Energy Efficiency Services Sector: Workforce Education and Training Needs

Jane S. Peters and Nathaniel Albers, Research Into Action, Inc.
Charles A. Goldman, Elizabeth Stuart, and Merrian Fuller,
Lawrence Berkeley National Laboratory

ABSTRACT

The Energy Efficiency Services Sector (EESS) Work Force Needs Assessment estimates four-fold growth between 2008 and 2020. From a 2008 base of 114,000 person year equivalents (PYE) to over 384,000 PYE by 2020, the total number of individuals engaged in EESS activities for some part of their work year could exceed 1.2 million by 2020. About 25% of EESS jobs will be filled by college educated professionals while the remaining 75% will be filled by building and construction industry contractors and trades people.

Training programs for the residential building and construction industry are currently on target to train over 12,000 residential contractors per year in green and performance buildings by 2012. Specific training for construction trades workers is less developed. While unions, trade associations and community technical college programs have advanced training capability for the commercial and industrial building industry, very little of it is targeted at energy efficiency solutions.

Educating EESS professionals is occurring at a somewhat lower level than residential contractors. About 4,000 people graduate with some training in energy efficiency each year, nearly 3,000 in architecture and engineering schools though this is 2-3% of all graduates and in the policy and social sciences just about 1,000 graduates have efficiency course work less than 1% of all policy and social science graduates.

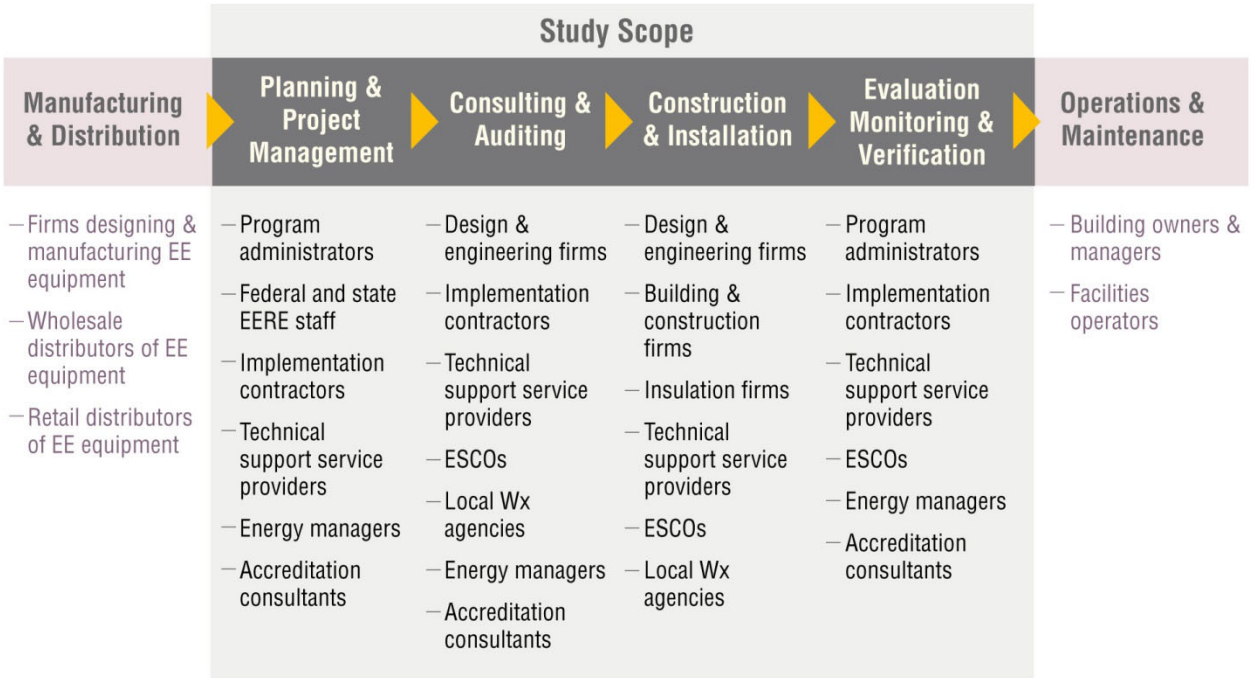
This paper reports the need for more training and education for the EESS, identifies the current energy efficiency training and education options and the challenges facing many of those programs, and discusses some of the exciting solutions that are emerging across the country.

Introduction

In the last year there has been a significant increase in funding for "green job" training and workforce development. For instance, the American Recovery and Reinvestment Act (ARRA) provided $500 million to the Department of Labor to fund new training programs and related research to support the development of a "green" workforce and 14 State Energy Programs (SEP) used $64 million of ARRA money to support energy efficiency training programs.

This study provides an initial assessment of the current state of workforce development in energy efficiency and identifies high-priority training needs for this sector. We focus specifically on the energy efficiency services sector (EESS), which includes those service-oriented jobs that target improving the energy efficiency of residential and nonresidential buildings. Figure 1 shows the market value chain for the EESS, sub-sectors included in this study, as well as the types of market players and specific occupations. Key segments of the EESS have experienced significant growth during the past several years. For example, from 2006 to 2008 energy efficiency program administrator budgets grew 19% per year (CEE 2008), and energy service company (ESCO) revenues grew by 22% per year (Goldman and Hopper 2007).

Figure 1. Energy Efficiency Services Sector and Key Market Actors



In 2009, our research team estimated the size of the current EESS workforce, and projected changes to the size and composition of the EESS workforce under low-growth and high-growth scenarios through 2020 (Goldman et al. 2010b). The research team also sought to understand education and training needs for the expanding EESS. We conducted ~350 interviews with program administrators, implementation contractors, ESCOs, and educational and training institutions between September 2008 and September 2009.[1] These interviews included questions about respondents' expectations for skills and knowledge of new hires and needs for ongoing education and training in energy efficiency. This paper summarizes the findings from that research, beginning with a review of key findings from our companion report that assesses the size, composition and projected growth of the EESS workforce (Goldman, et al. 2010a).

Estimated Size and Projected Growth of the EESS Workforce

The workforce needs assessment team estimated that the energy efficiency services sector accounted for about 114,000 person-years of employment (PYE) in 2008 (Goldman et al 2009). We also developed low-growth and high-growth estimates of future energy efficiency spending based on an analysis of state energy efficiency legislation, regulatory policy and market activity and the expectations of program administrators, implementation contractors, and ESCOs that were interviewed as part of this study. We then projected future workforce size based on our analysis of the relationship between energy efficiency spending/investment and employment in different parts of the EESS.

[1] We conducted 300 interviews with representatives of program administrators, implementation contractors, ESCOS, trade associations, education and training organizations, and unions. We also spoke with approximately 50 energy efficiency experts on workforce and training issues.

We estimate that the national EESS workforce will increase to 220,000 PYE (low-growth scenario) or 380,000 PYE (high-growth scenario) by 2020. This represents a two to four-fold increase in the size of the EESS from the 2008 baseline. Our estimates of future size of the EESS workforce may be conservative because they do not explicitly account for the impacts of proposed federal climate change legislation with aggressive greenhouse gas reduction targets or a national energy efficiency portfolio standard, which could spur additional investment in energy efficiency and more job growth.

Current EESS Workforce Training

Program administrators, implementation contractors, and ESCOs said that they are often unable to hire candidates with specific education or training in energy efficiency for a simple and compelling reason: there are few candidates with that experience. As a consequence, these contacts said they used a variety of *ad hoc* training resources to ensure their staff was skilled and knowledgeable after hiring.

Survey respondents reported that for professional job openings in the EESS, they generally hire applicants with at least a bachelor's degree in a field most likely to meet their firms' energy efficiency project requirements: engineering, economics, architecture, financial analysis, evaluation, statistics, and computer technologies. Most new hires require additional training to supplement their bachelor's degree in order to meet the organization's needs. Many program administrators expect some of their staff to have an MBA or experience with financial analysis and economics. ESCOs typically seek engineers with professional engineer (PE) licenses. Implementation contractors seek to hire employees who had earned the Certified Energy Manager (CEM) designation, but said they often paid for employees to take CEM training because relatively few applicants were CEM-certified.

Contacts reported that their greatest demand was for engineers with knowledge of energy efficiency and that there was stiff competition with other industries for talented engineering graduates. Contacts indicated that they were often able to find and hire engineers who were interested in, but had not already received, training in energy efficiency and then trained them on the job. A key challenge for the EESS is that many engineering graduates are unaware of the EESS and the potential career opportunities in this sector. Many disciplines within engineering align with specific occupations. For example, a degree in aerospace engineering can lead to a job with an airline manufacturer, a defense contractor, or a government agency that engages with the aerospace industry. Although the Association of Energy Engineers (AEE) has more than 9,500 members (AEE, 2009), the federal Bureau of Labor Statistics (BLS) does not track energy engineering as an independent engineering discipline. Moreover most engineering schools do not offer courses specifically on energy efficiency topics.

Program administrators and implementation contractor respondents involved in delivering programs that target residential customers (e.g., low-income weatherization, appliance recycling, or building shell efficiency improvements) indicated they hired employees with less than a bachelor's degree. After hiring, these employees often obtain certifications from training organizations certified by Residential Energy Services Network (RESNET) or through the federally-funded low-income Weatherization Assistance Program (WAP).

We also learned that most workers in the building and construction trades who worked on energy efficiency projects were unlikely to have specific energy efficiency training, except in a few cases. Respondents from building and construction trade associations and unions noted that

the most advanced training for journeymen sometimes addressed how to improve a project's energy performance. Training on high-performance equipment (e.g., furnaces, air conditioning systems, energy management, and/or lighting controls) typically was provided by the equipment vendor or was discussed in the manufacturers' instructions regarding the installation, use, and maintenance of the equipment.

Education and Training Requirements for EESS Occupations

Education and training requirements vary across occupations in the EESS. Some professional positions require a college degree, while building construction contractor and trades positions may require technical training, but not necessarily a college degree.

There are currently two primary paths for those who want to enter the EESS workforce:

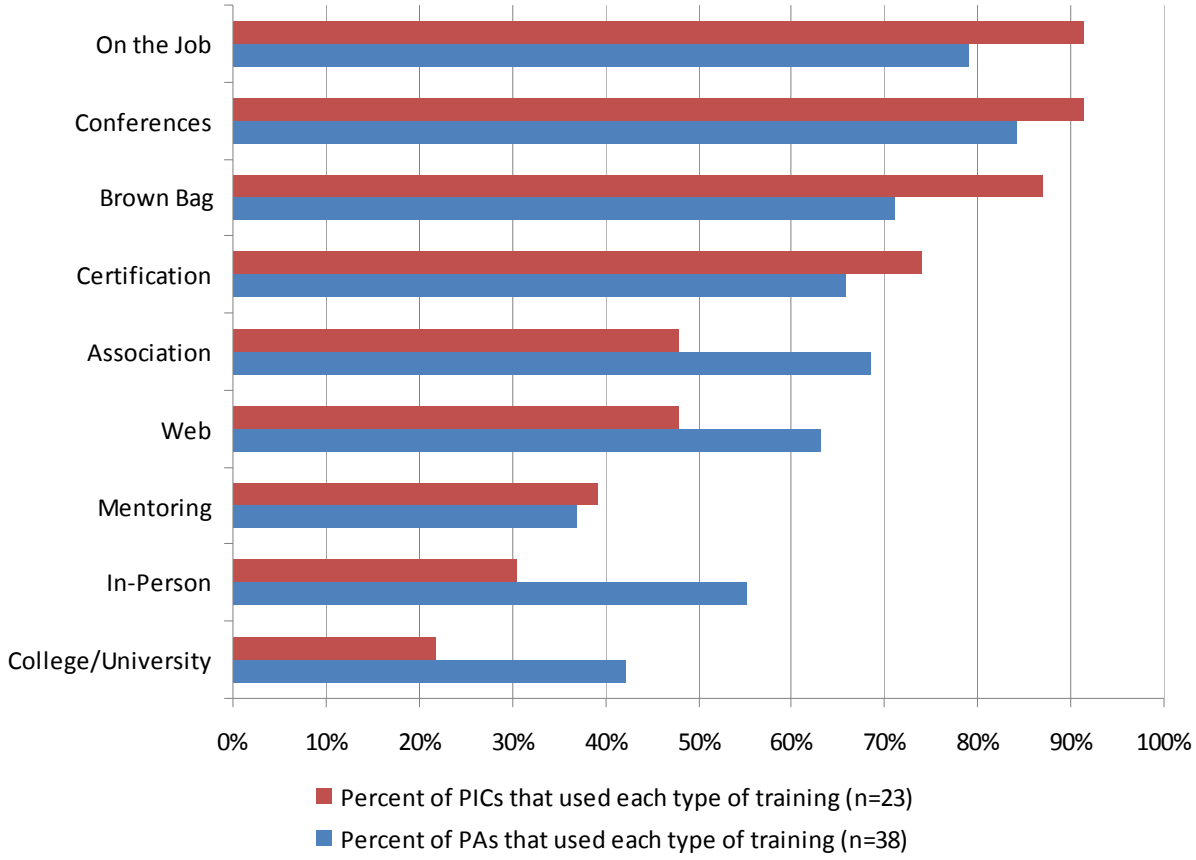
- Existing occupations (e.g., HVAC technicians, lighting contractors, construction trades, project managers) which are transformed into more energy efficiency-focused positions via retraining, and
- Emerging occupations that are somewhat unique to the EESS (e.g., home energy raters, commissioning services, energy/home performance services, energy auditors) and learning on the job.

In the future, as the EESS expands and EESS-related training programs become more widespread, it is likely that more new hires will receive initial training through certificate and degree programs offered at community and technical colleges and universities that are directly related to occupations in the EESS.

Current Approaches to After Hire Training

Program administrators, implementation contractors, ESCOs, and associations representing building and construction contractors indicated that they typically provided on-the-job training after hire for all entry- and mid-level employees. We asked program administrators (PA) and implementation contractors (PIC) to indicate the type of training resources used for their staff after hiring. Overall, PA and PIC survey respondents used conferences most frequently for training staff after hire, followed closely by on-the-job training (see Figure 2). Respondents indicated that conferences are valuable as networking opportunities and as a good way to keep abreast of industry developments and not solely for training. Mentoring is used least (<40%) by program administrators and college/university and other in-person training courses are used least (by only 20-30%) by program implementation contractors.

Figure 2. Types of Training Used by Program Administrators and Implementation Contractors



In the commercial/industrial sector, the building and construction trades involved in the EESS include mechanical insulators, mechanical contractors, electricians, and air conditioning, refrigeration, and sheet metal workers. Our contacts said that these people typically receive their technical training through trade apprenticeship programs, technical schools, and/or applicable military training prior to joining a company. Once these tradespeople are working, they receive on-the-job training, primarily from senior people in their company, and secondarily from vendors, trade associations, or union-based training programs.

The workforce in the residential building and construction industry consists of homebuilders, remodelers, and trades workers (e.g., carpenters, electricians, insulators, plumbers, and window installers). Survey respondents indicated that these workers are less likely to receive training through apprenticeship programs or trade schools compared to tradespersons in the commercial/industrial sector because their work requires lower-level skills. Workers in the residential EESS market receive much of their training on the job after they are hired.

On-the-job training of new employees by senior staff is standard practice across the trades. However, respondents noted several concerns about this approach. The EESS is a relatively small industry, comprised of small- to medium-sized companies (usually less than 100 employees), most of which have limited number of senior- and mid-level staff that can provide training/mentoring. Contacts also said that senior staff increasingly had to train new hires while continuing to perform their other job responsibilities. As one implementation contractor

respondent said, “This will not be a problem in 10 years, but it is a problem today.” One respondent from the Refrigeration Service Engineers Society (RSES) pointed out another shortcoming of this reliance on workers learning on the job from what he called “old people like me: This is good and bad, because we have lots of experience but they may also assume our bad habits.” Finally, relying solely on on-the-job training may be problematic for energy efficiency solutions that require new techniques or an approach that differs from common practice. If the senior electrician does not teach the electrician trainee to air-seal holes when running wire, that trainee will not learn this energy efficient construction technique.

Many building equipment contractors also receive training from equipment vendors and manufacturers, which is often their primary source of information about the latest equipment and technologies, including those that are energy efficient. However, contacts at EESS firms said they often were able to send only a limited number of employees – typically managers – to such trainings. Managers may benefit from this training; however, some contacts also indicated that it was difficult to assess the extent to which managers transferred information provided by vendors to their employees as part of on the job training.

One PA noted another concern with vendor-based training: such training often is both technical and sales-oriented. Thus, vendors may be incented to promote a particular product, not necessarily those that are most energy efficient.

Respondents from trade associations noted that there is a need to respond to customers, and that energy efficiency programs and mandates often help make it easier for an HVAC or electrical contractor to promote the energy-efficient product to a customer. As one contractor stated, “If the customers aren’t educated or the cities don’t mandate energy efficiency, it’s hard for contractors to convince customers to choose more energy-efficient equipment.”

Trade associations supporting commercial/industrial and residential construction contractors also offer energy efficiency training, from brief webinars to multi-day classroom trainings that lead to a specific energy efficiency certification or designation. Contacts involved with these training programs noted that a main challenge for expanding training was that the market does not yet adequately support builders and contractors who are “green” or even those who are certified by North American Technician Excellence (NATE) or Refrigeration Service Engineers Society (RSES). As a consequence, few contractors are willing to invest their own time and money to receive this training.

Issues with Current EESS Workforce

Three concerns about current workforce needs and future growth were articulated by respondents: lack of awareness of energy efficiency workforce needs among building and construction trades, a shortage of managers for energy efficiency and a shortage of energy efficiency engineers.

Lack of Awareness by Building and Construction Trades People

Another important finding is the need to inform the building and construction industry that the EESS is expanding. In our interviews, program administrators and implementation contractors understood that there was an increased demand for energy efficiency services, which was likely to continue in the future; these organizations were anticipating and planning for a growing workforce. For example, based on survey results, in aggregate, program administrators

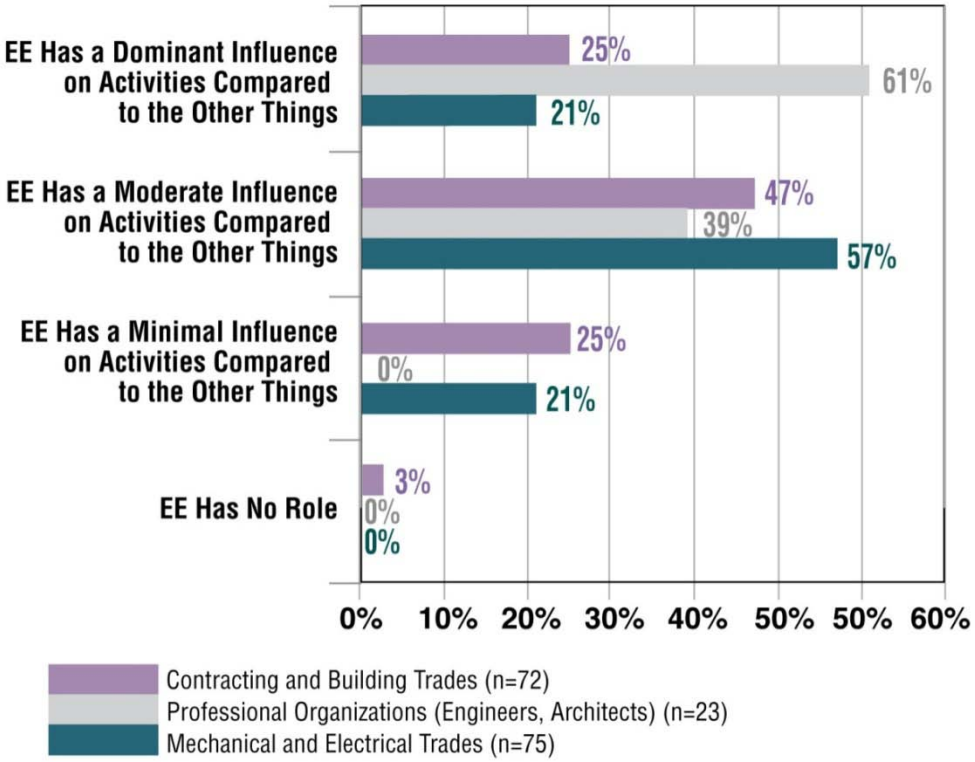
estimated that their energy efficiency staff would grow by about 19% by 2010, while implementation contractors anticipated a 64% increase.

In contrast, less than 50% of ~180 respondents who represented building and construction industry associations and trades could even estimate the percent of the workforce that was involved in energy efficiency. Of those who could, virtually all representatives of the design and engineering professional associations indicated that energy efficiency had a "dominant" or "moderate" influence on their activities. In contrast, over 70% of the representatives of other building and construction trade associations characterized the influence of energy efficiency on their activities as "moderate" or "limited" (see Figure 3).

Fewer than half of the building and construction industry association and trades contacts were able to estimate the role of energy efficiency on their members' businesses, and even fewer could estimate the impacts on their members' businesses if energy efficiency funding were to increase. Among the respondents who offered an estimate, those working in the residential sector anticipated a somewhat greater effect on their business than those working in the commercial and industrial sectors.

The representatives of building and construction industry associations and trades who were aware of these increases in energy efficiency funding and spending tended to be located in states with active energy efficiency programs, or represented a national organization or union. This lack of awareness among building and construction industry associations and labor unions is a concern overall, but particularly in those states and regions (e.g., Midwest) that are currently ramping up energy efficiency programs and who historically have not offered large-scale energy efficiency programs.

Figure 3. Influence of Energy Efficiency on the Building and Construction Industry



Shortage of Managers

According to PA and PIC respondents, *it is extremely challenging to find management-level applicants with experience in energy efficiency.*

Respondents reported that about 6% of the PA and PIC staff held manager-level positions; several noted that these positions had not been growing in number. Respondents said they highly valued people with energy efficiency knowledge and experience, both as effective employees and as mentors of the next generation of the EESS workforce. However many respondents noted challenges in hiring managers with significant energy efficiency knowledge and experience. One implementation contractor put it succinctly: "*It is almost impossible to find someone with energy efficiency program management experience.*" Some respondents indicated that the lack of management-level applicants with experience in energy efficiency was the primary limitation on growth of implementation contractor firms. Several program administrators also noted that difficulties in finding experienced energy efficiency managers constrain the pace at which they can expand both the number and scope of program offerings.

This issue may become increasingly important as the EESS workforce expands, because few schools and training centers offer energy efficiency curricula for managers. As a result, on-the-job mentoring is the primary source of training for managers that work for ESCOs and program administrators and implementation contractors.

An additional concern is the lack of sufficient staff in mid-level positions that can progress to senior-level positions throughout the EESS. This situation arose in part because many firms and organizations did not hire much or had layoffs during the 1990s (e.g., spending on ratepayer-funded energy efficiency declined from 1993 to 1998 due in part to uncertainties surrounding electricity restructuring and low fossil fuel prices). As a result, EESS companies lack or have a shortage of mid-level staff that can orient recent hires and develop into senior managers. While managers who have experience with other industries can provide some capacity, in order for the EESS to expand effectively and maintain high standards of service delivery, the EESS must attract, train, and retain new managers who have experience in energy efficiency that is deep enough to provide guidance to others.

Shortage of EE Engineers

Program administrators, program implementation contractors, and ESCOs that work with commercial and industrial customers indicated that it has been very difficult to find experienced energy efficiency engineers. Engineers play a key role in these organizations because they create and/or review the design and specifications for most energy efficiency projects and also often ensure that completed projects meet energy efficiency requirements. Engineers constitute between 20% and 25% of the workforce for program administrators and implementation contractors respectively and about 60% of the workforce for ESCOs (see Table 1).

Table 1. Role of Engineers in Different Types of Energy Efficiency Services Organizations

Organization Type	Number of Engineers in Survey Respondents' Organizations	Engineers as Percent of Total Staff
Program Administrators	548	17%
Program Implementation Contractors	661	26%
ESCOs	3,268	60%
TOTAL	**4,477**	

Survey respondents reported that few engineers enter the field with energy efficiency knowledge or experience. To be effective, EESS engineers need knowledge of, and preferably experience with: fluid and thermodynamics; building energy systems; performance optimization of existing HVAC, refrigeration, or industrial process systems; and communication skills that foster good working relationships with customers. Employers that are unable to hire engineers with all or most of these skills typically hire engineers with technical aptitude, communication skills, and/or some engineering experience.

Historically, engineering talent has been fungible when industries expand. Bell (1982) reported that the energy industry met the increased demand for engineers in the 1970s by hiring from related fields. For example, while oil companies preferred to hire engineers with expertise in the areas of petroleum engineering or geology, when people with these skills could not be found, they hired mechanical engineers and trained them in petroleum engineering. A similar phenomenon is happening currently in the EESS. Many program administrators, implementation contractors, and ESCOs indicated that they preferred to hire energy or mechanical engineers, but often hired engineers with technical aptitude who were interested in energy efficiency, and then trained them to work on energy efficiency projects. Several of the larger implementation contractors and ESCOs noted that they have little difficulty attracting talented engineers who then develop energy efficiency skills. However, a number of smaller firms said it was much harder to attract engineers due to their companies' limited recruitment and training resources.

Meeting Projected Demand for an EESS Workforce

We identified two opportunities for meeting the projected demand: to create and support more training for the building and construction trades, and to encourage expansion of training and continuing education for energy efficiency professionals.

Create and Support Training for the Building and Construction Industry

As large-scale energy efficiency programs expand beyond California, the Pacific Northwest, the Northeast, and upper Midwest, those states and regions that have limited energy efficiency services infrastructure will face the challenge of rapidly creating and supporting increased education and training opportunities, particularly for the building and construction industry. Energy efficiency education and training are a key component of a state's strategy to facilitate a smooth expansion of energy efficiency programs and market activity.

The effort underway in New York provides an example of a broad statewide education/training effort. NYSERDA's collaboration with Hudson Valley Community College is structured to increase the skills of the building and construction contractors and tradespeople throughout New York State. This type of training infrastructure can help states that are ramping up energy efficiency programs if building and construction contractors and trades are much less aware of energy efficiency-specific design and construction practices.

Another approach is to integrate building and industrial process system efficiency into existing curricula. This could be a cost-effective way to train large numbers of electricians, HVAC contractors, mechanical insulators, home builders and others. As one union contact said, teaching efficiency relies on "using existing skills and applying it to new technologies and measures." Because the building and construction trades constitute approximately 75% of the overall EESS workforce, this is the sector of the workforce for which training in energy efficiency can have a great impact.

One union trainer from a Midwestern state said his program was beginning to shift focus from specific systems, to providing "cross-skills training across our various unions." This could be useful for other, similar, union training programs. He said this change offered an ideal opportunity to integrate energy efficiency training into his programs, due to its whole-building approach. For instance, through cross-training, a carpenter can learn from an electrician how to make it easier for the electrician to run wire in a building, while also reducing the number of penetrations that might affect the building envelope's efficiency. Cross-training also helps the electrician collaborate with the mechanical contractor to integrate the building's lighting and HVAC systems to minimize energy use.

Expansion in training is underway, or soon will begin. Respondents at community colleges that already have HVAC, construction technology, and other building trades-related programs said their institutions were likely to incorporate energy efficiency into their curricula. In California, a concerted effort is underway to expand energy efficiency training at community colleges in selected occupations. Respondents indicated that this change will not require a significant investment or a total revamping of their programs, but they will have to adapt their curricula and train more instructors.

Expansion and Continuing Education for Professionals

While the primary need for expanded training in terms of sheer numbers is with the building and construction trades and contractors, four-year educational institutions also have an important role to play to prepare architecture, engineering, and social science professionals to be part of the EESS. Respondents expressed two needs: 1) multi-disciplinary approaches to energy efficiency education and training, and 2) an increase in the number of energy efficiency offerings and instructors.

For example, four-year educational institutions in states that are just ramping up their energy efficiency programs could provide additional courses with multi-disciplinary and system approaches to energy efficiency. A faculty member in an engineering program said, "Building systems are undervalued [in our programs]. Buildings should be the first step in carbon reduction. Energy efficiency should be [taught] in multiple areas of the campus, such as mechanical engineering, public policy, and business."

While many Ph.D.s in other disciplines stay in academia, most of the Ph.D.s with energy efficiency expertise find jobs in industry, due to high demand, excellent compensation, and a

shortage of high-level teaching positions. Most of the four-year colleges and universities interviewed prefer faculty with a Ph.D. and relevant experience and research, and an interest in teaching. Respondents from engineering and architecture departments also felt it was important for faculty to have some field or industry experience. As one respondent involved in an engineering program put it, "We need people with HVAC skills, modeling skills, and experience at the time of hire [because] we want [students] to have energy skills and think fluidly about energy." Another respondent noted that industry experience provides a connection between academia and industry, which is important for graduates of these programs.

The growth in demand for energy efficiency-related courses and programs may require educational institutions to add physical space and equipment to support education and training activities. Respondents suggested that the current four-year programs were approaching maximum capacity and that future growth in these fields would have to occur at other institutions because funding is not available in public institutions to expand and grow programs. Moreover, it typically takes many years to create a new program in four-year colleges and universities. One respondent said it took him eight years to develop a Ph.D. program, and that it took several more years before the program awarded its first degrees. While several four-year institutions have begun the process to create new degree offerings, none had been established during our research period, though the Indiana Institute of Technology (see sidebar) had just successfully launched a new program in 2008.

While the primary approaches being considered for training and education is to expand current programs, build new ones, and to integrate energy efficiency into existing education curricula, many professionals are already working that want or need training and education in energy efficiency. Moreover, many of the people with the skills in energy efficiency are not in the universities. As one respondent noted, some design firms are so skilled at building commissioning that their staff should instruct Ph.D. university faculty about the topic. Thus, there is a need to bring the knowledge of the energy efficiency community into the training and education world and that takes different strategies.

Because professionals have many of the needed knowledge and skills, new skills for energy efficiency need to be targeted. For example, trade associations (and some four-year schools) are offering professional development courses to help practicing architects and engineers better understand system approaches to building design and construction. Some respondents pointed out that it is important that practicing professionals be exposed to energy efficiency education and training that is tailored to the building stock and conditions found in specific regions (e.g. weather and building practices). One respondent in the Northeast said it would be valuable to have more regional lighting and ventilation testing labs, similar to the Integrated Design Labs in the Pacific Northwest sponsored by the Northwest Energy Efficiency Alliance (NEEA).

Some contacts said they planned to offer distance learning options such as online courses as a relatively inexpensive alternative to constructing new facilities and hiring new faculty. When asked how a program would respond if demand for workers and professionals trained in energy efficiency were to double in the next five years, one respondent in a large energy engineering program said, "We would develop more tools and make them available online [and] we would offer more [short-term] trainings." He did not think that the program would grow proportional to demand by adding traditional classroom capability. Contacts at some of the

engineering schools pointed particularly to the example of the Industrial Assessment Centers[2] (IAC) and suggested that such an approach could provide the additional benefit of training engineers, architects, and even policy and planning students in residential- and commercial-sector issues.

Recommendations and Conclusions

We recommend the following six actions to enable the EESS workforce training infrastructure to keep up with projected demand:

1) Provide Energy Efficiency Education and Support Targeted at Building and Construction Contracting and Trades People

We found a notable lack of awareness on the part of building and construction contractors and tradespeople that energy efficiency is poised for significant growth. Because building and construction contractors and tradespersons constitute approximately 65-75% of the overall EESS workforce, it is important to educate and support the building and construction industries to make sure they are able to provide a trained workforce to support this growth. This problem appears more severe in states that do not have long-running ratepayer-funded programs. There is also the issue of lack of access to resources in addition to lack of awareness. Even in cases where there is interest, the expertise and training required may not be available in the local area. As one contractor trade association contact noted, "We're in the boondocks and it's hard to get any kind of [energy efficiency] speaker out here. [Training needs are] more acute here because we are so isolated." It will also be important, especially in states that are ramping up energy efficiency, to integrate building and industrial process system efficiency into existing building and construction technical, apprenticeship, and trades curricula. This could be a cost-effective way to train large numbers of electricians, HVAC contractors, mechanical insulators, and home builders. As one union contact said, teaching efficiency relies on "using existing skills and applying it to new technologies and measures."

2) Coordinate and Track Training Efforts within States; Share Best Practices Across States

With the influx of ARRA funding, many states are initiating and/or ramping up a range of training and education activities that target workforce development in the "clean energy" sector. However, it was challenging to identify and determine those programs/courses that will provide education and training for the energy efficiency services sector. This information needs to be tracked in a systematic way going forward. There also needs to be greater coordination between the various types of EESS training programs within each state. Establishing broad statewide education/training efforts, such as NYSERDA's collaboration with Hudson Valley Community College, may be helpful to avoid duplication of efforts at the local level. This type of training infrastructure can help states that are ramping up energy efficiency programs if building and construction contractors and tradespeople are much less aware of energy efficiency-specific

[2] The Industrial Assessment Centers (IAC) are funded by the US Department of Energy as a training facility for engineering students and as a resource for industrial firms. Through the IAC, engineering students conduct energy efficiency assessments of industrial processes and facilities and provide the results to the industrial facilities.

design and construction practices. Finally, it is also important to note that similar efforts are happening in a number of states so increased sharing of best practices and high-quality curriculum could help lead to more rapid launch of effective training programs.

3) Increase Short-Duration, Applied Trainings to Augment On-The-Job Training and/or Introduce New Entrants to a Field

Much of the growth in the EESS will come from new entrants who already have some applicable skills (e.g. building and construction contractors who might become efficiency retrofit specialists). There is also a strong demand for periodic training for those who are currently employed in the EESS but who need to update or augment their skills. In both cases, short-duration courses on specific, applied topics will be more relevant than a two- or four-year degree program. These types of offerings will need to be significantly ramped up in the next few years and could be supported by energy efficiency programs funded by utility ratepayers and/or government. Examples of this type of offering include the Northwest Energy Efficiency Alliance's network of integrated design and lighting design laboratories that provide design assistance to architects, lighting designers, and engineers, and provide classes for contractors and building owners to increase their understanding of energy-efficient building solutions. In California, each of the three investor-owned utilities has training centers that provide classes for architects, engineers, lighting designers, contractors, building owners, and tradespeople on energy-efficient building solutions.

4) Increase Funding to "Train the Trainers"

Our research indicates that there is a lack of qualified trainers to train the workforce needed to support the projected growth in the EESS. For example, the WAP network estimates they will need 700 *additional* trainers by summer 2010 to meet their goals. Many community colleges rely on a small group of key instructors to teach courses and many are nearing retirement age. The Building Performance Institute, which provides certifications for residential retrofit contractors, experienced 5-fold increase in number of certifications between 2005 and 2008, and believe the number will almost triple between 2008 and 2009. These growth rates strain the capacity of existing trainers; additional resources from energy efficiency ratepayer and government funding could be directed towards training the next generation of trainers for the EESS.

5) Increase Access to On-The-Job Training for Mid- and Senior-Level Engineers and Managers

Our interviews revealed a need for more managers and engineers experienced with energy efficiency. There are some resources to address this, such as a growing number of industry conferences and formal trainings offered by the Association of Energy Services Professionals as well as certificate programs such as the Certified Energy Manager designation offered by the Association of Energy Engineers. Most firms report that they rely on on-the-job and informal training to ensure their staff was skilled and knowledgeable after hiring. Managers and engineers in potentially related fields need to understand the opportunity in the EESS and have increased access to professional training that they can complete on the job, or if they decide

to make a career change. An energy efficiency certificate for managers may be a good addition to the current offering so that firms can more easily identify candidates who have some experience with energy efficiency topics.

6) Prepare the Next Generation of EESS Professionals

We learned from our interviews that most professional roles within the EESS require at least a four-year degree and currently face a shortage of trained and knowledgeable workers. Few colleges or universities offer EE-specific curriculum and funding to grow these programs was extremely limited in most cases. Additional funding needs to support new programs and the expansion of existing programs and course offerings. Four-year colleges, especially in states that are ramping up large-scale, energy efficiency programs, need to provide additional courses with multi-disciplinary and system-based approaches to energy efficiency. The Department of Energy Industrial Assessment Centers have been a successful model to provide energy efficiency services to industry and a training ground for engineering students. Similar centers could be developed in conjunction with college- and university-based engineering, architecture, planning, and policy-focused programs. These centers could encourage research and innovation and attract new people to the field of energy efficiency by providing opportunities for students enrolled in energy efficiency programs to study, intern, and engage in energy efficiency programs. These centers could include building science centers for architecture and engineering students, and policy and planning centers that emphasize education/training needed for energy efficiency program design and implementation

References

Association of Energy Engineers, 2009. "**Energy Independence and Market Trends.** AEE.

Bell, S 1982. "**Recent Science and Engineering Graduates Working in Energy-Related Activities, 1979 and 1980**." Oak Ridge Associated Universities, ORAU-204, September.

Bureau of Labor Statistics, U.S. Department of Labor 2007. "**2006-16 National Employment Matrix, detailed by Occupation**." http://www.bls.gov/emp/empiols.htm., Washington D.C.: Bureau of Labor Statistics, U.S. Department of Labor.

Goldman, C., Fuller, M., Stuart, E., Peters, J., Albers, N. 2010a. "**Energy Efficiency Services Sector: Workforce Education and Training Needs**," Lawrence Berkeley National Laboratory, LBNL-3163E, March 2010.

Goldman, C., Fuller, M., Peters, J., McRae, M., Albers, N., Lutzenhiser, S. and Spahic, M. 2010b. "**Energy Efficiency Services Sector: Workforce Size and Expectations for Growth**," Lawrence Berkeley National Laboratory, LBNL-XXXXX, April 2010.

Goldman, C., N. Hopper, D. Gilligan, T. Singer, and D. Birr 2007. "**A Survey of the U.S. ESCO Industry: Market Growth and Development from 2000-2006**." LBNL-62679, Berkeley, CA: Lawrence Berkeley National Laboratory.