some aspects of auditing or inspection in addition to other skills.

13.4.1 PROFESSIONAL AND MANAGERIAL PATHWAYS

Figure 13.1 shows pathways in the professional and managerial occupations related to energy efficiency, distributed generation, and demand response. The primary occupational areas we identified are architecture, engineering, and construction management. Career pathways in these professional occupations and others requiring a four-year degree are, for the most part, clearly defined: a student may start at a community college and transfer into a four-year school, or enter directly into a four-year program; the student then can elect to continue on for graduate education. [11] For professional degrees like engineering and architecture, education prepares students for employment and, after testing and required work experience is completed, for licensure.

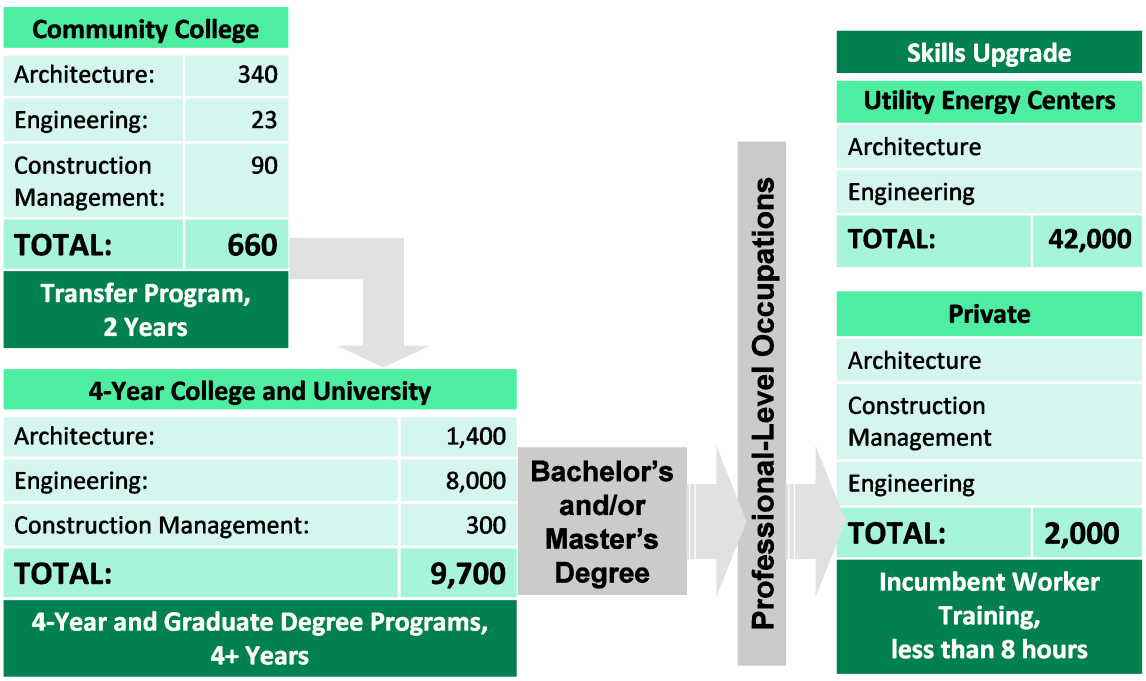
Four-year universities and colleges are the site of long-term, advanced training, graduating about 4,300 people per year with bachelor's degrees or higher. Community colleges offer two-year transfer programs in these areas, which help expand access to four-year and graduate degree programs. Strong articulation between community college and four-year programs help increase many disadvantaged workers' opportunities to enter higher-paying white-collar jobs, although many barriers still exist, so expanding recruitment pipelines and college preparation in underserved communities remains a critical task.

There are about 660 transfer graduates for the relevant subject areas each year. In addition, several thousand people attend skills upgrading training sessions at utilities' Energy Training Centers and private training programs each year. These short-term, high-volume trainings focus on a particular skill and are generally open and applicable

[11] Both four-year and graduate degree programs are considered under the "four-year university" category of institution for this study.

to many different but related occupations. For example, the U.S. Green Building Council (USGBC) offers training in the LEED system, which is often attended by architects, engineers, real estate developers, construction managers, and others.

Figure 13.1 Pathways: Professional and Managerial Occupations, Estimated Annual Graduates Statewide



13.4.2 COMMERCIAL AND PUBLIC SECTOR CONSTRUCTION PATHWAYS

Figure 13.2 shows pathways in the commercial and public sectors for construction trades and energy specialty trades. The primary occupations are in the traditional building trades, with energy-specific training included. Like professional occupations requiring a four-year degree, apprenticeships in the commercial construction sector also represent a clear career pathway. Jobs in the highly-unionized commercial and public construction sectors typically have long-term technical training through apprenticeship, more rigorous certification requirements, and clearer sequences for career advancement than their residential sector counterparts.

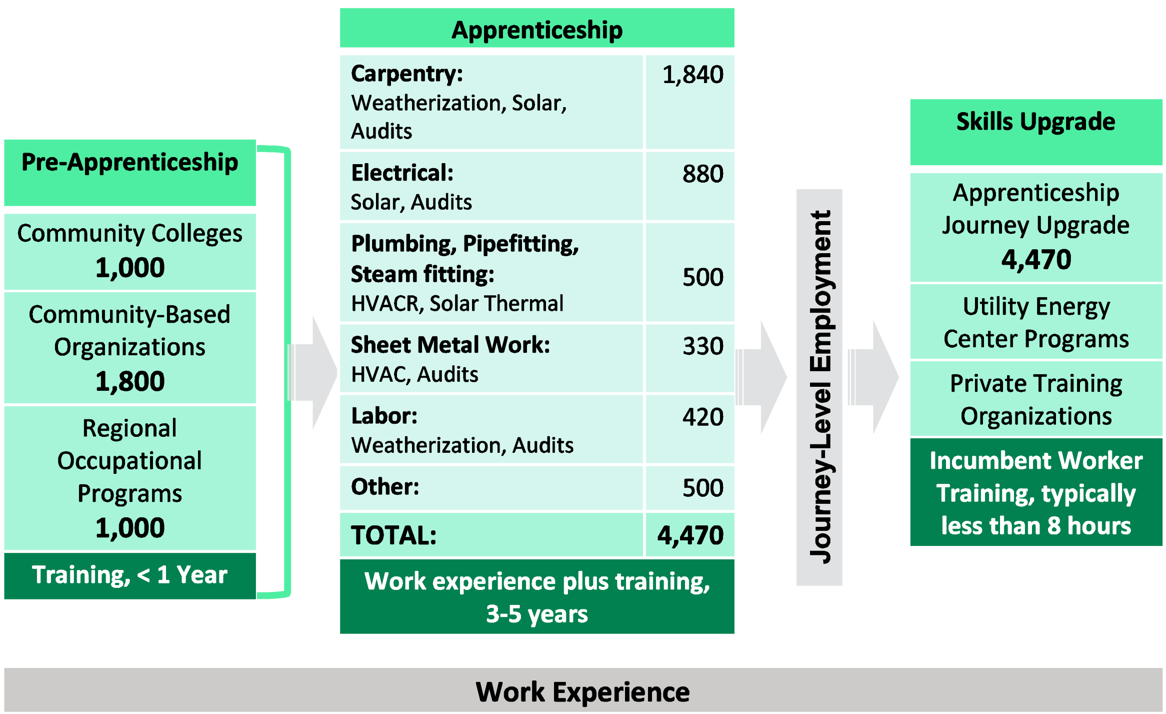
Apprenticeship is the main site of long-term, advanced training for these jobs, with about 4,470 graduates per year. Although apprenticeship has few entry requirements, other than testing, there are many applicants for few slots, so disadvantaged workers often face barriers to entry. Pre-apprenticeships help increase access to apprenticeship by offering short-term training in basic job skills and preparation for the entrance exams. Some of these exist at CBOs, community colleges, or ROPs, but they only represent a small portion of the total number of estimated graduates in these programs.

After completion of an apprenticeship, these programs continue to offer skills upgrading for journey workers to help them learn new technology and practices, giving them the chance to gain skills to advance in their careers.

Utility energy centers and private training programs also provide advanced skills upgrading for incumbent workers in this sector.

A journey card is not required to work in the construction trades, and some individuals go straight to work for non-union employers without participating in apprenticeship training. However, the relatively high union density in the commercial and public sectors means the apprenticeship system is more common and overall training standards are higher.

Figure 13.2 Pathways: Commercial and Public Sectors, Construction Trades and Energy Specialties, Estimated Annual Graduates Statewide



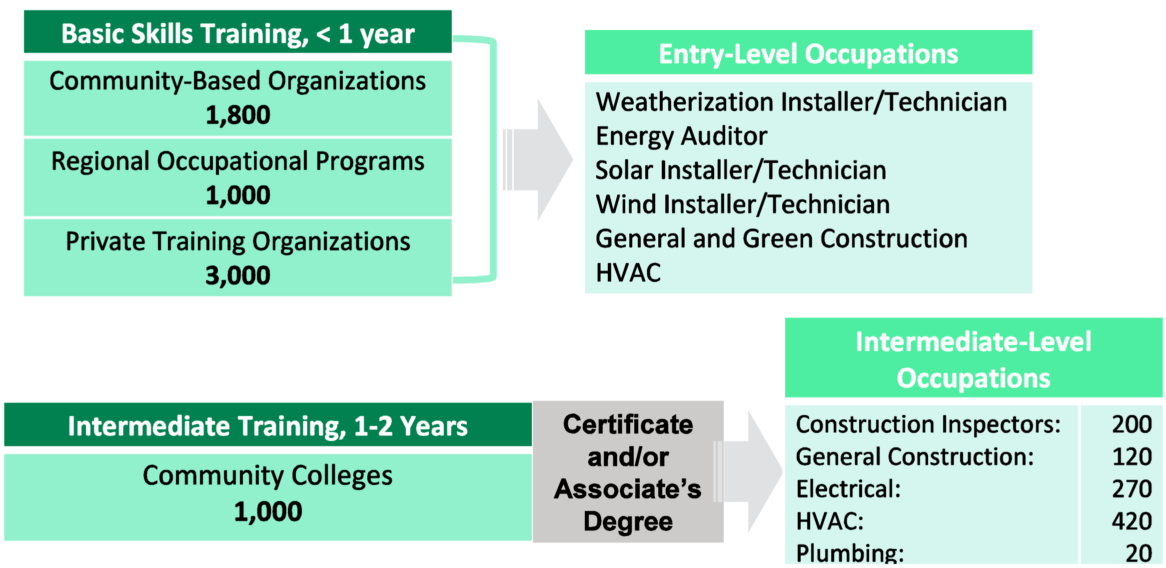
13.4.3 RESIDENTIAL AND SMALL COMMERCIAL SECTOR CONSTRUCTION PATHWAYS

In the residential construction sector career pathways become more muddled and levels are not linked. Most workers learn on the job and have no formal training. In California, many are immigrants and have less than a high school education. The training programs that exist are very basic job readiness and entry-level occupational training like solar installer, specialty trades training like HVAC, white-collar training like building inspector, or training for specialized certifications for contractors. We found no evidence of training programs that have successfully linked these into a training pathway for students, though several are attempting to do so. The best programs attempt to provide multiple pathways for students *out* of residential construction and into higher education or apprenticeship.

Figure 13.3 also shows pathways in the construction trades and energy specialty trades, but in the residential and small commercial sectors. This draws a sharp contrast to the equivalent pathways in the large scale commercial and public sectors, which has a basis of long-term, advanced skills training via apprenticeship. In the residential sector most programs are short-term, entry-level, or short-term technical skills upgrading. There is very little long-term, advanced skills training apart from a small number of residential tracks in apprenticeship programs. As a result, workers gain skills primarily through work experience, based on the particular needs of the employer.

Training programs that do exist are more general, and target either entry-level general construction jobs or entry-level, energy-specific jobs like weatherization technicians. Community Based Organizations, ROPs, and Private training programs all offer short-term training for entry-level construction or energy-specific jobs. Each type of institution trains about 1,000 people per year in these programs. Community colleges also graduate about 1,000 per year with certificates or two-year degrees in the trades, and some have started new energy-related programs, like training for solar technicians. A significant, though uncounted, number of workers also enter the residential construction industry with no formal training and learn the trade on the job.

Figure 13.3 Pathways: Residential and Small Commercial Sectors, Construction Trades and Energy Specialties, Estimated Annual Graduates Statewide



13.5 SUMMARY AND CONCLUSIONS

California has a substantial training and education infrastructure available to meet changing work requirements of the transition to a clean energy economy. Our analysis has revealed that each institution has a role to play, but the depth and scope of training and connections to career pathways differ, impacting worker outcomes and skill availability for employers:

- Apprenticeships and four-year universities both offer long-term training that leads inexperienced individuals to acquire advanced skills and recognized credentials in trades and professional/managerial occupations, respectively. These career paths offer the greatest potential for standardized quality of work and positive long-term workforce outcomes.

- Community colleges provide a variety of intermediate-level occupational training for transfer to four-year universities, pre-apprenticeship, and direct employment, presenting the most varied array of training in multiple pathways. These programs are particularly useful in filling gaps in the workforce system by creating bridges between other programs, or career stages, and pipelines into longer term apprenticeship or further higher education.
- Community colleges are less effective in training for terminal certificates and degrees in energy efficiency occupations than they are in training for traditional trades and professions, at least in terms of number of graduates. This is probably because of the lack of widespread industry-recognized standards in energy efficiency, particularly for the residential sector, as well as the relative lack of demand for these specialized occupations.
- Community-based organizations, ROPs, and private organizations offer short-term basic job skills training and job readiness preparation in the construction trades and energy-specific occupations. While some CBOs and ROPs are pre-apprenticeships with strong linkages to apprenticeship, recognized training curricula, and a number of skills certifications, the remaining short-term, entry-level programs that lack connections to clear career pathways can leave workers trained but unemployed, or stuck in low-paying jobs with little opportunity for advancement.
- Private organizations and the IOU Energy Training Centers provide short-term technical skills upgrading for incumbent workers. Apprenticeships also offer this training through their journey-upgrade courses. These courses are crucial for keeping up with changing technological requirements and also enable workers to advance within their field over time, but they do not substitute for the long-term broad occupational training that apprenticeships and bachelor's and above provide. Private programs are expensive compared with other programs and, in many cases, receive public subsidies.
- Career pathways and the skills required to advance to the next level of training tend to be more clearly defined at the professional/managerial level than in other types of occupations. Credentialing and skills standards play an important role in defining and these skills and training requirements. In the building and construction trades, the standard for credentialing and training is less well defined, and therefore the range of skills and types of training associated with these occupations varies widely.

This portrait of the training system provides important policy direction. Given the relatively few new jobs, and the high unemployment amongst experienced workers, particularly in the construction trades, there is currently an oversupply of pre-employment training programs, rather than a gap. Some, like the apprenticeship programs, simply stop taking new entrants until there are real jobs; others do not have good mechanisms to calibrate training slots to jobs.

Incumbent worker training is clearly an area for emphasis. There are usually many times the number of incumbent workers compared to new entrants, and this is exacerbated in the current period. Thus, integrating new energy efficiency practices into continuing education and licensing requirements for engineers and architects, and journey upgrade training for the trades, marks a clear opportunity for improving practice.

In the long run, the workforce infrastructure will be called upon to provide new cohorts of workers in both the professions and the trades. Again, integrating energy efficiency and related principles, skills, and knowledge into the core long-term training institutions is essential, especially since achieving our energy goals largely requires changes in process, not new products. While a market that is specialized and dedicated to energy retrofits may develop, it is likely that it will continue to be embedded in remodeling and equipment change-out work that requires broader construction skills. This also supports the emphasis on greening traditional occupational programs rather than creating new specialized programs.

In the commercial sector, it is clear that state-certified apprenticeship programs are the key training institution that policymakers concerned about both high quality work and solid career pathways should support. Community colleges are important partners to apprenticeship but they do not substitute for it, because community college programs are shorter term, lower level, and not tied to jobs and careers. Policymakers should therefore support community college and apprenticeship collaboration to take advantage of the comparative strengths of these institutions. This kind of collaboration can be encouraged for all levels of training: for journey upgrade training, for classroom supplemental instruction during the apprenticeship period, and especially as pipelines for workers from disadvantaged communities who need additional basic skills and job readiness training in order to be successful applicants and apprentices. Pipelines into apprenticeship from other institutions, like CBOs and ROPS, should also be supported. Links and collaboration between apprenticeship and community colleges already exist to some degree, but can clearly benefit from more systematic and intentional statewide and local collaboration.

The residential construction sector presents the greatest challenge and biggest quandary for policymakers because there is no long-term training institution that prepares unskilled workers to gain mastery of their craft, so there is no training program into which energy efficiency knowledge and skills can be easily integrated. Though some apprenticeships have residential tracks, the reality is that the residential sector is predominantly non-union and there are very few jobs available to apprentices in this sector. There are training programs for entry-level jobs in residential construction, but job placement rates and wages are generally low unless there are local hire or other high-road agreements, like in the City of Richmond.[12] Most workers learn on the job and wages are too low to warrant investments in training by jobseekers. Many community colleges and WIBs are reluctant to train their students and clients for these low-wage jobs.

If the residential retrofit market expands dramatically, training in specialized residential retrofit may produce better placement rates, but there is no clear reason to expect this since there is already an experienced incumbent (mostly immigrant and trained on the job) workforce in residential construction. The current strategy in Energy Upgrade California is to focus certification requirements and training investments on contractors, not on workers. As discussed in Chapter 4, this model may produce the quality of work needed, but probably won't create good green jobs or a professionalized workforce. The other strategies discussed in the chapter highlight that training is not in and of itself a solution but rather needs to be embedded in other strategies that change the nature of the jobs.

Policymakers designing programs that hire workers in the trades have a choice: whether to set standards that support robust career pathways with advanced, comprehensive training, and certifications that require continuing education, or whether to leave the option open for minimal training that may result in dead-end jobs. This choice is even more pronounced in decisions about energy efficiency policy, where sectors are not yet so clearly defined and training is critical for success. On the one hand, minimal skills training focused on energy efficiency-specific jobs has the potential to be time and cost-effective, if the training is well coordinated with labor market demand and quality assurance is well enforced. On the other hand, long-term training in the traditional trades that incorporates energy efficiency skills provides workers with a comprehensive skill set that gives them the ability to perform at a higher level, adapt to changing technologies and demand, and advance in their own careers. In the commercial sector, where training costs and higher wages are already incorporated into a sufficient portion of the contractor community and a high-road business model already exists, the clear choice is to invest in the existing apprenticeship system and those that collaborate with it. In the residential sector, where a high-road model is not established, the choices and strategies are less clear. Here, they will require experimentation, openness to new approaches, and new collaborations.

[12] The City of Richmond's local hire policy and linkages with the Richmond BUILD pre-apprenticeship program are described as an example of best practice in Chapter 16.

CHAPTER FOURTEEN:

14. K-12 EDUCATION AND TRAINING

14.1 INTRODUCTION

While Part Two of this report primarily focuses on education and training for adults in the workforce, kindergarten through 12th grade education on energy science, practices, and careers also plays an important role in preparing the next generation of the clean energy workforce and energy consumers. This chapter examines the efforts of public and private stakeholders to educate K-12 students about clean energy and potential career opportunities. Specifically, this chapter provides the following:

→ A description of existing programs, curriculum resources, and delivery models that address K-12 education and training related to clean energy, including both energy awareness and career development (see Appendix L for the complete inventory of programs);
→ Discussion of the challenges and issues in educating K-12 students about clean energy and careers in the clean energy field;
→ Identification and documentation of the best practices in energy awareness education; and
→ Identification of the best practices in career education for K-12 students, particularly as these relate to the clean energy field.

The growing number of green career training programs and the variety of practices in energy-related education create opportunities for a coordinated and strategic approach in this area.

14.2 METHODOLOGY

The research team developed an inventory of K-12 energy education programs drawn from interviews with subject matter experts and an online literature review, as well as a review of California's IOU Program Implementation Plan (PIP) filings and Research Into Action's evaluation of the 2006–2008 EARTH Education and Training Program administered by the IOUs. This database contains 106 programs, including those focusing on clean energy awareness and career development. The database includes examples of various types of programs, including programs limited to California, as well as programs offered in other states and throughout the U.S. With the exception of including all of the energy efficiency education programs offered by the California IOUs for K-12 students, the database is not intended to be comprehensive, but instead to provide examples of various types of programs. Special attention was given to identifying programs that illustrate best practices. The research team applied a maximum variation sampling strategy to select programs to be interviewed. The objective of the interviews was to identify the diverse approaches that various K-12 programs utilize.

An in-depth, largely qualitative interview approach was selected for data collection. In total, administrators of 38 programs were contacted and invited to participate. Of those 38, administrators for 22 programs were interviewed, roughly a 58 percent response rate.[1] The 22 programs that were administered by those interviewed

[1] Twenty individuals were interviewed for a total of 22 programs, because some administrators oversee multiple programs.

varied by a number of characteristics, including funding source, service area, years in operation, target audience, grade level, and intended impact. The description of these programs is based on information gathered in interviews with subject matter experts, in developing the resource inventory, and from interviews with program administrators.

We also interviewed subject matter experts and administrators for each of the K-12 educational programs of the four major California investor-owned utilities. Interviews were conducted with administrators and program experts at Pacific Gas and Electric (PG&E) and Southern California Edison (SCE).[2] Additionally, evaluations of utility education programs were reviewed to gain insight into the variety of programs funded by the IOUs. The information in these evaluations aligned with and supported information gathered through interviews.

14.3 OVERVIEW OF PROGRAMS

In order to be considered for this study, the objectives of a program had to include: (1) clean energy awareness; or (2) career awareness, exploration and preparation. Some programs addressed both program objectives. These two program objectives are described in more detail in subsequent sections of this report. Of the 22 programs interviewed, 15 were focused on energy awareness and seven were focused on career development.

14.3.1 CLEAN ENERGY AWARENESS PROGRAMS

The primary focus of programs categorized as 'clean energy awareness' is on educating youth, their families, teachers, and/or the community in general about the foundational issues relating to energy efficiency, energy conservation, renewable energy, and non-renewable energy. These programs provide a broad spectrum of offerings ranging from specific curriculum resources, hands-on lab kits, and teacher workshops to multi-year in-school and after-school programs. The inventory also includes programs that target all levels: elementary, middle, and high school.

Clean energy awareness programs fell into one of two categories based upon funding sources: (1) ratepayer-funded programs and (2) government and privately-funded programs.

14.3.1.1 RATEPAYER-FUNDED PROGRAMS

Programs funded by ratepayers were identified throughout the U.S. The ratepayer-funded programs interviewed were located both in California and in other states. All of the in-state programs included in the interview sample were IOU programs and under the purview of the California Public Utilities Commission (CPUC). No programs offered by California POUs were interviewed. As a consequence, all of the in-state programs funded by ratepayers are guided by the set of principles and goals found in California's Long Term Energy Efficiency Strategic Plan (EE Strategic Plan) adopted by the CPUC in 2008.

The programs offered by California's IOUs are designed to educate students at all grade levels about the science-based clean energy concepts and their application in the social and economic aspects of life. These programs are designed and have been found to encourage energy saving practices among parents and schools. Although these

[2] During our research, we did not interview representatives from Southern California Gas or San Diego Gas and Electric. We believe we captured the relevant programs funded through these utilities through our interviews with the representatives from PG&E and SCE. Table 14.1 identifies these programs.

programs focus primarily on consumer education, in early 2010, a career exploration component was added to at least one of the K-8 programs. Teacher and student response to this new career exploration module has not yet been evaluated. The California IOU programs, which are also addressed in Chapter 12, are described in Table 14.1, along with a brief overview of the out-of-state ratepayer-funded programs.

In total, we identified ten programs funded by ratepayers, and conducted interviews with administrators of eight. These programs receive the majority, if not all, of their funding from ratepayers. Some of these programs are implemented by third-party providers, such as the Alliance to Save Energy (Green Schools) and the Energy Coalition (PEAK).

Table 14.1 Ratepayer-Funded Programs Interviewed

Program	Description	Sponsoring Utility	Program Location	Years in Operation	Grade Level	Target Audience	Scale (yearly average)
IOU Funded Programs In California							
PEAK	A hands-on, standards-based energy science program that incorporates action-based learning. The program aims to expose students to green careers and inspire students to take action.	PG&E, SCE, SCG, SDGE	Service area of sponsoring utilities	12	3-7	Students	20,000 students
Energenius	An interactive series that includes lessons plans, take-home materials and student activity books.	PG&E	Service area of sponsoring utility	20	K-8	Teachers & Students	2,000 teachers, 55,000 students
Green Pathways	A virtual web-based / social media learning community, connecting teachers, career counselors and practicing professionals with high school students so that they may be able to make more informed choices about education and careers in the green economy.	PG&E	Service area of sponsoring utility	< 1	9-12	Students	(Piloting)
Green Schools	Students and teachers learn to track the energy usage and savings of their school using equipment provided by the program.	SCE	Service area of sponsoring utility	14	K-12	Teachers & students	65 individual schools
Living Wise/ Energy Wise	Classroom materials and take-home kits of efficiency measures and supplies for each student. Students use the kits to conduct home audit and retrofit activities with their families. Supplementary materials promote careers in energy, resources, and conservation.	SCE, SCG	Service area of sponsoring utility	17	6	Teachers & Students	100,000 Households
Ratepayer Programs In Other States							
KEEP			Wisconsin	15	K-12	Teachers & Students	350 teachers, 5,000 students
NYSERDA			New York	6	K-12	Teachers & non-formal educators	1,109 teachers

14.3.1.2 GOVERNMENT AND PRIVATELY-FUNDED PROGRAMS

The second category consists of programs that receive funding from a variety of other sources, including federal and state-level grants, private donations and grants from private foundations. Fifty-seven programs were identified and included in the program inventory. Programs interviewed in this study that fall within this classification vary in their target audience, grade level focus, service area and years in operation (see Table 14.2).

Table 14.2 Government and Privately-Funded Programs Interviewed

Program	Program Location	Years in Operation	Grade Level	Target Audience	Impact (yearly average)
Green Learning Adventure	California	2	5-8	Students	225 teachers; 5,650 students
Infrastructure Academy	California	2	9-12	Teachers, Students	14 teachers, 320 students
Protect Your Climate	California	5	K-8	Teacher	85 to 110 teachers; 2,550 to 3,300 students
Florida Solar Energy Center	Florida	20	K-12		150 to 200
CEWD: Credential Program	National	< 1	9-12	Teachers & Students	In progress
National Energy Education Development Project (NEED)*	National	30	K-12	Students, Teachers, Parents	Unavailable
Kid Wind	National	7	6-12	Teachers	1,000 to 1,5000

*NEED applies to CEWD as well.

14.3.2 CAREER AWARENESS, EXPLORATION, AND PREPARATION PROGRAMS

An important aspect of the K-12 system is the extent to which these programs contribute to career development. The purpose of K-12 career development programs is to inform students about the careers available to them and provide them with the necessary occupational skills and/or knowledge for entering into these careers, and/or moving into a post-secondary education on a selected career track.

Research suggests that K-12 career development programs, including programs focused on energy careers, are most effective when they follow a progressive sequence that includes: (1) career awareness, (2) career exploration, and (3) career preparation (see Figure 14.1). This sequence, or a similar variation, has been adopted by several states including Wisconsin,[3] New Jersey,[4] Colorado,[5] and Georgia.[6] For example, career awareness is typically targeted towards K-5, which serves as the foundation for career exploration around grades 6 through 8, and that, in turn, gets students ready for career preparation in high school. Since this sequence has been adopted by several states, the programs interviewed were analyzed using this framework. In practice, we found that programs may differ in how they implement this sequence and how early they start to follow it.

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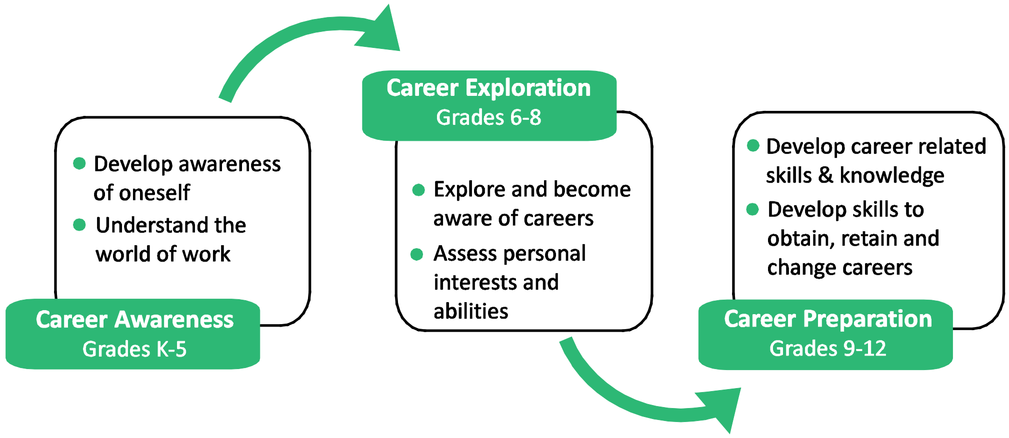
[3] Wisconsin Department of Public Instruction, http://dpi.wi.gov/cte/pdf/k12comcd.pdf.

[4] New Jersey Department of Education, https://www13.state.nj.us/NJCCCS/ContentAreaTableView_21st.aspx.

[5] Colorado Department of Education, http://www.cde.state.co.us/cdesped/download/pdf/TK_CareerDevelopment.pdf.

[6] Georgia Department of Education, http://www.doe.k12.ga.us/ci_cta.aspx?PageReq=CICTACareerRelatedEd.

Figure 14.1 Career Education Sequence



Although many energy awareness K-12 programs incorporate some degree of career awareness and exploration, most do not identify career-related learning outcomes as their main focus. We found only two career exploration programs, the High School Sustainability and EnergyVenture Camp, that focus on career related learning outcomes.[7] Our interviews suggest that the majority of K-12 programs dedicated to career education focus on the last two stages of the sequence, career exploration and career preparation for high school students, primarily through career technical education (CTE).

14.3.3 CAREER TECHNICAL EDUCATION PROGRAMS

The majority of California's high school career preparation programs are found in grades 10 through 12 and are guided by specific CTE foundation standards mandated by the California Department of Education. The primary goal of CTE courses in high schools is to educate students about the career options available to them and provide them with occupational skills and knowledge. The majority of clean energy programs are found in such career programs as Regional Occupational Centers/Programs (ROPs) and California Partnership Academies (CPAs).

ROPs strive to prepare students for entering the workforce by providing occupation-specific pathways training that aligns with industry sectors. The primary objective of these programs is to prepare participants with entry-level skills, creating a foundation for a career. It is assumed that once completing the program, participants will be better prepared to enter the workforce in an entry-level position or pursue more training or education to further develop their skills. Fifty-nine of the 74 ROPs in California offer energy-related courses. More detailed information and analysis related to ROPs is provided in Chapter 11 of this report.

CPAs focus on educating students through career-oriented classes within industry pathways, as well as by providing career guidance. Funded by the state budget through competitive grants, these CPAs offer career preparation to students in grades 10 through 12 and in many cases are required to focus on underperforming student populations. Unlike ROPs, CPAs do not focus on employment as the main outcome for students, but rather try to engage students into thinking about career pathways and setting individual career goals. CPAs focus on supporting

[7] PG&E has recently launched a pilot program "Green Pathways" that is focused on career awareness and exploration. Since the pilot has just started, it could not be included into the study. However, it is important to recognize that California IOUs are devoting more attention and resources in this area.

underperforming and at-risk students, in particular, and aim to reduce dropout rates. In order to assist in the transition to additional education, many CPAs (and ROPs) have articulation agreements with local community colleges. These agreements allow students to receive course credit at their next institution for the work completed during their time at the CPA or ROP.

Located in 464 high schools across the state, CPAs create a smaller, more specialized education community within their school of operation. Ninety-nine of the 464 CPAs in California are related to the broad occupational categories within the scope of this study, such as architecture, engineering, and general construction. Of those 99 programs, 39 trained students for occupations that are considered to be specifically green careers, such as green construction, alternative/renewable energy generation, and green technology. (Figure 14.2 provides a map of locations of CPA Programs.)

Recent legislation, known as the Green and Clean Technology Initiative (AB 519, Budget Item 6110-166-001), is providing the foundational resources and funding needed to make these "Green" CPAs (or "Green Academies") a success. Funding for this legislation is provided from the Public Interest Energy Research (PIER), Development and Demonstration Fund for the 2009–2010, 2010–2011 and 2011–2012 school years.[8] In order to be eligible for the Green and Clean funding, CPAs must "focus on clean technology and energy businesses and provide skilled workforces for the products and services for energy or water conservation, or both, renewable energy, pollution reduction, or other technologies that improve the environment in furtherance of state environmental laws."[9] It is important to note that during a time marked by budget cuts throughout California, special grants have been available to promote these programs. It is clear that there are high expectations for the Green and Clean CPAs and for the potential impact the programs will have for California.

In-depth interviews were conducted with five CPAs that focus on energy efficiency related occupations. Most were in their first year of operation, having completed planning grants and teacher training prior to implementation. Table 14.3 gives an overview of the career oriented high school programs interviewed for this study.

The first of the CPAs interviewed was the Alternative Energy Academy, located in Desert Hot Springs. The primary focus of this CPA is Renewable Energy and Alternative Learning (REAL), which includes topics such as solar power generation, wind turbines and other green technologies. Alternative Energy Academy also has formed a partnership with Southern California Edison, and hopes to create articulation agreements with local community colleges by the time the first cohort of students graduates.

The second CPA interviewed, the Efficient Use of Water and Energy Green Academy, has been in operation since 2009. Through hands-on activities, students study topics such as electricity, power generation, energy sources, water treatment and soil. In addition to a high school degree, students in the program also receive an energy auditing certificate. Similar to other CPAs, this program has formed a relationship with the local investor-owned utility, PG&E. While all of the CPAs are geared towards at-risk students, this program also caters to students that show interest within the general student population (outside of at-risk groups). Students are also encouraged to be involved in environmental efforts and community projects outside of the classroom by participating in the school environmental club and a school-wide environmental awareness day.

Environmental Technology Academy in San Diego is the third CPA interviewed. This program has a heavy focus on the use of technology, such as Geographic Information Systems (GIS) mapping software, and also teaches about green research and careers. One of the smaller CPAs, in terms of enrollment, this Academy primarily focuses on

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[8] California Department of Education (2009). Report on the Budget Act of 2009. Retrieved from: http://www.cde.ca.gov/fg/fr/eb/documents/br09reviseaug2010.pdf.

[9] California Department of Education. Green CPA Program. Retrieved from: http://www.cde.ca.gov/fg/fo/profile.asp?id=1882.

GIS and the environment. An administrator of this program indicated that the plan was to add more classes, such as underwater robotics and solar panel installation.

Figure 14.2 Map of Locations of California Partnership Academies

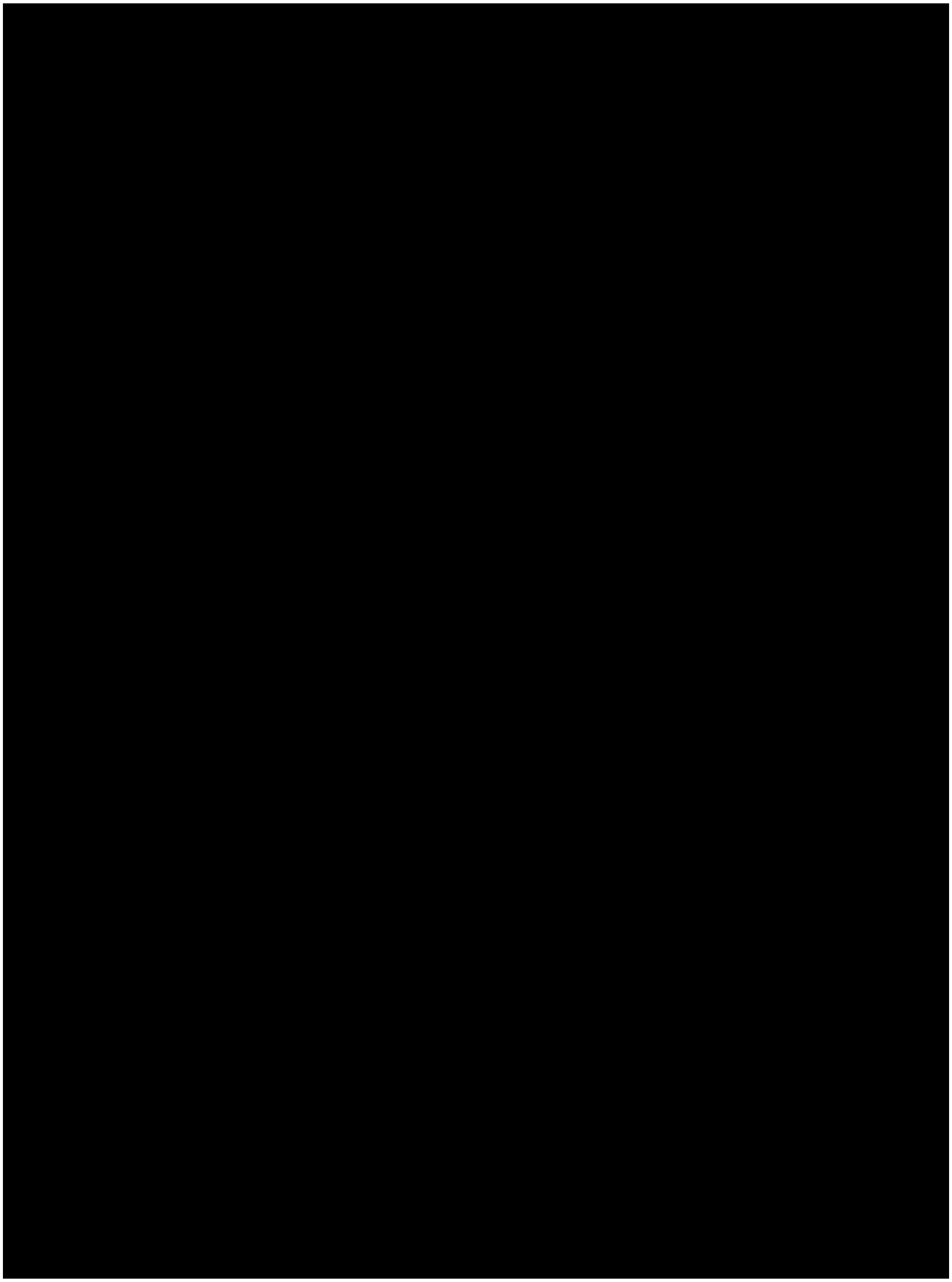


Table 14.3 Career Related Programs Interviewed

Program	Service Area	Years	Grade Level	Target Audience	Impact (yearly average)
Career Awareness / Exploration					
High School Sustainability	Marin County, California	5	11-12	Teachers	50 to 100 teachers
Energy Venture Camp	Texas	2	8	Students	280 students
Career Preparation					
Alternative Energy Academy	Desert Hot Springs, California		10-12	Students	
Efficient Use of Water & Energy Green Academy	Woodside, California	1	10-12	Students	
Environmental Technology Academy	San Diego, California	1	10-12	Students	70
Green Energy Academy	Hayward, California	<1	10-12	Students	102
Renewable Energy Academy	Oakland, California	< 1	10-12	Students	65

The fourth CPA interviewed, Green Energy Academy, located in Hayward, California, is in its first year. Energy-specific courses offered include Alternative Energy Sources, Science and Technology Internships, and Green Marketing. This CPA aims to help prepare students to work in multicultural environments by including courses in ethnic studies. The Green Energy Academy also encourages students to be involved outside of the classroom. Specifically, the staff organizes two camping retreats per year and maintains an organic garden that students work in at least 30 hours during the academic year. Teachers within the Academy have built connections with other energy education partners such as the National Energy Education Development program, PG&E and other local organizations in the Bay Area.

The fifth and final CPA interviewed was the Renewable Energy Academy, located in Oakland. Approximately half of the students participating in this program are considered to be at-risk. In addition to following a classroom curriculum, the Academy explores renewable energy and energy efficiency through the use of field trips and guest speakers. The Renewable Energy Academy has established connections with local organizations such as Save the Bay, Earth Team and private companies for mentor programs and internships for students in the 11th and 12th grades.

14.4 ESTABLISHING AND FUNDING K-12 ENERGY PROGRAMS

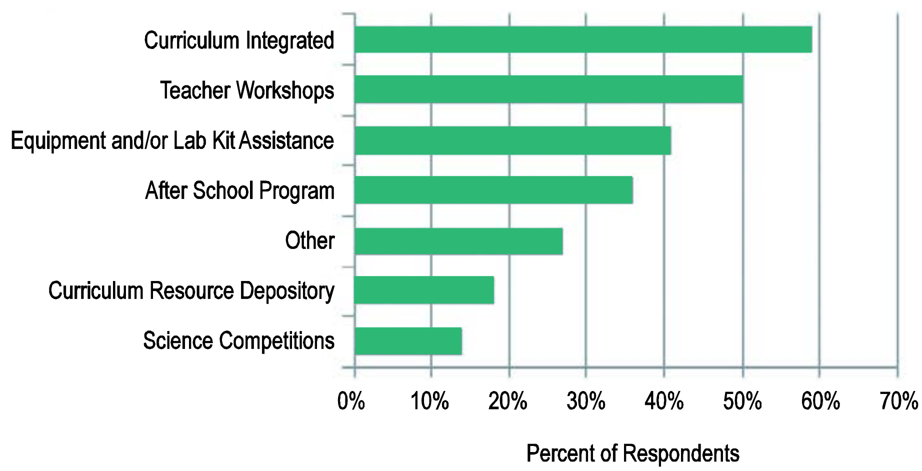
The availability of public funding and regulatory direction has contributed to the growth of K-12 energy awareness programs in California. The current ratepayer-funded programs are intended to focus on energy awareness, although recent direction has introduced career development as an additional emphasis as well. The programs are designed to contribute to the energy savings goal by equipping K-12 teachers to educate their students in order to influence their future behavior as consumers as well as the current behavior of their families. The more established programs have not systematically focused on career development until recently. The Green Schools program is one of the exceptions, because the career development sequence is used as a key benchmark of the program. Based on information gathered through the interviews, career awareness components are being included in several programs for the 2010–2012 energy efficiency program cycle, as well as in a recently implemented pilot program.

The availability of state funding has been an important factor in launching the Green Academies. Of the five interviews with administrators of these programs, all stated that their start-up and continued existence were highly dependent on targeted funding, given the past and ongoing budget cuts to public education. The funding provided has allowed the schools to focus on at-risk students, with the intent of reducing their likelihood of dropping out of high school, and putting them on a college-bound track. Teacher participation is voluntary, and faculty from math, sciences, English, and history are among the teachers participating.

14.5 K-12 PROGRAM DELIVERY

In general, integrating clean energy education into the main course of study was the most utilized program delivery format (n=13), followed by teacher workshops (n=11). Many programs create standards-based curricula so that teachers can easily integrate the material into their classes. These programs typically, but not always, utilize teacher workshops to assist with the integration process. Other programs provide workshops for professional development, aimed at increasing teacher's personal knowledge of energy. Other program delivery mechanisms included after-school programming, lab kits, science fairs, student film competitions, web-based/social media delivery, campus-wide environmental awareness days, field trips, and summer camps. Figure 14.3 provides a visual of identified methods of program delivery from the interviews conducted.

Figure 14.3 Methods of Program Delivery



The results indicate that both the focus on teacher engagement and the ability to integrate a program into state-approved, science-based curricula are practices for K-12 programs that may contribute to program success, in that they work in concert with school goals and requirements. This may in turn lead to program sustainability. These factors are also interconnected. Teachers tend to be more interested in the programs that meet state standards for a given grade level, and therefore are willing to devote necessary attention to the energy-related modules in their classrooms. As one of the interviewees stated, it is important "not to add to the existing instruction, but rather replace it with newer material that has real life application for students." The programs that were able to engage teachers, either through providing them with lesson plans or through organizing professional development workshops, were found to produce greater impact (reach more students and teachers) and be more sustainable in terms of teacher engagement. In many cases, successful teacher engagement ensured that teachers would continue using the program in the classroom beyond the program performance period.

14.6 CURRICULUM DEVELOPMENT

Both energy awareness and energy career related programs have developed their curricula internally, using experts in an advisory capacity. According to the respondents, such an approach ensures that "agenda-free" content and effective instruction approaches are incorporated. For example, the National Energy Education Development Project (NEED) stated that they would not ask the solar community to develop solar lessons, but rather would seek their input on curriculum improvements.

For ratepayer-funded energy awareness programs in California, those interviewed reported using a similar approach to develop and improve their curricula. Those interviewed also suggested that these programs have tended to use a curriculum development process involving: (1) identification of learning goals; (2) review of a curriculum/program by experts in field; and (3) feedback from target audience. While these steps are not uncommon, it is worth noting that all ratepayer-funded programs explicitly indicated use of this curriculum development process. Almost all programs in California, and elsewhere, ensure that their instruction aligns with state curriculum standards. This is especially true of the Career Academies, recently established in California, which are required to comply with the California Career Technical Education (CTE) standards. The energy awareness programs, on the other hand, are not bound by such requirements. Yet, many of these programs attempt to align with the state standards to make adoption of their curricula more appealing to teachers.

14.6.1 SKILLS AND KNOWLEDGE FOCUS

Energy awareness education programs stress the importance of a strong comprehension of the basic and foundational information regarding forms of energy. This assertion was addressed by both the subject matter experts prior to data collection and by the 22 programs interviewed. Furthermore, most administrators for energy awareness programs mentioned that they wanted students to know the difference between renewable energy and non-renewable energy sources in order to expand understanding of the ways in which these sources affect daily life. Across renewable energy programs, solar was mentioned most often as being a core aspect of the program, followed by wind energy.

Career awareness and education programs focus on providing students with (1) knowledge regarding possible careers in the energy efficiency and related sectors; (2) information on further education/training available within a career track; and (3) basic skills required in a specific career. California Partnership Academies, specifically, focus on providing hands-on skills related to a chosen career pathway, including pathways for various construction trades. Additionally, these CPAs stress the importance of soft career development skills. For example, they offer training for the students in such job readiness areas as interviewing, communication, self-awareness, and networking.

Energy audits proved to be the most common topic of instruction regardless of whether a program focuses on energy awareness or career development. It is reasonable to believe that this crossover is due to the fact that energy audit skills provide both foundational and applicable knowledge.[10] Many programs that we interviewed reported that hands-on energy audit exercises get students interested in the topic of energy efficiency because they can help relate the science to real life.

[10] Energy audits can be considered foundational knowledge being that it is a core competency taught throughout K-12 programs. Energy auditing can also be a part of the skill set requirements in any energy efficiency occupations, and therefore can be considered an applicable knowledge area.

14.7 PROGRAM EVALUATION

The objectives and approaches used for evaluation of most K-12 programs in both energy awareness and career education vary substantially. Of the programs that conduct evaluations, the most common method evaluation cited by those interviewed is a standard pre- and post-test for students and teachers. This approach typically addresses one or both of the following: (1) knowledge learned and retained; and (2) opinions about the program. These formative objectives are relatively straightforward to assess through tests and interviews, without extensive post-program evaluation. Furthermore, pre- and post-tests allow for statistical analyses to determine the effectiveness of the program for achieving the specific objectives, while controlling for other variables that may contribute to changing behaviors (such as a popular ad campaign for energy efficiency).

There are of course limits to how these types of evaluations can be used, however. For example it is difficult to isolate energy awareness education as a causal factor in reducing energy consumption. The standard pre- and post-test designs also have weak external validity, which is the ability to generalize results to populations outside of participants. As a result, a program may be considered successful at one site or with certain participants, but this result cannot predict whether it will be a success elsewhere.

Other forms of evaluation practices noted in our interviews were teacher activity logs and focus group sessions during faculty retreats. Additionally, a handful of programs asked for comments from parents. Only two programs reported using objective impact measures such as measuring the energy usage and costs for schools and households as a form of program evaluation. The Green Schools program, for example, incorporates energy tracking into the program by "establishing a baseline for energy use, and tracking the savings from the student-initiated behavior and operations changes."[11] Although the importance of impact evaluation is widely recognized among all programs, many have limited resources and choose to use their resources for program delivery as opposed to evaluations.

Based on recently completed evaluation studies and interview results, many energy awareness programs appear to be meeting their goals of increasing awareness among students on energy savings.[12] However, the deeper impact of such learning outcomes on changes in household and community practices has not been tracked systematically, and therefore no conclusion about such impacts can be made. Additionally, no long-term evaluation of career education programs exists, because these are so new. Improved program evaluation for career education could produce a better understanding of the effects of career development education throughout grades K-12. Long-term evaluations of these programs could then help track whether career development education affects the career choices students make when entering the job market.

14.7.1 PROGRAM SUCCESSES

Across various types of K-12 programs, the most popular self-reported success is the noticeable improvement in student and teacher knowledge and skills. A variety of different program-specific successes were reported by interviewees, such as:

[11] Green Schools (2010), flyer received via email from program administrator.

[12] Some evaluation studies reviewed included: McRae, M.; N. Harris, J. Van Clock, and T.L. Hanson (2009, August). Process Evaluation of the 2006-2008 EARTH Education & Training Program. Research Into Action and Educational Consulting Services. Study ID: SCE0276.01 / CPUC ID: SCE 2504., and Skumatz Economic Research Associates (2008). *Evaluation of Indirect Effects of Four Student-Oriented "Green" GHG-Reduction Programs*. for Strategic Energy Innovations.

- → Program completers (for programs serving grades 9 through 12) are actively engaging with educating their communities; for example, students are speaking to small business owners about energy efficiency.
- → Programs are being recognized with awards at both the national and regional levels.
- → Savings in school energy costs and usage are achieved as a result of a program.
- → Ratepayer-funded programs within California identified program sustainability, measured by teachers continuing to order the program each year, as a major indicator of success.

Green Career Partnership Academies note increased student engagement, as evidenced by a noticeable shift in student behavior as it relates to learning. As interviews suggest, Green Academies students, many of whom were at risk or underperforming prior to enrolling in the Academy, show more respect for teachers, improved communication and teamwork skills, and a greater understanding of energy issues and career options available to them. While CPAs aim to significantly reduce dropout rates of at-risk youths, the programs interviewed have not been operating long enough to determine these outcomes. Because these programs are very new (some were in their first few months of operation), there is little if any outcome data or independent evaluations yet available, though an evaluation is currently being carried out. Thus, for outcomes, we are limited to these positive but potentially biased reports from program administrators.

14.7.2 PROGRAM CHALLENGES

One of the major challenges faced by K-12 energy education in California is the lack of a systematic, organized effort to institutionalize these concepts and programs. The K-12 Science Content Standards for California Public Schools, for example, only briefly touches upon energy education stating that high school students should "know the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society."[13] In order to begin the process of integrating energy education into K-12 schooling, the Department of Education and other educational agencies would need to increase collaborative efforts with energy and environmental education programs and sponsors.

The California Environmental Protection Agency (EPA) is attempting to make an improvement in this domain by establishing the Education and the Environment Initiative (EEI). The EEI curriculum, tested and developed in collaboration with the California Regional Environmental Education Community Network (CREEC), hopes to help California integrate environmental literacy into core curriculum by aligning units with state-approved standards.[14] This may provide an opportunity to insert energy education into a broader effort to integrate environmental education into the state approved standards. While the EEI curriculum has support from governing boards, such as the California Department of Education, its implementation is optional for schools and teachers and, therefore, requires significant teacher engagement and effort across the state. Continued support for an initiative of this kind may help to make programs of this nature more common throughout the state. The efforts of EEI, however, are primarily focused on environmental literacy, focusing on changing behavior much like the energy awareness programs. This initiative would benefit from developing and incorporating career awareness, exploration, and preparation into programs. While the EEI curriculum is considered complete and is unlikely to be changed, the IOUs and other program sponsors can work with the organization as a reference when developing new programs. The IOUs in California are well positioned to collaborate with the EEI on these efforts, since utility programs have recently started incorporating career awareness into their current cycle of programming.

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[13] California State Board of Education (1998, October). Science Content Standards for California Public Schools Grades K-12. Retrieved from: http://www.cde.ca.gov/be/st/ss/documents/sciencestnd.pdf.

[14] California Environmental Protection Agency (2011). Education and the Environment Initiative Home Page. Retrieved from: http://www.calepa.ca.gov/education/eei/.

Almost every program interviewed, both within California and out, reported lack of funding or inconsistent funding as the single largest challenge in program implementation. Limited and sporadic funding is usually a barrier to enrollment growth. Many programs report that they are unable to serve all students and teachers who demand their services due to budget constraints. For example, while considered successful and oversubscribed, the Infrastructure Academy in Los Angeles County is not currently running its program, as there are no funds available.

Connected to the funding issue are the restrictions (or understood restrictions) on applicable use of ratepayer funds. One long-running program that raises awareness among middle school students about broader climate change topics reported that the program was not able to access ratepayer funding, as this funding source is restricted to energy savings education only.

Another key challenge faced by K-12 programs is that of recruiting teachers to participate. This issue is closely related to the recent economic downturn and educational budget cuts. As one program stated, the statewide budget cutback has impacted the grades with which a teacher works: when a teacher is moved to a new grade, he/she may be required to use any discretionary time to develop standard classroom materials and may not have the time to take on more projects, such as an energy curriculum or program.

Finally, the ever-changing workforce landscape, including the introduction of new maintenance practices and new technologies, provides another challenge faced by programs. Energy awareness programs must be structured in such a way that allows for them to be able to adapt quickly to the changing technological environment and workforce needs. Since the rate of change, especially with regards to advancing technologies, is so quick, staying current with and having access to new equipment is difficult and expensive for many programs.

14.8 MODEL PROGRAMS AND BEST PRACTICES

In order to identify promising practices, the research team utilized a range of approaches. First, we reviewed recent evaluation reports of several energy education programs, as well as published studies on career development education. Second, we conducted interviews with subject matter experts on energy education, K-12 career development education, and evaluation of utility-sponsored programs. It is important to note that practices identified through interviews were derived from program self-reporting rather than an evaluative process. Through this process we developed an initial list of best practices for both clean energy awareness and career development education, which can be found below in Table 14.4. Third, we asked the administrators for the 22 programs in the interviews about whether or not they incorporate these practices and, if yes, how. Through the answers they provided and the information we gathered through the previously mentioned research, the following elements were identified as the promising practices of K-12 programs:

- → Effective energy-related curriculum, program planning, and pedagogy;
- → Integration of career awareness, exploration and preparation;
- → Tailoring program to regional needs in energy efficiency and renewable energy;
- → Focus on teacher engagement; and
- → Industry partnerships.

Table 14.4 Best Practices

Clean Energy Awareness Education	Career Development Education
• Develop and/or follow a program plan that describes learning objectives and expected outcomes related to energy awareness • Develop energy awareness curriculum using input from industry and/or other technical experts • Integrate energy awareness into established state-approved curricula • Define and target desired behavioral changes related to energy awareness • Integrate energy efficiency building/facility components into learning to provide students with hands-on experiences • Provide problem-solving exercises that students can easily relate to their own lives • Identify the key success indicators early in the program development process • Emphasize personal responsibility in regards to energy • Provide materials that enable students to increase energy awareness at home and/or in the community	• Integrate energy-related career education throughout existing classes • Provide activities in which students research a variety of careers and present findings to peers. • Monitor the industry needs to ensure that training is relevant to the demands of the marketplace • Deliver career education in three stages that follow each other: 1) career awareness, 2) career exploration, 3) career preparation • Engage students in games that encourage the recognition of energy related careers and skills needed • Work with higher education segments to prepare students to enter college programs • Include knowledge professionals, parents, and community in career planning • Provide activities that allow students to explore their own self concept in relation to occupations • Have articulation agreements with colleges or universities • Have input from an advisory board that includes energy industry representatives • Provide students the opportunity to visit companies specializing in renewable energy/ energy efficiency • Use a structured student advising program to provide career guidance • Evaluate career education outcomes • Include skill preparation course(s) for energy related careers

The majority of K-12 programs (at least three in four among those interviewed) incorporate all key promising practices related to energy curriculum, program planning, and delivery. In contrast, many practices regarding career awareness, exploration, and preparation are fragmented among the programs studied. Although a few programs do integrate strong career awareness and education modules into their curricula, there is no systematic approach to the continuum of career awareness, exploration, and preparation components. As a rule, career awareness components are more common at all grade levels than those of career exploration and preparation. This is especially true for ratepayer-funded programs, which demonstrate strong energy savings educational outcomes and incorporate some career awareness components, but largely overlook the development of career exploration and preparation. In the career education group, practices related to industry connections are among the most widespread. These include having functional industry advisory boards, organizing field trips to energy efficiency/renewable energy companies, and seeking input from the industry professionals on the curriculum. The other practices that were common among the respondents are classroom activities related to career education in general and specific to the exploration of energy/clean energy occupations. Only one out of 22 programs interviewed reported having a systematic student advising function. Only a few of the programs evaluate career-related outcomes. This might be explained by the fact that the sample included many ratepayer-funded programs that have not included career preparation components, for which student advising and evaluation of career outcomes is crucial.

The analysis of best practices has been done to draw comparisons between the three grade levels: elementary, middle, and high school. Since no significant differences were identified between the promising practices for elementary and middle school programs, we have combined our observations into one group of K-8. Table 14.5 shows the list of best practices that are critical for each group.

Table 14.5 Best Practice Comparisons for K-8 and 9-12 Grade Levels

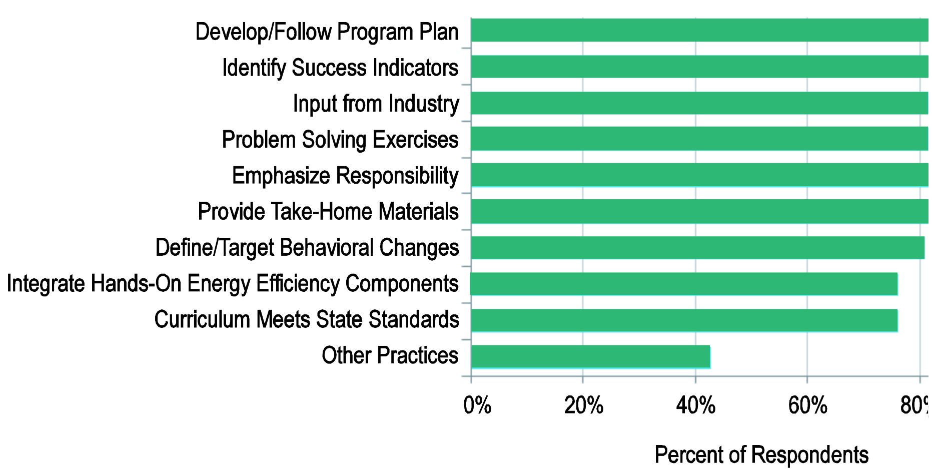
Best Practices for K-8	Best Practices for 9-12
• Effective energy-related curriculum, program planning, and pedagogy • Integration of career awareness and exploration into curriculum: • Strong career awareness components • Strong career exploration components (for middle school) • Tailoring program to regional needs • Teacher engagement • Industry partnerships	• Effective energy-related curriculum, program planning, and pedagogy • Integration of career awareness, exploration, and preparation into curriculum: • Sequence of awareness/exploration/ preparation is important • Strong career exploration and preparation components • Tailoring program to regional needs • Teacher engagement • Industry partnerships • Connection to higher educational segments and articulation agreements

Each of these elements is elaborated on and analyzed based on training program interviews in the sections to follow.

14.8.1 EFFECTIVE ENERGY-RELATED CURRICULUM, PROGRAM PLANNING, AND PEDAGOGY

A myriad of program planning and teaching approaches can be found in best practice K-12 programs. Figure 14.4 provides an overview of the reported use of each practice for each of the programs interviewed, including the proportion of programs that use "other" practices, such as holistic curricula and specialized program evaluations.

Figure 14.4 Practices in Clean Energy Awareness K-12 Programs



During interviews, respondents were asked to describe how they implemented each practice. Based on these responses, we synthesized the common patterns into the following groups:

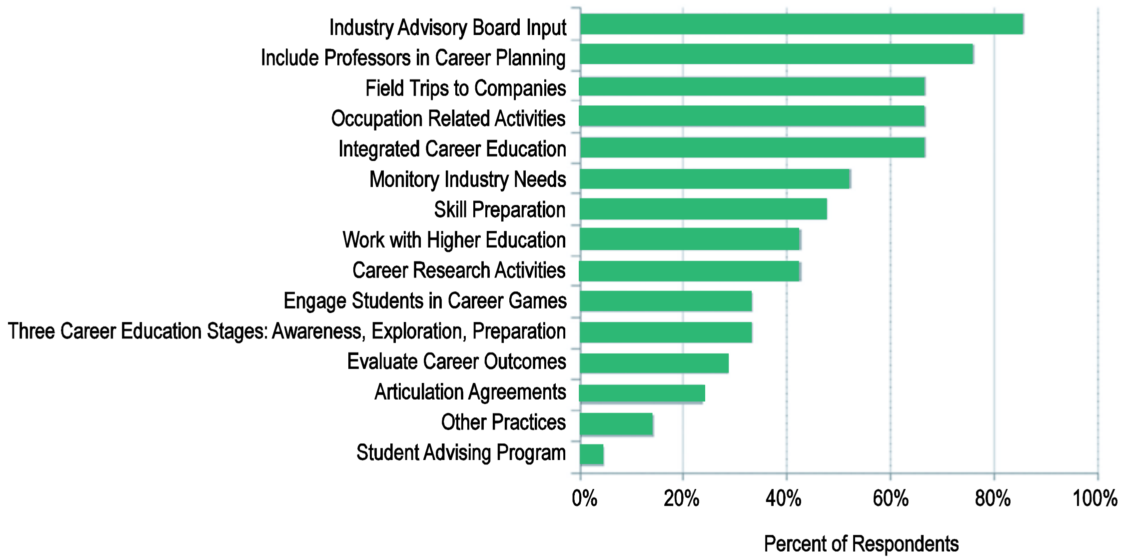
- EFFECTIVE PROGRAM PLANNING: Ninety-five percent of programs interviewed reported that they developed and followed a comprehensive program plan with clearly defined learning objectives and targeted energy awareness outcomes. Many also identify the key success indicators early in the program development process.
- INDUSTRY INPUT is sought and incorporated into energy awareness curricula.
- REAL-LIFE APPLICATION: Curricula that are built upon real-life application of energy-related science-based concepts result in higher interest to the program among both students and teachers. The methods that programs use to incorporate contextualized learning into curricula vary from integrated hands-on exercises using real energy auditing or renewable energy technologies on campus to problem-solving exercises in classroom setting and take-home kits that enable students to increase energy awareness at home and/or in the community.
- MEETING STATE CURRICULUM STANDARDS: Integration of energy awareness lessons into established state-approved curricula ensures higher levels of participation among teachers.
- HOLISTIC CURRICULUM that includes not just energy awareness but broader implications of greenhouse gas emissions, climate change, and understanding how energy use impacts these broader environmental issues. Teachers tend to be more interested in bringing such holistic topics into their classrooms. Increased collaboration between and within ratepayer-funded programs and environmental agencies may help to develop such curriculum.
- PROGRAM EVALUATION: For energy awareness programs, tracking energy savings is a challenging task that most programs have not attempted. Pre- and post-tests that gauge the knowledge imparted and participants' reaction to a program are fairly common, however.

14.8.2 INTEGRATION OF CAREER AWARENESS, EXPLORATION, AND PREPARATION

Programs that systematically integrate energy career awareness and education throughout existing classes appear to play a crucial role in promoting energy related careers and building pathways for students. Figure 14.5 provides an overview of the reported use of each career-related practice by the programs we interviewed. Although the delivery of career education in three stages (career awareness, exploration, and preparation) was only reported by one-third of the programs interviewed, the leading programs that engage students and teachers at all grade levels, i.e., K-12, tend to use this approach successfully. This sequence is especially crucial for the programs targeting high school students, as it provides students with multiple career options upon graduation and equips them with information to make those decisions. Two Green Academies that incorporate all three elements (career awareness, exploration and preparation) into their curricula are able to demonstrate "real-life" application of knowledge they receive and thus an increase in students' motivation to graduate. Depending on the grade level, programs use various teaching approaches to incorporate career-related education, such as:

→ Providing activities in which students research a variety of careers and present findings to peers;
→ Engaging students in games that encourage the recognition of energy related careers and skills needed;
→ Providing activities that allow students to explore their own self concept in relation to occupations; and
→ Including skill preparation course(s) for energy related careers.

Figure 14.5 Practices in Career Related K-12 Programs



Connection to industry and community is another important component in providing effective energy career education. Most programs report engaging career education professionals, parents, and community in student career planning, as well as seeking input from an advisory board comprised of energy industry representatives, and providing students with opportunities to visit companies specializing in renewable energy or energy efficiency.

For career technical education, devoting attention to energy-related career pathways and strong relationships with higher education segments are crucial elements. Green Academies are especially successful in building partnerships with post-secondary institutions in both informal and formal (through articulation agreements) ways.

14.8.3 TAILORING PROGRAM TO REGIONAL NEEDS IN ENERGY EFFICIENCY AND RENEWABLE ENERGY

Based on the information collected through the interviews, organizations that work collaboratively with the local/regional industries and communities and tailor programs to their needs are better able to provide the education and training that is relevant to the marketplace and appealing to the community. The effect of such approach is twofold: (1) contextualized learning provides immediate relevance of the material to the students, and (2) strong partnerships with community and industry are secured.

14.8.4 FOCUS ON TEACHER ENGAGEMENT

Programs that focus on providing teachers with resources and training and engaging them in energy awareness education tend to produce broader impact. For example, NYSERDA (New York State Energy Research and Development Authority) has extensive experience in providing energy awareness education to K-12 segments in the state of New York. NYSERDA's efforts are focused almost exclusively on professional development activities for teachers and non-formal educators, as this delivery method allows them to educate larger numbers of students at all grade levels about energy efficiency and conservation. Engaged teachers also contribute to the long-term sustainability of a program, as they are more likely to continue the program even if or when the funding expires. In addition to professional development workshops, best practice programs engage teachers by providing them with kits and materials for hand-on exercises, as well as connecting them with industry professionals, and organizing field trips for students.

14.8.5 INDUSTRY PARTNERSHIPS

There is a consensus among K-12 program and curriculum providers that strong partnerships with the industry are critical. The research shows that program providers involve industry representatives in many stages of program development and implementation process. Many programs interviewed report that they have functioning industry advisory boards. Industry partnerships are recognized as an important factor of success as they help the programs in the following areas:

- → Developing and upgrading curriculum that is relevant to the marketplace;
- → Securing funding for the program;
- → Organizing field trips and industry presentations for the students;
- → Providing internship opportunities for students and externship opportunities for teachers; and
- → Donating equipment and materials.

14.9 STUDY LIMITATIONS

The data collected come with limitations that should be noted. The following are two factors that may have influenced the findings of this study and should be taken into consideration.

- → First, collecting data through interviews allows the potential of biased answers. It is possible that program administrators embellished on the positive aspects while withholding negative features.
- → Second, the sample size (n=22) is relatively small, so the results based on these interviews may not be representative of other programs.

14.10 RECOMMENDATIONS

- INCREASE COLLABORATION AMONG VARIOUS STAKEHOLDERS AND ENTITIES in the K-12 education community within California. These partnerships should focus on developing a systematic, organized effort to institutionalize energy awareness and career awareness education programs, and align them with California Content Standards. This could begin by exploring key partners' willingness to establish an ad hoc committee to support these priorities/goals and partnerships. The Career Awareness Committee within the Florida Energy Workforce Consortium is a possible model that could be explored. They successfully integrate utilities and state educational community to work towards common goals.

  Partnerships should include organizations and programs that have *an explicit focus on serving disadvantaged communities and lowering school dropout rates*, like the Career Academies. The following is a list of possible entities to be included in the collaboration: California Department of Education, California Partnership

Academies, investor-owned utilities, publicly-owned utilities, California Energy Commission, California Public Utilities Commission, California Environmental Protection Agency, organizations providing after-school educational programming, and high-performing K-12 energy education programs (representative of all funding sources). Collaborative efforts could also extend outside of California to compare ideas and stay current on developing technologies and approaches with such agencies and organizations as NYSERDA, the Wisconsin K-12 Energy Education Program (KEEP), and the Florida Energy Workforce Consortium (FEWC). National programs, such as the Environmental Protection Agency's Education and the Environment Initiative of the Education and the Environment Initiative may be strong resources with which to work and/or support on a statewide level, if they are found to align with identified key goals.

- COORDINATE, LEVERAGE AND MAXIMIZE IMPACTS OF FUNDING: Identify and consider how best to coordinate multiple sources of funding with multiple objectives of funders, for the purpose of determining how to best leverage these funds. Programs should also consider and identify ways to reduce budgets without sacrificing program elements, for example, by utilizing reusable materials). During application processes, funding agencies should require programs to explicitly indicate how they will incorporate and address the best practices identified in this report. For example, the programs that incorporate teacher engagement activities could be scored higher on their applications. Also, when considering programs to fund, utilities should identify successful, oversubscribed programs that lack the funds and resources necessary to be sustainable.
- PLACE MORE EMPHASIS ON CAREER AWARENESS AND CAREER RESOURCES: This includes Increasing the emphasis on all three stages of career awareness, exploration, and career preparation topics in programs addressing energy awareness and could include developing grade-level appropriate career resource guides that explicitly outline what is to be covered in career awareness, exploration and preparation education. Such guides could include links to career development websites, job descriptions, companies that offer on-site field trips, etc. These resource guides could be utilized by K-12 teachers and students throughout the state to better enhance career development education.
- DEFINE AND DETERMINE ADDITIONAL IMPACT METRICS that are realistic and measurable for future program evaluations and recognize the distinct objectives and restrictions of the collaborators.

14.11 SUGGESTIONS FOR FUTURE RESEARCH

- EXPLORE THE DEVELOPMENT AND INCORPORATION OF STANDARDIZED METRICS for K-12 programs. Such metrics should be measurable and should take into account the distinct objectives and restrictions of program collaborators. Our research indicates that most energy awareness programs used pre- and post-tests to evaluate changes in awareness; relatively few programs track the energy consumption changes in individual households and schools. For career awareness, very little tracking is done of how career awareness programs influence future career paths of students. The development and the inclusion of affordable metrics would help to provide objective measures of program impact. Conduct research and/or acquire data that illustrates program success in terms of job placement, especially for the grades 9 through 12 programs. Completer data helps to provide a better understanding of how programs continue to affect students once they have graduated.
- CONTINUE AND EXPAND RESEARCH OF THE GREEN CALIFORNIA PARTNERSHIP ACADEMIES: Since these programs are relatively new (some only in operation a couple of months at the time of interviews), no outcomes data are available. Additional research is needed in order to determine the effectiveness of these programs and should be done as the green CPAs are become more established.

- DETERMINE DATA AND COLLECTION METHODS necessary to measure the effectiveness of K-12 programs. Key data should be collected to determine the ways in which programs affect the ongoing education and training of California's students and future workforce, but more research is necessary to determine the most important information and what data programs should be required to collect and maintain. For example, tracking outcomes over time would allow for observation of the behavioral and career impacts of programs, but would require considerable coordination.
- CONDUCT FORMAL EVALUATIONS OF PROGRAMS TO DETERMINE TRUE BEST PRACTICES: The practices outlined in this report are based on self-report from interviewed programs, expert interviews and relevant and recent literature. Program evaluations would provide a better understanding of effective practices and the impact they have on program participants.
- EXPLORE ENERGY-RELATED SERVICE LEARNING ACTIVITIES FOR STUDENTS: Service-learning activities may increase student and teacher buy-in with the program.

CHAPTER FIFTEEN:

15. EMPLOYMENT INFORMATION SYSTEMS

15.1 INTRODUCTION

This chapter provides a review of "employment information systems" relevant to employers and job seekers in the energy efficiency labor markets. Employment information systems (or "EIS") include job banks, job matching systems, and other Internet-based information systems designed to connect workers with employers.

The purpose of this chapter of the Needs Assessment is to provide a more thorough understanding of where, how, and how effectively EIS contribute to matching labor demand with supply in the relevant markets. This information is intended to offer guidance on decision-making and future investment for a WE&T web portal, which was proposed as a near-term strategy in the California Energy Efficiency Long Term Strategic Plan, adopted by the Commission in September 2008. As described in the EE Strategic Plan:

> *The web portal will include links to various demand-side management (DSM) related training programs and will allow for a single point of communication. The portal will also serve as a repository for all demand-side management and energy efficiency training, educational conferences, and career opportunities. This portal will be created and funded in collaboration with other appropriate entities, and linked to the statewide energy efficiency web portal.*

To better inform the development of the web portal, this chapter provides an overview of existing Internet-related job matching systems and an exploration of the various types and functions. It also assesses effectiveness of EIS in job matching, and identifies major challenges for EIS providers as well as nationwide best practices. Based on this information, and the findings of the Needs Assessment as a whole, we offer our recommendations on the development of an EIS for energy efficiency in California and possible next steps.

The analysis we present here is based on a variety of strategies used to gather information on Internet-based EIS, including a literature review, conversations with subject-matter experts, web research, and qualitative one-on-one interviews with EIS providers. More detail on the methodological approach of this research can be found in Appendix J.

15.2 BASIC FUNCTION OF EIS

EIS can play an important intermediary role in labor markets by facilitating the exchange of information between job seekers and employers. For both job seekers and employers, lowering the costs (both time-related and financial) of obtaining information makes finding a job and hiring the right employee more efficient. Job seekers benefit from increased awareness of employment opportunities, training requirements, and options for training and education programs. Employers benefit from advertising job opportunities to potential employees, and accessing a pool of job applicants.

Anthony Dais of the U.S. Department of Labor's (DOL) Employment and Training Administration (ETA) characterizes the two sides to an EIS as the "labor market exchange" and "labor market information."[1] Here we concentrate on the labor market exchange component of these systems. EIS generally include job postings, as well as news and information useful for a job search by workers and an employee search by employers.[2] The synthesis of job postings and information is the common purpose of all EIS, and the basis for the working definition we use:

> *An Employment Information System is any service that exists to facilitate labor market exchange between employers and jobseekers. At minimum, EIS should include job bank components (primarily defined as listings of job postings) but may also include comprehensive search algorithms, resume banks, career information, training opportunities, educational programs, social net working capability, etc.*

15.3 TYPES OF EIS

The federal government runs the largest and most comprehensive EIS for all sectors and workers through its One-Stop Career Center system, coordinated by the DOL ETA.[3] The "One-Stop" system is the central component of the federal Workforce Investment Act (WIA), passed in 1998. In California, there are 259 One-Stop Career Centers spread throughout the state. One-Stops are designed to provide a full range of assistance to job seekers under one roof. The centers offer training referrals, career counseling, job listings, and similar employment-related services. Individuals can visit a center in person or connect to the center's information through a personal computer or a remote access kiosk. One-Stops are operated by a variety of entities, including local Workforce Investment Boards (WIBs) and county agencies, as well as non-profit organizations that are contracted to provide all or some of these services. All are supported by federal funding, and frequently One-Stops offer access to wrap-around or support services for specific populations such as youth and dislocated workers.

The private sector has also established a variety of EIS. In contrast to the broad audience that is served by One-Stops for no fee, most private systems are narrowly focused job listings that serve a targeted, paying clientele. Over the past ten years, systems for sharing job information, particularly those using electronic systems, have grown in volume and variety from electronic "help wanted" ads to full-featured services encompassing employment sections on corporate websites, online application forms, searchable resume databanks, "spidering" systems that compile information from multiple sites, and (less frequently) links to training and career exploration. The most comprehensive list of the various types of EIS that are relevant to a green industry focus is offered by Jim Cassio in his *Green Careers Resource Guide*. He outlines the following types of EIS:

→ General purpose employment websites or job boards (e.g., Monster.com)
→ State job banks (e.g., CalJobs, EmployFlorida)
→ Local/regional employment websites (e.g., Craigslist)
→ Local/regional newspaper online classified ads (e.g., Los Angeles Times)
→ Niche employment websites serving specific industries or professions (e.g., Energy Central Jobs, CleanTechies.com)
→ Employer websites (e.g., Target, Wells Fargo)

[1] EIS labor market information refers to the government data collection system of labor market data. in California this is the Labor Market Information Division, which though useful to workers and employers, has a much broader function.

[2] Cassio, J. (2009). Green Careers Resource Guide, Green Capital Alliance. Retrieved from: http://www.greencapitalalliance.org/docs/GreenCareersResourceGuide(Fall09).pdf.

[3] For more information, visit the Employment and Training Administration (ETA) website at http://www.doleta.gov.

→ Job Search engines (e.g., Simplyhired.com, Indeed.com)
→ Networking websites (e.g., LinkedIn, Facebook)
→ Offline networking (e.g., Internships, networking groups)

Most of the EIS identified by Cassio are represented in Appendix K, the inventory of EIS compiled for this report. Some programs fall into multiple categories. The inventory includes four non-governmental, general purpose employment websites, four state employment websites and job boards, nine local One-Stop Center systems, one networking site for workforce professionals, seven career exploration resource sites, and 45 niche job boards and websites, among which many can also be classified as job search engines, spidering systems, or employer job boards. There is a noticeable concentration of niche ("green") job boards in the inventory, as the aim of this study was to identify features and characteristics of EIS that would benefit the energy efficiency related sectors. Green job boards are a new and emerging type of job board, and as such, general job boards were contacted and interviewed to contribute to the forming of best practices for Employment Information Systems. In addition, the EIS inventory includes organizations which primarily focus on providing pre-employment services to the job seekers, such as career and industry information. These service providers were not interviewed but can be a valuable resource for the workforce arena.

In order to capture the full scope of offerings of EIS, this study identified two distinct groups: (1) job boards, primarily in green related sectors, and (2) full-service EIS. Most job boards are private sector, and most—but not all—full-service EIS are connected to the One-Stop Career Center System.

15.3.1 JOB BOARDS

Job boards are Internet-based job search websites that serve both general and niche job markets. The job boards serving the green and energy efficiency labor markets are primarily privately funded with either commercial or non-profit goals. A niche job board focuses employment matching efforts on a specific industry or cluster of industries, while a general job board supports labor exchange in all industries. Our study specifically focused on green and energy efficiency related niche job boards in order to gain a better understanding of what services are offered specifically to job seekers and employers in these sectors.

Through web search and literature reviews, we identified 47 green-related and general job boards for this study. The majority of them (87 percent) have an industry or occupational specialization in energy (traditional, renewable, wind, solar, etc.), energy efficiency, general green, environmental health and safety, or non-profit fields. The remaining job boards are general-purpose employment websites and spidering systems. Among the market leaders in the commercial job matching industry, Monster.com and Careerbuilder.com were included in the inventory. However, administrators of these EIS did not respond to our requests for an interview.

Of the 47 job boards, 12 can be categorized as more than one type of EIS, including general and niche job boards, spider search engines, employer websites, etc. Spider search engines account for six of the job boards in the inventory. Spider search engines supply job seekers with job vacancies pulled from a variety of employer, recruiter, and job board websites. Job boards typically do not have a physical location; their services are offered only online. In addition to job postings and related job information, job boards generally contain a resume board and resume search function and have incorporated social networking and blogs into their menu of services. Nearly all job boards are open access systems for job seekers, with only one (Net Impact: Career Center) requiring a for-fee registration. As a general rule, green job boards do not restrict their postings to one local or state area, and instead are open nationwide.

We attempted to contact the sponsors of all 47 boards for an interview; providers of 11 job boards agreed to participate, yielding a 23 percent response rate. Table 15.1 shows the list of job boards and job matching websites that responded to the survey. The table incorporates the name of the job board, the duration of its existence, its industry focus (if any), an indicator of the size of the employment matching operation (in number of postings or other reported metric), geographic service area, and the targeted job seeker profile.

A brief description of the 11 niche job boards interviewed follows:

- CLEAN TECHIES: A niche job board dedicated to jobs in clean technology. Clean Techies incorporates blogs and related career resources into their services for job seekers.
- EFFICIENCY FIRST JOB BOARD: A niche job board dedicated to jobs in the home performance industry. The parent organization, Efficiency First, is a national, membership-based non-profit trade association for the home performance workforce.
- ENVIRONMENT, HEALTH, AND SAFETY (EHS) CAREERS: A niche job board with a focus on the postings related to environmental regulations, occupational health, and safety occupations.
- ENERGY CENTRAL JOBS (ECJ): A niche job board portion of parent company, Energy Central. ECJ targets mid-level professionals in the energy sectors.
- ENERGY JOBS PORTAL: A self-described niche job bulletin for occupations related to energy and utilities sectors. It is based on the West Coast.
- GREEN CAREER CENTRAL: A niche job board that provides educational information about green careers as well as job matching services related to broadly-defined green jobs.
- GREEN JOBS: An information center that hosts job postings from employers in the field of renewable energy, such as wind, solar, and geothermal. Although it has global representation, the majority of the postings are from firms in North America.
- GREEN JOBS SPIDER: A spidering job search engine that generates job postings from several green-related job boards.
- IDEALIST.ORG: A niche job board that has an emphasis on social and environmental responsibility and caters to job seekers looking for employment with non-profit organizations or government agencies.
- JOB CENTRAL: A general job board/web portal that provides direct links to employer websites. This is an employer membership-based service.
- SUSTAINABLE BUSINESS.COM – GREEN DREAM JOBS: An informational portal that hosts green job postings, as well as providing information on a variety of topics, such as investing in green industries and technologies and building a green business.

Table 15.1 Characteristics of Green Job Boards Interviewed

Name	Years in Existence	Industry	Size (postings)	Geographic Service Area	Target Audience
Clean Techies www.cleantechies.com	2	Clean/Green Technology	80 per month	U.S.	White collar professionals, career changers, unemployed
Efficiency First jobs.energyliberty.org	<1 (2 weeks at the time of interview)	Home Building Performance	44 (after 2 weeks of operation)	U.S.	Anyone involved in the home performance industry
Environmental, Health, Safety (EHS) Careers www.ehscareers.com	7	Environmental, Health, Safety	450 per month (avg.)	Global	Workers with 2-3 years of experience to professionals
Energy Central Jobs www.energycentraljobs.com	13	Energy and Utilities	35,000 unique users	U.S., Canada, and some international presence	Mid-level professionals with 4-7 years of experience
Energy Jobs Portal www.energyjobsportal.com	8	Energy and Utilities	201 (at time of interview)	Contiguous U.S.	All job seekers
Green Career Central www.greencareercentral.com	3	Green	No response	U.S. and some international presence	Job seekers and educators
Green Jobs www.greenjobs.com	6	Renewable Energy/Energy Efficiency	250	U.S. with some international presence	All job seekers
Green Job Spider www.greenjobspider.com	10	Green, Renewable Energy and Energy Efficiency	12,500 per month (avg.)	U.S.	College students, professionals, anyone looking for a green job
Idealist.org www.idealist.org	10	Non-profit organizations or government agencies	5,670 (at time of interview)	Global	All levels of skill and education
Job Central www.jobcentral.com	9	None	750,000 per day	U.S.	Recent graduates
Sustainable Business: Green Dream Jobs www.sustainablebusiness.com	16	Green industries	No response	U.S.	Anyone looking for a green job

The skill, education, and professional level of the target audience vary across job boards. Seven of the 11 respondents indicated that their audience is job seekers of all backgrounds. However, when asked about average skill level and educational attainment of the job seekers that they serve, most green job boards reported middle- or higher-skilled professionals and job seekers with college degrees. Interviews and the analysis of the current postings showed that these green job boards provide very limited services and resources to low-skilled, less educated populations.

According to the data collected from the interviews, all job boards offer an opportunity for job seekers to search a database of available job openings, but very few provide additional information and services not directly related to the job matching function. Among the most commonly offered additional features or functionalities included on green job board websites are:

→ Posting of resumes (Efficiency First, EHS Careers, ECJ, Job Central)

- → Resume writing services that are usually offered for an additional fee (Clean Techies, Job Central)
- → Industry related information or blogs (Clean Techies, EHS Careers, Green Career Central, idealist.org, Green Jobs, Green Jobs Spider, Job Central)
- → Connection to networking sites, such as LinkedIn and Facebook (Clean Techies, ECJ, Green Career Central, Green Jobs Spider, Job Central)
- → Automated notification services (EHS Careers, idealist.org, Job Central)

Hosting of an information exchange and/or blogging about industry trends and careers seems to be a prevalent additional service provided by green job boards to their users. Seven of the 11 job boards interviewed cited the availability of such feature on their sites. The inclusion of networking tools for a more enhanced search experience is reported as one of the important trends of where the industry is going. This feature is normally added in connection with such social media websites as LinkedIn and Facebook. Five job boards explicitly stated that they currently operate a page or an account on these sites and/or utilize professional networks created there.

15.3.2 FULL-SERVICE EIS

Full-service EIS include any workforce agency, banner center, or One-Stop Center. [4] Funding for full-service EIS is typically provided by governmental agencies directly or indirectly through contracts. A full-service EIS provides access to job boards and other Internet-based systems but also provides on-site services (e.g., interview practice sessions).

To inform the study and analyze best practices, we compiled a list of 22 full-service EIS through online searching and peer referrals. These full-service EIS include five One-Stop Career Centers in California (out of 259),[5] four One-Stop Career Centers in other states, including New York and Florida, four comprehensive statewide labor market and employment websites in California and three other states,[6] one local green career site (privately funded), and eight career information and employment resource websites. The state employment website in California is represented by the Employment Development Department–Labor Market Information Division portal. It includes a variety of related content as well as extensive resources for employment matching. One full-service EIS with a specific focus on energy, Minnesota's ISEEK Energy website, is also included in the inventory.

Of the 22 full-service EIS, nine have a physical location in addition to a website, and many offer employee screening. Access to full-service EIS is usually unrestricted for job seekers. These full-service EIS tend to service a local and/or regional population and provide extensive services to disadvantaged populations. The majority (17 out of 22) of the systems and services identified have a general industry focus; the other five EIS are energy or green career specific sites. Generally, full-service EIS have not incorporated a social network component to their service offerings and do not operate blogs.

Out of the 22 full-service EIS contacted, seven administrators agreed to participate in the study. A set of basic characteristics about these seven are presented in Table 15.2. The table includes the name of each EIS provider,

[4] A banner center is a physical location that provides resources and services with a focus on education and training for the workforce. Banner centers rely on partnerships with workforce, education, industry, and economic development entities to supply their services.

[5] These five One-Stop Career Centers were included in the inventory for one or more of the following reasons: their successes related to job matching, operating a comprehensive online labor exchange system, and focusing on clean energy or green careers and jobs.

[6] The states' employment service is an integral part of the One-Stop delivery system that provides universal access to an integrated array of labor exchange and Workforce Investment Act services delivered through the statewide One-Stop Career Center system. These services are available to all job seekers in a given state. Although they provide connection to One-Stop system services, they often utilize additional public and private funds to develop additional services and informational resources.

the duration of their existence (in number of years), the industry focus, the geographic area they serve, and the target audience for their services.

The following is the short description of each full-service EIS covered in the interviews:

- GREEN CAREER NETWORK (GCN): A local job matching site that is a service of the Center for Sustainable Energy, a private non-profit agency located in San Diego County. This EIS combines information about green careers, and connects local residents to job opportunities in clean energy sectors.
- LOS ANGELES URBAN LEAGUE (LAUL): A local network of workforce and One-Stop Centers with a focus on education, training, and employment placement. The LAUL serves the population in South Los Angeles.
- NORTH VALLEY JOB TRAINING CONSORTIUM (NOVA): A local One-Stop Center that provides customer-focused workforce development services as well as employment matching services. NOVA works with a variety of sectors. However, its administrators are devoting special attention to renewable energy and energy efficiency sectors.
- SACRAMENTO EMPLOYMENT TRAINING AGENCY (SETA): A workforce agency and One-Stop Center agency of the City and County of Sacramento. It provides multiple services to displaced workers and profiles local green-related industries on its employment website.
- EMPLOY FLORIDA MARKETPLACE (EFM): A state employment website with a connection to case management through the Florida One-Stop system.
- ISEEK ENERGY: A career information and employment website for job seekers in Minnesota that focuses on energy and incorporates such elements as career assessment, labor market information and job search. It is an industry specific part of a general career and employment website "ISEEK."
- WORKFORCE FLORIDA: A non-profit organization that administers and oversees workforce development policies, programs, and services in Florida.

We found that full-service EIS were, in general, older and more established than the green job boards that we interviewed. Most full-service EIS interviewed (five out of seven) have been in existence for more than 10 years. The geographic service area of full-service EIS is specific to either a local cluster of counties or an entire state. The audience that full-service EIS target includes not only job seekers and employers, but also intermediaries that provide needed support services, such as educators, training providers, counselors, and community based organizations.

Full-service EIS typically do not have a particular industry focus but instead provide services to meet the labor matching needs of the more prominent industries in their region. The focus of full-service EIS is to provide not only employment matching services but also a continuum of services to support successful labor market exchange with the ultimate goal of lowering unemployment. This continuum of services includes career assessment, career counseling, employability training, information about jobs in demand, connections for displaced workers to available education and training options, training and retraining, and case management services.

Table 15.2 Full-Service EIS Characteristics

Name	Years in Existence	Industry Focus	Geographic Service Area	Target Audience
Green Career Network www.energycenter.org	1	Energy, Utilities, Renewable Energy, Energy Efficiency	San Diego, CA	People who are currently in the green industry but want information about additional opportunities and people who are looking for a career change or who are displaced and are now starting to consider starting a green career
Los Angeles Urban League (LAUL) www.laul.org/worksource-centers	90	General	South Los Angeles, CA	Students, parents, educators, intermediaries, job seekers, and employers
North Valley Job Training Consortium (NOVA) www.novaworks.org	18	General	Northern Santa Clara County, CA	Unemployed workers in the service area
Sacramento Employment Training Agency (SETA) www.seta.net	32	General	Sacramento County, CA	Students, adults, seniors (industry professionals who want to switch careers), employers, and trainers.
Employ Florida Marketplace www.employflorida.com	4	General	Florida	Students, parents, educators, intermediaries, employers, job seekers
ISEEK Energy www.iseek.org/industry/energy	12	Energy, Health Care, Information Technology, Manufacturing	Minnesota	Students, parents, teachers (K-12 and secondary), dislocated workers, veterans, disabled workers, ex-offenders, immigrants, refugees, counselors, and advisors.
Workforce Florida www.workforceflorida.com	75	Clean Energy, Life Sciences, Information Technology, Aviation/Aerospace, Homeland Security/Defense, Financial/Professional Services, and Manufacturing	Florida	Students, parents, educators, intermediaries, employers, job seekers

Information provided by administrators of full-service EIS indicated that the most common services offered by these EIS either through web portals or at their physical locations were:

- Job posting and search (All)
- Information about education and training options, and/or delivery of training (EFM, Green Career Network, LAUL, NOVA, SETA, Workforce Florida)
- Resume and cover letter assistance (ISEEK Energy, LAUL, NOVA, SETA)
- Skills assessment (EFM, ISEEK Energy, LAUL, SETA, Workforce Florida)
- Case management and job placement services (NOVA, LAUL, SETA)

Full-service EIS providers often partner with other agencies and institutions to deliver many of the above services. While green job boards tend to be fragmented and primarily partner with large employers and industry groups, full-service EIS heavily rely on partnerships with other local, regional and state institutions to support labor exchanges. Such partnerships are deeply rooted in the communities and regions where these EIS operate and involve organizations such as educational institutions, training facilities, industry leaders, and state or local workforce agencies.

The most common partnerships that full-service EIS providers engage in include:

- TRAINING OPPORTUNITIES: Six of the seven full-service EIS administrators interviewed noted partnerships with public and/or private institutions for the offering of training programs to job seekers; these were the One-Stop Centers that are part of the federal WIA system. Some also connect employers with training providers for skill enhancement of incumbent workers and training of newly hired employees at an employer site. These partnerships are instrumental as they allow low-skilled job seekers to obtain additional skills that are required by employers, making them more employable and helping them to advance. Community colleges are often mentioned as training partners of full-service EIS.

- JOB POSTINGS: Full-service EIS typically do not operate their own online job boards, especially the ones focused on green industries. Instead they depend on the job board of their state and on relationships with regional businesses to keep apprised of job vacancies.

- OUTREACH AND ADVERTISING: Because the web presence of full-service EIS is limited and does not guarantee an easy outreach to all groups that need their services, the partnerships they foster with local businesses, educational institutions, community based organizations and other strategic entities assist in advertising their services to the public and employers. These partnerships help EIS providers reach out to populations that may not otherwise be aware of their services.

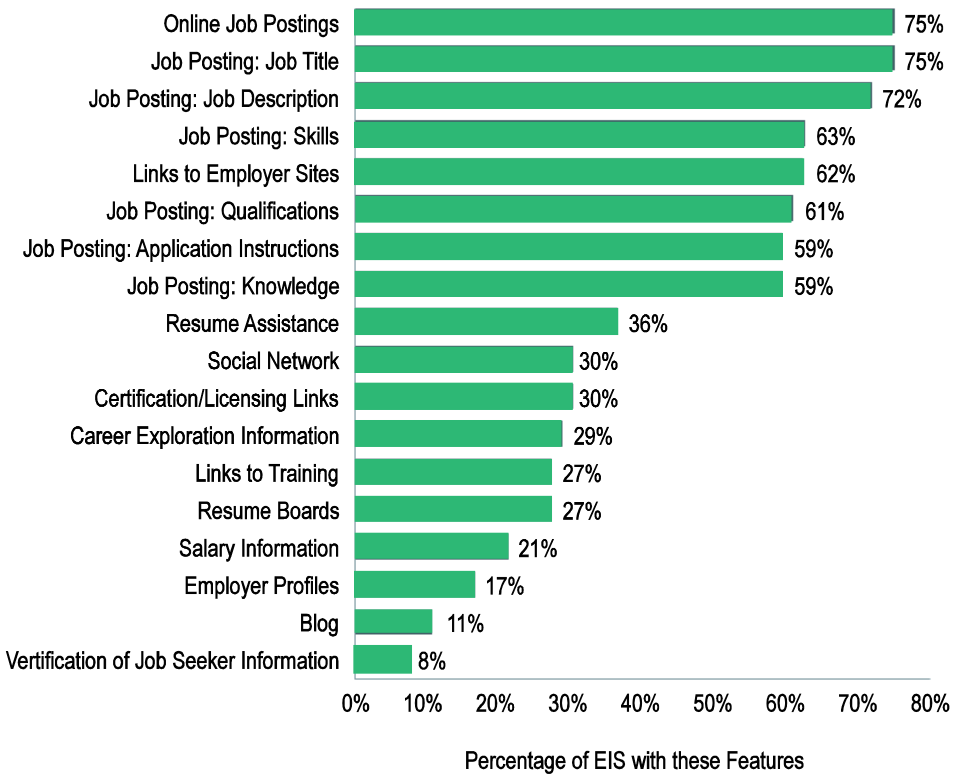
15.4 FEATURES OF EIS

After the list of various EIS was compiled, we conducted a cursory online review of each system to document common characteristics and features. We specifically were interested in whether or not a given EIS incorporates the following features and services: job posting details (title, description of duties, qualification requirements, etc.), additional site features (resume uploads, employer site connections, and social networking), additional intermediation services (links to training, career information, resume preparation services, etc.), and verifiable job seeker data, such as some type of a credential or skill-based test scores.

Figure 15.1 shows the list of the features and services that were tested, sorted from the most commonly utilized down to the least common. The bars on the graph represent the percentage of EIS that incorporate each of the features. All 68 EIS included in the inventory were screened for these features and services. Please note that three EIS could not be screened for some of the features directly related to job posting because access to these sites was restricted.

As expected, the most common feature is online job postings; included in 75 percent of EIS. The rest of the EIS (that do not have online labor exchange system and operate only a physical location) either connect to a different job site or provide only pre-employment services. Among the job posting features, job title and job description are the most commonly supplied data. Only three percent of EIS provides a job title, but then links to another site for more detailed information related to the job opening. Among the reviewed EIS, job posting features offered also include skill requirements (63 percent), minimum qualifications (61 percent), application instructions (59 percent) and knowledge requirements (59 percent). However, salary information is provided by only one out of five EIS reviewed.

Figure 15.1 Common Features of EIS



In addition to job posting features, other common services offered by EIS interviewed are links to employer websites (62 percent of EIS provide this type of connection) and social networks (30 percent). Intermediation services—which include links and/or access to training, certification, licensing, career exploration tools, resume assistance and interview preparation—are provided by less than a third of EIS identified. Of these intermediation services, resume uploading and other assistance was the most prevalent among the EIS included in the inventory (36 percent of EIS provide this).

We also looked at the frequency of content update among the EIS that have a web site. The content of the EIS (among those covered in the survey) is typically updated frequently; 89 percent update their content on at least a daily basis. The other 14 percent that perform content updates less frequently are full-service EIS, which provide services primarily off-line.

In the attempt to provide a high level assessment of the ease of use of each EIS, we ranked each online EIS using a scale from "very difficult" to "very easy" to use. The criteria utilized for this ranking included the availability of clear instructions for a job seeker, ability to access the site without registration, the number of clicks necessary to generate a listing of jobs, and other related criteria, All 66 EIS with an online component were assessed. The majority of the EIS are easy to access based on our criteria; 74 percent of the identified EIS were ranked as "easy" or "very easy" to access by the research team. Those that were ranked poorly on the ease of use required registration (either for a fee or without), did not provide clear instructions or paths for a job seeker to navigate the site, or required more than five clicks to get to job listing, These results can only be considered preliminary as a more comprehensive and representative evaluation of the ease of use of EIS is necessary. Such assessment would include evaluations from representative panels of target job seeker and employer populations of various aspects of the sites.

15.5 FUNDING

According to the data collected from the interviews, green job boards and full-service EIS are funded differently. Job boards are privately funded either directly through fees collected from employers for job posting services or by non-profit groups, such as industry and workforce associations. Most of the full-service EIS covered by our survey are supported by governmental funds, either through the U.S. Department of Labor or state and local labor or workforce agencies. Green Career Network in San Diego is the only full-service EIS among those interviewed that is not directly supported by governmental funding, but rather by a private non-profit organization.

As mentioned, job boards depend on the revenue they generate through their services. Most of this revenue comes from employer job posting fees. Some job boards also collect fees for advertisements on their websites and additional services to job seekers, such as resume writing assistance or career coaching. Since job boards' budgets depend so much on income generated from job posting fees, employment information systems with strong ties to the industry tend to fare better than those without such ties. For example, Energy Central portal was created by the utility and energy companies as an engine that would support labor exchanges in their industries. The interest of the industry in this job board allowed for significant growth and market share in the labor exchanges of this industry. On the other hand, the survival of job boards without explicit ties to the employers is dependent on their ability to solicit employer participation. Many of these job boards interviewed cited lack of funding as a main obstacle to development. As a rule, they don't have sufficient resources to offer additional services to job seekers.

Full-service EIS are able to provide the level and amount of services that they do because of the funding they receive through workforce related grants. Not only do grant funds support the expanded offerings of full-service EIS but in most cases grants dictate the use of funds toward specific purposes for specific types of jobseekers. The attainment of grants with a particular industry focus, like green jobs, translates to full-service EIS incorporating particular skills, training, and information into their offerings.

15.6 EFFECTIVENESS OF EIS

Although Internet-based job search has become standard practice for all ages and demographics in a variety of industries, the literature suggests that EIS are only partially effective in meeting the needs of employers and jobseekers. Specifically, online job boards prove to be the most instrumental in providing an initial set of contacts for employers and job seekers, but have achieved limited results for successful job matching that leads to employment. The information from our interviews with subject matter experts in the field of labor exchanges suggests that employers are experiencing a low match rate, even after going through large pools of resumes generated by online job posting.

This may be explained by one of two factors. The first is a poorly designed matching algorithm that provides an employer with hundreds of candidates who do not qualify for a given position. Experts claim that larger, more established online job boards as well as some spidering job search systems tend to have more sophisticated matching algorithms compared to smaller or industry-specific job banks. Indeed, our research supports this proposition—when asked about specific matching algorithm utilized, the administrators of green job boards reported no specific job matching system in place, other than a keyword search.

The second factor is the lack of other verifiable information about job applicants built into an automated labor exchange system that would be used to produce the most relevant matches between job seekers and employers. Such verifiable data include diplomas, certifications, references, credentials, test results, etc. According to Richard Maher of Maher & Maher, a management consultant specializing in e-learning for the public workforce systems, very few online job search systems offer these, and employers have recently started turning to social networking sites and online communities in search of talent.

There is also a significant body of literature suggesting that online job search systems primarily benefit employed workers and prove to be relatively ineffective in reducing unemployment durations. Stevenson finds that the vast majority of workers using the Internet to gather information about employment are those who are already employed.[7] In addition, employers prefer to hire workers that are employed elsewhere because they are looking for experience and suitable skills. Since online job search engines make it easier for employers to identify such workers, these systems may particularly advantage employed versus unemployed job seekers.[8] This raises an important issue—the role of EIS in expanding the pool of new workers vs. simply "reshuffling" existing workers. This issue takes on greater importance given the current levels of unemployment in California and across the U.S.

However, even among employed workers looking for employment elsewhere, the effectiveness of online job search differs. For example, various experts we interviewed suggested that professionals at higher levels of education are more likely to use Internet job search engines. Stevenson complements this observation by showing that the number of low-skill jobs advertised online is significantly fewer relative to the number of high skill jobs, and concluding that "Internet job search as a mediating mechanism may have a much smaller effect, or no effect, on those with a high school degree or lower and a larger effect for those with some college education and beyond."[9] In fact, among the green job boards included in our study, the majority are serving middle-skill and college educated job seekers.

This may also suggest that the full-service type of EIS explored in our study provides a more successful model of job matching for unemployed and disadvantaged populations. These EIS are better positioned to offer additional labor market intermediation services, such as career exploration, resume and interview assistance, connection to training, case management and other employment-related services. Privately run job banks are not designed for this purpose and primarily function solely as a "marketplace" for employers and job seekers.

Strategic partnerships that full-service EIS providers form with other agencies play a vital role in their successful employment matching functions. Through partnerships and ongoing dialogue with local employers, full-service EIS can ensure that they are meeting the needs of businesses in their immediate service area. Employers are provided with potential job candidates who have been screened for particular qualifications and a successful match is more likely. Since most full service EIS are One-Stop Centers they have full access to the federal resources of WIA including the additional support services for disadvantaged job seekers.

However, our research suggests that because some full-service EIS do not operate green job boards online and, in most cases, are limited in the geographic scope of their services, their role in labor market exchanges in green industries is limited. These EIS only host jobs available in their geographic service area and do not post job opportunities in energy efficiency and renewable energy careers that would require relocation. Some of the EIS interviewed offer additional labor market, career awareness and training information related to green careers on their websites, but, as a rule, they do not tie this information to job postings. The most extensive online energy-related EIS offerings are found at ISEEK Energy portal. This web portal includes significant learning resources for a job seeker who is looking into starting or transitioning to a clean energy career. The features of the site include career guides, aptitude assessment tests, and connection to education and training requirements. However, the employment matching portion of the site is limited to (1) providing links of the online job boards of major

[7] Stevenson, B. (2009)." The Internet and Job Search." Ch. 2 in Studies of Labor Market Intermediation. D.H. Autor, ed. Chicago, IL: The University of Chicago Press. p. 84

[8] Nakamura, A.O. et al. (2009). "Jobs Online." Ch. 1 in *Studies of Labor Market Intermediation*. D.H. Autor, ed. Chicago, IL: The University of Chicago Press. p. 36

[9] Stevenson, 2009, p. 82

renewable energy industry associations and groups, and (2) connecting the user to the general online job bank, in this case Minnesota Works, that posts all available jobs and doesn't systematically differentiate between energy related openings and general job postings.

Green job boards are fairly successful in providing job listings within their industry specialty, but have a very limited ability to secure jobs for low-skilled and currently unemployed individuals. Online job boards appear to be used far less often by low-skilled workers, which may be a result of a lack of Internet access among this population, or a lack of necessary skills (such as English proficiency) to use these services. Or, it may be simply because employers are not using these job boards to post low-skilled employment opportunities. Based on our interviews, many employers do not wish to post low-level openings online because they fear they would get overwhelmed with the number of applications received, and they do not typically have matching or sorting algorithms that would allow doing that automatically using a certain criterion, such as educational level, certification, etc. Niche job boards appear to work well for employers that need to fill vacancies in middle- and higher-skill areas within their specialized industries, however. Administrators of more established job boards report that returning clients constitute the majority of their customer base. Because available jobs are typically returned to job seekers through a simple keyword search within the green area represented by the job board, limiting the job bank to only those in green-related occupations provides relevant job vacancies as opposed to more general openings.

Further analysis of how effective the full-service EIS and green job boards are as intermediaries in labor exchanges is difficult because there are no outcome measures that are consistently tracked and reported. When asked about how they track their performance, most green job board administrators reported that they do not follow-up with employers to find out whether or not a vacancy was filled and how successfully. The number of postings is claimed to be the main self-identified measurement of their success. Some online job boards also collect general feedback and testimonials from repeated customers, but such efforts are sporadic and do not allow for an objective evaluation of outcomes.

The inclusion of social networking and blogs is a relatively new component of job boards and, according to the survey data, proves to increase effectiveness in ensuring successful matches. Social networking tools allow for outreaching to job seekers and employers, relaying real-time information to their networks, and providing a form of screening for both employers and job seekers. Among those included in the survey, green job boards are the only EIS group that is currently operating social networking accounts or blogs. The full-service EIS that were interviewed have yet to incorporate these tools into their operations.

15.7 CHALLENGES

We asked the EIS providers surveyed about the challenges they face in operating their online systems. Administrators of both types of EIS reported a variety of issues. Because of the inherent differences in funding streams and organizational support between green job boards and full-service EIS, we describe these challenges separately.

15.7.1 JOB BOARDS

Challenges reported by green job board administrators touch upon operational issues specific to their area of expertise as well as those that are faced by the labor market as a whole. The challenges reported include:

- ECONOMY (e.g., ECJ): The current economic condition has created a flood of unemployed job seekers of all skill levels. Job bank operators report that they have more job seekers looking for positions, while the number of job postings is generally down. In addition, they are concerned that "overqualified" candidates that are out of work apply for lower level positions, thus limiting the chances of low-skilled individuals to secure employment.

- VISIBILITY (e.g., EHS Careers, Job Central): The challenge to remain visible and reaching the target audience is another concern for job boards, both green and general. They also face the issue of educating users of their site to ensure that all services are being utilized as a tool to employment procurement.

- FINANCING (e.g., Clean Techies): Retaining sufficient financial resources for growth and development of new services is challenging for green job boards, as they are predominantly self-supporting, private entities. Their budgets are often limited to day-to-day operations, and do not allow for additional support services to disadvantaged populations.

- "GREEN" ACCEPTANCE (e.g., Green Jobs Spider): The challenge to instill a sense of security about green jobs is important. Some online system administrators report that job seekers exhibit some hesitancy toward moving to a green field because of perceived instability in this emerging sector, as well as lack of awareness about (or existence of) career ladder opportunities.

15.7.2 FULL-SERVICE EIS

When asked to identify some of the key challenges facing full-service EIS, administrators reported some internal and external issues. The key issues impeding the successful matching of job seeker and employer include:

ACCESSIBILITY (e.g., ISEEK Energy, LAUL): Several full-service EIS administrators felt that it is crucial that their target audience be able to easily utilize the services and understand the importance of the services offered. However, due to limited marketing and outreach budgets, their ability to market and make the services available to disadvantaged or special populations is a concern.

ECONOMY (e.g., LAUL, Workforce Florida): The current state of our country's economy is a major challenge, as there are an insufficient number of jobs to employ the masses of currently unemployed workers.

RELEVANCY (e.g., ISEEK Energy, EFM, Workforce Florida): Multiple full-service EIS providers reported facing the challenge of staying current with labor market trends and continually updating services to keep job seekers desirable to employers.

15.8 BEST PRACTICES

We identified best practices in EIS based upon the information gathered through interviews with EIS administrators, as well as interviews with subject matter experts in the early stages of research. The best practices identified here represent key components that make employment matching successful. The practices that were noted by multiple EIS administrators include the following: (1) establishment of strategic partnerships, (2) offering a wide range of additional services to job seekers, (3) maintaining social networking accounts and blogs, (4) maintaining current information, (5) utilizing well-developed matching mechanisms and verifiable data, and (6) providing support services to disadvantaged populations.

15.8.1 ESTABLISHING STRATEGIC PARTNERSHIPS

- Many full-service EIS providers establish partnerships with community colleges and private education institutions. These partnerships allow EIS providers to connect job seekers to affordable training and education options, thus improving the job seeker's chances of securing employment. For example, the Los Angeles Urban League attributes its success in job placement of the "tough to serve" population in South Central Los Angeles to the partnerships they formed with local education providers.

- Partnerships with other governmental agencies, community based organizations and non-profit establishments are also crucial for advertising the services of EIS to job seekers who have no easy access to computers and the Internet.

- Partnerships with industry play a significant role in supporting EIS sustainability and relevancy. According to the data we collected, green job boards that have strong ties to employers and industry groups are more sustainable and financially viable. For full-service EIS, partnerships with local industry leaders provide a conduit for EIS to connect job seekers to employers in the immediate geographic area. For example, Sunnyvale-based North Valley Workforce Investment Board (NOVA) is primarily composed of industry representatives from its service area who play an important role in job placement.

15.8.2 ADDITIONAL SERVICES TO JOB SEEKERS

- According to various studies and subject matter experts, job posting by itself is not effective in addressing unemployment unless it is a part of a continuum of employment matching services. In isolation, job listings primarily benefit employed workers looking for jobs elsewhere, but when complemented by other employment services, EIS can provide better job outcomes for unemployed and underemployed populations. Some of the important additional services we identified include offering of skills and aptitude assessment tests, providing career cluster and occupational demand information, connecting a job seeker with a training provider, clarifying certification and licensing requirements, assisting with resume writing and self presentation, and connecting job seekers with potential employers through social networks online. Considering the high level of confusion surrounding green industries and careers, it is especially important for EIS to contain information necessary to educate its user about options available to them in green areas.

- Specialized training in key industries can often be supported through federal funds. Sacramento Employment Training Agency (SETA) is currently able to offer green training to its audience through recently acquired federal funds.

- Special projects that are geared toward developing existing services in a focused area can be accomplished with dedicated funding. Workforce Florida, for example, has allocated funds for "innovative demonstration projects related to clean technology."

15.8.3 MAINTAINING SOCIAL NETWORKING ACCOUNTS AND BLOGS

- As an emerging phenomenon, online social networking offers unique solutions to some of the shortfalls of traditional EIS. Social networking accounts provide sets of data for employers and job seekers about each other. These data inform the decision-making of both labor market participants. Employers utilize social networking accounts to filter potential candidates using verifiable sets of data about them. With most EIS not confirming credentials or training, social networking sites fill in as a proxy for verification. Job seekers use these sites to learn more about potential employers in the industry or specialty of their interest and form opinions about where they would or would not want to work. Most of the green job boards interviewed use social network accounts such as Facebook and LinkedIn, while full-service EIS have been slow in capitalizing on this trend.

- Another important online tool used by the green job board that is crucial for success is blogging. The use of a website blog allows EIS to provide timely, relevant information to its users. For example, the blog of idealist.org posts information about labor market trends, relevant conferences, and tips for job seekers. The combined usage of social network accounts and blogs work to create a network of like-minded job seekers and employers, establishing a community of users and thus strengthening the purpose of EIS.

15.8.4 MAINTAINING CURRENT INFORMATION

- Keeping up with trends in industries and occupations is integral to maximizing the efficiency of an EIS. Acquiring labor market information through research organizations or state Departments of Labor can influence the decisions that EIS providers make regarding who is being employed, where they are being employed, and what skills are necessary for employment. Some large general job boards, such as Monster.com and Simplyhired.com, as well as some full-service EIS, such as SETA, include occupational trend information on their websites, while green job boards rarely address this need due to budgetary constraints. Employ Florida, a full-service EIS, identifies and posts career clusters in demand. This information influences their decisions regarding the type of training that should be recommended to job seekers.

- Staying current with technology and new developments in the field of labor market exchanges is important for keeping an EIS visible to its users. EHS Careers notes that in order to maintain market leadership they strive to "keep current and maintain and build upon visibility in the market."

15.8.5 ONE-STOP SERVICES FOR SPECIAL POPULATIONS

- Making available some self-help services for job seekers who do not have access to essential products/services extends the reach of EIS to marginalized populations. For example, a physical location that contains a computer lab, copy machine, fax service, clothing, transportation, and case management services can better assist the low-income population that has needs not met by job boards alone. These services ensure that the portion of the population that may not have Internet availability at their homes can still take advantage of the assistance offered by full-service EIS. Additionally, focused training, skills assessment, and case management for traditionally marginalized groups (formerly incarcerated, long-term unemployed, etc.) may help reduce unemployment durations among them.

- EIS that have employers who are looking to hire job candidates of a specific population can more effectively target unemployment reduction among those groups. Job Central, for example, notes that their members specifically reach out to military, veterans, and disabled job seekers.

15.9 SUMMARY OF KEY FINDINGS

The following are the key findings of our research into the various types of EIS and their strengths and weaknesses:

- The two main types of EIS are job boards and full-service EIS. Both provide labor market information to job seekers and employers in order to improve efficiency of the exchange.

- Job boards are typically privately run and funded, and offer a narrow set of services centered on an online search platform. Most serve a broad geographic area, and they may be general or focused on a niche industry like green.

- Job boards have been effective at targeting specifically green occupations, particularly for higher skilled workers with a college degree. They have used social networking and frequent updates to their online content to increase their effectiveness. Job boards are much less effective at targeting middle- and lower-skilled workers, however, because of a lack of employer interest and job seeker barriers to accessing this information.

- Most green job boards use simplistic matching algorithms, as they do not have extensive experience with, or budget for, sophisticated matching software. This significantly limits the functionality of online EIS and creates difficulties for employers in filtering candidates when large numbers of applications are received.

- Job boards that are a service of established industry groups seem to fare better than those without such industry ties, as they have more job postings indicating a consistent flow of employment opportunities.

- Full-service EIS are publically run and funded through the One-Stop system, and offer a comprehensive set of services, typically based at a physical location. Full-service EIS often partner with other organizations and agencies to provide support services and access to education and training.

- Full-service EIS generally have a local or regional focus. While this limits the options available to job seekers and employers, it may also enable stronger industry ties and tailored matching.

- Full-service EIS have been slower to use online content and networking to expand their reach, and few have specifically targeted job matching for green occupations. However, they may provide a better model of how to target disadvantaged and/or unemployed populations, as well as less-skilled workers.

- Most EIS of both types do not capture complete information on success and placement, making evaluation of outcomes difficult.

15.10 CONCLUSIONS AND RECOMMENDATIONS

The CPUC's WE&T Task Force outlined a basic vision for creating an EIS-style web portal for energy efficiency related jobs in California, and included this description in the EE Strategic Plan. We were tasked with assessing the various options for creating this portal, and making recommendations about how to proceed. The premise for this task was that job mismatch or "gaps" in labor demand and supply for the energy efficiency sectors would be a problem that EIS could help address.

Based on the findings of this WE&T Needs Assessment, however, this is no longer the correct approach. Current levels of spending in energy efficiency initiatives are unlikely to yield a significant number of new jobs that require new workers to be trained. Additionally, the limited job growth that will occur will most likely be in traditional occupations that include energy efficiency related skills, rather than energy efficiency-specific occupations. The WE&T Needs Assessment also shows the complexity of the training and career paths that exist, and the fact that not all training programs are created equal, as many programs do not have adequate links to jobs, and some lead to low-wage and dead end jobs. As a consequence, the training programs that label themselves "green" are actually less likely to provide job seekers with needed career preparation than traditional occupational programs.

The implications of these findings for the creation of an energy efficiency web portal for California are twofold. First, the CPUC *should not* create a new job board specific to the energy efficiency sectors. There is very limited data on the effectiveness of EIS in improving outcomes for job placement, and furthermore these niche jobs are not projected to be in high demand.

Second, EIS is clearly the responsibility of workforce agencies not energy regulators. The federal government has already committed enormous resources to providing employment information services via the One-Stops. Job matching is not an easy task, and it has been attempted in many different ways with mixed results. Though we know that the One Stop system does not serve every unique industry or worker adequately, any initiative to improve coordination and efficiency of the energy efficiency labor market should build off this existing resource. It clearly represents the best point of entry if the CPUC elects to get involved in EIS, because of its comprehensive services and strong partnerships, targeted support for unemployed and disadvantaged populations, and existing infrastructure targeted regionally throughout the state.

Rather than try to reinvent the wheel, we suggest that the CPUC encourage state action to improve the One-Stop system in California so that it can better collaborate. Specifically, the One-Stop system in California should take a sector strategy approach that acknowledges energy efficiency (like ISEEK in Minnesota). From this point, the CPUC could more effectively expand its working relationships with the One-Stop system and other strategic partners, such as Job Central, the member organizations of the Green Collar Jobs Council, and the EDD's Labor Market Information Division and green information portal. The CPUC could also support the use of existing resources that represent best practices for EIS, such as incorporating social networking sites, and increasing the usability and relevance of online materials.

Building career pathways is an extremely complex process, and our study just scratched the surface of understanding how this works in the energy efficiency sectors in California. Stepping into this arena can actually be a disservice to workers if the CPUC portal provides superficial information rather than the in-depth set of career development services that can support job seekers in developing successful careers related to energy efficiency and other demand-side activities.

15.11 CASE STUDIES

The following are three case studies of EIS conducted as part of this analysis.

15.11.1 EMPLOY FLORIDA MARKETPLACE

https://www.employflorida.com
850-414-7638

15.11.1.1 OVERVIEW

Established in 2004, Employ Florida Marketplace (EFM) is the job matching portion of the state's One-Stop Centers. EFM links all of Florida's state and local workforce services and resources. The primary goal of EFM is to have a comprehensive marketplace for posting and finding jobs. In addition to online access, the services and resources of EFM are also available to users at the physical One-Stop Career Center locations.

15.11.1.2 PARTNERSHIPS AND FUNDING

EFM operates on funds provided through the Workforce Investment Act. Strategic partnerships enable EFM to provide a wide range of resources for job seekers and employers. Some of these established partnerships and their services include:

- → *Florida's Department of Education*: To provide information about available education programs. EFM is in the process of incorporating programs that have "green" emphasis.
- → *Florida's Department of Children and Families*: To identify job seekers who are receiving Temporary Assistance for Needy Families (TANF) and food stamps.
- → *Florida Research and Economic Database:* To provide labor market information data that allows a job seeker or employer to see the opportunities that exist near their home.

15.11.1.3 JOB SEEKER SERVICES

Services provided for job seekers include:

- → Ability to post multiple resumes
- → Job search
- → Resume and cover letter builder
- → Skills inventory
- → Employer information
- → Virtual recruiter
- → Job market trend information
- → Green job portal (currently in development)
- → Consumer reports about education costs (currently in development)
- → Website tutorial (currently in development)

15.11.1.4 EMPLOYER SERVICES

Services provided for employers include:

- → Job posting
- → Resume search
- → Work keys (to assess candidate certifications)
- → Training grant information
- → Labor market information
- → Information about government tax incentives

15.11.1.5 SPECIAL AUDIENCE SERVICES

EFM offers specialized information and resources for some special audiences namely, veterans and older workers. The job seeker web page has links to resources for both of these groups. In addition, EFM currently allows employers to flag veteran jobs and green jobs.

In addition to jobs specific to veterans and older workers, EFM occasionally creates special job portals. For example, in response to the recent oil spill in the Gulf of Mexico, EFM opened a temporary job portal to serve the needs of the employers in the area.

15.11.1.6 TARGET AUDIENCE

EFM's target audience is job seekers and employers, consisting of students, parents, educators, and intermediaries. The majority of EFM's job seekers and employers reside and operate in the state of Florida but there is some presence from entities outside the state of Florida.

15.11.1.7 ENERGY EFFICIENCY/RENEWABLE ENERGY INCORPORATION

EFM has incorporated green jobs into its current service offerings. Additionally, the organization is in the process of creating a green jobs portal to consolidate all jobs and resources related to this sector. Green jobs postings, information about related education, and relevant training programs will be included in the green jobs portal. Employers and jobs listed in the green jobs portal will undergo a verification to ensure green authenticity.

15.11.1.8 CHALLENGES

One of the main challenges cited by EFM is to create balance between the needs of job seekers and the needs of employers. Another noted challenge is keeping information up to date which can be difficult if the source agency does not update their data in a timely manner. There is also an issue of maintaining the security of a user's personal information. EFM has found that some job seekers do not want to share information that is needed for reporting of federal funds. Finally, misuse of the system is an ongoing challenge. There has been detection by EFM of misuse of resumes and some presence of marketing or scams on their job posting site.

15.11.1.9 SUCCESSES

EFM measures its success by heavy website traffic and the number of job postings. In the month of September 2010, EFM cites 150,000 users and approximately 21,800 jobs posted on their peak day. In the same month, postings from external sites, numbered 244,000. The site boasts about 7,500 employers and roughly 320,000 unique job seekers. EFM claims that their site has, in one place, more services and resources than most other states.

15.11.1.10 FUTURE PLANS

Future plans of EFM include the addition of consumer reports, a user tutorial, the green job portal, verification of green postings, and protecting the security of job seekers. EFM feels that these additions are necessary steps toward realizing their primary goal of being a comprehensive marketplace for the posting and finding of jobs.

15.11.2 ISEEK ENERGY

http://www.iseek.org/
651-201-1512

15.11.2.1 OVERVIEW

ISEEK was established in 1998 by Minnesota's then governor to be a one-stop information center for job seekers. The purpose was to combine career, job, and education information in one easily accessible location. ISEEK began as a partnership with state government agencies and education institutions to collectively supply career and education related information.

15.11.2.2 PARTNERSHIPS AND FUNDING

Funding for ISEEK is provided by contributions made by its joint power organization. ISEEK also operates through grant funds and income from new projects. Partnerships that ISEEK has established to expand their service offerings include:

→ Minnesota State College
→ University of Minnesota
→ Various Minnesota state departments

15.11.2.3 JOB SEEKER SERVICES

Services for job seekers include:

Career Information

→ Energy Careers Information and Knowledge Test
→ Energy industries information
→ Description of energy careers
→ Description of green energy careers
→ Information on Minnesota green careers and industries

Education Information

→ Information on energy classes
→ Student testimonials

- → Energy pathways
- → Competency models
- → Training and program information
- → Educator resources

Job Information

- → Energy jobs in demand and salary information
- → Energy employers and employer profiles
- → Information on what energy employers are looking for
- → Energy job search
- → Links to related job sites

15.11.2.4 EMPLOYER SERVICES

Services for employers include:

- → Job postings through MinnesotaWorks.net

15.11.2.5 SPECIAL AUDIENCE SERVICES

ISEEK's industry sites offer resources for special audiences. Their industry sites have a focus on Energy, Healthcare, Information Technology, and Manufacturing. The special audiences that are served by ISEEK include workers with disabilities, ex-offenders, immigrant workers, and refugees. Resources for special audiences consist of specialized information, career choices, job training and education, job search, and links to other related information sources.

15.11.2.6 TARGET AUDIENCE

Services provided by ISEEK are geared toward Minnesota residents. ISEEK's target audience consists of students, parents, teachers (K-12), the special audiences listed above, and intermediaries.

15.11.2.7 ENERGY EFFICIENCY/RENEWABLE ENERGY INCORPORATION

In addition to general industry information, ISEEK Energy provides links to credit and non-credit programs offered at education and other organizations in the state for specific industries, such as renewable energy or energy efficiency. The home page of ISEEK Energy contains a link to a state-specific Careers fact sheet and brochure, in addition to information about Minnesota's Renewable Energy Marketplace (MNREM).[10] MNREM is an extensive site that provides information on training, job creation, and industry innovations all related to renewable energy.

15.11.2.8 CHALLENGES

ISEEK identified four notable challenges toward meeting their primary goal. The first is gaining people's attention. Given the large pool of employment assistance sites, it can be difficult to attract the attention of job seekers. Second, ensuring ease of usability is a challenge noted by ISEEK. Making a site easy for users to navigate is important for keeping a strong user base. The third challenge reported by ISEEK is to keep data current. Lastly, maintaining adequate funding is a challenge faced by the organization.

[10] http://www.mnrem.org/wiki.

15.11.2.9 SUCCESSES

ISEEK counts among its successes the quality of the content provided by its partners. The organization also measures their success by the amount of website traffic they experience. On average, they report 100,000 unique users each month on ISEEK.org. Additionally, ISEEK claims that they receive positive feedback from users, industry professionals, their Board of Directors and have received numerous performance awards.

15.11.2.10 FUTURE PLANS

Future goals for ISEEK are focused around keeping current with technological advances and applying them to their user services. The main ISEEK site will continue to offer specialty sites that reflect the future high growth industries and occupations.

15.11.3 GREEN JOB SPIDER

http://www.greenjobspider.com/
203-816-0339

15.11.3.1 OVERVIEW

Green Job Spider is a niche green online job search engine serving the United States. The site's founder, Chris Russell, states that connecting job seekers and employers is the primary goal of his website.

15.11.3.2 JOB SEEKER SERVICES

Green Job Spider offerings the following services for job seekers:

- Job listings
- Green job blogs
- A calendar of green events
- Videos relating to trends and opportunities in the green workforce industry
- Podcasts of green blog topics

Job seeker services are provided at no cost. Green Job Spider cites their target audience as anyone who is looking for a green job. This group includes recent graduates and the recently unemployed, as well as experienced professionals.

15.11.3.3 EMPLOYER SERVICES

Employers in any green industry can purchase any of the following fee-based services through Green Job Spider:

- Job "scraping" from corporate websites
- Job "spidering" to other green job boards
- Cross-posting of jobs
- Advertisement

15.11.3.4 OPERATION

Green Job Spider notes that they post an average of 12,500 job postings each month. This online job board is self-funded through fees paid by employers who purchase their services. Advertising is done online and in person at various green related events. The content of Green Job Spider is updated daily through an indexing process that takes place every night. Job matching on this website is done with the use of third party software supplied by JobSoftware.com.

15.11.3.5 CHALLENGES

One main challenge in matching job seekers and employers, reported by Green Job Spider, is the hesitation in moving from traditional industries to green industries because of the uncertainty about the "green" economy. The website's administrator notes, however, that this issue is less prevalent among recent graduates.

CHAPTER SIXTEEN:

16. PIPELINES FOR DISADVANTAGED WORKERS

16.1 INTRODUCTION

The purpose of this section is to identify strategies and best practices to promote the successful participation of minority, low income, and disadvantaged workers in WE&T programs that lead to job placement and retention in family-supporting jobs with career paths in the energy efficiency sectors. Since the 1970s, there has been a significant decrease in the number of middle-income jobs that do not require a college degree, which makes it more difficult for Californians from disadvantaged communities to compete in the job market.[1] The decline in the manufacturing sector throughout the United States, and particularly in California, has had an especially large impact on the ability of those without a post-secondary education to find steady employment in living wage jobs.[2] As stated in Chapter 2, since the 1970s we have seen the rise of a bifurcated labor market with a concentration of low education and low-wage jobs at one end of the market and high education, high-wage jobs at the other end. As a result of these structural changes, there is a significant shortage of good jobs that provide advancement opportunities for those without college degrees, especially workers from disadvantaged backgrounds that may have additional barriers to employment.

16.1.1 DISADVANTAGED WORKERS AND BARRIERS TO SUCCESS IN THE JOB MARKET

The term "disadvantaged worker" is commonly used as an umbrella term for any individual who may have greater than average difficulty finding and retaining employment or moving beyond a low-wage job. In this chapter, we use it to address both job seekers and low-wage workers. Disadvantage often arises from historical and socioeconomic factors that affect entire communities or groups of people, such as poverty or racial, gender or other forms of discrimination, or from individual physical or other disabilities.[3]

Other factors that are commonly cited as barriers to employment for disadvantaged workers include low levels of educational attainment, homelessness, single parenthood, having a criminal record, and difficulty in accessing jobs due to lack of reliable transportation. Many of these factors are mutually reinforcing or result in additional barriers, and it is common for low-income individuals to have more than one of these challenges, compounding their difficulty in obtaining and keeping a living wage job. The 2002 National Survey of America's Families found that the number of barriers to employment significantly impacts a person's ability to find and maintain work—51 percent of

[1] Mazzeo, C., B. Roberts, C. Spence, J. Strawn (2006). Working Together, Aligning State Systems and Policies for Individual and Regional Prosperity. Washington, DC: Working Strategy Center and CLASP.

[2] Miller, C. & K. E. Porter (2005). Barriers to Employment for Out-of-School Youth: Evidence from a Sample of Recent CET Applications. New York: MDRC.

[3] Although many employers may not intentionally discriminate based on race, a recent study in New York City showed that white applicants for entry level positions received twice as many call-backs from employers as equally qualified black applicants. See Pager, D., B. Bonikowski, B. Western (2009). Discrimination in a Low-Wage Labor Market: A Field Experiment. American Sociological Review. 74:777.

those surveyed with no barriers to employment were employed compared with 29 percent of participants with one barrier and only 13 percent of those with two or more barriers.[4]

Finally, disadvantage is defined, in part, by the profile of labor demand in a particular time or sector, so it is important to contextualize what we think of as "barriers." For example, when union manufacturing jobs were plentiful, having only a high school diploma was not a disadvantage. Furthermore, being a woman is not a disadvantage for the teaching profession, but it is for work in construction.

Strategies for overcoming barriers for disadvantaged students, job seekers or workers must take into account the multifaceted nature of barriers. As we have emphasized throughout this report, it is important to look at both the supply side of the labor market, i.e., preparing workers and helping them overcome barriers that they are able to change, as well as the demand side of the labor market, including the kinds of jobs that are created and the specific practices of employers.

16.1.2 OPPORTUNITIES IN GREEN AND SECTOR STRATEGIES

The large public investment in, and resulting growth of, the energy efficiency and related sectors in California presents a potentially viable opportunity to build pathways out of poverty for individuals who have been historically disadvantaged in the labor market. A large number of the jobs in green sectors are considered "middle-skill" opportunities, meaning that they require less than a bachelor's degree but do require some college, apprenticeship or other technical training, as affirmed in our job projections (see Chapter 3), as well as in other studies (see Chapter 2). Because they do not require a college degree, middle-skill jobs that pay living wages and provide opportunities for advancement are a promising career option for workers starting out with limited educational opportunities.

The development of these sectors is not immune to the structural changes described above and in Chapters 2 and 5; as they grow, these industries may follow the same pattern of many existing sectors, with low wages for workers in many of the non-professional jobs.[5] Although there may be middle-skill opportunities, there is no guarantee that these jobs will pay middle wages. Therefore, demand-side strategies become critical to stimulate demand for the right kind of job, that is, middle-skill, middle-wage jobs, and/or lower-skill jobs that have a living wage floor and are connected to a career pathway.

As described in Chapter 3, because of high rates of unemployment in energy efficiency related sectors like construction, current levels of investment may not lead to the new job growth needed to employ large numbers of entry level workers in the field. Usually when implementing a sector strategy, funders and implementers identify sectors and jobs that have substantial job openings, have living wages as a starting salary, and provide career pathways that allow workers to move up a wage ladder as they acquire skills. In targeting disadvantaged populations, prerequisites for jobs must be matched with job seekers who can attain them. However, for the WE&T Needs Assessment, the targeted sectors have been chosen for reasons other than their expected workforce outcomes (i.e., their expected energy savings outcomes). Therefore, supporting disadvantaged workers in these specific industries will likely only be effective if they include some combination of strategies that address labor demand.

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[4] Baider, A., & A. Frank (2006). Transitional Jobs: Helping TANF Recipients with Barriers to Employment Succeed in the Labor Market. Washington, DC: CLASP.

[5] Holzer, H., & R. Lerman (2007). America's Forgotten Middle-skill Jobs. Washington, DC: The Workforce Alliance.

The high concentration of middle-skill positions presents an opportunity for those who can acquire the needed skills. Such training is often offered at the community college level and, particularly in construction, in state-certified apprenticeship programs.[6] As stated earlier in this report, there is widespread recognition in the workforce development field that sector-based strategies, which address the needs of both employers and workers, and build collaborative partnerships between stakeholders within a particular industry, have had the most success in training, placing, retaining, and creating career pathways for workers in jobs that do not require college or post-graduate degrees.[7]

The same elements and best practices of sector strategies hold true for connecting disadvantaged workers with middle-skill jobs. However, additional attention must be devoted to creating pathways that specifically support disadvantaged workers. Building career pathways that are real pipelines out of poverty requires addressing challenges on both the demand side of the labor market, ensuring that a significant number of high-quality jobs are accessible to disadvantaged workers; and the supply side, making certain that workers are sufficiently prepared to take advantage of such opportunities when they arise. Demand-side strategies involve deep engagement with employers to provide industry-specific expertise, and policies that will stimulate demand and shape job quality in the sector. Labor supply strategies, on the other hand, require deep engagement with workers to provide career matching, screening, and other supports, as well as integrated skills training that includes technical training, basic skills, and job readiness in each sector.

Much work has previously been done on building pathways out of poverty,[8] and the issues and best practices relevant to energy efficiency sectors are not unique. However, there have been some innovative applications of these strategies that are specific to the construction industry and have been applied in green programs. Therefore, this chapter first gives a brief overview of the existing best practices for both demand-side and supply-side strategies, presenting the key program elements that funders and policymakers should look for to distinguish promising initiatives. Next, in order to illustrate a variety of ways in which these strategies have been put into practice, we present three case studies.

16.2 SUPPLY-SIDE STRATEGIES: WORKFORCE PREPARATION

Preparing low-income and disadvantaged workers and job seekers for placement and retention of a good job requires addressing multiple barriers and challenges. These include financial and logistical challenges, low educational attainment, language barriers, and others. Here we focus on the type of barriers that can be addressed through targeted training and supportive services. There is an extensive literature on barriers to employment, which we will not fully review here, but from which we have extracted a number of best practices for developing training programs that serve the needs of disadvantaged workers from recruitment to sustainable employment. This section gives an overview of the critical features of such programs.

EXTENSIVE RECRUITMENT AND SCREENING OF CANDIDATES is essential to ensure that training opportunities are made widely available to disadvantaged workers. This usually requires deep engagement and

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[6] Holzer & Lerman 2007.

[7] Conway, M., A. Kays Blair, S. L. Dawson, L. Dworak-Munoz (2007). Sectoral Strategies for Low-Income Workers: Lessons from the Field. Washington, DC: Aspen Institute.

[8] See, for example, Giloth, R., ed. (2004). Workforce Intermediaries for the 21st Century. Philadelphia: Temple University Press.; Fitzgerald, J. (2006) Moving Up in the New Economy: Career Ladders for U.S. Workers. Ithaca: Cornell University Press.; or Maguire, S., J. Freely, C. Clymer, D. Schwartz, and M. Conway (2010). Tuning in to Local Labor Markets: Findings from the Sectoral Employment Impact Study Philadelphia: Public/Private Ventures

relationships of trust with the targeted communities. Recruitment is often achieved through collaboration with embedded community or faith-based organizations.

Screening and matching candidates for specific jobs is also critical so that prospective trainees are fully aware of the requirements of the target occupation and to make sure the occupation matches the student's interests and abilities. Screening also ensures that there are no insurmountable barriers that would limit a trainee's ability to find employment once they entered the labor market. Screening and matching of basic physical requirements should happen before students enter training programs.

SOFT AND BASIC SKILLS include training in basic job skills, or "soft" skills, such as time management, basic communication, and understanding of how to interact with colleagues and customers.[9] Holzer and Wissoker examined surveys of over 3,000 employers in four large metropolitan areas and found that people lacking soft skills such as basic job readiness and social skills had a harder time performing well or keeping their job than those who only lacked technical skills.[10] Individuals with a limited educational background may also lack the basic math or reading skills necessary for certain jobs. This is particularly a barrier to apprenticeship programs that require an entrance exam.

EFFECTIVE LEARNING STRATEGIES address students where they are. Best practice programs include a comprehensive curriculum that prepares workers for life-long careers and skills advancement and uses adult learning strategies. The curricula for these programs often include leadership and environmental literacy, soft skills, and occupational skills as well as contextualized learning of math and language skills using practice-based adult learning pedagogy. Cohort-based programs that move the same group of participants through the program together have proved to provide needed mutual support, while bridge programs, geared to adults who have been out of school for many years, support students as they transition into educational environments. Some programs also offer opportunities for trainees to network with employers, learning from them as mentees. These are the types of learning strategies that have proved to be important elements of many successful programs. In addition, programs geared toward low-income adults must also make logistical and scheduling accommodations to ensure minimal financial impact on students and enable participation.

A COMPREHENSIVE PACKAGE OF SERVICES that link to employment is crucial for supporting low-income workers as they transition from public assistance, to training, to employment. Such wrap-around services include public assistance, transportation and child care subsidies, and possibly income supports during training, or paid training, like in apprenticeship programs. Other services include career counseling, job placement, and case management. Once a student is employed, post-employment services are an important factor in ensuring sustained employment. These include continued intensive case management, job retention counseling, additional educational development, and continued emergency financial supports,

STACKABLE, PORTABLE, AND INDUSTRY-RECOGNIZED CERTIFICATIONS AND CREDENTIALS that allow students and workers to get credit for previous training and that link explicitly to identified "rungs" on a career ladder. Students should be exposed to multiple pathways leading to options for further education, entry into apprenticeship programs, and other careers. As described in Chapters 4 and 5, certification is a key component of ensuring job quality. For disadvantaged workers, it is especially important to have the opportunity to earn individual industry-recognized skills certifications as well as entry level occupational certifications. These provide an immediate benefit in the job market, as well as a foundation that can be built upon through further training and experience.

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[9] Pavetti, L., M. Derr, J. Kauff, G. Kirby (2005). Universal Engagement in Practice: Lessons from the Implementation of the Pathways Case Management System. Washington, DC: Mathematica Policy Research, Inc.

[10] Holzer, H. J., & D. Wissoker (2001). "How Can We Encourage Job Retention and Advancement for Welfare Recipients?" New Federalism, Series A, No. A-49. Washington, DC: The Urban Institute.

PRE-APPRENTICESHIP PROGRAMS are a specific example, in the construction industry, of preparation for industry-recognized credentials at the front end of a career pipeline. Pre-apprenticeship programs that have a real commitment to helping disadvantaged workers gain entry into an apprenticeship in the trades establish partnerships with one or more apprenticeship committees in their region, and use a curriculum that is designed to prepare a worker for apprenticeship testing and the apprenticeship itself. The Multi-Craft Core Curriculum of the Building and Construction Trades Department of the AFL-CIO is a good example of how pre-apprenticeships can better support disadvantaged workers. This new curriculum, which is being integrated into several YouthBuild programs in California, provides a gateway from entry-level training programs into union apprenticeships, and establishes, for the first time, standardized pre-apprenticeship for entry into any one of the building trades.[11] In many other cases, pre-apprenticeship programs are related to apprenticeship in name only. This is the situation when they are not well-articulated with the trades and are simply entry level construction training programs with no links to career pathways.

ON-THE-JOB TRAINING OR OTHER WORKPLACE-BASED LEARNING that provides a hands-on learning experience and focuses on gaining skills in the workplace, usually through demonstration by a more experienced worker. This benefits employers and workers simultaneously because it increases the likelihood that skills taught are industry-relevant and in demand. Moreover, the benefit of this type of instruction for workers is enhanced in programs like apprenticeships, which pay apprentices for their hours of on-the-job training and increase wages corresponding to an increase in skills.

A SUSTAINABLE FUNDING SOURCE ensures the program can continue providing service without interruption. Successful programs leverage multiple funding streams from state, federal, and charitable sources. Some also receive support from industry.

MEASURING OUTCOMES, including job placement and retention, is important for evaluating the success of any training program.

16.3 DEMAND-SIDE STRATEGIES: SHAPING THE LABOR MARKET

Policies to stimulate demand were outside the scope of this research project, but they are clearly the key to creating significant numbers of jobs and increasing opportunities for disadvantaged jobs seekers and workers. Though California leads the nation in the amount of ratepayer resources devoted to energy efficiency investments, major barriers to market expansion of these industries (particularly financing) have not yet been overcome. The contribution of the WE&T Needs Assessment to the question of job creation is to underscore the need for realistic views on the number of jobs created by these investments (see Chapter 3), and the importance of a professionalized workforce and high work quality standards in the market and in market expansion (see Chapter 4).

Short of job creation, there are demand-side strategies that can specifically address improving outcomes for disadvantaged workers. We separate these into voluntary partnerships with employers, and policies that set job quality and job access standards.

16.3.1 EMPLOYER ENGAGEMENT

[11] Pleasure, R. (2010) "Building Trades Curriculum." Building & Construction Trades Department, AFL-CIO; Emerald Cities Collaborative.

As a rule, sector strategies must be "demand-driven," so that training programs are developed in response to skills shortages identified by employers. A common element among successful training programs is their deep connection with an employer, or group of employers, in a particular industry, within a specific labor market. Through these relationships, programs identify employers' workforce and training needs, design occupation-specific skills trainings to meet those needs, and connect employers with potential workers. In some cases, employers commit to hiring directly from a training program or provide internship opportunities for workers, enabling them to get work experience and skills advancement through on-the-job training.

As shown in the previous chapters, most of the training programs, whether they be in community colleges, community based organizations or elsewhere have engaged employers in a variety of capacities, such as guidance on curriculum development, etc. However, these relationships haven't always resulted in job placement, the key metric of success. These voluntary strategies work—i.e., result in hiring from training program participants—when employers see the benefits of partnership. This can be due to lowering search and hiring costs or subsidizing training that they would otherwise pay for themselves.

Employer engagement is also critical to address specific barriers to employment affecting specific groups. In some cases, there may be ways to reduce these barriers. For example, employers may have a blanket requirement that job applicants have no criminal record, but there have been cases in which employers have been convinced to accept applicants with infractions that are not relevant to the job at hand, developed supervision strategies to lower perceived risk, or other reentry strategies.[12]

Voluntary adoption of skills certification by employers and the creation of career pathways is another strategy to improve outcomes for disadvantaged (and other) workers. Union apprenticeship programs are one example of a clearly defined way to attain middle-skill jobs that pay living wages and enable advancement along a payscale linked to skills advancement, because the career ladder is codified in the collective bargaining agreement. However, union density has fallen, the number of union jobs is limited, and apprenticeship programs have long waiting lists, making it even more difficult for disadvantaged workers to access these premium career pathways. In the non-union sector, there seems to be a lack of clear career pathways from low-wage, entry-level jobs to career steps that progressively reward workers as they gain skills and experience. A root cause of this problem in the non-union sector may be related to a lack of clear skills standards and employer-recognized certifications that command a wage commensurate with the training investment.

In some sectors, like the hospital industry, workforce development practitioners have worked with employers to build a standardized progression of skills and certifications so that workers have a pathway up as they add experience and training.[13] As described in Chapter 4, the DOE's efforts to create guidelines for skills standards and certifications in the residential retrofit sector are an example of this career pathway development, which addresses the needs of unskilled workers as well. Development of skills standards, in this case, was primarily motivated by the goal to improve work quality, but the potential workforce benefits are evident. If these guidelines are adopted by industry, they could provide a framework for wage progressions linked to skills acquisition, although this is not guaranteed.

16.3.2 WAGE FLOORS AND HIGH-ROAD STANDARDS AND CAREER PATHWAYS

[12] National Employment Law Project PolicyLink, Ella Baker Center (2010). *Expanding Opportunity: Employing the Formerly Incarcerated in the Green Economy.* Available online at http://nelp.3cdn.net/86140a17fe3652675a_bgm6b807d.pdf.

[13] Fitzgerald, J. (2006). *Moving up in the New Economy: Career Ladders for U.S. Workers.* Ithaca, NY: Cornell University Press.

Adequate starting wages and the existence of rungs in a career ladder are critical in designing sector initiatives for jobs in energy efficiency related sectors. Since these conditions are not present in some segments of the construction industry, particularly the residential and small commercial sectors,[14] efforts to improve job quality and job access have been the focus of many pathways out of poverty initiatives and advocacy groups, including Green for All, the Apollo Alliance, the Emerald Cities Collaborative, and other labor and community organizations. The following strategies represent best practices for addressing job quality and job access.

LOCAL, TARGETED, AND FIRST SOURCE HIRING POLICIES: Some cities and jurisdictions have local hire policies that apply to publicly funded construction projects. These require contractors to make efforts to employ workers who live in a designated area or who graduate from a city-approved training program. Some policies stipulate a specific quota of workers that must be hired from a target area, while others require "first source" hiring, meaning employers must make a good faith effort to hire from the local community before looking elsewhere. In some cases targeted hiring can be from anywhere within the jurisdiction, while in other cases it is more specifically targeted to low-income zip codes or subdistricts. In some states, hiring is targeted expressly at women and minorities, who are underrepresented in construction jobs. However, because Proposition 209 prohibits public entities in California from affirmative action to address discrimination, local hire policies, whether city ordinances or negotiated as part of a Project Labor Agreement (PLA), may serve as a substitute for reaching disadvantaged workers.[15]

Although local or targeted hire agreements are helpful in creating opportunities for workers, the more targeted the policies, the more likely they are to reach disadvantaged workers. For example, a generic local hire policy targeting a particular city could create opportunities for only the most educated or qualified residents. A policy that sets specific quotas for hiring from particular CBO-run training programs or outreach centers would be more likely to benefit workers with barriers to employment.

HIGH-ROAD AGREEMENTS: High-road agreements (sometimes also known as community benefits agreements) spell out the workforce goals of a given project or program. They include both targeted hiring policies and labor standards to ensure minimum wage and benefit levels. These agreements are usually negotiated through a multi-stakeholder process on publicly funded construction projects and have recently been extended to cover energy efficiency programs in many cities, including Portland, Oregon, Seattle, New York, Milwaukee and Boston, among others. In some cases labor standards are tied to a multiple of the minimum wage or other wage standard. In other cases, high-road agreements are pre-hire collective bargaining agreements (often called project–labor agreements) with one or more unions that establish the terms and conditions of employment for a specific construction project. Along with wage standards, they can include the local or targeted hiring provisions mentioned above, minimum apprentice ratios, and/or funding for pre-apprenticeship programs.[16] This creates a pool of high-road contractors who can be relied upon to provide good jobs.

MANDATORY CERTIFICATIONS AND LICENSES: Mandatory certifications and licenses set standards of competency in a particular occupation, which often lead to a market-determined higher wage. This creates value for workers who invest in training. For disadvantaged workers, mandatory licensing can increase the number of good jobs, but can decrease access unless accompanied by specific inclusion strategies. At minimum this includes strong training pipelines, as discussed in the previous section, as well as subsidies for the cost of testing and obtaining a mandatory certification or license.

[14] See Chapter 4 for more information on the labor market conditions of these sectors.

[15] Text of Proposition 209 available at http://vote96.sos.ca.gov/Vote96/html/BP/209text.htm.

[16] Kotler, F. (2009). *Project Labor Agreements in New York State: In the Public Interest*. Ithaca, NY: Cornell University, School of Industrial and Labor Relations—Extension Division, Construction Industry Program.

16.4 CASE STUDIES

The following three case studies illustrate many of the best practices discussed above. They also illustrate the variation in the intermediaries that lead sector strategies. The Los Angeles case is led by a community college, the Bay Area case by a city economic development agency, and the San Diego case by a community-based organization that serves as a Weatherization Assistance Program contractor.

16.4.1 LOS ANGELES ENERGY-UTILITY SECTOR INITIATIVE

The Los Angeles Energy-Utility Sector Initiative is a multi-stranded sector initiative involving multiple partners in the city of Los Angeles. The Initiative operates under the umbrella of the city's comprehensive economic and workforce planning process, under the direction of the Mayor's office. The city of Los Angeles coordinates its workforce development activities by convening key stakeholders, including the Chamber of Commerce, the LA County Federation of Labor, key educational partners and others, for high level agreements about which sectors to target for funding and which organization should be the designated workforce development intermediary for each targeted sector.

The Regional Economic Development Initiative (REDI) at Los Angeles Trade–Technical College (LATTC) was selected as the workforce intermediary for the energy-utility industries. REDI leads a strategic alliance of key organizations, including employers, educational institutions, public agencies, labor unions, and community-based organizations. This group of partners, called the Los Angeles Infrastructure and Sustainable Jobs Collaborative (the Collaborative), is working to create an integrated education, training, and workforce infrastructure for the sector. With functional control of the city's workforce development funds and as the designated lead for external funding opportunities, LATTC is tasked with analyzing needs, coordinating partners, and filling in gaps in the workforce system.

The Collaborative has conducted labor market research, built relationships with employers, and developed detailed assessments about specific skill and competency needs for job categories that are projected to grow in the energy efficiency sectors, including weatherization and energy auditing. In all these programs, training is tailored to the unique requirements of the energy-utility industry, but also integrated into the programs of the public career technical institutions, including LATTC.

Training program design is based on identifying multiple career pathways for students, including associate degree transfer programs to a four-year college, articulated with California State University Los Angeles (CSULA), apprenticeship, and entry-level employment as weatherization installer. Training for entry-level weatherization jobs is structured as a full-time, short-term, "fast track" training academy that integrates technical, basic, and soft skills into one curriculum, but also includes efforts to make students aware of career pathways up from entry level jobs, such as installers, to more skilled positions, such as energy auditors. Training is thus structured to create a full range of stackable certificates and degrees and with articulation between non-credit and credit programs.

The Utilities and Construction Prep program and the Weatherization program were designed to meet the particular needs of disconnected and underprepared adults. Using a cohort-based learning community, these programs address basic skills in math and English through contextualized learning, work readiness, and financial literacy, all in the context of preparing for careers in the utility and related construction sectors. Upon completion, students are ready to move into employment, or to continue in apprenticeship or educational programs to obtain certificates or degrees.[17] While not directly involved in local hire or high-road agreements, LATTC is the chosen training provider for Los Angeles's Green Ordinance, which includes a high-road agreement. The college is also involved in efforts to create a new job classification for energy efficiency work at the Los Angeles Department of Water and Power (LADWP), and facilitates entry into the utility apprenticeship program. Thus, though LATTC does not lead strategies to improve job quality and access, it does partner with groups who are engaged in such efforts. The college does this with the express purpose of avoiding or minimizing investments in training for low-wage dead end jobs.

16.4.2 RICHMOND BUILD

Richmond BUILD is an example of a sector strategy embedded in city government. The city of Richmond's Construction Skills and Green Careers Training Academy, named Richmond BUILD, is a pre-apprenticeship program that provides employment and career training for low-income disadvantaged Richmond residents in the construction, energy efficiency, and renewable energy industries. The program is a model of collaboration between many partners to serve the needs of both employers and the disadvantaged workers that the program trains. The 15-week program provides training in a variety of construction and career skills, including weatherization and solar installation; basic math and reading; computer and job searching skills; work readiness; and environmental literacy. Training is a combination of classroom learning, lab work, and on-the-job training.

The program offers a comprehensive package of wrap-around services and post-employment support, which has contributed to the excellent job placement and retention rate of graduates. In order to further facilitate job placement, the program has also developed a partnership with employers to provide continued on-the-job training for a twelve-week internship period, during which the city subsidizes half the trainee's wages. In the solar industry, Solar Richmond, a Richmond BUILD partner, reduces risk for employers by temporarily covering the workers' compensation insurance and tax costs of hiring graduates. This and other internship programs allow solar companies to "try out" graduates, enabling graduates to prove themselves on the job.[18] Due to the program's success—placing 90 percent of graduates into jobs paying at least $17/hour and 25 percent into building trades apprenticeships—75 to 100 residents compete for entry into each cohort of 30 students.

In addition to being a best practice program, Richmond BUILD's success with placing graduates into good jobs has been bolstered by the city's local/targeted hire policy. All city-funded construction contracts require that contractors set aside 25 percent of project work hours for Richmond residents who have completed the Richmond BUILD program. The Director of Employment and Training Development for the city of Richmond not only oversees Richmond BUILD, but also oversees compliance for the city's local hire ordinance. The director is in a unique position to understand the hiring needs associated with upcoming city projects and closely monitors that contractors hired by the city are complying with the local hire agreements and employing Richmond BUILD graduates. The City of Richmond also recognizes Richmond BUILD graduates as having the equivalent of six months' work experience, so graduates have a better chance when applying for city public works jobs.

16.4.3 MAAC

[17] Regional Economic Development Initiative (2009). *Los Angeles Infrastructure and Sustainable Jobs Collaborative Progress Report: Outcomes Achieved to Date*. Retrieved from: http://www.lattc.edu/dept/lattc/REDI/Utility.html.

[18] One training provider in another city cautioned that care needs to be taken to ensure that employers do not simply use training subsidies as short-term free labor, but rather as effective on-the-job training leading trainees to long-term employment.

The Metropolitan Area Advisory Committee (MAAC) Project is a San Diego-based organization that promotes self-sufficiency for low- and moderate-income families by providing social, educational, housing, and employment services. In addition to providing a range of programs to improve clients' economic standing, the MAAC Project runs the San Diego area's federally-funded Weatherization Assistance Program (WAP), which provides weatherization services to low-income families. The MAAC Project combines workforce development and weatherization work in its ARRA-funded "Green Careers in Weatherization" training program. The grant for this program doubled WAP funding and set aside at least 20 percent of funds for training. MAAC also conducts green construction job training through the U.S. Department of Labor funded YouthBuild program, which has also been expanded with ARRA funding.

The MAAC Project decided to take on an expanded training program in weatherization only after doing extensive research, which ensured that there was sufficient demand for new hires and identified employer skill needs. The infusion of ARRA funding into weatherization projects has promoted some growth in the industry, at least in the short term. The program has made considerable efforts to connect with local unions and apprenticeship programs, offering a rare career ladder from the lower wage residential sector into the higher wage commercial sector. Union partners provide an assessment of MAAC Project trainees' "soft" and "basic" skills so that the program can better address their needs in these areas. These partnerships have created pathways for MAAC program graduates to enter state-certified apprenticeship programs to continue their training.

In terms of employment, the San Diego Unified School District's (SDUSD) Project Labor Agreement/Construction Careers Project Stabilization Agreement (PSA) provides a considerable number of union construction jobs for graduates of the MAAC programs who enter apprenticeship programs. This agreement, which governs a $2.1 billion bond passed in 2008 to repair, renovate, and revitalize 181 neighborhood schools, stipulates that SDUSD will hire workers from within San Diego County, with 70 percent of all workers coming from the county and 35 percent of all workers coming from areas of high poverty and unemployment.

The MAAC Project has years of experience doing workforce development in low-income communities. Both the Weatherization and YouthBuild programs provide a comprehensive set of services for participants, including case management services, employment readiness, and job search training, as well as financial assistance and incentives. Students have the opportunity to earn an industry recognized certification through the program, and receive assistance with job placement, as well as case management for a year after graduation.

Although the MAAC Project demonstrates many of the qualities of a successful program, the labor market in San Diego, for the most part, is still not creating jobs, including weatherization jobs. Even with training, many MAAC Project graduates have significant barriers to employment, which put them at a competitive disadvantage in today's tight labor market. Although ARRA funding has boosted the weatherization industry temporarily, the lack of an overarching retrofit policy in San Diego contributes to uncertainty in the labor market.

16.5 IMPLICATIONS AND ANALYSIS

There are a number of established best practices for connecting low-income and disadvantaged workers to good jobs, and successful programs that are already using them to good effect in California. Some of these components were incorporated into the recent California Clean Energy Workforce Training Program (CEWTP) solicitation, an innovative ARRA-funded program jointly managed by the California Workforce Investment Board (WIB) and the California Energy Commission (CEC). While the training programs are too new to evaluate their success in implementation of these practices, their outcomes, or their sustainability, the CEWTP represents a significant leap forward in terms of promoting sector strategies and many of the specific components outlined here.

Unfortunately the existing best practice programs are still very small and make only a tiny dent in fulfilling the needs of low-income, minority, and disadvantaged communities. The limiting factor for all these programs is demand, not workforce infrastructure. All good programs have very long waiting lists, but program administrators are reluctant to expand training if they cannot connect graduates to jobs.

Creating demand is the key strategy for overcoming these limitations. The CPUC and other funders of incentives and programs have an opportunity to create demand that is conducive to successful incorporation of low-income, disadvantaged workers. However, measures must also be taken to shape the labor market in such a way that the jobs created provide real opportunities for workers coming out of poverty. Workforce preparation programs that provide basic, soft, and hard skills training and wrap-around services are most effective when *married* to demand-side programs such as high-road agreements and skill certifications that help ensure job quality and job access. LATTC's de facto position as the training organization for Los Angeles' green ordinance, the SDUSD Project Stabilization Agreement, and other emerging demand-side programs illustrate the power of implementing strategies on both the demand and supply sides.

The paucity of new jobs will inevitably lead to tensions between the policy goals of getting dislocated and experienced unemployed workers back to work and bringing in new low-income and disadvantaged workers. Given the choice, employers are likely to favor experienced workers. While there are no easy solutions, strategies that maintain or improve job quality in the construction industry—such as high-road agreements tied to strong pipelines into apprenticeship programs—can and are being used to build alliances among the existing workforce and new, more disadvantaged job seekers. Creating and funding training programs that do not lead participants into a job with strong wage floors and career pathways may be a tempting solution during a time when "any job is a good job," but in the long run may undermine the goals outlined here.

16.6 RECOMMENDATIONS

- When making investments in energy efficiency that are aimed at the inclusion of low-income, minority, and disadvantaged workers and job seekers, program administrators should use the best practices outlined in this document as a set of criteria to evaluate potential programs and applications for funding.
- In examining current practice at the CPUC or the IOUs, it is not clear which WE&T or resource programs are currently tasked with improving the inclusion of low-income, minority, and disadvantaged workers in training programs leading to good jobs. The CPUC needs to clarify this policy goal and link it to specific ratepayer-funded programs.
- There are several ways in which ratepayer- and publicly-funded energy efficiency programs could potentially contribute to these goals if they are implemented as policy. However, funding, competing priorities, and regulatory constraints would each need to be addressed.
- As noted in the case study of residential retrofits in Chapter 4, program design can explicitly incorporate the demand-side elements listed above, such as high-road agreements that set labor and local hire standards in retrofit programs. Portland's Clean Energy Works program illustrates this approach.
- The utility LIEE program could expand partnerships, like the weatherization pilots with LATTC and CityBuild (also described in Chapter 12), but program goals and design would have to change to ensure strong wage floors and clear career ladders that reward skills acquisition if better workforce outcomes for disadvantaged communities is prioritized. Policymakers need to weigh the competing policy goals and budgetary constraints of these programs, since reaching the target number of households is now codified in statute.

- Utilities could allocate a percentage of their training funds to support workforce programs that meet the best practice criteria described above.

CHAPTER SEVENTEEN:

17. IMPLICATIONS, CONCLUSIONS, AND RECOMMENDATIONS

The WE&T Needs Assessment has included (1) a comprehensive examination of the economic restructuring that will result from energy efficiency and other demand-side management policies and programs and (2) an extensive review of the capacity of California's current workforce education and training infrastructure in preparing workers for jobs in these sectors. This year-long project has been framed by two goals:

- Ensuring the availability of a qualified and engaged workforce to achieve California's energy efficiency and other demand-side management goals; and
- Maximizing the opportunities for California's workers, including workers and job seekers from low-income, minority, and disadvantaged communities, to obtain good jobs with career ladders.

The first goal was articulated as the vision statement for addressing workforce issues in California's Long Term Energy Efficiency Strategic Plan (EE Strategic Plan), adopted by the CPUC in September 2008.[1] The second goal derives from the CPUC's objective of ensuring full participation of minority, low-income, and disadvantaged communities, addressing education at all levels, and developing successful collaborations with workforce and educational institutions (whose mission is successful career outcomes for students, workers, and jobseekers). Given that the CPUC's primary mission is not focused on workforce outcomes, the WE&T Needs Assessment attempts to reveal the circumstances in which workforce goals and energy efficiency goals are complementary, and what the trade-offs are when these goals do not complement each other.

The WE&T Needs Assessment is a third-party report. The analysis and recommendations presented here are solely the responsibility of the authors and do not necessarily reflect the views of the utilities or the CPUC. In addition, the recommendations in this chapter are not limited to actions that are under the purview of the CPUC and/or the utilities, but also call for action by other policymakers and program designers in a variety of agencies and institutions.

This chapter summarizes the analyses presented in the previous chapters, draws implications from these findings, and presents recommendations for actions going forward.

17.1 THE CURRENT STATE OF THE CALIFORNIA ECONOMY

The state of the California economy sets the overall context for analyzing how energy efficiency and related policies and programs affect jobs and create a need for changes to the workforce education and training infrastructure. At present, two major problems plague the California economy. The first problem is a result of the Great Recession and the jobless recovery. California's unemployment rate stubbornly remains at over 12 percent

[1] The EE Strategic Plan states, "By 2020, California's workforce is trained and fully engaged to provide the human capital necessary to achieve California's economic energy efficiency and demand-side management potential." California Public Utilities Commission (2008b). *Long Term Energy Efficiency Strategic Plan: Achieving Maximum Energy Savings in California for 2009 and Beyond,* page 74. Retrieved from: http://www.cpuc.ca.gov/NR/rdonlyres/D4321448-208C-48F9-9F62-1BBB14A8D717/0/EEStrategicPlan.pdf.

as of early 2011 and is significantly higher among construction workers. The second problem is the long-term structural bifurcation of the labor market into well-paid, higher-skilled jobs and low-wage, lower-skilled jobs, with little growth of jobs in the middle.

This situation has two implications for the WE&T Needs Assessment. First, there is a large queue of unemployed workers, particularly in construction, where 43 percent of jobs in California have been lost since the industry's peak in 2003 (see Chapter 2). Second, without specific policy interventions, the jobs created by the investments in energy savings will mimic the wage disparities seen in the rest of the economy, with some high-wage jobs in professional occupations and many low-wage jobs for those without a college degree. These wage disparities have immediate serious social implications for families and communities in California and, ultimately, will undermine the competitiveness of California's economy.

17.2 LABOR DEMAND AND SUPPLY IN ENERGY EFFICIENCY SECTORS

The energy efficiency and related investments resulting from programs and policies identified in this report provide a significant stimulus to the California economy. Using our medium scenario, we project these programs and policies will result in an investment in 2020 of about $11.2 billion dollars from ratepayers along with state, federal, and private sources, up from an investment of about $6.6 billion in 2010. The 2020 investment is projected to create a total of 211,000 jobs for that year, including jobs directly generated by the investments in energy efficiency activities, indirect jobs resulting from demand for inputs for these activities, and induced jobs resulting from the increased household and business incomes and reduced energy expenditures from these activities. These are job person-years, meaning that each job represents one full-time job for a single year, not a permanent job.

The number of directly-generated jobs in energy efficiency and related activities is projected at 52,371 full-time equivalent jobs for the year 2020; the remaining jobs are the result of the indirect and induced labor demand. These direct jobs represent a significant growth from the 27,718 total direct jobs we estimate were generated in 2010 from energy efficiency and related policies and programs. Direct jobs are the focus of this study because they are directly linked to energy efficiency and related activities and the potential need for skill development.

The number of trained workers needed to fill the new jobs created is projected to be at least 78,205 over the eleven-year period beginning in 2009. This number is larger than the number of full-time equivalent jobs (52,371) because most jobs include both energy efficiency and other work (i.e., the work from one new full-time equivalent job will be distributed to more than one worker). To forecast training needs, the key estimate is the yearly increment of workers needed to fill new positions, above and beyond those hired in the previous year, since the latter were presumably trained before hire. For the year 2020 alone, the number of new workers that will require specific training in energy efficiency and related sectors is forecast at 5,262. Thus, from a total job creation forecast of 211,000 person-year jobs in 2020, the number of new slots available for workers needing specific training in energy efficiency and related skills is only 5,262.

Two-thirds of the workers in these additional direct jobs are in the construction trades (e.g., electricians, plumbers and pipefitters, sheet metal workers, carpenters, laborers, and construction supervisors). Another 17 percent of workers are in the architecture and engineering, management and public administration fields (including utility and third-party program administrators). The remaining 16 percent are in manufacturing, advertising, office administration, and other industries.

The proportion of new jobs in traditional occupations dwarfs the number of workers needed in new and emerging specialized occupations (e.g., solar installers or energy auditors). This finding is based on current staffing plans estimated from government data; if specialized energy efficiency occupations become more prevalent over time, this balance may change. The degree of specialization depends partly on business decisions, but also on what certifications the state encourages and where it spends its training resources.

At present, there are a significant number of unemployed and underemployed skilled workers in the relevant industries that employers are likely to draw from before hiring new inexperienced trainees. Graduates of training programs will be competing against experienced workers and can be expected to have difficulty in finding work utilizing their newly acquired skills, a point echoed many times in our interviews with training providers. In all sectors, this pool of unemployed workers is likely to exceed the number of new jobs created in the energy efficiency and related sectors at least until 2020.

Emphasis on incumbent worker training (as opposed to pre-employment training) is critical because the number of workers currently employed in energy efficiency related occupations far outweighs the number of new workers that are projected to enter these fields through 2020. Some, if not many, of these incumbent workers are likely to require skills upgrade training as new methods of work and new technologies are introduced.

The quantitative analysis shows that, at least through 2020, concerns about shortages of new workers for energy efficiency and related work are unwarranted, particularly for the primary energy efficiency occupations. There may be difficulty hiring for specialized niches. Such as professionals with significant work experience, or short-term shortages for positions with new certification requirements, but these are the exception. In contrast, concerns about shortages of jobs for recent graduates of education and training programs are real and likely to persist through 2020, particularly for those with less than four years of college. As a result, great caution should be used in considering the funding of new training programs; the focus should instead be on upgrading the energy efficiency skills and knowledge of the incumbent workforce.

17.3 WORK QUALITY AND JOB QUALITY: CASE STUDIES OF HVAC, RESIDENTIAL RETROFIT, AND ADVANCED LIGHTING

The WE&T Needs Assessment project includes case studies on work quality and job quality in three key sectors—the heating, ventilation, and air conditioning (HVAC) sector, the residential retrofit sector, and the commercial lighting sector. These studies focus on the incumbent workforce and examine workforce issues that create obstacles to achieving the state's clean energy and workforce goals.

A key obstacle to achieving energy goals, which was frequently identified in our interviews, is the prevalence of low-quality energy retrofit work, with the improper installation and maintenance of HVAC equipment being a prime example. For the large commercial and public sectors, these quality concerns were mentioned only rarely, and were not identified in the EE Strategic Plan as problematic. For the residential and small commercial sectors, the problem of low-quality energy retrofit work was frequently mentioned in our interviews and was also confirmed in numerous reports on utility- and publicly-funded programs. Whenever equipment is improperly installed, the actual energy savings are less than expected and the cost-effectiveness of programs suffers as a result.

Our analysis suggests that poor quality work is not simply a consequence of a lack of training of the construction trades workforce, but rather is due to the overall market dynamics in the residential and small commercial markets. These markets are characterized by "low-road" conditions, including lax enforcement of building permits, codes and standards, employment laws, and contractor licensing requirements. Such conditions in these sectors make it difficult for businesses to compete on the basis of quality and also result in workers not being rewarded for high standards of competence. Low-road conditions are usually correlated with low wages and high turnover, and neither employers nor workers have an incentive to invest in training. Public investments in workforce education and training are not sufficient to build a high-road market. Training investments in low-road markets frequently are not recovered, as so many workers leave the field. Furthermore, these investments do not lead to changes in practice, as employers compete on cost, not quality.

Low-road conditions are prevalent in the entire residential sector, but this is particularly the case in HVAC. Prior studies have reported that in the HVAC sector 30 to 50 percent of energy savings potential is lost due to poor quality installation, less than 10 percent of HVAC change-outs are done with building permits, and there is a very widespread recognition by industry players of the prevalence of the low road. HVAC is a cautionary tale that is important to keep in mind as the new Energy Upgrade California residential program rolls out and as the low-income programs are revisited. Program managers and policymakers need to pay careful attention to low-road conditions in the residential sector, and they should implement measures to ensure that such conditions do not undermine quality and the success of these initiatives.

As a general rule, utility- and publicly-funded programs have addressed quality through back-end inspections and verification, but not by conditioning incentives on up-front contractor and worker quality standards. This is now changing, and recently these programs have begun to focus on the quality of work being performed, as well. There are now several examples of new programs that focus on quality in an effort to carve out higher quality market segments and improve installation and maintenance of energy efficient equipment and systems. New programs include the HVAC quality installation and maintenance programs, the advanced lighting controls program, and, to a more limited extent, Energy Upgrade California.

Clearly, the utility programs cannot drive the market or build the high road by themselves. The utilities are part of a statewide effort to improve quality in HVAC, which was called out in the EE Strategic Plan for major restructuring. This effort includes the development of the Western HVAC Performance Alliance, an industry and government partnership to build consensus and specific strategies to close off the low road. Some of the strategies include efforts by the California Energy Commission (CEC) and the California State Licensing Board (CSLB) to enforce code and penalize contractors who perform unpermitted work, as well as establishing partnerships to carry out trainings for local building inspectors. This combination of incentives for high-road contractors and efforts to close off the low road is an important step forward. If these efforts are successful, they will support the development of a more stable and professionalized workforce. They will also likely drive up the up-front costs of HVAC installation. While further evaluations are warranted, the expectation is that higher energy savings, particularly the more valuable peak energy savings associated with the lower peak energy use under properly installed HVAC systems, will compensate for the higher labor costs over the long run.

In the residential retrofit sector, Energy Upgrade California is the new statewide program for implementing AB 758 and has aligned $275 million for residential retrofits from the investor-owned utilities (IOUs) and state and federal sources. It is designed to carve out a home performance market with a strong focus on quality work, along with the delivery of substantial energy savings. Whether or not this program will be able to professionalize or create good jobs for the residential retrofit workforce is uncertain, as near-term cost considerations seem to be paramount. Thus far, the program design only includes standards and certification requirements for contractors, with no requirements for workers. In addition, the standards that have been adopted emphasize building envelope and auditing, rather than quality installation of HVAC and other building systems with known quality concerns.

The deployment of advanced lighting controls in the commercial construction sector presents an important contrast to the conditions in the residential and small commercial sectors for HVAC and building retrofits. The commercial advanced lighting controls industry was faced with deficiencies in quality installation similar to those found in the HVAC market. In response to this situation, the lighting sector has demonstrated how the utilities, with the support of the CPUC, can be proactive leaders in planning for workforce needs and setting standards that support quality work. Creating an industry partnership (known in the workforce development world as a sector initiative), utility program managers collaborated with research institutions, manufacturers, and others to address deployment of advanced lighting control technologies that had been stymied in the market. Recognizing the quality installation problems plaguing the deployment of these technologies, the utilities collaborated with the International Brotherhood of Electrical Workers (IBEW) and the National Electrical Contractors' Association (NECA) to develop journey upgrade training. In a relatively short period of time, this training has been disseminated throughout the network of electrical apprenticeship programs, community college programs, and utility training centers. Early on, Southern California Edison funded curriculum development, while the apprenticeship programs and community colleges funded the training. The advantage of working with the apprenticeship system is that it represents an existing industry partnership, with employers at the table—a key characteristic of successful sector initiatives and one necessary to ensure that the training is put into practice in the field. Partners and mechanisms are already in place to facilitate agreements about skill standards and to provide access to a stable, professionalized incumbent workforce that can integrate new knowledge into a base of solid occupational training. Targeting training to electricians, who must be licensed in California, and limiting participation in incentive programs to those who have achieved this standard of training has paved the way for contractors to compete on the basis of quality in this industry.

Adoption of rigorous training standards and certifications is a key step for addressing the quality issues that threaten the state's achievement of its energy efficiency goals. It raises both the technical skills of workers and the bar for contractors, enabling them to compete on quality considerations rather than cutting corners to offer the lowest bid. However, certification requirements should be approached with care, as not all credentials are created equal. Rigorous, industry-recognized credentials should be distinguished from other certificates offered by some training programs that neither meet a common set of standards nor receive wide recognition within the industry. In interviews, employers in both residential and commercial sectors stressed the importance of on-the-job training and work experience, and expressed doubts about certificates that could be obtained without training in the field. Professional licenses and state-approved certifications usually require a minimum amount of work experience along with testing and other requirements.

The loss in energy savings due to improper installation and poor maintenance practices in the energy efficiency sectors appears to be closely correlated with poor outcomes for workers. Although additional documentation and assessment are needed, anecdotal evidence suggests that there are low wage floors and limited career ladders in most job categories in residential and small commercial retrofit and HVAC markets. These low-road conditions may contribute to diminished energy savings due to poor installations. Limited-scale policies and programs with energy efficiency as the primary objective cannot be expected to fundamentally change these markets' broader labor conditions, but policymakers do still have options to consider that effect, and potentially ameliorate these market conditions.

Moreover, poor worker outcomes also exist in some of the low-income programs that are fully subsidized by ratepayer and public sources. Since most programs do not report wage levels (programs funded under the American Recovery and Reinvestment Act are the exception), we do not know how widespread low wages are. But the fact that these programs are fully funded by government and the utilities means that these entities can set the rules in this market, in terms of contractor requirements, use of certifications, and potentially, agreements with employers about wage floors and ladders.[2] With the support of the CPUC, the utilities can take critical leadership roles in addressing the workforce obstacles that impede energy savings goals, such as spearheading sector initiatives that bring together industry stakeholders, and supporting quality training and certification standards. These efforts can support improved worker outcomes, but they will be more effective as part of a more comprehensive strategy for market transformation.

[2] Outside the energy efficiency domain, the utilities have required labor standards when they have agreed to Project Labor Agreements (PLAs) in, for example, power purchase contracts. PLAs incorporate prevailing wage and other labor requirements.

In the residential sector, where this comprehensive strategy for market transformation is most needed, broad efforts to improve conditions and provide upward career trajectories for workers include two sometimes overlapping strategies: "high-road" agreements and certification strategies. High-road agreements set labor standards (wage floors) and local hire requirements, thereby mandating both job quality and access to jobs for workers from low-income, minority, and disadvantaged communities. Certification strategies encourage employers to adopt graduated levels of certifications that are directly or indirectly tied to wage progressions. Both of these efforts are being promoted by the Obama administration through its "Recovery through Retrofit Working Group." In response, the Department of Energy (DOE) has developed a set of industry guidelines for skill standards and certifications for the main job categories in residential retrofit, and is encouraging their voluntary adoption by states and employers. In addition, the DOE ARRA-funded Better Buildings grant program is funding a number of residential retrofit programs based on high-road agreements. However, these strategies are not as well developed in California as in some other parts of the country.

17.4 THE STATE OF OUR CURRENT WORKFORCE DEVELOPMENT INFRASTRUCTURE

Programs to prepare Californians for work in energy efficiency and related activities are embedded within the state's larger, complex workforce infrastructure. Among the numerous institutions responsible for workforce education and training for both new and incumbent workers, only the utilities' Energy Training Centers are exclusively dedicated to training in the energy efficiency and related arenas. The vast majority of education and training for energy efficiency is embedded in existing institutions, which parallels our findings in the labor demand projections that most of the new energy efficiency work will be integrated into existing occupations.

Although existing institutions are the main venue for energy efficiency training, this does not necessarily mean that the existing workforce development infrastructure is fully prepared to meet the needs of the energy efficiency workforce. As in many states, California's workforce development infrastructure is highly fragmented. Efforts are being made at both the national and state levels to rectify this situation, but at present coordination is still limited and irregular among the federally-funded Workforce Investment Boards (WIBs), the community colleges, the state-certified apprenticeships, and other training and education agencies. The WIB system is currently driven by a "work first" mandate, with most resources going to the One-Stop Career Centers to connect workers to any job as quickly as possible rather than investing in skills upgrading and career development. The limited training funds that are available are dedicated to individual training accounts, hindering the ability of the WIBs to coordinate with either community colleges or apprenticeship programs. Sector training strategies built on partnerships among business, labor, workforce education and training institutions, and other stakeholders, combined with a system of portable and stackable credentials and certifications, have been embraced as key directions for reform by both the Obama administration and the state of California. However, they are not well established in most sectors, including the energy efficiency and clean energy sectors.

Our research identified a surprisingly large number of training programs (over 1,500 training tracks) targeting occupations identified as prominent in our jobs projections or self-identified as teaching energy efficiency, demand response, or distributed generation. These programs vary by level, depth, and scope, and include the eight main training institutions: K-12 schools, high school level Regional Occupational Programs (ROPs), community-based organizations (CBOs), community colleges, private sector training programs, apprenticeship programs, utility training centers, and four-year colleges and universities. The majority of training programs are in traditional occupations, and there is a range in the degree to which they have incorporated energy efficiency skills and knowledge. Training programs that are specialized in energy efficiency constitute a minority of training programs in relevant occupations. Most of these specialized programs are either very short courses targeting advanced incumbent workers, mostly professionals; short-term, narrowly focused training for entry-level workers at CBOs and private organizations; or intermediate technical-level training at community colleges. Comparisons across programs are hindered by the lack of consistent record keeping and the lack of outcomes data that tracks program participants into jobs.

In the professional occupations (architecture, engineering, construction management), clear career paths and articulation agreements exist between community colleges and four-year colleges. In addition, there is a systematic linking of educational degrees and professional certifications and licensing in many professions. This system leads to significant returns to education investments both for students, through higher wages (and in this recession, lower unemployment), and for employers, through worker retention and higher productivity. In the training programs serving the commercial and public construction sectors, union apprenticeships (run by joint labor–management committees, or JACs) provide the greatest number of trained tradespeople, the greatest depth and scope of training, the highest degree of certification, and the best worker outcomes in terms of jobs and wages. Unfortunately, for both apprenticeship and four-year colleges, access to entry is beyond the reach of many disadvantaged workers. There are some pre-apprenticeship and college bridge programs that help break down these barriers and more of these are needed to build strong pipelines for disadvantaged workers.

In the residential sector, there is a much spottier training infrastructure and far fewer graduates from training programs, as most workers learn primarily on the job. There are some entry-level programs at CBOs, ROPs, and community colleges, but these are of short duration and low skills level, and mostly lead into low-wage jobs. There are also a limited number of programs leading to residential technical specialties such as HVAC worker, auditor, and building inspector. Finally, there are utility classes that are typically taken by contractors or professionals, and less so by construction workers. These different levels of training are not linked to each other in either the job market or in training pathways, though some programs at community colleges are attempting to forge these links.

Other elements of California's workforce infrastructure include the educational programs, including career development programs, offered by the K-12 system, and various job matching services, including the statewide One-Stop Career Center system for all sectors and the private job boards with niche markets in energy efficiency or green.

17.5 WHAT THIS STORY TELLS US: IMPLICATIONS FOR FUTURE DIRECTIONS

The picture painted by this research shows us what is needed to address the various workforce issues in energy efficiency and related sectors. If unaddressed, the issues and problems will undermine our ability to achieve our energy efficiency and other clean energy goals, as well as our ability to create opportunities for Californians, including those from disadvantaged communities, to obtain good jobs with career pathways.

First, our findings suggest that we need to have a more realistic understanding of the numbers of "green" jobs that result from energy efficiency policies and programs. Even with an investment of $11.2 billion in 2020 (our medium scenario forecast)—which will generate a significant overall stimulus of 211,000 jobs—only about 5,300 additional workers will require energy efficiency training in the year 2020 and about 78,000 additional workers over the ten-year period from 2010 to 2020. The huge queue of unemployed workers in the key occupations overwhelms the number of new openings. As a consequence, current training program graduates will continue to face severe challenges in competing for scarce jobs. At the same time, there are many times more incumbent workers who will require some training to upgrade their skills as new technologies, more stringent codes, and new operations and maintenance practices are introduced.

The concern that there will be a shortage of workers available to enter new energy efficiency jobs is unwarranted for most jobs, and particularly for middle-skill jobs, at least through 2020. However, skill deficiencies among the incumbent workforce in some specific sectors remain an issue. The most prominent concern that has emerged is the prevalence of work that does not meet quality work standards for the installation, maintenance, and operation of energy efficient equipment and materials.

Our research shows that while training workers is part of the solution, the problem is deeply embedded in larger market issues that limit the ability of high-road firms, who compete on the basis of quality, to compete successfully with low-road firms, who compete on the basis of up-front cost.

The current lack of work quality standards and/or their enforcement undermines employers' incentives to invest in training and to recruit and retain a qualified professionalized workforce. Although hard data is lacking, anecdotal evidence suggests that turnover is high in sectors like HVAC, where quality problems are endemic. When this is the case, public investment in training is partially lost because trained workers leave the industry. Moreover, the absence of skill standards and certifications that correspond to work quality standards renders training providers unable to determine what precise skills to train for. Numerous trainers in our interviews said, "Just give me the standards so I know what to train for."

The CPUC regulates the IOUs, firms that are responsible for a multi-billion dollar energy industry in California. The CEC is the primary energy policy agency; it has responsibility for building and appliance standards and currently allocating the energy-related ARRA funds. The leadership of these agencies in building a clean energy economy strengthens their role as critical drivers of economic development in the state. Through their decisions and policies, both the CPUC and CEC affect not only the quantity of jobs created (by stimulating the demand for energy efficiency and clean energy), but also the quality of work and the quality of jobs that are created. The CPUC and the CEC have become increasingly aware of this role and are now explicitly addressing workforce training issues. The findings in this report suggest that these agencies can and should help build the high road and close off the low road by supporting strong conditions on contractors who benefit from incentive programs, the establishment of common skill standards and certifications, compliance with existing codes, and other quality standards that are part of a high-road strategy. These agencies and the IOUs can also support the development of sector initiatives that follow the model of the California Advanced Lighting Controls Training Program (CALCTP), and bring together, employers, labor, educators and other stakeholders in a particular industry to coordinate their efforts.

The tendency in the recent period, particularly with ARRA funding, has been to use public workforce investment dollars to fund short-term training programs—usually around 40 hours in length—that are specific to energy efficiency and renewable energy occupations, such as solar installer or energy auditor. These are mostly geared toward the residential construction industry where, as we have shown, there is very little formal education and training for non-professional workers.

This strategy was utilized by the CEC and the California Workforce Investment Board, the main agencies in charge of ARRA funds for clean energy investments and green jobs training (respectively), and was intended to spur innovation and lasting partnerships. It was a strategy that made sense before the severity of the recession in the construction industry was apparent, and when several major demand drivers, including Property Assessed Clean Energy (PACE) and Home Star, were expected to generate significant numbers of jobs in the residential sector in a very short period of time. The ARRA-funded programs have yet to be completed or evaluated, so their effectiveness cannot yet be assessed. The evaluation of these ARRA programs was announced by the CEC in 2010, but the extent to which workforce outcomes will be appraised is unclear at this time.

For the future, we propose a different approach. Our analysis has identified a plethora of training programs in the existing institutions that comprise California workforce education and training infrastructure for energy efficiency and related activities. These programs are mostly for traditional occupations in which the specific skills related to energy efficiency are being integrated or could be integrated into existing curriculum. Although California's existing workforce education and training infrastructure is certainly not without its flaws, we recommend, to the extent possible, that the focus be on improving this existing infrastructure and "greening" the relevant education and training programs. Shorter-term, specialized programs are not viable substitutes for longer-term occupational training.

IN THE COMMERCIAL AND PUBLIC SECTORS, our research clearly shows the union apprenticeship programs to be the major long-term occupational training leading workers to achieve mastery of their trade and be placed into career-oriented jobs. Apprenticeship programs also have the advantage of being embedded in a structure in which employers support training, provide good wages and benefits, and garner the value of their training investments through the retention of a highly skilled and highly productive workforce. Community colleges support this system through pre-apprenticeship programs and related classroom instruction. This combination of classroom training and heavily emphasized on-the-job training under the supervision of journeypersons contributes to the comprehensiveness and sustainability of the apprenticeship system, as do the following characteristics:

- → Clear standards regulated by the state and the federal Department of Labor (DOL);
- → The incorporation of numerous industry-recognized certificates in specific skills that are embedded in a broad multi-year occupational training;
- → Direct management of the training programs by a consortium of employers who can continually update curricula as needed; and
- → Self-financing mechanisms.

Community colleges also have terminal degrees in some of the same occupations as the trade apprenticeships, such as HVAC, but these reflect much lower skill attainment than apprenticeships, which are usually five-year programs.

Given the state's interest in supporting a stable and professionalized construction workforce that can meet all necessary work quality standards, apprenticeship is the system that should be most strongly supported. In terms of investments in training, the state and the utilities should prioritize working with the apprenticeship system and ensuring that these programs have the resources and expertise to integrate the latest energy efficiency skills into their curricula. Because apprenticeship can be difficult to access, investment of public dollars also should go towards providing strong pre-apprenticeship pipelines using proven best practices and clear articulation with the trades, in order to help disadvantaged workers gain ingress to apprenticeship programs.

Supporting apprenticeship also entails avoiding the investment of public training dollars in firms that directly compete with employers who pay into apprenticeship training trusts, as this creates an uneven playing field and undermines private investment in training. Wherever possible, when determining standards for participation in incentive programs, the state and the utilities should use bidding mechanisms that consider quality and demand high standards; this will help ensure that employers working within the apprentice system are given opportunities to participate in incentive programs and other investments in energy efficiency and clean energy. Requirements and rankings for contractors in contract bids and in incentive programs should recognize the value of the employers' financial contribution to training. Although not the only candidates, union employers are generally in a good position to meet both the goals of quality work that can achieve energy savings and quality jobs that can maintain a professionalized workforce, due to the fact that they are integrally linked to apprenticeship programs and pay high wages and benefits.

IN THE RESIDENTIAL SECTOR, the challenge of developing the skills of new workers and upgrading the skills of incumbent construction workers is much greater, and carving out a market for high quality energy efficiency work will require overcoming many obstacles. Apprenticeship programs are much less common in the residential sector; the market share of unionized contractors is limited to a few specialty trades in a few regions. Most workers learn on the job, receive very little formal training, have low levels of educational attainment, and many do not speak English. Most training in the residential sector is targeted at disadvantaged workers for entry-level jobs in weatherization, solar installation, and other lower-skill jobs, or is private fee-based training for jobs such as energy auditing or rating. There has been mixed success, both in terms of job placement rates and in terms of the wage and career ladders of the available jobs when there is successful placement. In addition to entry-level training for workers, there is some skills upgrade training for contractors at the utility training centers and in private training programs.

The experimentation that is occurring in attempts to transform the residential retrofit market presents opportunities for assessing the relative effectiveness of various strategies for both energy savings and workforce outcomes. These strategies include Energy Upgrade California's emphasis on certification of contractors, DOE's voluntary guidelines for skill standards and certifications for workers in the main job categories in residential retrofit, and high-road agreements that include labor standards and local hire provisions. Some of the projects using high-road strategies are trying to introduce union labor, with its apprenticeship structure, into residential retrofit initiatives. If successful, this could overcome work quality and job quality issues, but these projects are challenged by union labor's rigid craft lines (and their associated wage levels) that don't make sense in the context of small jobs in individual houses.

For low-income and disadvantaged workers, the present situation creates a severe challenge because of the scarcity of jobs and the surplus of experienced workers that employers are likely to prefer. Here there are choices, and we take a strong stance: The first choice is to invest in short-term trainings that lead into jobs in the residential retrofit or renewable sectors. These are unlikely to be good jobs—unless there are significant labor demand strategies such as high-road agreements that improve wages in these markets. The other choice is to invest in longer-term pipelines that lead to real career pathways. This entails investing in post-secondary education that terminates with a degree or recognized and valuable certification, or investing in pre-apprenticeship programs that lead into apprenticeship. This lesson—that training for bad jobs does not help disadvantaged workers—has been learned in other sectors and applies equally to energy efficiency related sectors.

The emphasis on worker outcomes for the low-income programs funded by utility ratepayers does involve significant changes to the structure and goals of these programs. These programs have focused exclusively on the installation of energy efficiency measures for low-income customers. Workforce outcomes were not a program objective and were not tracked by either the utilities administering the programs or the individual contractors. We recommend restructuring these programs so that in addition to providing access to energy efficiency measures for low-income customers, they will also provide access to energy efficiency jobs for low-income, minority, and other disadvantaged workers.

17.6 JOB CREATION

Though this study was not about job creation, the enormity of the unemployment problem underscores its importance at every turn. This study suggests some avenues (albeit limited) to bolster job creation. First, poor quality work limits the cost-effectiveness of existing energy efficiency and related programs and undoubtedly works against comprehensive market transformation. When poor installation renders energy efficiency equipment less effective, and energy usage does not decline as promised, consumers are less likely to invest. Financing is a case in point: Financial institutions want investment-grade audits that are rigorous enough to guarantee a stream of revenue from energy savings to pay back loans. These require a licensed and bonded Professional Engineer, often cost over $10,000, and are currently only used in very large commercial buildings where the energy savings is great enough to warrant the investment in a high cost audit. This rigorous licensing is deemed necessary, not only because of the knowledge needed for the audit, but also for accountability, as the engineer puts his or her license on the line. If a lower level of certification, based on a journey-level skilled trade rather than a professional engineering license, could be developed for smaller buildings, lower cost audits could expand financing and thus the market for retrofits.

In addition, public resources should only be allocated to job training programs when there is a documented need for training (i.e., the job training programs should be demand-driven). If there is a choice, funds should be allocated to job creation strategies rather than training strategies when there are limited job prospects due to the queue of experienced, unemployed workers. And, as has been shown by other studies, energy efficiency building retrofits create more local jobs than many other investments in traditional or renewable energy, largely because fewer dollars go to importing materials and fuels from outside the state.

17.7 RECOMMENDATIONS

Below we present specific recommendations for these specific groups of stakeholders:

→ The CPUC, the CEC, the utilities, and other agencies and policymakers that support investments in energy efficiency and related activities;
→ Policymakers, funders, and practitioners in the workforce development realm; and
→ Utility workforce education and training programs.

Our targeted recommendations fit into two overarching prescriptions that are driven by the state's intertwined clean energy and workforce goals. They address the role that the California state government has in shaping the kinds of jobs that are created as the state moves towards a clean energy economy, as well as the capacity of our workforce development infrastructure to effectively respond to this economic restructuring. Implementing these recommendations will require partnerships, coordination, and collaboration on behalf of all parties.

- CREATE AND ENFORCE STANDARDS TO EXPAND THE HIGHER QUALITY SEGMENTS OF ENERGY EFFICIENCY SECTORS: Establish policies and require utility and other publicly-funded programs focused on energy efficiency and other demand-side management activities to clearly delineate and align the skills, certifications, and additional standards governing workers and contractors, so that quality work conditions can be maintained and workforce planning can occur.

- IMPROVE WE&T PLANNING AND COORDINATION: Establish state-level policies, support effective collaborations, and provide incentives to improve workforce planning and coordination among clean energy agencies and workforce agencies, and among the major education and training institutions, particularly apprenticeships, community colleges, and utility training programs. Emphasis should be placed on sector strategies built on partnerships between business, labor, and training and educational institutions.

17.7.1 RECOMMENDATIONS FOR CPUC, CEC, UTILITIES, AND OTHERS AGENCIES SUPPORTING INVESTMENT IN ENERGY EFFICIENCY AND OTHER DEMAND-SIDE MANAGEMENT ACTIVITIES

State agencies, utilities, and others involved in energy efficiency and related programs and policies should determine and align skill certifications and analyze costs and options for encouraging their adoption by industry in the following ways.

- INCENTIVE PROGRAMS: Require contractors who participate in energy efficiency rebate and incentive programs to have third-party certifications, licenses, building permits, and/or other relevant standard certifications. Certification requirements should apply to both workers and contractors.
- DIRECT CONTRACTS: Award state and utility direct install contracts using a best-value contractor rating system that includes documented history of high-quality work, hiring of workers with appropriate certifications, ongoing investments in worker training, and compliance with building codes and employment laws.
- LOW-INCOME STATE AND IOU RESIDENTIAL PROGRAMS: For fully subsidized low-income programs, modify program objectives to include workforce outcomes. Assess current workforce outcomes and if they are not adequate, use high-road agreements and sector strategies to pilot incorporation of the new national DOE skill standards and certifications or other strategies to improve both energy efficiency and workforce outcomes.
- ENERGY UPGRADE CALIFORNIA FOR RESIDENTIAL: Require Energy Upgrade partners and implementation contractors to include not only building envelope standards but also standards for HVAC installations and other building systems. Establish pilot programs that include high-road agreements as part of the portfolio of funded programs, paying particular attention to strategies that bundle jobs to achieve a large enough scale to attract a broad set of contractors, including those with strong administrative and training capacity.
- ENERGY UPGRADE CALIFORNIA FOR COMMERCIAL: Require the use of high-road agreements, including apprenticeship, prevailing wage, and local hire provisions. The use of high-road agreements will support higher quality installations, increase the benefits of training investments, and promote the achievement of California's workforce goals.
- LICENSING: Review and if warranted change licensing requirements for building and construction trades contractors and technicians to ensure competency-based licensing.
- REPORTING OF WAGES, TURNOVER, AND OTHER LABOR CONDITIONS: Modify program evaluation methodologies and protocols for energy efficiency, demand response, and distributed generation to require the inclusion of worker outcomes, including compensation, benefits, turnover, and retention rates. Existing methodologies address energy and environmental costs and benefits but do not address workforce costs and benefits. Workforce issues affect both the costs and benefits of these programs, by way of the quality of installations and maintenance and the benefits associated with investments in training. Moreover, the achievement of the state's energy efficiency goals needs to be considered alongside the achievement of the state's workforce goals.

- PUBLIC CHARGE REAUTHORIZATON: Include desired workforce outcomes in the list of goals for energy efficiency, low-income, and renewable programs (including distributed generation) with the reauthorization of the public goods charge.

- SECTOR STRATEGIES: Encourage drivers of energy efficiency investments to support sector strategies for deployment of new measures and technologies such as energy storage, integrated demand-side management, commercial building benchmarking, and others, through co-funding, participation in setting work and skill standards, and serving as conveners of contractors and other key stakeholders.

17.7.2 RECOMMENDATIONS FOR WORKFORCE DEVELOPMENT POLICYMAKERS, FUNDERS, AND PRACTITIONERS

- SECTOR STRATEGIES: Direct and support workforce development funders (including Workforce Investment Boards, the Employment Training Panel, etc.) and training and education institutions as they develop, serve as intermediaries for, and coordinate their programs with sector strategies. When key elements of sector strategies already exist, as in the case of the Western HVAC Alliance, the workforce development community should participate by providing co-funding and technical assistance on sector strategy best practices, as well as by providing training and education services.

- GREENING TRADITIONAL OCCUPATIONAL PROGRAMS: Incorporate energy efficiency skills and knowledge into traditional occupations in the construction trades and the relevant professions, particularly engineering and architecture. This greening should focus on the main training institutions of apprenticeship, community college, and four-year colleges, and be a preferred alternative to creation of new, shorter-term, narrowly focused programs in specialized skills related to energy efficiency.

- INCUMBENT WORKER TRAINING: Focus resources on incumbent worker training and journey upgrade training. Consider the adoption of meaningful continuing education requirements for licenses and certifications to support participation of incumbent workers in these trainings and to integrate energy efficiency into the main knowledge and skill base of the relevant professions and trades.

- COMMUNITY COLLEGE AND APPRENTICESHIP COLLABORATION: Promote system-wide collaboration between the community colleges and the apprenticeship programs at the pre-apprenticeship, apprenticeship, and continuing education levels. Further investigation of barriers and best practices is necessary to identify strategies to do this at a system level.

- CERTIFYING PRE-APPRENTICESHIP: Support and strengthen pipelines into skilled trades work, using models such as PG&E's Power Pathways program, pre-apprenticeship programs, and high school career academies. These pre-apprenticeship programs should be linked to state-certified apprenticeship programs and built on best practice models. Efforts to build stronger pipelines should be connected to workforce and economic development policies, including high-road agreements with local hire clauses.

- DATA ON TRAINING OUTCOMES: Promote improved data availability on outcomes for training program participants by making available (with security safeguards) administrative data on employment of publicly-funded training program graduates. Job placement rates and career advancement should be adopted as priority metrics of program success. New policy is needed to make existing data that can track individuals in training programs and in the labor market available for research, while safeguarding privacy and confidentiality issues.

17.7.3 RECOMMENDATIONS FOR CHANGES TO UTILITY WORKFORCE EDUCATION AND TRAINING PROGRAMS

- SUPPORT SECTOR STRATEGIES: Initiate, help fund, and partner with other organizations to develop robust sector strategies in key energy efficiency sectors such as HVAC, building operators, benchmarking, and other emerging areas (as well as LIEE or other programs undergoing review or redesign).

- TRAINING CENTER CLASSES: Modify the structure of classes offered by the Energy Training Centers to increase the number of course series that are longer in length than typical classes, focus on a specific occupation, have a workplace-based hands-on component, and offer clear learning objectives that lead to certification. These course series were shown to have a greater impact on energy savings than the typical short classes. In addition, recognized certifications for contractors and workers are expected to improve workforce outcomes as well.

- COLLABORATIONS: Expand collaborations between the Energy Training Centers and contractor associations and building and construction trades associations. The emphasis should be on collaborations with high-road associations demonstrating commitment to investments in ongoing workforce training, such as participating in apprenticeship programs.

- SUPPORT FOR CURRICULA DEVELOPMENT: Actively participate in the content development, review, and updating of curricula, and support instructor professional development for the main "home institutions" that train building and construction professionals and tradespeople, such as apprenticeship programs, community colleges, and four-year institutions. Energy Training Center staff should be encouraged to share their expertise as appropriate to ensure that curricula incorporate up-to-date information on new technologies and practices.

- GOALS FOR INCLUSION OF DISADVANTAGED WORKERS: Adopt as a goal for the Energy Training Centers the inclusion of low-income, minority, and disadvantaged workers and job seekers. Develop and implement specific programs in collaboration with organizations that have a track record in this arena, emphasizing sector strategies that can lead to placement in good jobs with career ladders.

- EVALUATION OF WORKFORCE OUTCOMES: Assess and determine what additional information is required to evaluate workforce outcomes for the Energy Training Centers. At a minimum, the Energy Training Centers should begin to collect information from participants on occupation, prior education, and work experience.

- CAREER DEVELOPMENT AND ENVIRONMENTAL INTEGRATION IN K-12 PROGRAMS: Increase the emphasis on career awareness and career exploration in ratepayer-funded education programs servicing K-8 students and support career preparation programs in career academies and Regional Occupational Programs. Evaluate and work toward the integration of environmental and ratepayer-funded energy curricula. There is substantial evidence that the integration of environmental and energy curricula will increase the support of teachers for these programs. These efforts should be supported by strong collaborations with K-12 schools, particularly those programs, like the California Partnership Academies, that target disadvantaged students.

- EVALUATION OF K-12 EDUCATION PROGRAMS: Work with education agencies, schools, and funding partners to allow for the collection and reporting of demographic information on students participating in ratepayer-funded education programs (i.e., Connections). The present lack of information hampers the evaluation of existing programs.

17.7.4 RECOMMENDATIONS FOR FURTHER RESEARCH AND CAPACITY BUILDING

- WORKFORCE OUTCOMES OF ENERGY EFFICIENCY PROGRAMS: Expand funding for research on the implications of energy efficiency and related investments on jobs, job quality, and job access, and on employment and career outcomes for training program graduates. Comparative research that captures the impact of different labor conditions on energy efficiency outcomes should be prioritized. Basic job and workforce information is needed for the state's major clean energy and efficiency investments, including wages, turnover, and workforce characteristics.

- SECTOR STRATEGIES RESEARCH: Provide funding to support research on, and technical assistance and capacity building for, existing and emerging sector strategies in the energy efficiency sectors. These funds should be used to disseminate best practices of CALCTP and other successful sector initiatives to new initiatives, and to provide technical assistance to these initiatives. Sector initiatives should target commercial building benchmarking and retro-commissioning, new forms of energy storage, measures to support integrated demand-side management, vehicle electric charging station infrastructure, or others.

- FUTURE WE&T NEEDS ASSESSMENTS: Future studies in targeted sectors are needed to assess the specific skill requirements and effectiveness of training programs. These needs assessments, including the one programmed for HVAC, should not be limited to skill gaps analyses but should include analyses of key labor conditions such as wages, career ladders, turnover and retention rates, and employer investments in training and retention. Needs assessments should include an employer survey of the various segments of the targeted sector in order to gather this information. This approach is critical to assess the higher quality segments of the industry, determine skill standards and certifications when necessary, and ensure that training investments help support high-road development.

- NATIONAL CENTER FOR THE CLEAN ENERGY WORKFORCE: Support and fund the California Energy Commission's proposal to create a National Center for the Clean Energy Workforce. The mandate of the proposed center is to help California grow a clean energy economy by promoting high-road economic and workforce development. The proposed center would work toward these ends by supporting research, providing technical assistance, and serving as an information clearinghouse. In these ways, the center would help the state achieve energy savings while improving the lives of California workers.

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The Donald Vial Center carries out research on the emerging green economy and climate change policy in California, as these relate to the labor market, to workforce development, and to workforce policy.

The Center for Labor Research and Education (Labor Center) is a public service project that links academic resources with working people.

Both the Labor Center and Donald Vial Center are projects of the UC Berkeley Institute for Research on Labor and Employment

Research Into Action, Inc., is a social marketing and evaluation research firm specializing in evaluation research and market assessment design and analysis services in the fields of energy efficiency, renewable energy, and natural resource management.

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Public/Private Ventures (P/PV) is a national consulting non-profit organization dedicated to creating and strengthening programs that improve lives in low income communities.

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