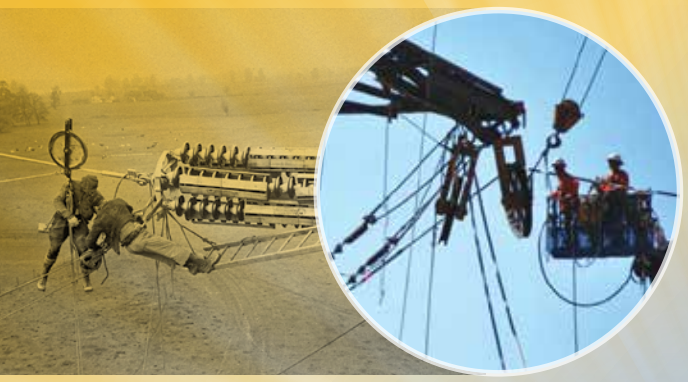

Workforce Challenges *of* Electric Power Employers *in the* Pacific Northwest

By:
Alan Hardcastle, Ph.D. with Pamela Jull, Ph.D.
and Sally Zeiger Hanson, M.Ed.

Washington State University Energy Program

For the:
Pacific Northwest Center of Excellence for Clean Energy
"A Centralia College Partnership"

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Tacoma Power's Alder Dam – Photo courtesy of Mick Klass

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For More Information

Contact: Barbara Hins-Turner, Executive Director, Pacific Northwest Center of Excellence for Clean Energy (PNCECE), Centralia College, (360) 736-9391 ext. 477, bhins-turner@centralia.edu, or Alan Hardcastle, Senior Research Associate, Washington State University (WSU) Energy Program, (360) 956-2167, hardcast@wsu.edu.

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Executive Summary

The primary purpose of this study was to understand the employment and workforce education needs of electric power employers in the Pacific Northwest region, while also noting some of the shifts that have occurred since completion of an earlier report produced in 2008, just as the U.S. entered a major recession. Quantitative and qualitative data were collected from 16 employers using a standard survey protocol. The results identify several important findings that have implications for regional, state, and local economic and workforce development policymakers, energy employers, and workforce education and training providers. A brief summary of findings, conclusions, and implications is provided below.

Findings and Conclusions

The Recession and Electric Power Employment

The U.S. recession reduced the demand for electricity nationally. Employers implemented cost-cutting measures that limited new hiring, especially at the entry level. The uncertain economy caused many experienced employees to delay their retirements. For most new hiring, employers targeted applicants with energy-sector backgrounds, filled vacancies from within, or sought experienced personnel from other utilities or industry sectors such as manufacturing to meet critical skill gaps. Much less emphasis was placed on hiring new, less-experienced individuals at or near entry level.

The 16 employers who participated in this study employ nearly 9,000 workers in the nine occupational groups studied across the five-state region. Comparisons of employment for a subset of 12 employers between the 2008 and 2013 study periods revealed that while overall employment grew by nearly 18 percent, employment in the technical craft occupations studied declined by nearly 10 percent; only electrician employment grew between the study periods (+18 percent).

Retirements, New Hiring, and Job Vacancies

Employers anticipate losing 1,522 craft and professional employees to retirements during the next five years, which represents nearly 17 percent of their current workforces across nine occupations. Employers also reported that they intend to fill all but 30 of these retirement openings. The largest number of projected retirements is for line workers (386), electricians (251), and power engineers (177), representing between 18 and 26 percent of the current workforce in these occupational groups. Because this study was limited to 16 regional employers, the actual number of retirements that will occur across the electric power industry is probably much higher. Comparisons of 2008-2013 data showed a 10 percent decline in forecasted craft retirement; however, the number of electricians expected to retire increased by 40 percent.

Employers' forecasts for adding new positions in the future are modest: Only three employers said they plan to add new positions in these occupations during the next three years, and their combined forecast of 48 additional positions will add just one-half of one percent to the total employment base. Power engineers and mechanics are slated to share 77 percent (37 FTE) of all new employment across these occupations. Comparisons of 2008-2013 data showed that employers' three-year forecast for new craft hiring declined by 69 percent. Overall, these findings seem reasonably consistent with a combined five-state labor market forecast, which projects nearly flat (-1.4 percent) utility industry employment growth between 2010 and 2020.

Employers were trying to fill a total of 305 job vacancies across the nine occupations. Power engineers (67), line workers (60), and customer services representatives (51) accounted for the largest number of current job openings. For line workers and electricians, employers

reported that many of these openings may go unfilled due to budget constraints, a lack of qualified applicants, or job restructuring. Comparisons of 2008-2013 data showed a 55 percent decline in craft job vacancies since 2008.

Recruiting and Hiring Challenges

Although the recession increased the overall pool of available labor, most employers continue to struggle to attract, recruit, and retain qualified applicants, especially at the middle levels of experience. The general challenges cited by employers in 2013 are similar in many respects to the concerns voiced in the 2008 study. Recruiting and hiring concerns noted by all or most employers in 2013 include:

A Shortage of Qualified Applicants

Nearly all employers reported that they continue to find it difficult to recruit and hire qualified employees. Employers are expanding their reach into other industry sectors to recruit qualified applicants. In some cases, they have had to accept new hires then conduct upgrade training to meet requirements.

- **A Limited Secondary Labor Pool**
  Reductions in other industry sectors appear to have had a negative effect on the secondary labor market often used by energy employers, such as manufacturing and construction.

- **Recruiting and Hiring Costs Increase**
  Employers report that they have to recruit more widely—looking out of the state and region—to secure qualified applicants to fill position openings. Filling some high-demand vacancies, such as for power engineers, can require an extensive search and take a long time. Competing successfully for experienced candidates usually requires higher compensation and other incentives.

- **Filling the Skills Gap**
  Employers continue to rely on outside contractors for work that can be more efficiently done through short-term contracts, or where regular employees lack the time or expertise. More often mentioned by employers in 2013 than in 2008 was the need to cross-train some employees in other tasks and functions typically performed by other employees.

- **Working Conditions and Lifestyles Matter**
  Many electric-sector craft jobs are physically difficult and potentially dangerous. Urban work environments involve large projects, a congested work setting, and living in or near large population centers, while rural sites and assignments can require extensive travel and isolation from work colleagues. Rural lifestyles are often more relaxed, but the range and number of amenities are more limited.

- **Diversity Lacking**
  Challenges in recruiting and hiring qualified ethnic minorities and women continue to be long-standing human resources issues for employers. Qualified women and minority candidates are aggressively sought by employers inside and outside of the energy industry.

Photo courtesy of PacifiCorp

Specific Hiring Challenges

Each of the general challenges cited also pertains to the specific recruiting and hiring challenges by occupation noted in the Findings section (Table 10). The three occupations identified as the most difficult to fill include power engineers, power system operators, and electricians.

Workforce Succession Planning is Evolving

Employers are more actively engaged in workforce succession planning than in the past, but there is considerable variation among employers in the processes and practices used. Many employers are still establishing (or upgrading) their workforce succession planning processes, and relatively few employers regularly and systematically analyze, forecast, and plan strategies to meet future employment requirements. A few employers have established sophisticated analytical tools, team-based approaches, and other "best practices" that underlie their succession planning process. Many employers noted that they should be doing more with succession planning than they currently are.

College Connections are Limited

Employers' reliance on postsecondary institutions as sources of training and employee skills upgrading appears to be fairly modest. Employers rely primarily on training that is developed in-house, by product vendors or consultants who typically deliver short-term trainings. Community and technical colleges were mentioned as sources of pre-apprentice or apprentice-level training for craft occupations, while four-year schools were frequently identified as sources of new engineering talent. Budget constraints are reducing employer support for off-site trainings, including college programs, and they are relying increasingly on online programs and short-term trainings to reduce program and labor costs.

Apprenticeship Enrollments are Declining

More than 500 apprenticed employees were identified by 15 organizations, representing eight percent of all positions across the six craft-related occupational groups. The largest apprenticeship groups are represented by line workers, operators, or electricians, and around 32 percent of all current electrician and line worker apprentices were enrolled in 2012. Several employers reported that the recession has led them to reduce the number of new apprenticeship participants during the past several years, and the data comparing 2008 to 2013 confirms this declining trend: The number of craft apprentices dropped by 33 percent between the two study periods. Employers are increasingly looking to the open market to recruit experienced craft workers, using apprenticeship instead as a supplemental strategy for new hiring and development rather than as the primary approach.

Building the K-12 Pipeline

Respondents expressed great enthusiasm for building strong relationships with local K-12 schools and finding ways to generate interest from students at all levels – high school, middle, and elementary – in preparing for energy careers. Many employers have worked to enhance student and teacher awareness about the importance of solid academic preparation and Science, Technology, Engineering and Mathematics (STEM) competencies for energy careers at all levels. Students view the energy field as "green" and as an opportunity to work on renewable energy and efficiency projects that are sustainable and environmentally responsible. Employers described many specific activities designed to build awareness about careers in energy among students at all levels, and that connecting with existing K-12 partnerships has helped them cope with limited budgets for outreach. Several best practices were described by employers.

Implications

The study results and conclusions raise a number of implications for the electric power industry in the Pacific Northwest.

The Retirement Effect

The national recession led many experienced employees to delay their retirements, which meant that less of the collective knowledge and skills of these employees were lost during this period. Nonetheless, although adding new positions is forecast to be modest, employers expect to lose more than 1,500 craft and professional employees to retirements during the next five years, and they expect to fill nearly all of these openings. More than 60 percent of utility workers across the region are now 45 years of age or older, and demographic forecasts, industry reports, and educational research suggest that the future labor pool will be smaller and that many candidates will be under-prepared for high-skill energy careers. Competition for qualified job seekers is likely to be intense within the energy industry and from other industry sectors that require similar skills. Replacements for all the occupations studied will pose challenges for employers, especially electricians, power engineers, and line workers, which will account for more than half of all future retirements. The study sample of 16 regional firms did not account for retirements at other electric power employers; thus, the results likely understate the actual number of retirements across the region.

Is Industry Prepared?

Electric power employers have been forced by weak economic conditions to limit or reduce entry-level hiring and apprenticeships. This trend presents future risks and challenges to hiring, recruiting, and developing new employees as retirement turnover occurs and internal promotions generate new demand for entry-level hires. Energy employers continue to report difficulty filling open craft and professional positions, and for most energy jobs the internal development of new employees can take many years. New technologies and restructuring may reduce future labor requirements in some areas, but the electric power industry will continue to depend heavily on a knowledgeable, skilled workforce.

Employers are becoming more attuned to the importance of developing and applying a systematic approach for workforce succession planning, and several employers described strategies, best practices, and actions that have proven effective. Some employers continue to be informal and limited in their approach, however, and many also said they should be doing more to prepare for labor and skill gaps now and in the future.

Solutions and Actions

All employers described their approaches to fill labor and skill gaps, solve immediate shortages, and moderate disruptions caused by future retirements. They include one or more of the following:

- Encourage key employees to delay their planned retirement by enhancing compensation, retirement benefits, or other incentives.
- Restructure the work of near-retirees to allow more time to mentor and train replacements.
- Re-hire retirees as contractors to temporarily fill critical skill gaps or to train new workers.
- Analyze and document the critical work functions, activities, and competencies of key employees to capture and transfer specialized knowledge to other employees.
- Restructure jobs or increase the use of technologies to reduce labor requirements.
- Expand internal and external training options.
- Target recruitment to leverage new sources of skilled labor, such as military veterans and other industry sectors.
- Expand the use of incentives, compensation options, flexible work schedules, and benefits to attract and retain high-demand employees.

Long-Term Solutions

Looking ahead, employers and their workforce development partners should look for ways to enhance and extend the effective education and training strategies that are already in place, while also investing in new approaches that can support the future needs of the industry, as described below.

Leverage and Expand Partnerships

Employers should continue to support development of partnerships between industry, organized labor, education and government to promote and cultivate the electric power workforce. Some employers are already leveraging their limited education and training budgets through consortia partnerships, building on the shared resources, synergies, and effective actions these collaborations can produce.

Enhance Education and Training Capacity and Responsiveness

Employers and their education and training partners should continue to assess the specific skill gaps that currently exist and identify the incumbent worker training and postsecondary programs that can be implemented to fill those gaps across the region. Industry's education and training connections with colleges and universities should be strengthened; investments by all partners will be needed to create, maintain, and enhance innovative workforce development programs as conditions change. Employers should restore apprenticeship capacity to meet future demand for entry-level craft employment.

Adapt to the Future Labor Supply

Employers are now focused on hiring experienced personnel, but the electric power industry will need to continue to identify and develop a pipeline of new talent for the future. Promising strategies that employers are considering – or already using – should help the electric power industry secure the new talent they will need in the future, including:

- Work with K-12 teachers, counselors, students and parents to inspire and attract young people to the industry; and
- Enhance recruiting and hiring practices, workplace conditions, and development opportunities to adapt to the unique talents, interests, and characteristics of younger generations.

Regional and State Policy Considerations

As the region and individual states continue to invest in a clean energy future through legislative action, public policies, incentives, and regulation, the industry will need to maintain the existing systems that are effective while also upgrading the grid to improve system reliability and efficiency, integrate renewables, and promote energy conservation. Electric power is both a technology and a knowledge-intensive industry, and its future will continue to depend on the availability and development of a talented workforce.

Regional and state policy strategies should:

- Align clean energy economic development policies and strategies with the industry's workforce education and training priorities.
- Continue investments in mature regional collaborations to address future workforce education needs and leverage the effective strategies, products, and best practices that have already been produced.
- Continue industry research to identify high-demand occupations and develop industry-defined competencies to stay current with industry needs and improve the responsiveness of public education and training.
- Provide and expand Institutional support for targeted innovations in electric power education and training programs, curriculum development, and program delivery.
- Promote the expanded use of – and support program and degree requirements for – work-based learning strategies within K-12 and postsecondary programs.

Further Research

Several recommendations for further research are described on page 64.

Summer 2012 graduates of Avista/Spokane Community College lineworker school at Avista's Jack Stewart Training Center.

Photo courtesy of Avista

Introduction

The primary purpose of this study was to understand the employment and workforce education needs of electric power employers in the Pacific Northwest region, while also noting some of the shifts that have occurred since completion of an earlier report produced in 2008, just as the U.S. entered the Great Recession.[1] Changes in the energy industry and societal trends as a whole have also affected the availability and characteristics of key resources relied upon by energy employers – its labor force. This report focuses specifically on the workforce challenges facing electric power employers in the Pacific Northwest.

The report begins with a review of national employment and workforce trends in the energy industry. It then focuses on trends among five states in the Pacific Northwest, including data that relate to the availability, preparation, and development of a skilled energy workforce now and into the future. The report describes the employment characteristics and challenges facing regional employers, analyzes trends and changes since the 2008 report, and provides a set of conclusions and implications for economic and workforce development policymakers, energy employers, and workforce education and training providers.

The study describes industry trends and employment-related workforce challenges based on available economic and labor market information, and includes industry data collected directly from 16 regional electric power employers in Idaho, Montana, Oregon, Utah, and Washington. Detailed quantitative and qualitative workforce data was collected for nine craft and professional occupations from participating employers.

The study was sponsored by the Pacific Northwest Center of Excellence for Clean Energy at Centralia College and its regional industry, organized labor, education, and training partners through a $5-million (leveraged to $12-million) U.S. Department of Energy – Smart Grid Workforce Training grant.[2] The overall goal of the grant, and an intended outcome of this study, is to enhance the:

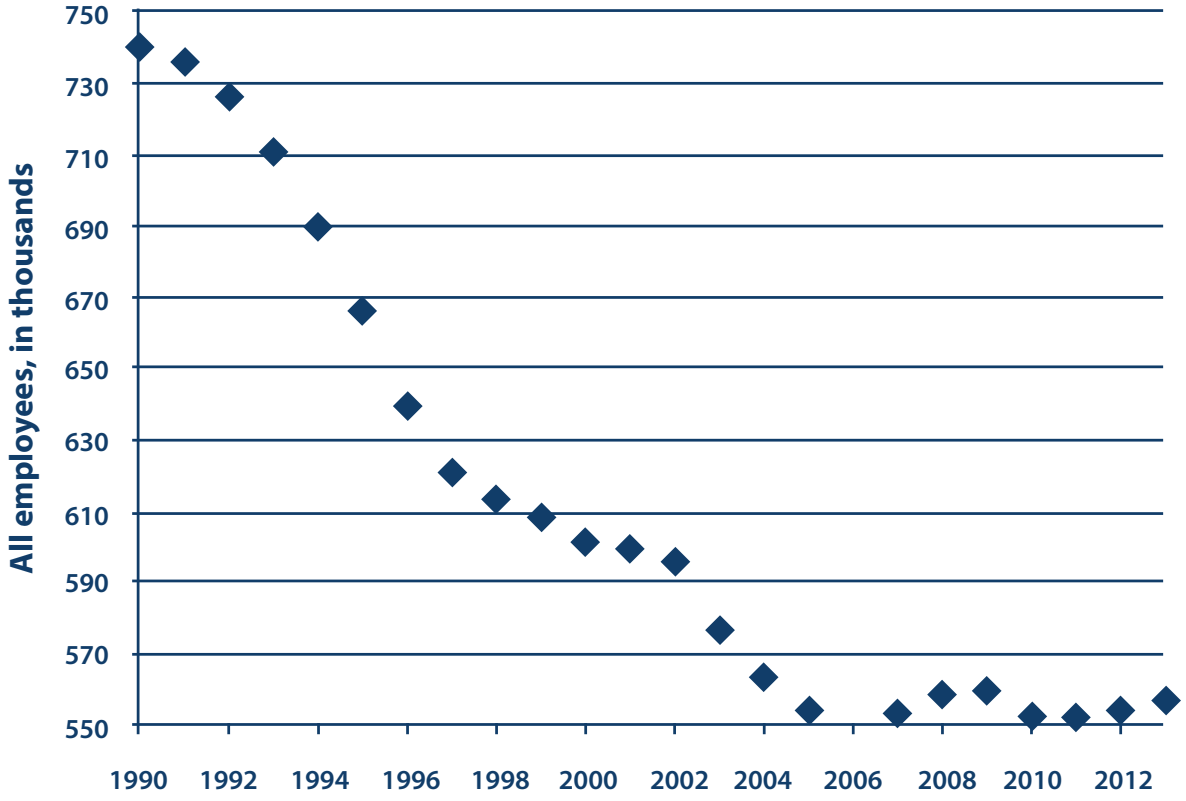
- Responsiveness of education and training providers, and
- Program quality for energy industry employers, employees, and students who will become the future energy workforce.

The Energy Industry in Context

Improved production, operating efficiency, and consolidation in the U.S. energy industry led to a 25 percent decrease in utilities employment between 1990 and 2005 (Figure 1). Between 1990 and 2006, utility employment declined by 200,000 and reductions were made in education and training needed to support the industry. Since then, employment has remained fairly stable, even as the demand for energy and its consumption have increased.[3]

The nation's electrical energy system is becoming more sophisticated than ever before; however, its physical infrastructure is also degrading and needs to be replaced. At the same time, there is growing political pressure to expand and integrate clean and renewable energy sources and increase energy efficiency to reduce environmental pollution, improve energy security, and spur economic development and job creation. Public policy and legislation have led public- and investor-owned utilities and governments to invest heavily in new research and technology upgrades to support a "smarter" electrical grid, increase the use of renewable sources of generation, boost consumer education, and expand incentive programs to spur greater energy efficiency through consumer engagement. Indeed, the nation's electrical power industry is in the midst of some of the most significant, long-term changes in its history.

Figure 1. U.S. Utilities Employment 1990-2013 (seasonally adjusted)[4]



Labor Shortages Anticipated

Effectively implementing systems changes to achieve these broad strategic goals will require a talented workforce. In the original 2008 Workforce Challenges study, a number of studies and reports were cited in which researchers and industry observers warned of a coming labor and skills shortage, due mainly to the predicted exodus of long-time, highly skilled, utility-sector craft workers who were expected to retire.[5] At that time, some national reports projected that as many as 50 percent of existing utility employees would retire during the following 10 years, with critical shortages in the number of qualified workers available to replace experienced retirees in many key craft and professional occupations.[6] Several of these studies cited related reasons why the utility industry was about to enter a period in which long-term labor challenges were likely to worsen:

- Hiring freezes and downsizing that limited the influx of new skilled workers to the utility industry.
- Lack of succession planning within utilities to ensure continued upward mobility and stability of the workforce.
- Lack of training facilities adequate to support the need for new, appropriately skilled workers.
- A long decline in electric power engineering and engineering technology programs and degrees from U.S. colleges and universities.
- An aging electric utility workforce.
- Impacts of the aging baby-boom generation on the U.S. labor force overall.

By 2008, the national recession had begun to visibly erode the U.S. economy, leading to growing unemployment and weakening stock performance that reduced the value of pensions and retirement portfolios of thousands of Americans who were preparing to retire.[7] These factors, combined with a sustained weakness in financial markets and few alternative employment options, led many prospective retirees to postpone their departures. The economic conditions in the energy industry were also negatively affected, as lower demand for transportation fuels and electrical energy forced utilities to adjust by trimming staffs and budgets for some functions, departments, and services, including workforce education and training.[8] Subsequent discoveries of natural gas reserves and improved extraction of natural gas and oil enabled by hydraulic fracturing methods (or fracking) boosted supplies, which softened energy prices further while consumers continued to limit spending. These factors contributed to an already-anemic economic recovery. Weakness in energy markets also led to reduced investments in renewables and energy efficiency development.[9] For most utilities, including those in the Pacific Northwest, these economic factors meant that considerably fewer retirement-eligible employees left their utility jobs than was expected.[10]

Finally, although the recession served to slow the loss of experienced utility employees, the weak economy also meant that few new positions became available at the entry level. Total employment in utilities remained fairly stable following the recession, but the number of mass layoff events reported by employers nearly doubled between 2007 and 2009.[11] The little new growth that occurred was mostly limited to those with experience; hiring at the entry level, including through registered apprenticeship programs, decreased. Federal economic stimulus funds provided through the American Recovery and Reinvestment Act (ARRA) supported energy projects that likely stimulated some new hiring and moderated energy-related job reductions.[12] The biggest job creation effects, however, likely went to manufacturers, information technology companies, technical service providers, and other suppliers of equipment and technical expertise for the utilities sector.[13]

During this period, the workforce challenges associated with recruiting, hiring, and retaining qualified employees continued to plague energy employers, even as the pool of job-seekers increased.[14] As the economy continues to improve, there is a renewed concern among energy industry observers and employers about the potential disruptions that may result when the improved financial circumstances of would-be retirees – a group that continues to grow in number over time – leads them to implement their planned departures.[15]

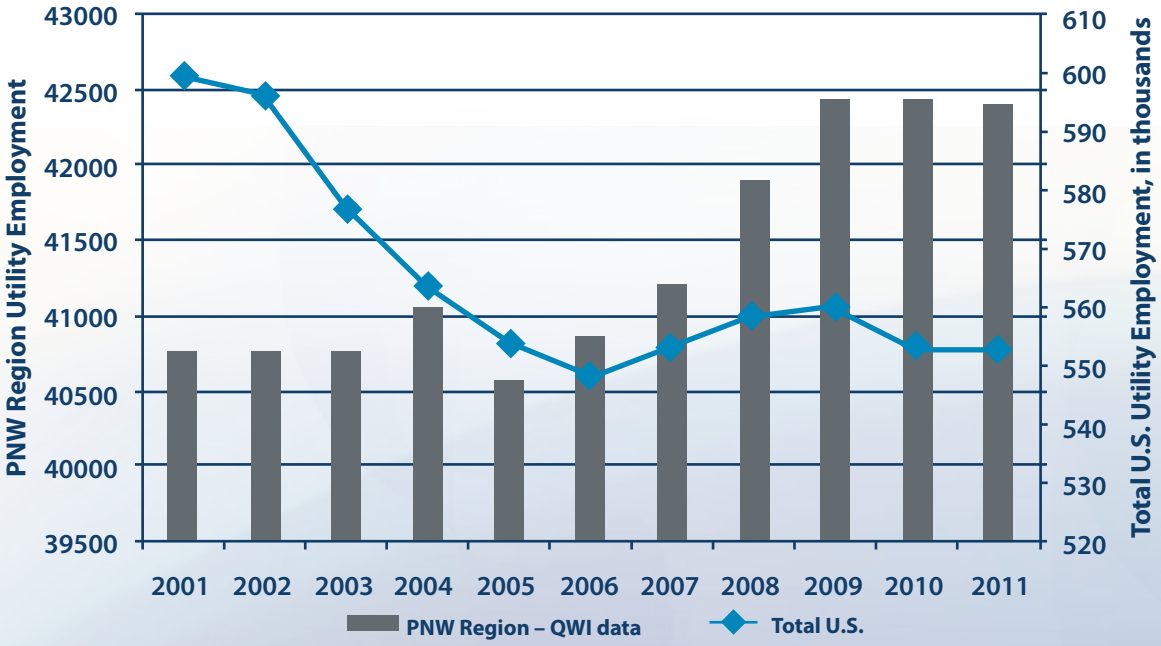
The Electric Sector in the Pacific Northwest

Compared to the rest of the nation, electric power employment in the Pacific Northwest has enjoyed relative stability and even some growth in the past decade.[16] As shown in Figure 2, while national employment in utilities remained mostly flat during the past several years, Pacific Northwest utilities have experienced modest growth, with only negligible declines in employment following the peak in 2009.

As noted earlier, ARRA funding may have helped cushion the blow for utilities: Organizations across the five Pacific Northwest states were awarded a total of more than $4.2 billion from the U.S. Department of Energy alone for various energy-related projects, including research and development, power generation, energy efficiency, smart grid demonstration projects, and environmental initiatives such as cleanup at Washington's Hanford site.[17] Of that total, more than $115 million was awarded directly to regional utilities in the Pacific Northwest to support utility-based projects. This total does not include additional ARRA awards by other federal agencies, or energy awards to non-utilities that have indirectly supported utility employment or workforce education.

Figure 2. Growth versus Decline: U.S. and Pacific Northwest Utility Employment – 2001-2011

Sources: U.S. Bureau of Labor Statistics, Quarterly Census of Employment & Wages (federal), and U.S. Census Bureau, Quarterly Workforce Indicators (non-federal).



Centralia College Energy Technology graduate.

Photo courtesy of Seattle City Light

The Hydropower Advantage

The Pacific Northwest is unique in several other important respects as well. One important difference is that electric power generation is deeply rooted in the region's abundant hydroelectric resources. Nationally, around 68 percent of the electricity generated in 2012 was from fossil fuel (coal, natural gas, and petroleum); more than half of that total is attributed to coal. Just seven percent of the nation's electrical energy came from hydropower.[18] However, hydropower makes up nearly half of all electrical power generation in the Pacific Northwest region. Table 1 shows that more than two-thirds of the electrical power generated in Washington – and over half of the total electricity generated in Idaho and Oregon – comes from hydro sources. In contrast, Montana and Utah generate a majority of their electrical power from coal-fired power plants.

Table 1. Total Electricity Generation by Source (in Gigawatt hours): Five states, December 2012 (Percent of total)

	Idaho	Montana	Oregon	Utah	Washington	Total by Fuel Source
Hydroelectric	59%	25%	53%	2%	68%	48%
Other Renewables[19]	24%	8%	14%	2%	10%	10%
Natural Gas-Fired	17%	0%	26%	13%	8%	13%
Petroleum	0%	0%	0%	0%	0%	0%
Coal-Fired	0%	67%	7%	82%	5%	25%
Nuclear	0%	0%	0%	0%	10%	4%

Source: Energy Information Administration, Electric Power Monthly, February 2013. Note: Some columns do not total 100 percent due to rounding.

There are 55 major hydroelectric projects located on the Columbia River and its tributaries. Thirty are federal dams owned by the U.S. Army Corps of Engineers or the Bureau of Reclamation. Twenty five are publicly and privately owned. These and some not shown give the Pacific Northwest the largest hydroelectric system in the world.

BPA - http://www.bpa.gov/power/pl/columbia/2-multi.htm

Courtesy of Washington State Department of Ecology.

Electricity Demand Growth Forecast

The regional demand for electrical power is forecast to grow in the decades to come. The Northwest Power Conservation Council (NWPCC) reported in 2005 that the industry was poised for growth during the next two decades, with increases estimated at 40 percent between 2003 and 2025, or around 7,000 average megawatts. In NWPCC's Sixth Power Plan, its most current, electricity demand in the medium-case forecast is anticipated to grow from about 19,000 average megawatts in 2007 to 25,000 average megawatts by 2030 (Table 2). The average annual rate of growth in this forecast is about 1.2 percent. This level of growth does not take into account reductions in energy demand from new conservation resources, which could reduce demand further. Through energy efficiency (primarily) and renewables, the plan proposes to meet 85 percent of the new load growth for electrical power in the region within the next 20 years.[20]

Table 2. Sixth Northwest Conservation and Electric Power Plan Electricity Demand Forecast Range (MWa)

	Actual 2007	2010	2020	2030	Growth Rate 2010-2020	Growth Rate 2020-2030	Growth Rate 2010-2030
Low	19,140	18,860	20,463	22,010	0.8%	0.7%	0.8%
Medium	19,140	19,292	21,820	25,275	1.2%	1.5%	1.4%
High	19,140	19,591	22,651	27,761	1.5%	2.1%	1.8%

[21] *Source: Northwest Power and Conservation Council, 2010*

Clean and Renewable Energy

According to the Energy Information Administration, renewables (including hydropower) made up around 13 percent of U.S. electricity generation in 2011; more than half of all renewable energy goes to producing electricity.[22] Wind has led all renewable sources of generation, growing from just six billion kWh in 2000 to 140 billion kWh in 2012. Individual states are also providing policy leadership for clean energy, which has spurred the development of renewables and energy efficiency. In the Pacific Northwest, most states have legislatively established renewable energy portfolio standards and environmental policies that require or encourage the development of renewable energy sources and energy efficiency; only Idaho does not have renewable portfolio standards or goals.[23]

States in the region have also aggressively pursued economic development and environmental strategies aimed at renewables and energy efficiency in an effort to reduce greenhouse gas emissions, revitalize their economies, and boost job growth. Since 2001, the region has witnessed considerable increases in non-hydropower generation capacity, especially wind power, with additional growth in bio-energy, geothermal, and solar.[24] Clean energy development has also added employment in the region among utilities, contractors and consulting firms, renewable energy manufacturers, and suppliers.

The Smart Grid

The existing grid, while having served its intended purpose well, is worn out and will require replacement of its major physical systems. One report concluded that the electric power industry will need to invest up to $1.5 trillion to upgrade its physical infrastructure from 2010 to 2030.[25] Efforts to shift to clean and renewable sources of generation will require upgrades to the existing electrical grid, enabling greater flexibility needed to achieve high levels of penetration by renewables and enhance efficiency. At the same time, concerns about the causes of climate change have grown, and electricity generation is the single largest contributor of greenhouse gases in the U.S.[26]

The development and use of smart grid technology is changing how utilities generate, transmit, and distribute electrical power. While there are many definitions, "smart grid" generally denotes a set of technologies that can be used to upgrade the current electrical grid.[27] These technologies are shifting how the industry interacts with and manages our nation's complex energy system, while providing new opportunities for consumer engagement. Substantial investments in grid upgrades have already occurred, and the provision of recession-era funding under ARRA since 2009 has extended earlier work and supported many new upgrade projects, including several among electric-sector consortia partners in the Pacific Northwest region. [28]

The use of smart grid technology is also expected to impact the work and skill needs of energy employees; however, some reports suggest that many of the basic technical competencies required by skilled craft positions are not expected to change.[29] The broader implications for workforce skill needs may be more subtle and tied to greater understanding of systems and integration, cross-disciplinary knowledge and teamwork, and other foundational workplace skills.[30] The design, installation, and integration of advanced metering and communications devices is expected to vastly increase the volume and frequency of information available to utilities with which to monitor and improve system performance. The collection and management of "big data" requires specialized data management and analysis expertise that most utilities currently lack.[31] While engineers and other professional employees will lead in the development and integration of these technologies, operations and maintenance personnel must also work with these new systems, which call for a deeper understanding of system integration and an expanded use of interdisciplinary, team-based approaches to problem solving.[32] Even utility customer service representatives – a key entry-point for utility careers – have seen increases in the levels of knowledge and skill needed to function effectively in a smart grid environment.[33]

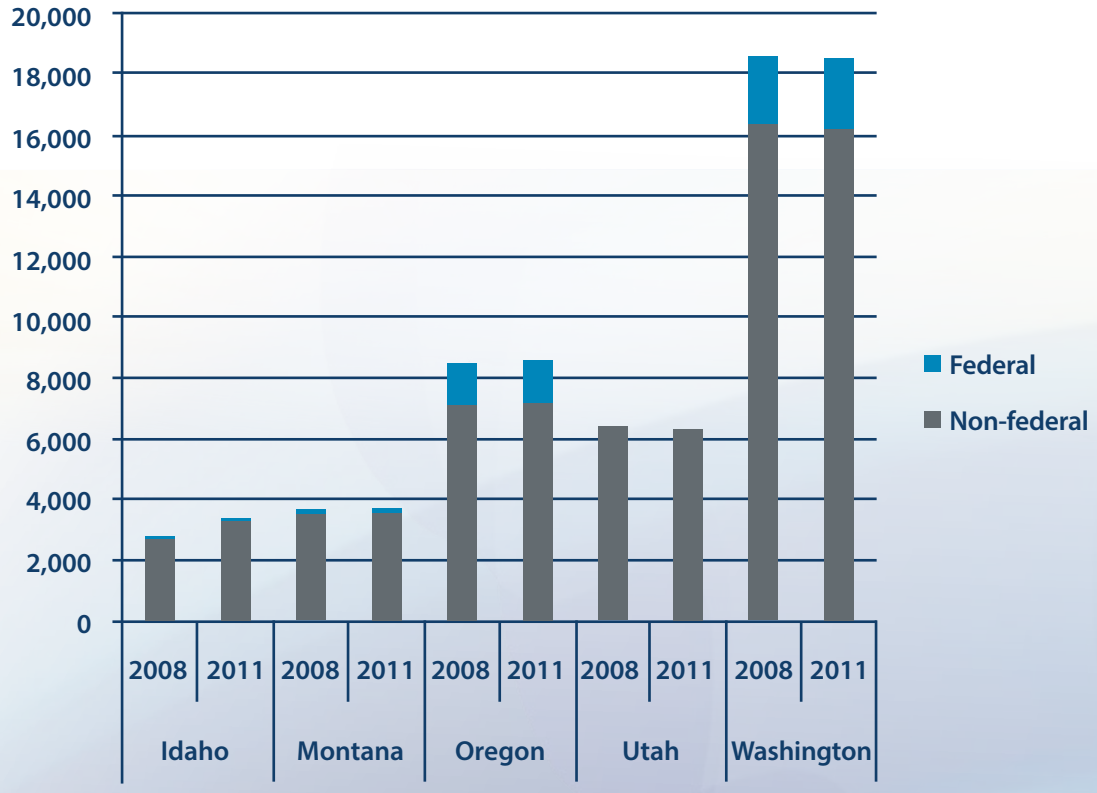
Utility Employment in the Pacific Northwest

Electrical power generation, transmission, and distribution activities support thousands of jobs across the Pacific Northwest. In addition to employment in utility organizations, the region's large hydropower presence contributes employment through federal agencies and jobs created to support numerous hydropower installations in the region, especially in Washington and Oregon, where several major dams along the Columbia River and other waterways are federally owned and operated.

In 2011, federal and non-federal utility organizations employed approximately 40,463 across the five-state region. Figure 3 shows that Washington leads the region in total utility employment with more than 18,000 jobs, followed by Oregon and Utah. The figure also shows the relative stability of utility employment since the national recession, with employment remaining remarkably constant between 2008 and 2011.[34] The notable exception is Idaho, which added more than 600 jobs (an increase of 20 percent) during the same period.[35]

Figure 3. Federal and Non-Federal Utility Employment by State: 2008 and 2011

Sources: U.S. Bureau of Labor Statistics, Quarterly Census of Employment & Wages (federal), and U.S. Census Bureau, Quarterly Workforce Indicators (non-federal).

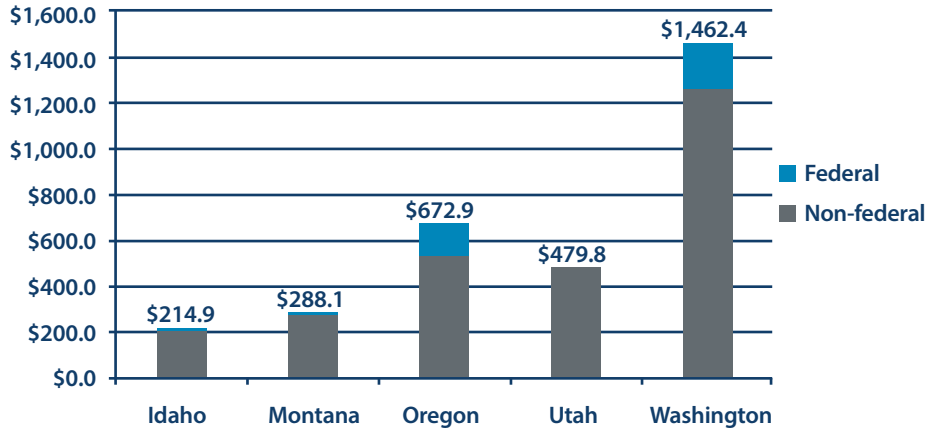


An Economic Engine

The availability of reliable electrical power forms the basis for all economies. Indeed, electricity is a product that underpins virtually all economic activity, and its importance in the development of modern societies is profound. Electrical energy drives our factories, businesses, schools, and homes; it powers our computers, appliances, and electronic devices, and has enabled the development and use of myriad other modern conveniences across the globe. Just as electrical power serves as a powerful economic catalyst, the region's electrical utilities also support regional and state economies directly in the form of payroll and tax revenues. In 2011, for instance, utilities across the five-state region provided nearly $2.8 billion in payroll. Figure 4 shows that Washington state, with its large utilities employment base, provided more than half of the region's total utility payroll, followed by Oregon and Utah.

Figure 4. Utility Payroll by State, 2011 in $ Millions (total = $2.77B)

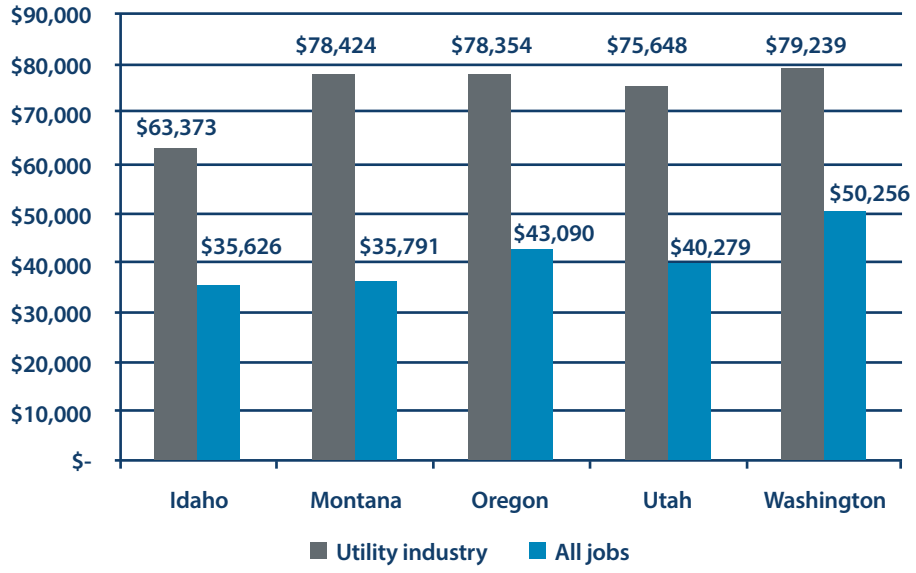
Sources: U.S. Bureau of Labor Statistics, Quarterly Census of Employment & Wages (federal), and U.S. Census Bureau, Quarterly Workforce Indicators (non-federal).



The economic contribution of utility jobs to the regional economy is also a function of the high wages (and benefits) offered by utility employers. On average, regional utility wages are 82 percent higher than the average for jobs across all industries; annual utility wages for the region are approximately $75,008, compared to just $41,008 for jobs across all industries.[36] Figure 5 shows that there is little disparity among the Pacific Northwest states with the exception of Idaho's utility jobs average, which provides somewhat lower pay than the other four states in the region.

Figure 5. Average Wages for Utility Industry Jobs versus All Jobs: Five Pacific Northwest States

Sources: U.S. Bureau of Labor Statistics, Quarterly Census of Employment & Wages (federal), and U.S. Census Bureau, Quarterly Workforce Indicators (non-federal).



Each state computes projections for employment across all industries – in most cases using data provided by the federal government, but often supplemented by other, state-level data.[37] Because each state has its own methods and models for determining their projections, the state employment forecasts shown below represent approximate trends based on available data that are not reliably comparable.

Table 3 shows that nationally, total utility employment is expected to decline between 2010 and 2020.[38] The Pacific Northwest offers a mixed picture: Private-sector utility employment across the five states is expected to decline only modestly, while Idaho and Washington are expecting modest growth. In contrast, Montana, Oregon, and Utah are expected to see declines.

Table 3. National and State Utility Employment Change, 2010-2020

	National	Idaho	Montana	Oregon	Utah	Washington	Five-State Total
Percent Change, 2010-2020	-6.5%	9.5%	-5.3%	-2.2%	-13.5%	6.1%	-1.4%

Sources: State information is from the Quarterly Census of Employment and Wages data maintained by the U.S. Bureau of Labor Statistics: http://www.bls.gov/news.release/ecopro.t02.htm.

Photo courtesy of BPA

Supplying an Educated Workforce

Federal and state funding sources have also targeted investments in workforce education and training that support the energy industry, especially projects that have the potential to create new jobs or up-skill employees to improve productivity and prevent dislocations.[39] Although some of the ARRA -funded projects have produced mixed results, others have generated good workforce training and placement outcomes while strengthening the connections between energy employers and education and training providers across the region.[40] Federal and state legislation and economic policies supporting clean energy continue to focus attention on boosting development of companies and products that would spur economic growth, enhance environmental protection, and spur new employment opportunities in "green" jobs.[41]

In 2008, there were concerns that the push to develop a green economy could falter because the available labor force lacked the required skills.[42] Some research showed that many employers reported difficulty finding qualified job applicants for a number of leading industry sectors associated with green jobs and clean energy development, including construction, agriculture, transportation and utilities, high-tech, and manufacturing.[43] Skill shortages reported by electric power employers in 2008 were exacerbated by the skill gaps in industry sectors such as manufacturing, which serve as a secondary source of skilled labor for energy companies. More recent studies suggest that, while the skill gaps reported by employers in these industries has improved somewhat, some serious gaps remain.[44] Labor and skill shortages in affiliated industries limit the ability of electric-sector employers to attract and hire applicants from those economic sectors.

Education and Competencies: Science, Technology, Engineering and Mathematics

Long-term, there continue to be serious concerns about the ability of U.S. education and training institutions to meet the future skill requirements of employers and new economic opportunities, which are expected to require much higher levels of skill in science, technology, engineering and mathematics (STEM).[45] The energy industry is already highly dependent on the talents of individuals with strong STEM preparation, and the development and application of new technologies is driving up the demand for STEM competencies among new and existing workers.

Due in part to the recession, the supply of some energy craft workers and power engineers appears to be growing, and colleges are seeing increased enrollments and growth in power and energy engineering courses, although the overall number of students interested in electrical engineering has been declining.[46] In the recent past, the education and training capacity supporting the energy industry, especially for some craft occupations and power and transmission engineers, suffered serious declines that were deemed inadequate to meet future demand.[47] Thus, many of the general concerns raised by industry and researchers about workforce talent are shared by most energy employers. As Carnevale notes, however, the growing need for STEM competencies now extends far beyond the elite occupations traditionally associated with advanced education and degrees.[48] Indeed, competencies necessary for innovation, competitiveness, and productivity are required in industries and occupations at all levels – including energy craft and professional jobs – and the scarcity of new workers with these competencies within and outside of the energy industry will present additional long-term labor supply challenges for electric power employers.

The energy industry is already highly dependent on the talents of individuals with strong STEM preparation, and the development and application of new technologies is driving up the demand for STEM competencies among new and existing workers.

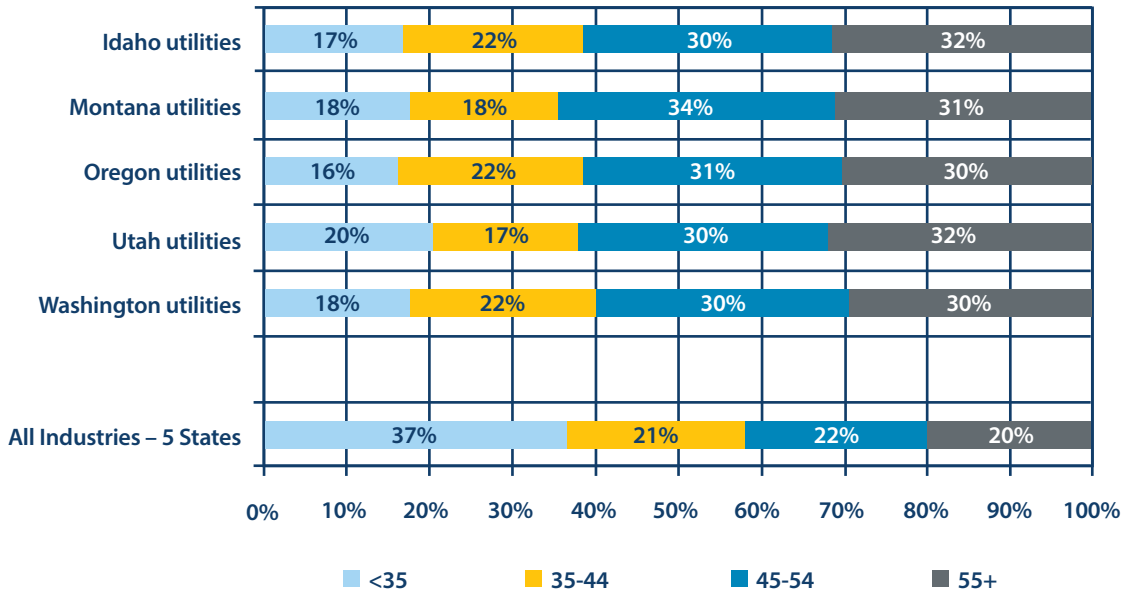
Population Dynamics – The Changing Labor Force

Future labor supply has been a rising concern in the U.S. for many years as the baby-boom generation ages. Demographic trends suggest that while the future labor pool will be smaller and more ethnically diverse, its members may also be less well-prepared than in the past.[49]

The national recession led to double-digit unemployment, and the U.S. unemployment rate, which has exceeded 8 percent since 2009, is now expected to persist at or near that level until 2014.[50] Despite a weaker demand for labor, the challenges associated with an aging workforce are a long-term concern for electric power employers nationally and in the Pacific Northwest. National survey data shows that in 2010, the average age of the utility workforce was 46, and that the number of utility employees with more than 30 years of service has increased by 5.2 percent since 2006.[51]

Figure 6 shows that among the age cohorts for all industries in the five Pacific Northwest states combined, 37 percent of the workforce is made up of employees under age 35 and just 20 percent of the workforce in all industries is age 55 or older.[52] In contrast, for each state's utility sector, just 20 percent or fewer of employees are under 35, while 30 percent or more are 55 and older. More broadly, more than 60 percent of utility workers across the region are now 45 years of age or older. As noted in the 2008 Workforce Challenges report, these dynamics suggest that the supply of less-experienced workers may not match the demand generated by future retirements among more experienced older workers. Thus, while the recession has reduced overall employment demand in all industries, including utilities, the aging of the utility workforce continues, posing potentially formidable replacement and workforce education challenges as these skilled workers transition into retirement.

Figure 6. Age Cohorts and Percentages by State: Utilities versus All Industries (five states combined)



Research Methods

The current year's study followed the design and intention of the 2008 project, with expansions that included three additional northwestern states and four additional occupations. To track change since 2008, all 12 of the original participating organizations from Oregon and Washington were recruited and all agreed to participate in the study.[53] Four additional participants representing Utah, Idaho, and Montana contributed to this year's study. As in the previous study, the sampling frame included organizations representing the full array of electric power producers in the region, from large public and privately owned organizations to small public utility districts (PUDs). The 16 participants and total employment are shown in Table 4.

The initial introduction and invitation to participate in the study were made through a letter emailed to selected organizations from the Executive Director of the Pacific Northwest Center of Excellence for Clean Energy at Centralia College, which sponsored the study. The letter included a description of the project, its importance, and a summary of the information that would be needed. Only three of the 19 organizations who were invited declined to participate.

Project researchers collected qualitative and quantitative information using standardized data collection protocols and forms through phone interviews and email exchanges. Telephone interviews were completed with a variety of personnel, most often with well-situated human resources directors or staff. A representative of the IBEW Local 77 was also interviewed.

Employer Interviews

Interviews were conducted from January through June 2013 and lasted 30 to 60 minutes. Each followed a data collection protocol that included questions about the following topics.

- Current employment and future demand
- Hiring trends and forecasts
- Total employment (all employees and in each of the five occupational groups
- Current vacancies
- Hiring challenges, skill shortages
- Retirement forecasts (five years)
- Future employment forecast (three years)
- Skill and degree certification requirements/ job descriptions
- Workforce succession plans and strategies
- Partnerships and training
- Apprenticeship enrollments and pre-apprenticeship programs
- Outreach to K-12 schools and students

Visit http://cleanenergyexcellence.org/occupations to learn more about careers in energy.

Photo courtesy of Puget Sound Energy

In addition to human resource managers, the following professionals contributed to the interviews: training and organizational development managers, business development managers, operations and engineering managers, and customer service and energy efficiency program managers.

Table 4. Participating Employers and Total Employment

Employer	Employment
Avista	1,672
Bonneville Power Administration (BPA)	3,089
Chelan County PUD	643
Energy Northwest	1,217
Grant County PUD	721
Grays Harbor PUD	152
Idaho Power	2,081
NorthWestern Energy	1,428
PacifiCorp	6,251
Portland General Electric (PGE)	2,547
Puget Sound Energy (PSE)	2,981
Seattle City Light	1,801
Snohomish County PUD	1,044
Tacoma Power	843
TransAlta	296
U.S. Bureau of Reclamation	1,093
Total Employment	27,859

Photo courtesy of Puget Sound Energy

Occupational Groups

The 2008 study included five groups of craft occupations, all of which were included in the current study. They were:

- Operator (primarily plant and substation operators, all levels)
- Mechanic (plant and system mechanics, all levels)
- Electrician (plant, "wiremen" and substation electricians)
- Technician: Instrument/Control/Relay/Meter (all levels of technicians, but not drafting or other non-energy system technicians)
- Line Worker (all levels excluding communications/fiber line workers)

Four additional occupational groups were included in the current study, based primarily on recommendations from the 2008 study, research results from the Smart Grid Workforce Training project, and sponsor interest. The new occupational groups were:

- Energy efficiency program manager (all levels)
- Customer service representative (all levels, except customer service cashiers)
- Power engineer (all levels)
- Power system operator (all levels, primarily transmission/load dispatchers)

Study Limitations

This study relied on employer-provided data and interviews of managers at the 16 diverse electric power organizations surveyed. The selection of the organizations was not based on statistical sampling procedures and the results cannot be reliably generalized to the industry as a whole. Washington state employers are over represented in the sample. The 2008-2013 comparisons are limited to the 12 participating employers and were based on data collected representing two different years only, and do not account for fluctuations between data collection periods.

Findings

This section summarizes the analysis of quantitative employment-related data provided by the 16 employers who participated in the study. [54] Employment is expressed as full-time employment (FTE) for each of the nine occupational groups. Tables on current employment, projected employment growth, retirements and replacements, and job vacancies are presented and described. All findings are presented in aggregate form to ensure confidentiality. A final section summarizes the 2008-2013 changes in a select number of these variables for craft occupations by comparing data from employers who participated in both surveys.

Current Employment

Table 5 shows that the nine occupational groups comprise more than 30 percent of the total employment for the 16 organizations surveyed. The largest group, line worker, includes 2,120 FTEs, while energy efficiency program manager is the rarest, with just 166 employed in that position at 13 organizations. The second largest group, customer service representative, includes more than 1,600 FTEs, followed by operator at 1,039. Only electricians (964 FTEs), mechanics (912 FTEs), and technicians (854 FTEs) are employed by all 16 organizations.

Table 5. Current FTEs per Occupational Group

Occupational Group	Number of Companies Employing Occupational Group	FTEs	Percent of Total Employment*
Operator	13	1,039	3.7%
Mechanic	16	912	3.3%
Electrician	16	964	3.5%
Technician	16	854	3.1%
Line Worker	14	2,120	7.6%
Power System Operator	14	388	1.4%
Power Engineer	15	878	3.1%
Customer Service Representative	13	1,635	5.9%
Energy Efficiency Program Manager	13	166	0.6%
Total Employment in the Occupational Groups		8,956	32.1%

**Note: column total is not precise due to rounding.*

Staffing Trends

The functional divisions between these occupational groups are not always clean, due mainly to a lack of standardization: job titles, job descriptions, and responsibilities often vary between organizations, sometimes considerably. These differences can be due to the different electrical power generation, transmission, or distribution systems and services, or because human resources conventions developed differently between companies over time. In some organizations, the duties inherent in some occupations include work tasks that in other firms are the responsibility of separate job classes. The amount of overlap among jobs can also vary due to safety considerations, collective bargaining agreements, company size, or the organizational and geographical circumstances under which the work is performed. In rural or remote areas, for instance, craft employees are often expected to serve more as generalists than as single-craft specialists. Smaller organizations, such as public utility districts, often emphasized the need for employees to have skills that cut across different job classes; however, larger firms are also encouraging more interdisciplinary preparation among their employees as well as the development of cross-functional skills (discussed later in this report).

Table 6 shows that during the next three years, employers anticipate little growth in the number of new hires in the nine occupational groups, and this estimate is exclusive of retirement replacements (discussed below). In all, employers expect to increase hiring in these occupations by 48 FTE, a gain of just one-half of one percent. In fact, only three of the 16 employers surveyed expect to hire any new employees. The limited new hiring that is projected is led by power engineers (2.2 percent growth) and mechanics (2 percent growth).

Table 6. Projected Staffing Change in FTEs per Occupational Group, 2013-2016

Occupational Group	Number of Employers Projecting New Hires	Net Growth in FTEs	Total Current Employment in Occupation	% Change Next Three Years
Operator	1	2	1,039	0.2%
Mechanic	2	18	912	2.0%
Electrician	1	6	964	0.6%
Technician	1	1	854	0.1%
Line Worker	1	1	2,120	< 0.1%
Power System Operator	0	0	388	0.0%
Power Engineer	2	19	878	2.2%
Customer Service Representative	0	0	1,635	0.0%
Energy Efficiency Program Manager	1	1	166	0.6%
Total New Employment in the occupational groups		48	8,956	0.5%

Retirements and Turnover

As in 2008, most companies expect substantial turnover due to retirements during the next several years. Table 7 shows that 17 percent of current employees in these positions are expected to retire in the next five years. The most substantial change will come from electricians, where 26 percent are expected to retire. Energy efficiency program managers are also expected to retire at a high rate, though only half of the 16 employers are anticipating change.[55] The least impacted will be customer service representatives, with 9 percent retiring.

Table 7. Projected Retirements in FTEs per Occupational Group 2013-2018

Occupational Group	Number of Employers Projecting Retirements	Number of Retirees Projected[56]	Percent of Current Workforce in the Occupation Expected to Retire
Operator	13	152	14.6%
Mechanic	14	150	16.4%
Electrician	13	251	26.0%
Technician	14	158	18.6%
Line Worker	12	386	18.2%
Power System Operator	10	66	17.0%
Power Engineer	13	177	20.2%
Customer Service Representative	10	144	8.8%
Energy Efficiency Program Manager	8	38	22.9%
Total in these occupational groups		1,522	17.0%

Replacements for these retirees were somewhat difficult to project; in three cases, employers reported that the number of projected retirees they would replace was "unknown." Based on complete data from the remaining organizations, however, employers indicated that they expect to replace nearly all of the retirees; all but 30 of these positions are expected to be replaced, representing an employment loss of less than three percent. The occupation with the highest non-replacement was customer service representatives, where 18 of the 30 retiree positions are not expected to be replaced, followed by power engineers, where just seven retiree positions will not be replaced. The remaining five non-replaced positions are spread across operators (2), mechanics (1) and electricians (2).

Job Vacancies

Employers were asked to report the number of job vacancies they currently had, including what portion they actually intended to fill (some employers reported they might not fill all openings due to budget constraints, lack of qualified applicants, or job restructuring). As noted in Table 8, not all employers reported having current job vacancies. Employers with openings reported that, while most vacancies are expected to be filled (all but 30, or 90 percent), some vacancies for line worker and electrician positions may go unfilled. Table 8 shows that of 39 electrician vacancies, only 25 positions (60 percent) of current vacancies were expected to be filled. Similarly, 47 of the 60 current vacancies among line workers were anticipated to be filled (78 percent). Just two of the current 24 vacancies among technicians, and one vacancy among 51 of customer service representatives, were not expected to be filled.

It should be noted that these data represent a snapshot view of openings at the time of data collection. Of course, employment openings are in a constant state of flux, so these numbers may or may not be representative of the overall hiring landscape at other times. Several employers noted that they had "just filled" one or more positions in some of these areas.

Table 8. Current Vacancies and Hiring Expectations by Occupational Group

Occupational Group	Number of Employers with Vacancies	Number of Vacancies	Number of Vacancies Employers Expect to Fill	Number of Vacancies Expected to Remain Unfilled
Operator	7	28	28	0
Mechanic	6	15	15	0
Electrician	7	39	25	14
Technician	6	24	22	2
Line Worker	10	60	47	13
Power System Operator	8	18	18	0
Power Engineer	9	67	67	0
Customer Service Representative	6	51	50	1
Energy Efficiency Program Manager	1	3	3	0
Total in these occupational groups		305	275	30

Recruiting and Hiring Challenges

Employers expressed that many of the recruiting and hiring challenges they faced in 2008 are still prevalent today: A shortage of qualified applicants still exists, and for many reasons employers continue to have difficulty attracting and retaining the best talent for positions they have to offer (see Table 9-- summary of 2008 challenges). In 2008, employers were noting a shifting labor pool, with fewer experienced workers in local and regional labor markets. To adjust, employers started recruiting from further away, exploring additional industry sectors for potential new hires and offering higher compensation packages than before. This was identified as an undesirable – but necessary – break from past hiring practices.

The context for labor recruitment and hiring has changed markedly since 2008, however. For instance, while the economic recession that began in 2008 expanded the labor pool considerably, several employers reported that with higher unemployment they are seeing more applications from unqualified job seekers – applications that require even more time to review and assess—than ever before. One employer described getting 500 applications for one craft-level job; of those applicants, 250 met the company's basic hiring qualifications and only 56 of those were able to pass employment testing for the position (roughly 10 percent of all initial applicants).

Moreover, most employers are focused on hiring for experience rather than taking on new or less-experienced employees, even though many managers have been encouraged to do so. One employer noted: "Managers have been encouraged to hire younger, more entry-level people but they want someone who can walk in and do the job today." Indeed, it seems likely that this combined emphasis by most regional employers on hiring only experienced new employees may have unintentionally exacerbated some of the hiring and skills shortages experienced by nearly all employers.

Table 9. Summary of Key Recruitment and Hiring Challenges, 2008

2008 Recruitment Challenges	2008 Descriptive Summary
Shortage of qualified applicants	"Seller's market" and some applicants unwilling to relocate for new jobs.
Shortages cut across industry sectors	Shortages mean that recruiting from manufacturing, other industries more limited; competition for electricians is keen, especially with construction boom.
Traditional recruiting strategies inadequate	Large, mobile labor pool disappearing; poaching ineffective – a shortage of skilled talent in the region.
Increased recruiting and hiring costs	Increased effort and resources required; began looking out of state – especially for line workers. Enhanced compensation packages required to recruit qualified workers.
Filling the skills gap with overtime, subcontractors	Increased dependence on overtime, use of subcontractors.
Adjusting hiring expectations to fill positions	Becoming more flexible in hiring processes, qualifications.
Working conditions and geography a challenge to hiring	Less willing to travel; reluctance to live/work in remote locations.
Ethnic and gender diversity lacking	Qualified ethnic minorities and women very difficult to attract, recruit and retain.

General Recruitment Challenges – 2013

As noted earlier, while the recession increased the overall pool of available labor, the qualifications of current applicants for the occupations studied has not necessarily improved since 2008. Most employers report that they continue to struggle to find qualified applicants, especially at the mid-levels of experience, where the majority of job vacancies are available. Recruiting and hiring concerns noted by most or all employers in 2013 are described here.

A Shortage of Qualified Applicants

Nearly all employers reported that they continue to find it difficult to recruit and hire qualified employees, even though the number of applicants has increased considerably. Employers typically look within the energy industry first, attempting to attract qualified candidates from other companies or energy-related contractors. Some employers have found qualified candidates on the open market, some of whom were laid-off due to weak energy demand following the recession. In other cases, economic contractions and layoffs in other industry sectors like manufacturing or construction boosted the availability of qualified applicants in some craft occupations, especially electricians and mechanics. In general, however, electric power employers reported that recruiting, hiring, and retaining qualified employees has continued to be difficult, especially for specific occupations, such as power engineers, and in several craft occupations, including electricians, mechanics, and some technician occupations.

A Limited Secondary Labor Pool

In the 2008 report, employers identified manufacturing as a useful secondary source of new craft employees with transferrable skills. The construction industry, which was booming at the time, also provided a potential source of new labor but in a very competitive environment. Reliance on secondary labor markets is not a perfect solution; workers from other industries may not be the best fit even for jobs in the same discipline due to very different work experiences, practices, and technologies. For example, several employers reported that, while mechanics and electricians can often be recruited from other industries, they rarely have any utility-specific skills – a disappointment to potential employers. Unemployed electricians from the construction industry were deemed insufficiently trained by some employers, who are struggling to find electricians with an understanding of high voltage work and have other energy-specific experience.

Since the recession, there have been wide-spread reductions in many non-energy industry sectors, which has had a negative effect on the secondary labor market often used by energy employers. Due to the weak economy, many manufacturers and construction firms shut down or downsized their operations and employment.57 Where employment reductions occurred, many laid-off employees moved to other industries or occupations because few options existed in these industries; many began new jobs and careers and were less available for re-hire as conditions improved. Over time, those who were still seeking employment saw their skill sets and marketability erode. For electric power employers, then, the opportunity to acquire laid-off employees from other industries was temporary. By 2013, employers reported that the secondary labor market had become a much less effective strategy to acquire new talent.

In addition to recruiting from other industries, another strategy that was mentioned prominently was recruiting and hiring military veterans. Many respondents commented on the large number of military personnel slated to return to the region. They also noted that many veterans have undergone extensive training and have work experience in energy-related crafts and professional occupations, most often as electrical and mechanical specialists or technicians. Some veterans have experience with specific fuel sources such as nuclear, which was deemed valuable. Employers also described most ex-military personnel as disciplined and well

trained. Some have solid leadership skills and experience in highly stressful work settings, not unlike the work conditions of some electric-sector positions. Power system operators and dispatchers were often characterized as high-stress occupations for which military training and experience under battlefield conditions were especially beneficial.

Recruiting and Hiring Costs Increase

Employers report that they have to recruit more widely – beyond the state and region – to secure qualified applicants for position openings that they cannot fill internally. Employers continue to "poach" workers from other utilities and they actively recruit locally for available talent, but local sources are often very limited. While the costs of recruitment have increased (also reported in the 2008 report), one trend that was often mentioned was a need to make the recruiting and hiring process more efficient and targeted. One approach mentioned by employers was to target fewer new hires at the entry levels in favor of recruiting individuals with higher levels of direct experience in the occupation and in the energy industry. Some employers described how this more targeted approach helped reduce the time and training required for newly hired employees to be productive than was possible with less-experienced candidates. Several employers noted that even this more streamlined approach does not eliminate the orientation period required for a new employee to be optimally productive: Once hired, workers can require from several months to a year to learn the culture and systems of the organization and the industry. This type of industry and company-specific knowledge is critical, but requires time that is in addition to technical skill development that may be needed.

These are among the reasons described by employers for why they prefer to fill openings internally whenever possible. Employers are also acutely aware of the need to retain and help develop the careers of good employees, as the costs associated with turnover due to the lack of career growth or wage progression are high. One employer noted how they encourage craft workers who are considering a transfer to another job or apprenticeship to participate in an exploratory job shadow experience with a journey-level worker, with return-rights and seniority protections for participants if the experience reveals that a transfer would not be a good fit.

Filling the Skills Gap

Electric power employers continue to rely on outside contractors for work that can be more efficiently done through short-term contracts, or where regular employees lack the time or expertise. More often mentioned by employers in 2013 than in 2008 was the need to cross-train some employees in other tasks and functions typically performed by other employees. One employer emphasized how electricians who have been cross-trained in some mechanical, electronic, or computer-based skills provide greater employee versatility and a more interdisciplinary approach to utility work and technologies, which are becoming more integrated. The value of cross-training and interdisciplinary preparation was also expressed as important for non-craft occupations. For example, power engineers who have developed additional experience in control systems and automation, information technology systems, and software were cited by employers as being beneficial to the company and for increasing the skill sets and career options for engineers.

Working Conditions and Lifestyles Matter

Many electric power occupations require that difficult physical work be performed, often in inclement weather. Safety hazards and emergency situations are characteristic of many jobs, especially among craft workers. Geographic factors also present varying challenges to work and quality-of-life issues. Urban settings frequently involve large projects, a congested work setting, and the requirement to live in or near large population centers. Rural sites and assignments, on the other hand, can require extensive travel and isolation from other work colleagues.

Although rural lifestyles are often more relaxed compared to city life, the range and number of amenities and employment opportunities for other

family members are usually limited. Employers who serve small towns and remote areas say that they deliberately target local residents – or those who have family connections – for employment because these individuals are aware of the unique characteristics associated with rural living and are usually more likely to remain employed at the company. One respondent noted: "The strategy is to find someone with family connections in town and hire them. This increases retention rates. If someone moves in from elsewhere, it is hard for their trailing spouse to find a job."

Diversity Lacking

Recruiting and hiring qualified women and ethnic minorities continues to be a long-standing human resources issue for employers. Across the board, employers remain concerned about the lack of ethnic and gender diversity in the qualified labor pool. Bilingual workers, especially in customer service, are more essential as the Spanish-speaking population in the region continues to grow. Many companies have stepped-up their efforts to attract a more diverse workforce by working with student groups and professional associations, and by actively working to attract minority candidates. Competition for applicants who are qualified is intense, as ethnic minorities and women interested in non-traditional careers are aggressively sought after by employers inside and outside of the energy industry. Most employers reported that they are working to diversify their workforces further.

Photo courtesy of TransAlta

Technology Tools and Skills

The technical and information technology (IT) demands of craft and professional jobs in the electric sector are increasing. With the application of new smart grid technology and increased use of information technology across the industry, most positions will now require employees to have expanded capabilities in using computers and various applications, including industry-specific mobile devices and software.[58]

Having a functional knowledge of computers; the ability to manage, analyze, and interpret data; and greater familiarity with IT-related tools and systems are more important than in the past. Some employers noted that where younger and less-experienced employees lack certain technical skills, they do often have greater familiarity with computers, software, and remote devices than many senior-level employees. A few employers noted that it has been difficult for some older employees to adapt to the growing use of computers and applications, including new communications and social media tools that are commonly used by younger workers. One employer noted: "Smart grid is changing our world. It changes the competencies and skills needed to be successful. Craft jobs are changing. It's hard for the workforce to adapt to the computer skill needs." On the other hand, some employers noted that, while younger employees often bring with them an advanced knowledge of technology and communications tools, they also have different expectations about work and careers that can make their assimilation into the existing workforce difficult. One employer expressed her concern that the need to hire more young workers in the future may amplify those differences further: "The different values, work ethic, and expectations of younger employees will create challenges in our workforce."

Specific Hiring Challenges

Employer responses about specific recruiting and hiring challenges varied considerably by company and by occupation. The lack of workforce diversity was noted by nearly all employers, who described the difficulty of attracting and hiring ethnic minorities. Many added that recruiting women for traditionally male-dominated craft jobs continues to be very difficult. Applicants who lack relevant electric-sector work experience in the occupation also presented a common hiring challenge that cut across most employers and occupational groups, but there were exceptions among some companies. Many employers noted the lack of solid math skills among applicants for some craft jobs.

Table 10 (see page 35-36) provides a summary of the most commonly identified challenges for each occupation. Employers' descriptions, frequency of response, employment and demand data were used to establish a general comparative ranking of the relative difficulty of recruiting and hiring qualified workers across the nine occupational groups.

Overall, employers report that power engineers are the most difficult to recruit and hire. Several employers noted that the competition for experienced power engineers (mid-levels and above) is especially intense, and that younger engineers – especially electrical engineers with power experience, which is a rare and often-mentioned shortcoming – are frequently lured to other companies by higher compensation, different work conditions, or other factors. Employers noted that these young professionals also tend to be very mobile and turnover can be high. Strong demand for this occupation means that qualified candidates have many employment options both within and outside of the energy industry.

Power system operators, while comprising a relatively small group, were also identified by many employers as very hard to find. This highly specialized occupational group often includes several related job types and levels, depending on the technical systems involved. This position requires many years of training, sometimes through registered apprenticeship programs, and also professional certification through the North American Electric Reliability Corporation (NERC). Candidates are typically developed internally, drawn from journey-level craft workers who undergo additional training. Several employers reported that military personnel with nuclear training are especially well-suited for training. Military discipline, leadership skills, and combat experience and training all provide useful preparation for the high-stress triage conditions under which many power system operators must work. Because of the long training required and the small number of positions in the power industry, companies are often forced to recruit experienced power system operators away from other firms to fill openings as they occur.

Electricians were also frequently reported as challenging to recruit and retain. While some employers reported having successfully hired construction electricians whose skills have transferred well, others noted that the electrician skills learned in non-energy industries and occupations were sometimes so specific that they did not readily fit their needs, requiring additional training, including cross-training in other craft areas.

Table 10. Specific Hiring Challenges, Rank-Ordered by Occupation

Rank	Occupation	Specific Recruiting/Hiring Challenges
1	Power Engineer	• Hardest to find • Four-year engineering degree (usually electrical engineering) • Power generation/transmission experience • For smart grid work, need more IT and computer science/software and automation knowledge and related skills • Multi-state recruitments to secure qualified engineers • Turnover: Many newer (new grads) engineers only stay for 3-5 years • Lengthy in-house training progression
2	Power System Operator	• Very hard to find • Education and experience (needs 6-10 years) • Expecting high rates of retirement in next 7 years • Poaching from other utilities; candidates hard to attract • Shallow internal "bench" to draw from • Stressful work • Most employers trying to grow their own
3	Electrician	• Relevant experience and education hardest to find • Failing aptitude/skills tests • Internal "bench" not deep enough • Applicants with a mechanical background needed • Reliance on non-utility hiring – skills do not always transfer • Need cross-training among types of technicians and electricians • Lack of ethnic/gender diversity
4	Operator	• Lack of qualified, experienced applicants • Difficult to discern transferability of skills – job titles vary among employers and industries • Math skills lacking • Lack of ethnic/gender diversity

Photo courtesy of PacifiCorp

Table 10. Specific Hiring Challenges, Rank-Ordered by Occupation (continued)

Rank	Occupation	Specific Recruiting/Hiring Challenges
5	Mechanic	• Lack of qualified applicants • Failing aptitude/skills tests • Math skills lacking • Lack of manufacturing/industrial labor pool – cannot find diverse mechanical experience in the non-utility labor market • Difficulty screening appropriately • Lack of ethnic/gender diversity
6	Technician	• Intermediate hiring challenge • Experience in some technologies can be hard to find • Instrumentation and control technician skills rarely taught in colleges, and are very technical • Retirements increasing; relying more on contractors for skills, support • Hard to screen for skills • Geography: reluctance to live/work in remote areas • Lack of ethnic/gender diversity
7	Line Worker	• Few hiring challenges • Education and experience or journeyman status • Location – maintaining apprenticeship pipeline harder in rural/remote areas • Lack of ethnic/gender diversity
8	Energy Efficiency Program Manager	• Easy to find interested candidates, but few have utility or power experience • Need commercial building analysts • Turnover low, small departments • Program management skills needed
9	Customer Service Representative	• Easy to find at entry level, but many applicants lack computer and software skills • High turnover (not region-wide challenge, varies by employer, wages, etc.) • Work often more demanding/difficult than anticipated (turnover or transfer) • Need more who are bilingual (especially Spanish) • Often unwilling to work part time • People and help-desk skills required to educate customers in smart meters, energy use data

Workforce Succession Planning

Employers' efforts to develop and implement workforce succession plans vary considerably. As noted in the 2008 report, all organizations conduct some form of strategic planning to address workforce development and the transition of employees. Similarly, the scope, depth, and level of sophistication of these efforts range widely among these organizations, from fairly informal approaches and processes to the use of highly technical analytic methods. Analysis of the 2013 data revealed some new trends and activities suggesting that overall, employers are becoming more focused in their efforts to develop and implement effective workforce succession plans.

The interviews with employers show that many of the same approaches, practices, and trends documented in the 2008 report still pertain today, but there are also areas in which employers appear to have become more intentional – and less informal – in their efforts to develop employees and plan for transitions.

Management Driven

All organizations engage in some form of workforce succession planning, with the management ranks as a primary target. Organizations that apply a multi-level approach tend to focus on development and succession planning for upper management first, with the intent of extending parts of that model down into other departments and professional employees within the organization. Typically, department managers are responsible for reviewing employee development needs and considering retirement data to determine future workforce requirements, often with support from human resources staff. This information is sometimes compiled and reviewed by management committees to identify and help plan for critical shortages across departments. Craft-level workforce succession planning activities were frequently described as a focus area by employers, who noted that these occupations tend to be large in number, contribute directly to the operational readiness of the organization, and represent areas where future retirements among experienced workers will present formidable replacement challenges.

More rare is the use of strategies and tools that are applied across entire organizations, or that employ highly integrated data and analysis methods to track and forecast workforce transitions. A few employers reported using statistical analysis software and regression modeling techniques to compute predictions about employee retirements and needed replacements, for instance.

Organizations that do employ sophisticated analytical methods tend to be larger and assign dedicated staff to support workforce planning and succession activities. Size and dedicated resources are not the only conditions associated with the use of sophisticated strategies and tools, however; even some large organizations reported that they continue to employ a fairly informal approach. Most respondents noted the importance of a commitment by top leadership to human resources strategic planning, which in turn signals to mid-level managers and departments that the organization is dedicated to developing employees and ensuring workforce continuity going forward, raising the bar for the entire organization.

Raising the Bar

A number of respondents reported that the recession caused their organizations to assume a lax attitude toward succession planning: Fewer retirements actually occurred, temporarily reducing the pressure to implement replacements, and

executives and middle managers were focused on attending to financial and operational challenges associated with weaker energy demand. As the economy and business conditions have improved, however, executive managers and boards appear to have resumed their attention to workforce issues, and many respondents noted that new or expanded efforts are now underway which has helped to raise the emphasis and focus on workforce succession planning in their organizations. Several employers tied the renewed emphasis on succession planning directly to the recovery in housing prices, stock markets and other economic factors that may compel potential more retirees to act. One employer noted: "We saw the largest retirement numbers this year and last. The 'waiting game' caused by the recession seems to be over. Retirement seminars revealed that the housing market is recovering, so it helps people to be able to go ahead and retire."

Another respondent described how the organization's board of directors pressed its executive team to ramp-up their succession planning efforts a few years ago. Executives are now working with department directors, who in turn will be expected to work with managers during the next year on a comprehensive succession plan for the company. One mid-level manager described their current efforts as "intense and in-depth" but that they had not done much to advance their workforce succession plan since 2010. She added:

> *We wanted to get our hands wrapped around talent management as a strategic approach – we will align workforce planning once that is better articulated. We're currently studying the critical functions of (the organization) and a way to assess the workforce and manage gaps, a holistic approach, at all levels; who, what risks are there, how to respond.*

Several respondents described how they are creating more tools and support to assist managers and employees to use for workforce development and succession planning, including asking employees themselves to participate in self-assessments, "360 assessments" (which include self-ratings by the employee and by colleagues and others) and in other activities that will facilitate the transfer of knowledge to other employees before they retire. One employer described how long-time managers are encouraged to develop a "knowledge transfer plan," to help ease the transition for colleagues and subordinates and inform the next cohort of employees. This plan might include the manager serving as a mentor over several months to help transfer some aspects of his or her unique knowledge and experience to their replacement. The same respondent noted that among the challenges they face to structuring knowledge transfer opportunities is that employees do not always want to divulge their departure plans, which they view as personal, and that employees' retirement plans frequently change. Hiring replacements early or matching internal candidates with mentors for the purposes of knowledge transfer, also carries cost and productivity implications that some organizations are unwilling to bear.

Effective Models and Practices

Employers who have managed to establish and maintain effective workforce succession plans and processes have generally been successful because they have the support of upper management and they have garnered the support of department managers for their efforts. Having dedicated staff support and resources for workforce succession planning – in the form of time and tools for individual managers to conduct data gathering and analyses, support from a dedicated organizational development or HR specialists, or as part of a team or committee – was described as a critical element to enable effective planning, and to ensure the effective implementation of the planned strategies.

One respondent noted that it has taken many years for them to refine and improve their approach to workforce succession planning, which has required consistent support by executive managers and a level of investment and expertise adequate to maintain the effort and infrastructure required to support effective planning. Another respondent summarized how corporate support for succession planning activities has helped her company develop an effective model that has served their needs well over time. Some aspects of this approach were articulated by several other respondents who are engaged in

comprehensive succession planning efforts, and these strategies appear to reflect elements of a "best practices" model:

> *We have been doing formalized talent review and succession planning for at least ten years. We refresh the plan annually. The process begins with a review of predictive retirement scenario data for all jobs across the company to forecast talent needs. Then "critical jobs" are identified that are hot spots for taking action to address.*

This employer described critical positions as those that meet one or more of the following conditions:

- Require specialized education, training, skills or knowledge
- Have forecasted labor shortages
- Are required to fulfill critical business needs
- Require industry specific experience not readily available
- Require three, five, or ten years to become fully competent
- Internal applicant pool lacks depth and breadth

Next, strategies are developed to prepare for future retirements (see below for types of strategies that may be used to address future talent gaps). Efforts to increase workforce (ethnic and gender) diversity are based on an internal analysis of current employee composition, which is used to drive future outreach and recruitment activities and goals. She added:

> *The succession planning process also helps us decide how many apprentices to start each year in our craft apprenticeship programs in order for them to be topped out by the time retirements happen. It also helps identify new recruiting strategies such as our current focus on fostering a military veteran pipeline as a potential source of diverse, work-ready talent for our industry. It also helps us predict future talent shortages in terms of current enrollments in engineering, craft and STEM fields, so we can be active in influencing early interest by students for careers in the energy industry.*

High-Impact Strategies

All employers employ specific strategies to fill critical skills gaps and plan for the future, but unlike the employer noted above, relatively few consistently employ a comprehensive approach that integrates strategies designed to recruit, retain and develop employees while also restructuring work to improve performance and enhance employee productivity. The "high impact mitigation strategies" used by this employer – many of which were echoed by other respondents – included the following:

- Employee development opportunities
- Talent reviews
- Development planning
- Core leadership course offerings
- Specialized recruiting
- Programs to prepare future leaders
- Open apprenticeships
- On-the-job learning
- 360 feedback and coaching
- Continuing education
- Adding extra positions/overlap
- Redistribute work
- Combine departments/groups

In summary, the findings suggest that compared to 2008, employers have become more formal in their succession planning efforts, and it appears that many are engaged in workforce succession planning at higher levels than in the past. Relatively few employers regularly analyze, forecast and plan strategies to meet future employment requirements in a comprehensive fashion (i.e., organization-wide), but many say they have 'raised the bar' and are working to enhance their planning processes and the strategies they will employ to prepare for workforce transitions and anticipate future hiring and replacement needs.

College Connections

Employers' reliance on postsecondary institutions as sources of training and employee skills upgrading appears to be fairly modest, although several respondents outlined training plans they are developing that would standardize training across their organization, as well as support succession plans in the future. However, as noted in the 2008 study, utilities reported that their connections with local colleges are relatively limited and mostly informal. Some employees connect to colleges on their own, and many are reimbursed for tuition by their employers, however tuition reimbursement was not typically attached to formal training programs. Instead, most employers rely on training that is developed in-house or by product vendors. In some cases management development, leadership and other specialty training such as Lean or Six Sigma was provided by internal or external consultants, and primarily through short-term workshops.

This is not to suggest that energy employers have no connections to local education and training institutions. Indeed, several respondents said that they have employees who serve as adjunct faculty at local colleges, or who serve as guest instructors or speakers. Staff also serve on college program advisory committees, providing the colleges with an industry perspective to inform technical program development. Community and technical colleges were often mentioned as sources of pre-apprentice or apprentice-level training for craft occupations, while four-year schools were frequently identified as sources of new engineering talent. Some employers provide summer internship opportunities or offer tuition assistance to promising engineering students they hope to hire after their degree is completed. A few employers offer scholarships to first generation ethnic minority students enrolled in technical programs in an effort to help diversify the labor pool.

Overall, however, the professional development opportunities that utilities have in place tend to be offered predominantly in-house or online, will little or no college or university involvement. In-house options described by respondents covered a range of topics and approaches including senior staff mentoring or training newer staff, or employees training each other across jobs and topics ranged from exploring opportunities for different employment within the same facility to specific technical training offered by vendors. Many of the common online trainings offered by employers develop skill sets with broad applications such as project management, communications and leadership, and general skills such as common computer software use (Microsoft® Office suite) and basic computer literacy. More specialized technical online trainings were offered for some occupations. Many respondents reported that due to budget

Energy technology and pre-engineering students at Centralia College.

Photo courtesy of PNCECE

constraints they are no longer sending employees off-site for intensive upgrade training or education. Instead they are bringing contractors to the facility to lower costs associated with travel and time away from the workplace, especially for training related to technical tools and devices. In the rarer cases where travel is involved, training often means participating in a workshop at an industry-sponsored conference, or through an industry-focused organization such as the Institute of Electrical and Electronics Engineers (IEEE), rather than at traditional educational institutions or through longer, more intensive programs.

Some employers have established a robust internal capacity to provide occupation and subject-specific training for their employees, which may explain in part why colleges are not more frequent training partners for some organizations. One employer noted: "Only 10 percent of the training we offer is provided by external sources. Most of our training is created in-house and offered online. Our system has been in place for 10 years and we have more than 1,000 courses offered including leadership, job specific skills, and computer training."

Apprenticeship

Apprenticeship is a method used by the majority of the employers surveyed to train workers for craft-oriented positions. Formal apprenticeship programs are typically initiated through partnerships between employers and their labor union(s), and programs are often managed by a Joint Apprenticeship Training Council (JATC). A state apprenticeship council usually oversees the policies and practices of all state-registered apprenticeships. Recent research shows that structured apprenticeships generally produce good outcomes for participants, companies and taxpayers.[59]

Apprenticeships for electric power careers are typically craft-specific training programs that prepare individuals to become journey-level experts in their fields through a long-term training program that typically takes three to five years to complete, and includes several thousand hours of on-the-job experience. Apprentices are typically paid at a sub-journey level "training" rate of around 50 percent of a journey worker, which increases incrementally with satisfactory performance. Most apprenticeships also require the completion of academic courses and content through related classroom instruction of around 144 hours per year, and these courses are often provided through partnerships with local community and technical colleges.

The selection of apprenticeship applicants is a competitive process, requiring reviews of past education, work experience, and ability and skills testing. Some companies and apprenticeship programs require completion of specific courses or certifications. Apprenticeships are long-term investments that require each apprentice to be supervised by a journey-level employee, which limits the number of apprentice slots an employer can support. The availability of apprenticeships is also tied to estimates about retirements and turnover; training is designed to end with full-time employment at the journey level.

Table 11 (page 42) shows that employers have made substantial investments in apprenticeship: More than 500 apprenticed employees were identified by the 15 organizations who reported apprentices, representing eight percent of all positions across the six craft-related occupational groups. Line workers represented the largest number of apprentices at 151, followed by operators (141) and electricians (90). As a percent of total employment in the occupation, operators and power system operators are the largest, with apprentices comprising nearly 14 percent of the total workforce in each of those occupations.

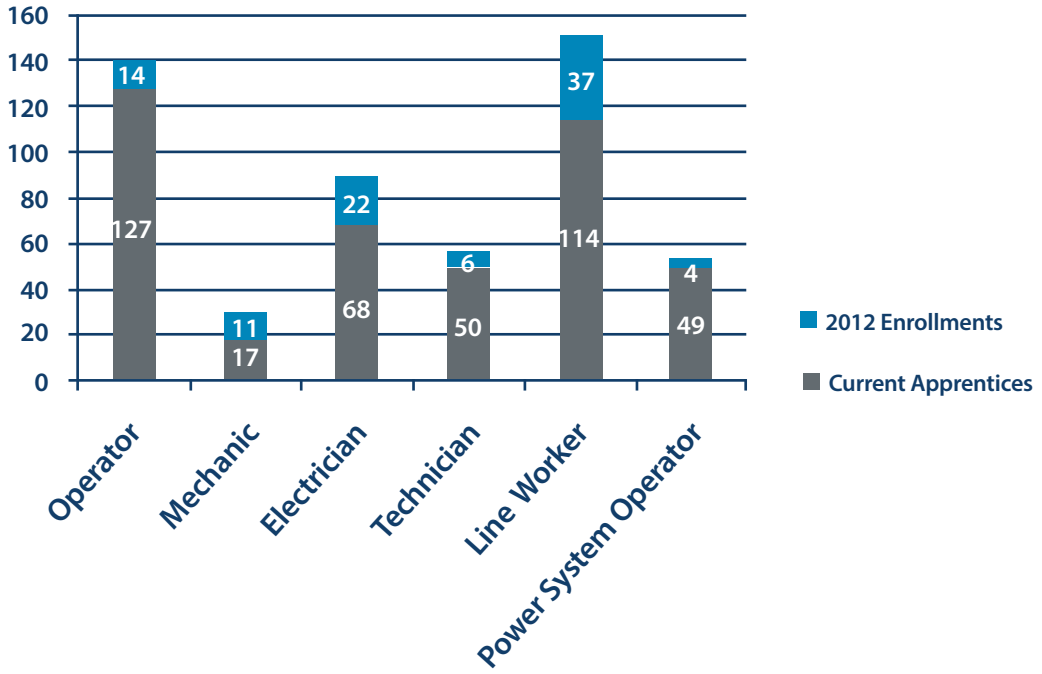
Table 11. Apprentices as a Percentage of Full Time Employment (FTE) by Occupational Group

Occupational Group	Number of Employers with Apprentices	Total Apprentice FTEs	Apprentices as a Percent of Total Workforce in the Occupation
Operator	8	141	13.6%
Mechanic	5	28	3.1%
Electrician	10	90	9.3%
Technician	8	56	6.6%
Line Worker	9	151	7.1%
Power System Operator	7	53	13.7%
Total in these occupational groups		519	8%

Employers have relied on apprenticeship programs to train new craft employees for many years, but the number of apprentices and new enrollees typically varies with shifts in the economy and employers' future hiring estimates. Several employers noted that the recession has led them to reduce the number of new apprenticeship participants during the past several years.[60] One respondent noted: "The recession has impacted apprenticeship enrollments. Each vacancy is considered carefully before replacing it with an apprentice."

Figure 7 shows the number of current apprentices and the number of new apprentices enrolled during 2012. The data show that while line workers saw the most new enrollments of any occupational group, Mechanics showed the largest percentage of enrollments (65 percent). About 32 percent of all electrician and line worker apprentices were enrolled in 2012. Overall, 2012 enrollments account for around 22 percent of total apprentice employees across the six occupational groups.

Figure 7. Apprentice Employees and 2012 Enrollments, by Occupational Group



It should be noted that these comparisons are limited as they only account for enrollments for one year, and apprenticeships typically take three to five years or longer to complete (see Appendix A). The data also do not reflect past or more recent enrollment trends. But the results do raise some questions about apprenticeship capacity and the supply of new workers; as noted earlier, employers' five-year retirement projections range from between 16 and 26 percent for these craft occupations (Table 7). For instance, while proportionately the number of mechanics has increased, the current number of apprentice mechanics (28) seems small when compared to employers' estimates that 130 mechanics will likely retire within the next five years. Similarly, 251 electricians are projected to retire during the same period, a reduction of 26 percent of the total. The data presented earlier suggest that some employers are looking increasingly to the open market to recruit experienced craft workers, using apprenticeship instead as a way to supplement new hiring and development, rather than as the primary strategy.

Pre-Apprenticeship and Trainee Positions

Most companies reported that in the past they have hired individuals into pre-apprenticeship jobs or preparatory training programs, which serves as a way to help fill apprenticeship program openings as they occur. Companies described how they routinely hire new employees in positions such as a helper or "ground worker" to support the work of journey-level employees and develop a pool for future apprentices. Although the numbers hired were small, this strategy is also a home-grown approach for identifying individuals in their communities who might qualify as future apprenticeship applicants or for other jobs in their companies. These opportunities also give trainees and the company a chance to determine if entering into an apprenticeship is likely to be a good fit. One employer noted: "People have to make intentional choices about working in the electrical field. Many people don't realize that it's a viable career. It pays well but demands expertise."

In the 2008 report, eight of the 12 employers reported hiring pre-apprentices or trainees for the five craft positions studied. In 2013, however, only four employers reported that they currently employ individuals in these trainee positions, and several reported that they had discontinued hiring at this level, at least for now. One employer described how they are developing a pool of seven ground workers to feed their apprenticeship programs in anticipation of an improving economy and retirements in several craft occupations. Another large employer said it annually provides pre-apprenticeship training to approximately 70 students as helpers in various craft occupations, most of whom then enter regular apprenticeship programs at other companies.

A number of employers also sponsor internships for college students, and several reported sponsoring students in electrical, mechanical and civil engineering degree programs or other scientific-technical areas. Some large organizations provide regular summer employment for college students, while others sponsor engineering trainee and internship positions on a regular cycle throughout the year, depending on project needs and the availability of internal staff support. Several employers said they have limited the number of engineering interns they sponsor due to budget constraints.

Building a K-12 Pipeline

Respondents expressed a strong collective interest in building connections with local schools and finding ways to garner student interest in energy industry careers. Even those employers that are not currently working with local colleges or universities expressed an interest and enthusiasm for working with high school students and even with middle and elementary school students.

Starting Early

In the 2008 study, many respondents were concerned that the energy industry – and especially energy craft jobs – suffered from a negative public image. They reported that craft jobs tended to be viewed as dirty, dangerous and physically demanding, and school counselors and teachers were placing much more emphasis on four year degrees and white collar jobs than vocational training for the crafts. While these comments did not surface as frequently during the 2013 interviews, it appears that many utilities have begun to address this concern by getting involved with students in the lower grades and by participating as partners with educators by developing curriculum, offering energy professionals as guest speakers and sponsoring energy-related classroom projects. Some respondents indicated that students seem to becoming more interested in energy careers, and some speculated that this is because more students see the field as "green" and as an opportunity to work on renewable energy and efficiency projects that are sustainable and environmentally responsible.

Many employers mentioned specific activities designed to build awareness about careers in energy that started with students before high school, sometimes as young as third grade. While all of the participating employers have some outreach efforts in place for high schools, six employers said they have initiatives designed for middle school students, and four employers reported that they have developed curriculum and activities specifically for elementary school students. The hope is that this early outreach will attract more students to prepare for careers in the energy industry.

Activities, Initiatives and Programs

Employers reported using a wide variety of activities to reach students in their communities, such as hosting field trips, sponsoring career fairs, science bowls, guest speaker programs, classroom projects, and Junior Achievement programs; and holding information sessions for parents to ask questions. Designing displays for "Take Your Child to Work Day," curriculum development projects, and essay contests were among the many activities noted.

While some employers offer short-term job shadow experiences, only two respondents indicated that they have a work-based internship program for high school students. Several respondents noted that there are safety issues that complicate having students in work-based learning activities at the worksite. On-site plant tours and presentations by managers, engineers and senior craft workers were also described as ways to expose students to the workplace and energy careers.

Most employers noted that while they have a variety of outreach activities in place, much of the effort is not tied to a strategic plan. Many indicated that they plan to be more systematic about their outreach efforts in the near future. In reflecting on why this outreach to students is important, one employer noted: "New high school grads are looking at a broader range of opportunities than ever before. Now they are considering craft occupations and technical opportunities."

Best Practices Emerging

Many respondents reported that despite its importance, they have limited budgets to conduct outreach activities with local schools and students. As a result, some employers are evaluating the work they do with the local schools to try to pinpoint which activities have the most impact. Several employers noted that they can make their outreach dollars stretch further by working in partnership with organizations that are already working in the schools; some organizations have built outreach activities around national initiatives such as the Center for Energy Workforce Development's Careers in Energy Week in October, or National Engineering Month each February. Others mentioned leveraging regional partnerships through local Workforce Boards that already hold career fairs and other events in which energy employers can participate.

Another highly effective approach is to send front-line professionals to participate in school career fairs, to conduct mock interviews, and act as guest lecturers.

Respondents noted that students respond well to people who are actually working in the field and in the occupations that are being promoted. In many cases, outreach efforts have a focus on encouraging women and minorities to pursue careers in STEM occupations, so employers try to have a diverse range of employees with different personal and career backgrounds available to participate in outreach events.

Providing hands-on experiences for students was another best practice mentioned by respondents. Employers noted that having a display booth at a career fair had only a moderate impact, but if they could provide an experience where students could use tools, cycle on an energy bike, ride in a boom truck, climb a pole, or build something, they were more likely to make a longer-term connection with that student. As noted earlier, safety concerns limited the types of activities available to students in the workplace, but these types of special projects and activities help to simulate real worksite conditions for students.

Girl scout experiments with wind technology during Careers in Energy Week.

Photo courtesy of Girl Scouts of America/East

Changes Since 2008

One objective of the study was to compare changes in employment-related data since 2008. Complete 2013 data were collected from each of the 12 of the organizations who participated in 2008.[61] In that study, which focused primarily on organizations operating in Washington and Oregon, the occupational targets included only operators, mechanics, electricians, technicians and line workers.

Comparisons of employment, apprenticeships, retirement projections, job vacancies, and projected three-year job growth were conducted. The comparisons help to enhance the identification and description of industry trends on some variables for these occupations. It should be noted that these comparisons are based on a snapshot view of data collected at two different time periods; the results do not account for fluctuations in employment or other workforce data that may have occurred during the study period.

Total Employment Up, Craft Employment Down

Table 12 shows that the 12 companies added 2,930 FTE during the past five years in total employment, a gain of nearly 18 percent. It should be noted that there were many differences between companies in employment during this period; some firms showed gains, while others shed employment, sometimes considerably, suggesting that employment churn and restructuring had probably occurred within the five-year period.

For the crafts studied, Table 12 shows that total craft employment decreased by 331 FTE, a decline of nearly 10 percent. In fact, all but one craft occupation (electrician) saw declines during the same period. The biggest decline was for technicians, which declined by 28 percent, followed by operators (-18 percent), and line workers (-13 percent). The only occupation to gain FTE was electricians, which showed an increase of 13.4 percent. In summary, the data show that while total employment in these companies grew during the study period, overall employment in craft occupations declined, with only electricians showing employment growth among the craft occupations studied.

Table 12. Change in FTEs by Occupation, 2008-2013

Occupation	FTEs Reported in 2008	FTEs reported in 2013	Numerical Change	Percent Change
Operator	610	502	-108	-17.7%
Mechanic	434	424	-10	-2.3%
Electrician	664	753	89	13.4%
Technician	565	407	-158	-28.0%
Line Worker	1,076	932	-144	-13.4%
Total (craft occupations only)	3,349	3,018	-331	-9.9%
Total Employment (all occupations)	16,467	19,397	2,930	17.8%

Declines in Apprenticeship

Apprenticeships are slightly less plentiful in these occupations than they were in 2008; overall rates of apprenticeship dropped from 10 percent of these occupations to 8.5 percent in 2013. Table 13 shows that overall, in 2013 employers had 116 fewer apprentices compared to 2008, a 33 percent decline. There were some notable differences between craft apprenticeships during this period: Employers added 30 operator apprentices, an increase of 81 percent, while the number of mechanic apprentices remained the same between the study periods. Conversely, the remaining three craft apprenticeships saw substantial declines of between 45 and 53 percent.

Many employers reported having reduced capacity to sponsor apprentices within the past several years, due largely to the weak economy; since apprenticeship programs try to guaranteed full-time employment at the end of their apprenticeships, delayed retirements among senior craft workers and a lack of new job creation effectively slowed the addition of new apprentices during the five-year period. Reductions in staffing also meant that the number of journey-level workers available to mentor and supervise apprentices was more limited.

Table 13. Apprenticeship Employment (FTE) and Percent Change, 2008-2013

Occupation	FTE Reported in 2008	FTE Reported in 2013	Difference, in FTE	Percent Change
Operator	37	67	30	81.1%
Mechanic	16	16	0	0.0%
Electrician	98	46	-52	-53.1%
Technician	60	28	-32	-53.3%
Line Worker	135	73	-62	-45.9%
Total	346	230	-116	-33.5%

Shifts in Retirement Projections

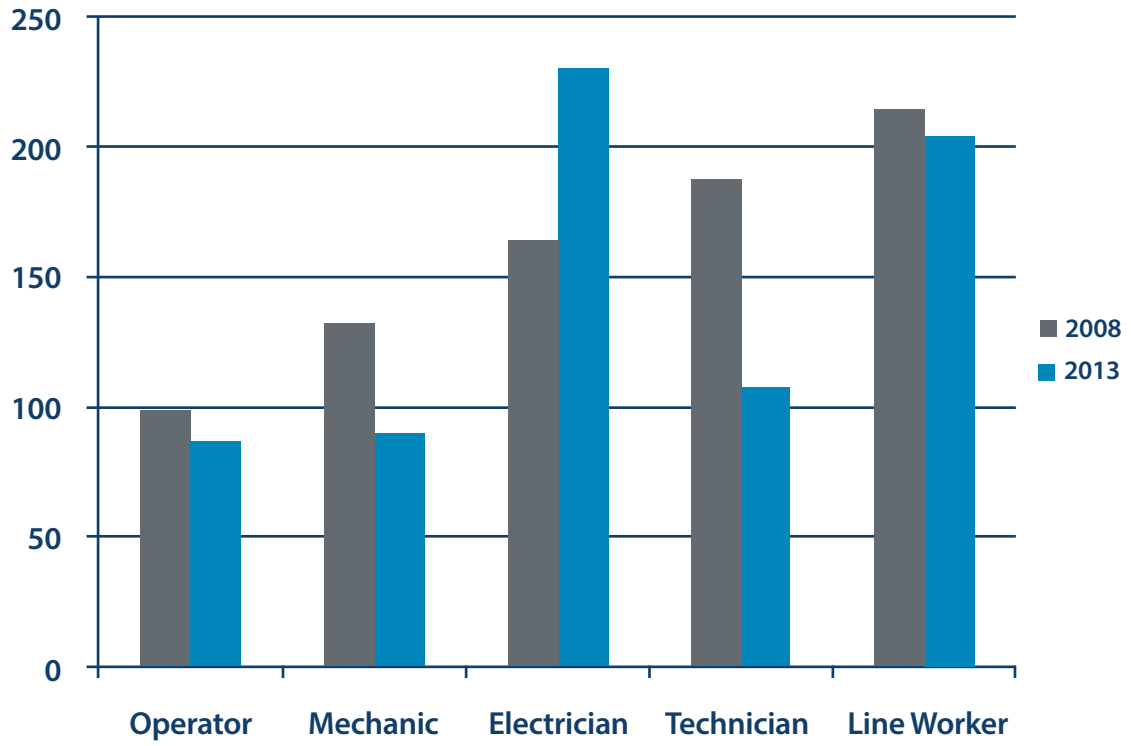
Five-year retirement projections also shifted substantially since 2008. As shown in Table 14, although there is an overall decline of 10 percent in forecasted retirements between the two study periods, the projected changes for some craft occupations are notable. Table 14 shows a 40 percent increase in expected five-year retirements for electricians between 2008 and 2013. Conversely, for all other craft occupations there are decreases: Technicians show a 43 percent decrease in retirements and mechanics show a decline of 32 percent in projected retirements. Figure 8 (page 42) compares the 2008 and 2013 projections by FTE for each occupational group.

Table 14 also shows that in 2013, employers projected that 721 of all individuals in these craft occupations (nearly 24 percent) are projected to retire during the next five years. The largest number of craft employees projected to retire includes 230 electricians (31 percent of total FTE) and 205 line workers (22 percent). The variability between craft occupation retirements could be due to many factors, ranging from the age composition of different occupational groups to organizational restructuring; it is possible that as a group electricians represent a comparatively older pool of workers or that technology changes have moderated the demand for electricians. Additional data collection and analysis would be needed to reliably explain these differences.

Table 14. Projected Retirements by Occupational Group (FTE and Percent), 2008 and 2013

Occupation	Projected Retirements 2008	Projected Retirements 2013	Percent Change 2008-2013	2013 FTE	Percent of 2013 FTE Projected to Retire
Operator	100	87	-13.0%	502	17.3%
Mechanic	133	90	-32.3%	424	21.2%
Electrician	164	230	40.2%	753	30.5%
Technician	188	108	-42.8%	407	26.5%
Line Worker	215	205	-4.7%	932	22.0%
Total	800	720	-10.1%	3,018	23.9%

Figure 8. Projected Retirements by Occupational Group (FTE), 2008 and 2013



Wenatchee Valley College energy technology students at Rocky Reach Dam.

Photo courtesy of Chelan County PUD

Decline in Job Vacancies

Comparing 2008 and 2013 job vacancies shows that employers reported nearly 55 percent (151) fewer current job openings in 2013 than they did for the 2008 study (Table 15). This finding is consistent with what many employers noted about the impact of the recession on employment demand generally: weak energy demand, staff reductions and lower employee turnover combined to depress employer demand for new hires.

Table 15 shows that between 2008 and 2013, there were substantial decreases in vacancies for all craft occupations except for electricians, which saw no change. The most substantial decline was for technicians with an 87 percent decrease, followed by mechanics with a 75 percent decrease.

Table 15. Number and Change in Current Vacancies by Occupation, 2008-2013

Occupation	Vacancies in 2008	Vacancies in 2013	Percent Change
Operator	33	27	-18.2%
Mechanic	28	7	-75.0%
Electrician	35	35	0.0%
Technician	106	14	-86.8%
Line Worker	74	42	-43.2%
Total	276	125	-54.7%

Declines in Projected Three-Year Employment

As shown in Table 16, participating employers in 2008 anticipated adding just 90 new jobs over the following three years, most of which were expected to be line workers (59). In 2013, however, employers expect to increase employment by just 28 positions, a 69 percent decline; only one employer anticipated adding a single line worker job (0.1 percent). The craft job that is anticipated to grow the most during the next three years is mechanic, with 18 new positions expected (up 4.2 percent). This is a substantial shift from the 2008 projections of just three positions (0.7 percent); however, nearly all of the anticipated new job growth for mechanics was attributed to one large employer.

Table 16. Projected Three-Year Employment Growth Rate by Occupation, 2008-2013

Occupation	Three-Year Job Growth 2008	Three-Year Job Growth 2013
Operator	0.7%	0.4%
Mechanic	0.7%	4.2%
Electrician	0.5%	0.8%
Technician	1.9%	0.2%
Line Worker	6.4%	0.1%
Total Projected Job Growth, in FTE	90	28

Conclusions

The primary purpose of this study was to understand the employment and workforce education needs of electric power employers in the Pacific Northwest region, while also noting some of the shifts that have occurred since completion of an earlier report produced in 2008, just as the U.S. entered a major recession. The report focused specifically on the workforce challenges facing electric power employers in the Pacific Northwest. The results identify several important findings and implications for regional, state and local economic and workforce development policymakers, energy employers, and workforce education and training providers.

The Recession

Prior to the recession, a number of research and industry reports raised warning flags about how looming departures of large number of experienced utility employees moving into retirement would create significant labor and skills gaps that were likely to exacerbate the workforce shortages that were already facing utility employers. The 2008 study findings confirmed that many of the same conditions, concerns and challenges facing electric-sector employers nationally were mirrored by employers in the Pacific Northwest. At that time, electric power employers reported a number of challenges to attracting, retaining and developing qualified new employees, in part because the availability of qualified craft workers was extremely limited. Many employers raised concerns about the limited availability of qualified engineers and some management personnel as well.

The national recession led many experienced employees to delay their retirements, which had a paradoxical effect on many electric power employers. On the positive side, fewer experienced employees retiring meant that less of the collective knowledge and skills acquired by these employees during their tenure actually walked out of the door. As with most industries, however, the recession also exacted financial stresses on utilities, because commercial and industrial customers began to use less energy as the demand for their products and services declined; residential customers became increasingly frugal, using less electricity in their homes. Energy markets, which saw broad declines, dropped further as new natural gas discoveries and the use of hydraulic fracturing methods boosted the supply of fossil fuel-based energy. The revenue impacts caused widespread belt-tightening that led many utilities to reduce employment or leave vacancies unfilled. Often, the least-experienced employees were the first to be released, both because of seniority agreements, and because employees with experience were deemed to be better-equipped to support existing operations.

The overall result was that most hiring that did occur during this period put a premium on experience: employers targeted applicants who had energy-sector backgrounds, filled vacancies from within, or sought experienced personnel from other utilities or industry sectors such as manufacturing to meet critical skill gaps; much less emphasis was placed on hiring new, less-experienced individuals at or near the entry-level. It seems likely that one downside of this trend was that the combined emphasis by most regional employers on hiring only experienced new employees probably contributed to the hiring difficulties that were experienced by nearly all employers. There is some evidence that this trend is changing: Some employers noted that the employment "waiting game" caused by the recession appears to be over, and that the number of senior employees who have already left, or are again planning to leave, is growing as the economy improves. As retirement rates accelerate, this long delay in hiring at the entry-level is also likely to widen the age and experience gaps among new and current employees.

Employment Demand is Modest

The results of this study suggest electric power employers in the Pacific Northwest do not currently have large numbers of vacancies in the occupational groups studied. Indeed, although the 16 employers who participated in the study employ nearly 9,000 workers across the nine occupational groups, in the short-term, employers reported that they are trying to fill a total of 305 job vacancies across the nine occupations. Power engineers (67), line workers (60), and customer services representatives (51) accounted for the largest number of current job openings. For line workers and electricians, employers reported that many of these openings may go unfilled due to budget constraints, a lack of qualified applicants or job restructuring.

Looking forward, forecasts regarding new positions are also modest; only three employers said they plan to add new positions in these occupations within the next three years, and their combined forecast of 48 new hires will add just one-half of one percent to the total employment base; power engineers and mechanics are slated to share 77 percent (37 FTE) of all new employment across these occupations. These findings seem reasonably consistent with the combined state forecast, which projects nearly flat (-1.4 percent) utility employment growth between 2010 and 2020.

Comparisons of 2008-2013 data for a smaller subset of employers regarding craft employment generally reinforce these findings. While total employment among the 12 companies grew by nearly 18 percent between 2008 and 2013, craft employment among the five occupations studied dropped by nearly 10 percent; only electrician employment was found to have grown (13 percent). Similarly, there were steep declines in the number of job vacancies and in employers' three-year job growth forecasts, and employment for apprentices dropped by one-third compared to the 2008 findings.

Retirements and Future Labor Shortages

Although these employers do not anticipate much new hiring in the next few years, they do anticipate a substantial loss of skilled employees to retirements: Employers anticipate losing 1,522 craft and professional employees to retirements during the next five years, which represents nearly 17 percent of their current workforces across the occupations studied. At the same time, employers that estimated replacing retirees reported that they intend to fill all but 30 of these future openings. The largest number of projected retirements is for line workers (386), electricians (251) and power engineers (177), representing between 18-26 percent of the current workforce in these occupational groups.

It is important to note that the data showing that new hiring will remain essentially flat do not include current job vacancies, forecasts for retirements or retirement replacements. This is notable because it suggests that while employers' growth estimates for new hires are tepid, anticipated employment demand due to retirement replacement may be substantial, requiring internal replacement and job progression that could eventually lead to increased hiring demand at the entry level.

Comparisons of 2008-2013 retirement forecasts for the subset of employers regarding craft employment show that five-year projections among the 12 companies shifted substantially since 2008. While there is a 10 percent decline in total forecasted retirements, the number of electricians expected to retire within five years (230) rose by 40 percent. Line workers, while showing a slight (-5 percent) decline in forecasted retirements since 2008, will nonetheless account for 205 retirements.

Photo courtesy of PGE

Recruiting and Hiring Challenges

As noted earlier, while the recession increased the overall pool of available labor, the qualifications of current applicants for the occupations studied has not necessarily increased. Most employers report that they continue to struggle to find qualified applicants, especially at the middle-levels of experience. The general challenges cited by employers in 2013 are similar in many respects to the concerns voiced in the 2008 study. Recruiting and hiring concerns noted by all or most employers in 2013 are described below.

A Shortage of Qualified Applicants

Nearly all employers reported that they continue to find it difficult to recruit and hire qualified employees, even though the number of applicants has increased. Employers continue to try to attract qualified candidates from other energy companies, and in some cases economic contractions in other industry sectors like manufacturing or construction have boosted the number of qualified applicants in some craft occupations, such as electrician or mechanic. Employers are also recruiting military veterans with relevant skills and training. In some cases employers have had to accept new hires that lack some of the needed skills, and then conduct training to fill the skills gap.

A Limited Secondary Labor Pool

Reductions in other industry sectors appear to have had a negative effect on the secondary labor market often used by energy employers. Many manufacturing and construction firms shut down or downsized during the recession, and in some cases employees have moved to other industries or occupations; others have experienced long-term unemployment and their skill sets have eroded over time. For electric power employers the overall effect is a reduction of a qualified labor pool from of related industry sectors.

Recruiting and Hiring Costs Increase

Employers report that they have to recruit more widely – looking out of the state and region – to secure qualified applicants to fill position openings. Filling some high-demand vacancies, such as for power engineers, can require an extensive, time-consuming search, and competing successfully for experienced candidates usually requires raising salary and benefit packages and offering other incentives that increase costs.

Working Conditions and Lifestyles Matter

Many electric-sector occupations require that difficult physical work be performed, often in inclement weather, and facing different safety hazards and emergency situations is characteristic of many jobs, especially among craft workers. Geographic factors also present varying challenges to work and quality of life issues. Urban settings frequently involve large projects and a congested work setting, and imply living in or near large population centers. Rural sites and assignments can require extensive travel and isolation from work colleagues. Rural lifestyles are often more relaxed compared to city life, but the range and number of amenities are usually more limited.

Diversity Lacking

Recruiting and hiring qualified ethnic minorities and women continues to be a long-standing human resources issue for employers. While many companies have stepped-up their efforts to attract a more diverse workforce by working with student groups, professional associations, and by actively recruiting minority candidates, those who are qualified are aggressively sought by employers inside and outside the energy industry. Most employers reported that they are working to diversify their workforces further.

Specific Hiring Challenges

Each of the general challenges cited also pertain to the specific recruiting and hiring challenges by occupation noted in the findings section (Table 10). The top three occupations identified by employers as the most difficult to fill include power engineers, power system operators, and electricians. Since most openings require experience, employers have reported some hiring challenges for most of the occupations listed.

Workforce Succession Planning is Evolving

The findings suggest that employers are more actively engaged in workforce succession planning than in the past. Overall, however, it appears that many of the employers included in this study are still establishing (or upgrading) their workforce succession planning processes; relatively few employers regularly and systematically analyze, forecast and plan strategies to meet future employment requirements, and there is considerable variation in the scope and depth of their actions. A few employers have established sophisticated analytical tools, team-based approaches, and other best practices that underlie their succession planning process.

Department managers typically are responsible for tracking transition and succession issues, and coordinating with human resources staff. In other instances, some firms – especially larger firms with additional staff resources – have delegated the overall organization and development of a comprehensive succession plan to an internal organizational development specialist. Individuals or staff teams are sometimes used to facilitate data collection and analysis, but in most cases individual department managers bear the responsibility for succession planning for their units.

College Connections are Limited

Similar to the 2008 study results, employers' reliance on postsecondary institutions as sources of training and employee skills upgrading appears to be fairly modest, especially regarding upgrade and technical training for existing employees. Although most employers support tuition reimbursement for employees who take college courses, employers rely primarily on training that is developed in-house or by product vendors. In some cases management development, leadership and other specialty training such as Lean or Six Sigma was provided by internal or external consultants, primarily through short-term workshops. Most employers often provide student scholarships, internships or other resources to colleges, and employees often serve on college and university boards and committees, act as guest teachers and speakers, but in most cases the professional development opportunities offered by employers are predominantly in-house. Online options are expanding for topics such as project management, communications and leadership, and general skills such as common computer software use. Budget constraints have led many employers to reducing support for off-site training or lengthy academic programs, relying instead on trainings delivered at the facility or online to control costs.

Apprenticeship Declines

More than 500 apprenticed employees were identified by the 15 organizations who reporting having apprentices, representing eight percent of all positions across the six craft-related occupational groups. The largest apprenticeship groups are represented by line workers, operators, and electricians. The 2012 apprenticeship enrollments accounted for around 22 percent of total apprentice employees across the six occupational groups. Line workers saw the most new enrollments of any occupational group, while mechanics showed the largest percentage of enrollments (65 percent). About 32 percent of all current electrician and line worker apprentices were enrolled in 2012.

Several employers reported that the recession has led them to reduce the number of new apprenticeship participants during the past several years. The data comparing 2008 to 2013 helps to confirm this declining trend: The total number of craft apprentices dropped by 33 percent between the two study periods. The results raise some questions about the adequacy of future apprenticeship capacity for supplying new workers. Craft occupations have long-relied on mentoring and on-the-job training as the primary methods used to impart employee knowledge and skill, but employers are currently looking to the open market to recruit experienced craft workers, using apprenticeship instead as a supplemental strategy for new hiring and development rather than as the primary approach.

Building the K-12 Pipeline

Respondents expressed great enthusiasm for building strong relationships with local K-12 schools and finding ways to generate interest from students at all levels – high school, middle, and elementary – in preparing for energy careers. Many employers have worked to enhance the awareness and improve the image of energy-sector employment to attract more students and to emphasize the importance of solid academic preparation for energy careers, whether in craft, professional, or managerial occupations. STEM-related preparation was often emphasized. Some respondents indicated that students are becoming more interested in energy because they view the field as "green" and as an opportunity to work on renewable energy and efficiency projects that are sustainable and environmentally responsible. One employer noted: "New high school grads are looking at a broader range of opportunities than ever before. Now they are considering craft occupations and technical opportunities."

Employers described many specific activities designed to build awareness about careers in energy that started with students before high school, sometimes as young as third grade. While most employers have a variety of outreach activities in place, much of the effort is not tied to a formal strategic plan. Many indicated that they plan to be more systematic about their outreach efforts in the near future, but that they have limited budgets to conduct K-12 outreach activities. Compared to 2008, employers reported there is a greater reliance on partnerships with organizations and programs that are already working with schools, and they are also leveraging regional partnerships through local workforce development boards or trade organizations that already hold career fairs and related events. Presentations and activities led by front-line professionals are very effective and well-received by students, and that this approach is also being employed to encourage women and minority students to pursue energy careers. Hands-on experiences that simulate real work conditions are very effective in imparting the knowledge and preparation needed for energy careers.

Changes Between 2008 and 2013

Complete 2013 data was collected from each of the 12 of the organizations who participated in 2008, enabling comparative analyses of quantitative employment and forecast data between 2008 and 2013 for five craft occupations. These numerical comparisons, which are integrated throughout the report, are also summarized below:

Craft Employment Declined

The results show that while total employment in these companies grew by 2,930 FTE between the two study periods (up 8 percent), employment in the five craft occupations declined by 331 FTE, a reduction of 10 percent. Only electricians showed employment growth (up 13 percent) among the craft occupations studied.

Apprenticeship Numbers Down

The number of apprenticed craft employees also declined between the two study periods, dropping by 33 percent (116). Operator apprentices increased by 81 percent (30 FTE), while mechanic apprentices remained flat; the remaining three craft apprenticeships saw declines of between 45 and 53 percent.

Shifting Retirement Projections

There is an overall decline of 10 percent in forecasted retirements between the two study periods, with the notable exception of electricians, which saw a 40 percent increase in projected retirements. For all other craft occupations the data show declines in expected retirements; the largest declines are for technicians (-43 percent) and mechanics (-32 percent). In 2013, employers projected that 720 of the individuals in these craft occupations (nearly 24 percent) are projected to retire within the next five years. The largest number of craft employees projected to retire includes 230 electricians (nearly 31 percent of total FTE) and 205 line workers (22 percent).

Decline in Job Vacancies

Employers reported nearly 55 percent (151) fewer current job openings in 2013 than they did for the 2008 study. There were substantial decreases in vacancies for all craft occupations except for electricians, which saw no change. The most substantial decline was for technicians (-87 percent) and mechanics (-75 percent). This finding is consistent with what many employers noted about the impact of the recession on employment demand generally: weak energy markets, staff reductions and lower employee turnover combined to depress employer demand for new hires.

Projected Job Growth Levels Off

In 2008 participating employers anticipated adding just 90 new jobs within three years, most of which were expected to be line workers (59). In 2013, however, employers expect to increase employment by just 28 positions, and only one employer anticipated adding a single line worker job. The craft job that is anticipated to grow the most during the next three years is mechanics, with 18 new positions, however nearly all of this growth was attributed to just one employer.

Implications

The study results and conclusions raise a number of implications for the electric power industry in the Pacific Northwest. Although there are many related issues worthy of discussion, the topics discussed below tie together several related issues and reveal core challenges and opportunities for further discussion and action among industry, education and training providers, and other workforce development partners across the region.

The Retirement Effect

The national recession led many experienced employees to delay their retirements, which meant that less of the collective knowledge and skills of these employees were lost during this period. New hiring at the entry levels including apprenticeship declined, however, as weak economic conditions and soft electricity markets forced employers to exact cost-cuts and streamline operations. From this standpoint the conditions are very different from those under which earlier national studies and the 2008 Workforce Challenges report were conducted, in which the urgent predictions about large numbers of retirements were more immediate. The results of this study show, that Pacific Northwest employers still do not have many job openings in the occupational groups studied, and that not much new employment growth is expected in the near future. Comparisons of the 2008-2013 study data reinforce these findings, showing a general decline in new openings and weaker future growth forecasts.

Nonetheless, employers reported that they expect to lose more than 1,500 craft and professional employees to retirements during the next five years, an overall loss of nearly 17 percent, and that they intend to replace nearly all of those openings. Line workers, electricians and power engineers are estimated to see the largest reductions due to retirement, representing between 18-26 percent of the current workforce in these occupations.

Although there was a 10 percent decline in anticipated retirements between the two study periods, and continued application of new technologies and industry restructuring could moderate actual retiree replacements in the future, even a reduced replacement rate will require more than simply replacing positions; the most disruptive adjustments are likely to occur as companies seek to replace the accumulated industry experience, institutional knowledge and skills that will be lost as retirees take their leave of the industry. Although future replacements for all the occupations studied could prove challenging for employers, there are several that deserve special mention:

- Electricians represent a high number of projected retirements (251) and the highest retirement rate of all occupations studied (26 percent). In addition, the number of projected electrician retirements rose by 40 percent between 2008 and 2013, when electricians were also the only craft occupation that showed employment growth (up 13 percent). Also, in 2013 the 12 employers who participated in both surveys expect 230 electrician retirements within the next five years, which is nearly 31 percent of their current FTE. More research is needed to determine the underlying causes, but the growth in predicted retirements and employment may signal that future changes in the composition of the electrician workforce could be substantial.

- Power engineers had the largest number of current job vacancies (67), and also a large projected retirement rate of more than 20 percent. Strong demand for experienced power engineers and a limited supply may have already stimulated more entry-level hiring, but the lack of industry experience could present special challenges to hiring and development of engineering staff during a period when many technological changes and grid upgrades are being planned and implemented.[62]
- Line worker retirements continue to be notable due to the large size of this craft workforce, which accounts for 2,120 employees or more than 7 percent of the total workforce among participating employers. Even though relatively few hiring challenges were noted by employers, a total of 386 line worker retirements are projected, the largest number of any occupational group; vigilance will be required to ensure that future apprenticeship enrollments are adequate to fill openings due to retirements across the region, while grid upgrades will likely require new technical skills and a broader understanding of advanced components, systems integration and communications.

Finally, the results of this study are based upon a sample of 16 regional firms and do not account for retirements at other organizations. Thus, the retirement estimates provided by employers likely understates the actual number of employee retirements across the occupations studied.

Filling the Pipeline

Electric power employers have been forced by weak economic conditions to limit or reduce entry-level hiring and apprenticeships. While this is a rational response to the recessionary business climate, the focus on hiring for experience has likely increased the competition for a limited pool of qualified applicants, unintentionally exacerbating the hiring and skills shortages experienced by nearly all employers. At the same time, it seems likely that reduced investments in cultivating entry-level candidates and limiting apprenticeship capacity across the industry as a whole could present some risks and challenges to hiring, recruiting and developing new employees as turnover due to retirements resumes as the economy improves. Employment 'churn' caused by internal promotions and work restructuring may eventually generate many new openings at the entry-level that could prove hard to fill with qualified candidates. Energy employers continue to report difficulty filling open craft and professional positions, and for most energy jobs the internal development of new employees can take many years.

Although it seems likely that the industry may achieve further efficiencies and reduced staffing requirements through the application of new technologies, automation, work re-design and other labor-saving strategies, the electric power industry will continue to depend heavily on a knowledgeable, skilled workforce. Long-term demographic forecasts, industry reports and some educational research suggest that the future labor pool will be smaller and more diverse than in the past, but not necessarily as well-equipped with the STEM and applied skills needed to succeed in many energy careers. Expanding recruiting efforts across other industry sectors and potential new sources of skilled labor, such as military veterans, are important strategies to supplement identification of new talent. Adjusting recruiting and hiring practices and enhancing workplace conditions to attract and retain younger workers are also important strategies for ensuring that electric power employers secure a talented workforce in the future.

Is Industry Prepared?

Employers who participated in this study appear to be attuned to the importance of developing and applying a systematic approach for workforce succession planning, and several employers described strategies, best practices, and actions that they report have proven effective for those purposes. Although more employers are engaged in succession planning activities than before, some employers continue to be informal and limited in their approach. For most employers the development of workforce succession planning is a process that continues to evolve. Nearly all employers reported that they are concerned about replacing retiring workers, but many also said they should be doing more than they currently are to prepare for the labor and skill gaps that future employee transitions are likely to generate.

Solutions and Actions

Several employers described strategies and action steps that they currently employ or are developing as part of their succession plans to address future hiring and replacement needs. A number of these solutions relate to the replacement of retiring employees, and several variations were mentioned in the 2008 Workforce Challenges report:

- **Encouraging key employees to delay their planned retirement by enhancing compensation, retirement benefits or other incentives.**
- **Restructuring the work of near-retirees to allow more time to mentor and train replacements.**
- **Re-hiring retirees as contractors to temporarily fill critical skill gaps, or to train new workers.**
- **Analyzing and documenting the critical work functions, activities and competencies of key employees to enable knowledge-capture and transfer to other employees.**
- **Restructuring jobs or increasing the use of technologies to reduce labor requirements.**
- **Expanding internal and external training options.**
- **Target recruitment to leverage new sources of skilled labor, such as military veterans and workers from other industry sectors.**
- **Expanding the use of incentives, compensation options, flexible work schedules and benefits to attract and retain high-demand employees.**

Long-Term Solutions

Looking ahead, employers and their workforce development partners should look for ways to enhance and extend the effective education and training strategies that are already in place, while also investing in new approaches that can support the future needs of the industry, including:

Leverage and Expand Partnerships

Employers should continue to support development of industry-education-government partnerships to promote and support continued development of the electric power workforce. Organizations such as PNCECE, with its broad-based consortium of employer, organized labor, education and training, and economic development stakeholders, have been successful in convening partners to address industry needs and education and training capacity, and in attracting resources to support improvements and expansions in energy workforce programming. PNCECE has served as an effective 'hub' for energy sector research, partnership development and action that should be further expanded to include additional states and partners across the region. Some employers are already leveraging their limited education and training budgets and outreach efforts through consortia partnerships in their areas, and they and their education and workforce partners should continue to build upon the shared resources, synergies and effective actions these collaborations can produce.

Bonneville Dam *Photo courtesy of BPA*

Enhance Education and Training Capacity and Responsiveness

The problem of matching employer expectations with a supply of qualified applicants continues to be a challenge, and it is not likely be remedied without the ongoing vigilance by all stakeholders. Many of the labor and skill gaps noted by respondents pertain to all companies, thus employers and their education and training partners should continue to assess what specific skill gaps exist now and identify what incumbent worker training can be implemented to fill those gaps across the region. While some strong partnerships do exist, industry's training connections with some providers – especially local two-year colleges – should be strengthened.

Employers should explore new ways to leverage the resources available through universities, colleges, and other training providers to stretch their own education and training budgets and to form stronger partnerships to ensure a supply of qualified applicants for future new hiring that will eventually be needed as employers replace employees who advance internally. Increased retirement rates will also boost the need for upgrade training to help incumbent workers replace those who leave. While industry needs to lead in defining this work, they will also need to make new investments themselves. With industry leadership and support, colleges, universities, apprenticeship and other workforce development partners can contribute effectively to provide workforce solutions, and their participation will help ensure that programs are responsive to employer needs in the future. Co-development of short-term, 'stackable' training modules, certificates and customized degrees and online delivery options are promising strategies that will require investments by all partners to create, maintain and enhance as workforce requirements change.[63]

Enhance and Restore Apprenticeships

Similarly, electric power employers would be wise to assess how they can restore and enhance apprenticeship capacity as the demand for entry-level craft employment recovers; it takes several years and a considerable investment of resources to develop skilled, productive craft employees, including providing program infrastructure and ensuring the availability of journey-level mentors to work with apprentices and pass on their institutional knowledge and craft skills to the next generation. While the core technical skills needed by craft workers are likely to endure and should continue to be taught, the advent of new technology-based tools, system changes and work restructuring is likely to require new knowledge and competencies of employees at all levels, and apprenticeship programs should be systematically reviewed and upgraded to ensure that future craft workers are well-equipped to succeed in their careers.

With industry leadership and support, colleges, universities, apprenticeship and other workforce development partners can contribute effectively to provide workforce solutions, and their participation will help ensure that programs are responsive to employer needs in the future.

The Future Labor Supply

Although employers are currently focused on hiring experienced personnel, the electric power industry will continually need to develop a pipeline of new talent for the future. Employers should be strategic and deliberate in their efforts: The pool of qualified applicants is already small, and most employers are looking longer and further away to meet their hiring requirements. Moreover, future demographic changes are likely to reduce the pool of qualified candidates further, and electric power employers will be forced to adjust to more of a seller's market than it is today. Competition for a smaller pool of qualified applicants is also likely to come from other industry sectors and companies that are also eager to recruit and hire new talent for their organizations.

Many respondents described their varied and ongoing work with K-12 schools, teachers and students to inspire and attract young people to the industry. Strategic efforts to build greater awareness among students about the opportunities in the electric power industry – and also to dispel the myths that have cast the industry and craft work in a negative light – are needed to generate enthusiasm among young people about the industry, and to leverage their growing interest in promoting a sustainable environment and a clean energy future. K-12 outreach also enables employers to explain to educators and students the many career opportunities that exist, including the level and type of academic preparation and applied skills that they expect.

At the same time, employers and the industry as a whole must be willing to adapt to a future in which the shifting values and expectations of young people—who are both energy consumers and the source of future labor--will continue to shape the industry. As one employer noted: "The different values, work ethic, and expectations of younger employees will create challenges in our workforce." Millennials (Generation Y) are influencing the labor market and electric power organizations in profound ways, and it seems likely that the expectations of youth about flexible work environments, ongoing learning opportunities and career mobility, access to the latest technologies and communications tools such as social media and mobile devices, represents some pervasive trends. A tighter future labor market and more industry and career options for talented young workers may compel employers to be even more willing than they are now to adapt their organizations to the characteristics of the future labor market in order to successfully attract, develop and retain a talented workforce.

"The different values, work ethic, and expectations of younger employees will create challenges in our workforce."

Regional and State Policy Considerations

The electric power industry provides a fundamental product and service that is essential to the social and economic prosperity of nation and the Pacific Northwest. As the region and individual states continue to invest in a clean energy future through legislative action, public policies, incentives and regulation, the industry will need to both maintain the existing systems that are effective while upgrading the grid to improve system reliability and efficiency, integrate renewables, and promote energy conservation.

Advanced technologies and future innovations will provide new opportunities to achieve these goals, but the electric power industry remains extremely knowledge-intensive, and its future will continue to depend on the availability and development of a talented workforce that can support and adapt to future changes in the industry. The Pacific Northwest region, individual states and industry have already provided leadership and investment to help develop the energy workforce, but more is needed, including enhanced policy leadership and investment for new initiatives, and the expansion of existing strategies and practices that have produced effective results.

Creating a clean energy future is a priority that underlies many state economic develop strategies. Encouraging a regional discussion among industry and workforce stakeholders about the role that workforce education and training should play and how best to align economic and workforce development priorities is central to achieving clean energy and economic goals across the region. A regional consortium approach could also extend work that has already been led by individual states and partners.[64]

Similarly, continued investment in effective regional collaborations such as Centers of Excellence can help build consensus about future workforce needs and priorities for the electric power industry, while leveraging and extending the coordination and benefits that have already accrued through mature partnerships and the proven workforce education strategies, best practices and tools they have developed and implemented.

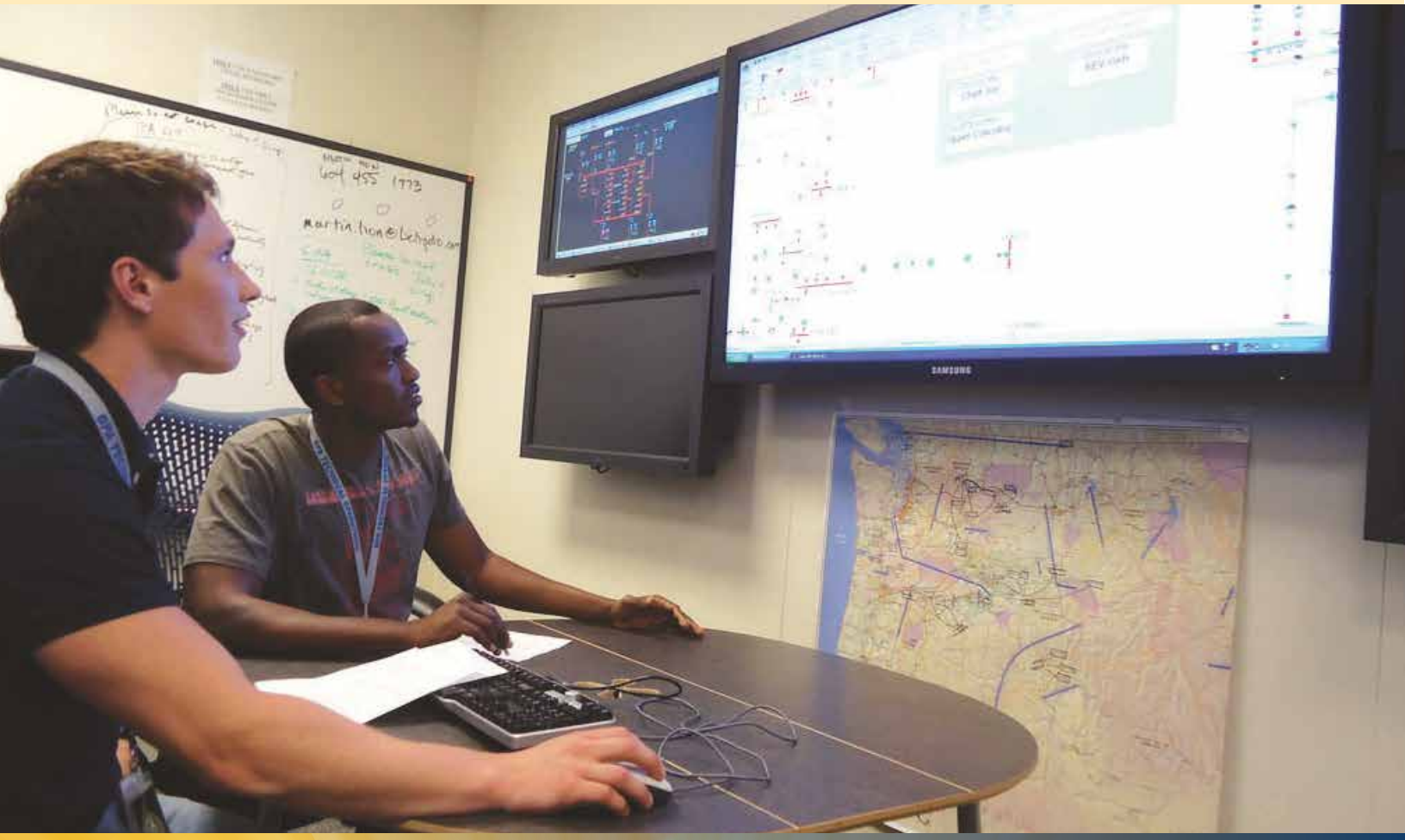
Related activities that a regional, collaborative approach could support:

- Provide and expand institutional support for targeted innovations in electric power education and training programming, curriculum development and program delivery for universities, colleges and apprenticeship. A number of federal, state and local investments have already been made, and the results of these projects should be leveraged and expanded across the region.
- Continue to define occupational labor and skill requirements through research and development of industry-defined competencies and skill standards to stay current with industry needs and improve the responsiveness of public education and training.
- Promote the expanded use of – and support program and degree requirements for – Work-Based Learning strategies within K-12 and postsecondary programs, to emphasize the importance of core academic content and applied learning strategies through industry internships and age-appropriate workplace exploration activities.
- Encourage and support special projects that establish or expand industry support and investment in workforce education solutions that target "high demand" occupations, skills and future technological changes that will affect future workforce requirements of electric power employers.

Recommendations for Further Research

- Repeat the Workforce Challenges study in 3-5 years to track industry and energy workforce changes across the Pacific Northwest region.
- Conduct additional occupation-specific research to clarify the causes and effects of predicted retirement and employment growth in specific occupations such as electrician.
- Analyze and compare enrollments, degree completion and employment outcomes for students in STEM-related programs across the Pacific Northwest region.
- Assess energy-sector apprenticeship enrollments, completions and standards to enhance program quality and align supply with industry demand.

Photo courtesy of BPA



Appendix A – Occupational Requirements Summary

	Operator	Mechanic	Electrician
Work Experience	2-4 years Journey-level experience via Apprenticeship or past equivalent experience (Trade or vocational school certification, or military experience**)	2-4 years Journey-level experience via Apprenticeship or past equivalent experience (Trade or vocational school, college, or ASE Master certification**)	3-5 years Journey-level experience via Apprenticeship or past equivalent experience (Two-year trade school or college plus 2 years relevant experience**)
Licenses	State Driver's License, Commercial Driver's License*, First Aid card, CPR certification, Operators' License*	State Driver's License, Commercial Driver's License*, First Aid card, CPR certification, some equipment certifications (forklift, backhoe)*	State Driver's License, Commercial Driver's License*, First Aid card, CPR certification, some equipment certifications (forklift, aerial lifts)*
Education	HS diploma or equivalent*	HS diploma or equivalent*	HS diploma or equivalent*
Testing	NJATC Aptitude test,* PEO or POSS test,* equipment testing, respirator testing, pre-employment physical*	WA state exam for chemicals on vegetation,* mechanical aptitude testing,* respirator and heat stress testing, pre-employment physical*	JATC selection tests, safety testing and equipment certifications, pre-employment physical*
Special Skills	Requires spatial ability, depth perception, and color discrimination; Use of two-way radio, safety equipment and complex systems	May be required to perform other craft work as needed. Must perform welding, fabrication. Maintain project roads*	May be required to perform other craft work as needed.* Use of two-way radio, safety equipment and specialized tools*
Work Conditions, Requirements	Work in adverse weather conditions and terrain, confined spaces; hazardous conditions and materials; may require overtime and emergency shifts. Live within reasonable commute (one hour or less)*	Work in adverse weather conditions and terrain, confined spaces; hazardous conditions and materials; may require overtime and emergency shifts. May require travel to remote locations*	Work in adverse weather conditions and terrain, confined spaces; hazardous conditions and materials; may be required to work overtime and emergencies. Live within reasonable commute (one hour or less)*

	Technician	Line Worker	Power System Operator
Work Experience	2-5 years Journey-level experience via Apprenticeship or past equivalent experience (Two-year trade school or college plus 2 years relevant experience, or military experience**)	3-5 years Journey-level experience via Apprenticeship or past equivalent experience	Minimum of two years of utility Control Center operating experience or related operating experience with the electrical system
Licenses	State Driver's License, Commercial Driver's License*, First Aid card, CPR certification, Flagging certification, Wireman/Meterman card*	State Driver's License, Commercial Driver's License,* First Aid card, CPR certification, Flagging certification, some equipment certifications (forklift, aerial lifts),* Lineman card,* May require pesticide applicator's permit*	NERC Certification
Education	HS diploma or equivalent*	HS diploma or equivalent*	Associate degree in electrical engineering or equivalent
Testing	JATC selection tests,* POSS/MASS Aptitude tests,* safety testing, equipment certifications, pre-employment physical*	JATC selection tests,*aptitude tests, pre-employment physical*	SCADA, NERC
Special Skills	May be required to fill other positions as needed.* Requires spatial ability, depth perception, and color discrimination. Use of two-way radio*	May perform as Foreman as needed.* Perform pole top and bucket rescue. Must participate in CVR/DAS equipment training*	Advanced computer skills including word processing, spreadsheet, email, database and SCADA system. Ability to work in a fast-pace, detail-oriented environment, meet strict deadlines and cope with frequently changing priorities

* Not required by all employers ** Allowed by a few employers

Appendix A – Occupational Requirements Summary

	Power Engineer	Customer Service Representative	Energy Efficiency (Conservation) Program Manager
Work Experience	3 – 5 years of experience	2 – 4 years of customer service related work experience	1 – 3 years of experience working in the energy field
Licenses	Professional Engineering license	None	Certified Energy Manager certificate needed for advancement
Education	Bachelor of Science degree in Engineering from ABET accredited school, emphasis on Power Engineering recommended	None required but some post-secondary education will enhance employability and career mobility	Bachelor of Science degree in Business or Engineering or equivalent functional experience (new building construction with a focus on sustainability or building energy efficient retrofits)
Testing	Engineer-in-Training (EIT) exam; Principles and Practices of Engineering (PE) exam*	None	None
Special Skills	Systems thinking along with project management skills and ability to integrate IT into designs	Proficiency with MS Office Suite, and the internet. Communication, problem solving and conflict resolution skills needed	Advanced knowledge of energy using systems (lighting systems, HVAC and boilers) used in residential and/or commercial buildings. Detailed knowledge of energy use and measurement by various types of equipment and measurement systems is essential
Work Conditions, Requirements	Power engineers typically work full-time and conditions can vary greatly. Senior power engineers may work in control room environments, analyzing problems and taking action to ensure continuous and reliable operation of equipment and systems. Power Engineers are required to use mechanical and electric equipment and tools and may come into contact with potentially hazardous chemicals	This entry-level position involves working on the phone for long periods of time and ability to handle multiple priorities in a contact center environment	Primary responsibilities of this mid-level position in utilities include supporting and administering existing energy efficiency programs and peak demand reduction programs

* Not required by all employers ** Allowed by a few employers

End Notes

1 Economic Policy Institute: http://stateofworkingamerica.org/great-recession/.

2 Matching funds from industry and other project partners leveraged the initial grant award to an estimated $12 million in total funding for the project.

3 Monthly Energy Review, Energy Information Administration, July, 26, 2013: http://www.eia.gov/totalenergy/data/monthly/pdf/sec1_6.pdf.

4 U.S. Department of Labor, Bureau of Labor Statistics, 2013.

5 Hardcastle, A. (2008). Workforce Challenges of Electric Sector Employers in Washington and Oregon, Washington State University Energy Program, for the Center of Excellence for Energy Technology (Centralia College): http://www.energy.wsu.edu/Documents/WSU_Workforce_Challenges_Final_Report_090311.pdf.

6 A summary of relevant research can be found in Workforce Challenges of Electric Sector Employers in Washington and Oregon (2008). See also: Workforce Trends in the Electric Utility Industry, U. S. Department of Energy (2006): http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/Workforce_TrendsReport_090706_FINAL.pdf.

7 Hurd, M. & Rohwedder, S. (2010). Effects of the Financial Crisis and Great Recession on American Households, National Bureau of Economic Research, Working Paper No. 16407 (Sept.): http://www.nber.org/papers/w16407.

8 The Close Tie Between Energy Consumption, Employment and Recession, The Energy Collective, Tverberg, G. (2012): http://theenergycollective.com/gail-tverberg/113806/close-tie-between-energy-consumption-employment-and-recession.

9 The Impact of the Financial and Economic Crisis on Global Energy Investment: EIA Background Paper for the G8 Energy Ministers' Meeting, 2009. http://www.iea.org/ebc/files/impact.pdf.

10 See: http://www.publicpower.org/Media/magazine/ArticleDetail.cfm?ItemNumber=27546.

Gaps in the Energy Workforce Pipeline: 2011 CEWD Survey Results
http://www.cewd.org/surveyreport/CEWD-2011surveyreport-021512.pdf
Need full citations, and more of them on this topic, national and PNW.

11 See: U.S. Bureau of Labor Statistics, Mass Layoff Statistics, Utilities. See: http://data.bls.gov/timeseries/CES4422000006?data_tool=XGtable.

12 In response to the economic crisis, Congress passed the American Recovery and Reinvestment Act of 2009 -- commonly referred to as the "stimulus" or the "stimulus package". The immediate goals of the Recovery Act were: 1) Create new jobs and save existing ones and 2) Spur economic activity and invest in long-term growth. http://www.recovery.gov/About/Pages/The_Act.aspx.

13 See, for instance: Economic Impact of Recovery Act Investments in the Smart Grid. Smart Grid Investment Grant Program. U.S. Department of Energy, 2012: http://www.smartgrid.gov/sites/default/files/doc/files/Smart%20Grid%20Economic%20Impact%20Report.pdf.

14 Nutter, T. and Hardcastle, A. Workforce Trends: What You Can Do Today, Western Energy Magazine, Spring 2012. http://www.westernenergy.org/WE/Archives/2012_Spring/WEI_Spring_2012.pdf.

15 Recommendations on Electricity Workforce: Energy Advisory Committee report October 17, 2012 http://energy.gov/sites/prod/files/EAC%20Paper%20-%20Recommendations%20on%20Electricity%20Workforce%20-%20Final%20-%208%20Nov%202012.pdf. See also the final report by the Task Force on America's Future Energy Jobs, National Commission on Energy Policy, 2009: http://bipartisanpolicy.org/sites/default/files/Final%20report.pdf.

16 The Pacific Northwest states included in this study are Idaho, Montana, Oregon, Utah, and Washington.

17 Calculations are based on data provided by Energy.Gov, updated March 2013. See: http://energy.gov/downloads/recovery-act-recipient-data.

18 U.S. Energy Information Administration, 2013: http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3.

19 In 2006, we reported that other renewables made up 2.3 percent of Washington's power generation profile and 3.5 percent of Oregon's. The reader can see that these have quadrupled since.

20 Sixth Northwest Conservation and Electric Power Plan, Northwest Power and Conservation Council, 2010: See: http://www.nwcouncil.org/energy/powerplan/6/plan/.

21 Source: Sixth Northwest Conservation and Electric Power Plan, Northwest Power and Conservation Council, 2010. See: http://www.nwcouncil.org/energy/powerplan/6/plan/.

22 U.S. Energy Information Administration, 2012. See: http://www.eia.gov/energyexplained/index.cfm?page=renewable_home.

23 Database of State Incentives for Renewables and Efficiency (January 2013), North Carolina Solar Center, North Carolina State University: See: http://www.dsireusa.org/summarymaps/index.cfm?ee=0&RE=0.

24 U.S. Energy Information Administration, 2013. See: http://www.eia.gov/todayinenergy/detail.cfm?id=6090.

25 Transforming America's Power Industry: The Investment Challenge 2010-2030. The Brattle Group, 2008: http://www.brattle.com/newsevents/newsdetail.asp?recordid=568.

26 Environmental Protection Agency, 2012. See: http://www.epa.gov/climatechange/ghgemissions/sources.html.

27 National Institute of Standards and Technology, 2012. See: http://www.nist.gov/smartgrid/index.cfm.

28 For a description of DOE-funded smart grid projects in the Pacific Northwest region, see: http://www.pnwsmartgrid.org/. See also: http://smartgrid.ieee.org/june-2012/601-largest-u-s-smart-grid-demo-project-is-set-to-roll.

29 The Smart Grid Evolution: Impact on Skilled Utility Technician Positions. Center for Energy Workforce Development (undated).

30 Hardcastle, A. (2013). Smart Grid Skills for the Energy Workforce. Washington State University Energy Program, for the Pacific Northwest Center of Excellence for Clean Energy. Also: The U.S. Smart Grid Revolution: Smart Grid Workforce Trends 2011. KEMA and Gridwise Alliance, July 2011.

31 Big Data: The Next Frontier for Innovation, Competition, and Productivity. McKinsey Global Institute, 2011. www.mckinsey.com/mgi.

32 For more information on the impact of smart grid technology on the future workforce, including the results and products generated by the DOE-funded Smart Grid Workforce Training project, see: Pacific Northwest Center of Excellence for Clean Energy: http://cleanenergyexcellence.org/.

33 Skill Standards for Utility Customer Service Representatives. Washington State University Energy Program, for the Pacific Northwest Center of Excellence for Clean Energy (2012): www.cleanenergyexcellence.org/skill-panel.

34 Analysis of the year-to-year data for this period revealed negligible differences in annual employment, and are not included here.

35 The reasons for utility job growth in Idaho is not clear, however Idaho did receive numerous ARRA awards from the U.S. Department of Energy for environmental management and energy efficiency and renewable energy projects that may have stimulated additional utility hiring. In addition, the state's largest utility, Idaho Power, received a $47 million award to support development and implementation of smart grid projects, which may also have required additional staffing.

36 Regional utility wages are a weighted average. The federal and non-federal data included in the Figure come from differently-structured data sources that are not directly comparable, therefore the data represent an estimate of combined wages for utilities.

37 Some states employ slightly different methods to arrive at long-term employment forecasts. State sources:

http://labor.idaho.gov/workforceglance/LongTermIndustries;

http://www.ourfactsyourfuture.org/cgi/dataanalysis/indPrjReport.asp?menuchoice=indprj

http://www.qualityinfo.org/pubs/projections/sw.pdf;

http://governor.utah.gov/dea/projections.html;

https://fortress.wa.gov/esd/employmentdata/reports-publications/industry-reports/employment-projections

38 Percentage changes presented in this table is based on comparable private-sector estimates only, and does not include federal and local utility employment. Data for Washington data is for 2011-2021.

39 The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America. The Pew Charitable Trusts, (2009); The Economic Benefits of Investing in Clean Energy: How the economic stimulus program and new legislation can boost U.S. economic growth and employment, Pollin, R., Heintz, J., and Garrett-Peltier, H., Department of Economics and Political Economy Research Institute (PERI), University of Massachusetts, Amherst (June 2009). See also: Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US? Wei, M., Patadia, S. and Kammen, D. (2010), Energy Policy, 38 919–931.

40 See for instance, the results of the DOE's $5-million investment through the Pacific Northwest Center of Excellence for Clean Energy to develop education and training to support development of the energy workforce: http://cleanenergyexcellence.org/.

41 The 2008 federal Green Jobs Act created an energy efficiency and renewable energy job training program as well as research and grant programs to support clean energy jobs and workforce development. In the Pacific Northwest, several states including Washington and Oregon passed legislation to target development of new green jobs and related research. See: 2008 Washington State Green Economy Jobs, Washington Employment Security Department (2009); Also: The Greening of Oregon's Workforce: Jobs, Wages and Training, Oregon Employment Department, (2009).

42 Hardcastle, A. (2008). Workforce Challenges of Electric Sector Employers in Washington and Oregon, Washington State University Energy Program: http://www.energy.wsu.edu/Documents/WSU_Workforce_Challenges_Final_Report_090311.pdf.

43 See: Survey of Washington State Employers' Workforce Training Needs and Practices – 2006, Washington State Workforce Training and Education Coordinating Board (2007); Oregon's Forgotten Middle-Skill Jobs: Meeting the Demands of a 21st Century Economy, Skills2Compete-Oregon campaign and The Workforce Alliance (TWA), 2009 (February).

44 See: Skills Gap or Mismatch Between Needs and Skills? Idaho Employment, Idaho Department of Labor, 2012 (September); Oregon Must Compete: Reducing our skills gap through innovative education models. America's Edge (2013); Survey of Washington State Employers' Workforce Training Needs and Practices – 2012. Washington State Workforce Training and Education Coordinating Board (2013).

45 Carnevale, A., Smith N. & Melton, M. (2011). STEM (Science, Technology, Engineering and Mathematics). Georgetown University Center on Education and the Workforce (October).

46 Preparing the U.S. Foundation for Future Electric Energy Systems: A Strong Power and Energy Engineering Workforce, U.S. Power and Energy Engineering Workforce Collaborative, Power & Energy Society, the Institute of Electrical and Electronics Engineers, 2009. See: http://www.ieee-pes.org/images/pdf/US_Power_&_Energy_Collaborative_Action_Plan_April_2009_Adobe72.pdf.

47 Workforce Trends in the Electric Utility Industry. U. S. Department of Energy (2006): http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/Workforce_Trends_Report_090706_FINAL.pdf.

48 Carnevale concluded that more than a third of all jobs in STEM occupations through 2018 will be for those with less than a Bachelor's degree; but that our education system has, thus far, not adequately produced these workers. See: Carnevale et al., (2011). STEM.

49 See: A new look at long-term labor force projections to 2050. U.S. Bureau of Labor Statistics, 2006: http://www.bls.gov/opub/mlr/2006/11/art3full.pdf. Also: Long-Term Features of the Washington Labor Force, Forecasting Division, Washington Office of Financial Management, 2011: www.ofm.wa.gov/economy/longterm/2011/lt11ch2.pdf.

50 U.S. Congressional Budget Office, Understanding and Responding to Persistently High Unemployment, 2/2012.

51 Gaps in the Energy Workforce Pipeline: 2011 CEWD Survey Results. Center for Energy Workforce Development, 2011: www.cewd.org.

52 Note: The age cohorts for all industries were combined to simplify the presentation of data. There was little variation noted among the individual state age profiles.

53 The data presented in the 2008 report was collected during the last quarter of 2007.

54 Data provided by two multi-state employers could not be reliably apportioned among the five-states in the study region; unless otherwise noted, tables include additional employment of approximately 800 FTE across portions of Northern California, Wyoming, Nebraska, South Dakota and Colorado.

55 Three of the organizations surveyed indicated they do not employ Energy Efficiency Program Managers.

56 One employer was unable to project retirees for any of the occupations shown.

57 For the five states combined, between 2007 and 2011 employment in construction dropped by 221,643, a 32 percent decline. Between 2007 and 2010, manufacturing employment dropped by 109,771, a loss of 14 percent, before recovering slightly in 2011. Source: U.S. Bureau of Economic Analysis, 2013: www.bea.gov.

58 See: Hardcastle, A. (2013). Smart Grid Skills for the Energy Workforce, Washington State University Energy Program, for the Pacific Northwest Center of Excellence for Clean Energy-Centralia College.

59 See: An Effectiveness Assessment and Cost-Benefit Analysis of Registered Apprenticeship in 10 States. Mathematica Policy Research, 2012 (July): http://wdr.doleta.gov/research/FullText_Documents/ETAOP_2012_10.pdf. See also: 2012 Workforce Training Results, Washington State Workforce Training and Education Coordinating Board: http://wtb.wa.gov/Documents/WorkforceTrainingResults2012.pdf.

60 An analysis of comparable apprenticeship data between 2008 and 2012 is presented in a later section of this report.

61 2008 participants included: Avista, Bonneville Power Administration, Chelan County PUD, Energy Northwest, Grays Harbor PUD, Portland General Electric, Puget Sound Energy, Seattle City Light, Snohomish County PUD, Tacoma Power, and the U.S. Bureau of Reclamation.

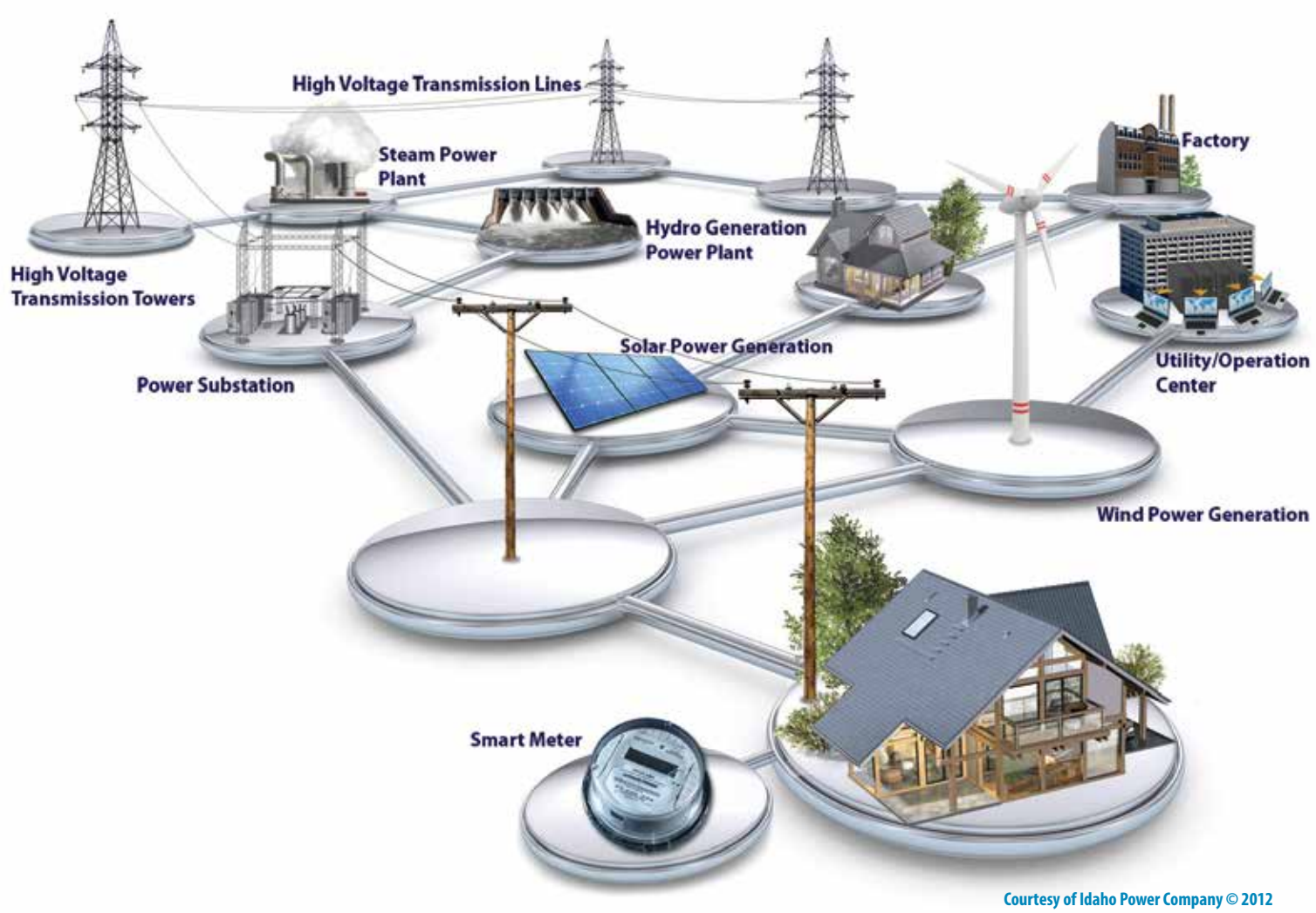
62 Recent research on the power engineering workforce reinforces these challenges. See: The Power Engineering Workforce in Washington and the Pacific Northwest: Opportunities and Challenges. (2013). Washington State University Energy Program, for the Energy Systems Innovation Center, Washington State University: http://esic.eecs.wsu.edu/.

63 Examples of curriculum and training modules, career pathways, and related workforce training resources produced by the Smart Grid Workforce Training project can be found at: http://cleanenergyexcellence.org/.

64 Washington has been at the forefront in aligning economic and workforce development goals, and this work is central to supporting a post-recession innovation economy that also supports a clean energy future. See: Advancing the Innovation Economy in Washington State: The Critical Role of Workforce Development. Washington State University Energy Program, 2012: http://www.energy.wsu.edu/Documents/Innovation%20and%20Workforce%2Development%20in%20Washington%20State%2012-31-12.pdf.

Puget Sound Energy's Snoqualmie Falls Hydroelectric Project.
Photo courtesy of Puget Sound Energy

Smart Grid City



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Visit the interactive career map at http://cleanenergyexcellence.org/careers