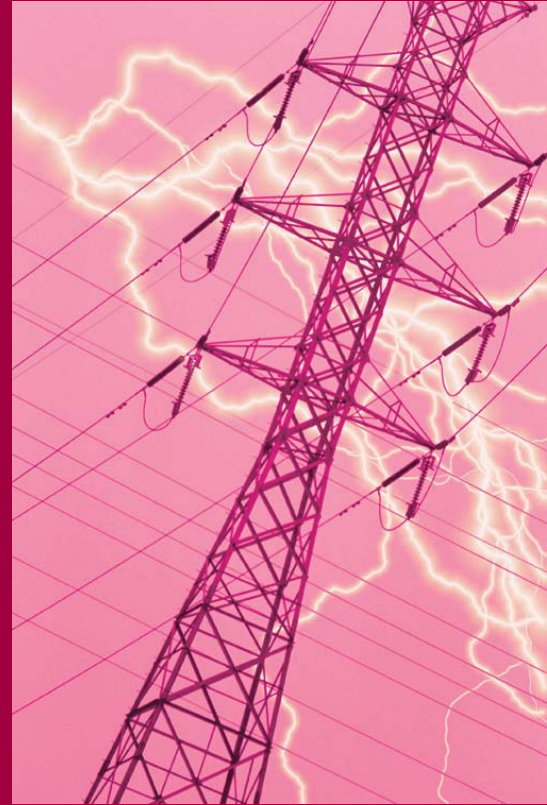


The Workforce Needs of the New Jersey Energy Industry



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January 2009

Executive Summary

The Workforce Needs of the New Jersey Energy Industry is a report by the John J. Heldrich Center for Workforce Development at Rutgers, The State University of New Jersey. It proposes the:

- Creation of a joint energy workforce strategy that New Jersey utilities, educators, government agencies, and non-profit organizations can use to increase the number of qualified applicants for high-demand energy sector jobs statewide; and
- Expansion of statewide utility partnerships encompassing high schools, vocational-technical schools, four-year colleges, distance and e-learning options, and pre-apprenticeship models.

In 2007-2008, interviews were conducted on the utility sector's current and projected workforce needs with key executives at four New Jersey energy companies: Atlantic City Electric, New Jersey Resources, Public Service Enterprise Group, and South Jersey Industries.

The Heldrich Center gratefully acknowledges the sponsorship of this report by these companies. The Heldrich Center, however, takes sole responsibility for the study's findings, conclusions, and recommendations.

Special attention was placed on critical jobs where the largest number of openings is projected to occur and where employers report the greatest difficulty in attracting and retaining qualified candidates.

The New Jersey utilities reported difficulty recruiting and retaining qualified workers in several important job categories, due largely to **retirements by veteran employees** and an

inability to attract enough younger job applicants with critical basic skills. Other factors driving demand included **turnover** by employees who fail once hired and **expansion of new services.**

Obstacles to creating a reliable "pipeline" of new talent for New Jersey utilities included entry-level job seekers with:

- Inadequate basic skills,
- Lack of fluency in English,
- Poor work readiness skills, and
- Lack of industry knowledge.

There was also a need for qualified applicants in specific jobs, such as customer service representatives with an understanding of energy sector services. Line workers, power plant operators, appliance service technicians and installers, relay technicians, and instrument/control process technicians were also in demand at one or more of the utilities surveyed.

The Workforce Needs of the New Jersey Energy Industry describes how changes in the energy workforce, energy technology, and state policy are reshaping the critical work skills required by the industry's key occupations. Among the findings:

- New Jersey's energy utility workforce is aging, becoming more diverse, and providing energy services with fewer employees;
- Energy technology trends will require New Jersey's utility workers to service a wide range of renewable and non-renewable power options;

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- The rising interest in “green” technology, and new state energy policies, will lead to the creation of more jobs specializing in energy efficiency and renewable energy;
- All energy sector workers must embrace a number of common “foundation” skills, regardless of their specific occupation; and
- Beyond the need to strengthen workers’ common foundation skills, New Jersey energy utilities are struggling to recruit and retain qualified workers with skills in specific sector jobs.

Green jobs in renewable energy and energy efficiency are generating special interest among government and business leaders. *The Workforce Needs of the New Jersey Energy Industry* serves as a companion to the Helldrich Center’s report, *Green Jobs in New Jersey’s Energy Sector*, prepared for the State Employment and Training Commission.

New Jersey energy utility employers can increase the supply of qualified candidates for its high-demand jobs by jointly adopting an action strategy to train more customer ser-

vice representatives and candidates for other high-demand jobs. A central step would be to examine model programs nationwide that could be adapted as part of an overall plan to generate qualified candidates for the New Jersey utility industry’s hard-to-fill occupations.

Recommendations for implementing an industry-wide workforce strategy include:

- Expanding utility training partnerships with New Jersey vocational-technical high schools and colleges;
- Exploring expanded opportunities for apprenticeship and pre-apprenticeship training;
- Exploring industry-wide initiatives to create new curriculum and training options in the state; and
- Using technology to train new job applicants or incumbent workers.

Introduction

Purpose of the Report

The Workforce Needs of the New Jersey Energy Industry is the latest and most detailed examination of the New Jersey energy sector's workforce needs by the John J. Heldrich Center for Workforce Development at Rutgers, The State University of New Jersey.

This report seeks to facilitate the creation of a single energy workforce strategy that New Jersey utilities, educators, government agencies, and non-profit organizations can use jointly to increase the number of qualified applicants for high-demand energy sector jobs. It also encourages the statewide expansion of industry partnerships to encompass high schools, vocational-technical schools, four-year colleges, distance and e-learning options, and pre-apprenticeship programs.

The primary goals of this report are to:

- Identify the factors driving the current and short-term future demand for workers in New Jersey's energy sector, with a focus on the specific skills, abilities, and educational requirements of selected occupations.
- Identify model programs nationwide that New Jersey educational and training institutions can adopt to meet expected demand for energy sector workers.
- Recommend steps to develop a New Jersey energy sector workforce strategy that state and local governments, educational institutions, and industry employers can use to prepare residents for energy jobs.

This report describes the sector's critical workforce challenges and priorities, and presents detailed information on the skill requirements of selected occupations. Once

the report is reviewed and approved by the project sponsors, copies will be distributed throughout New Jersey to secondary and postsecondary educators and state government policymakers.

Heldrich Center Energy Workforce Research to Date

Since its founding in 1997, the Heldrich Center has been engaged in conducting and disseminating research on the workforce needs of energy utilities in New Jersey and nationwide. In 2004, the Heldrich Center examined the skill and education requirements of the New Jersey utilities industry in detail, as part of an initiative called *Ready for the Job*. This initiative, funded by the State Employment and Training Commission, combined labor market data with in-depth interviews and focus groups involving top managers at leading energy companies.

The *Ready for the Job* utility sector profile identified high-demand jobs that would require qualified candidates in the next three to five years. The project also documented the industry-specific skills that job seekers must have to successfully fill those job openings.

High-demand jobs included:

- First- and Second-Line Supervisors
- Managers of Mechanics, Installers, and Repairers
- Line Workers (power line service)
- Customer Service Representatives (including call center clerks, bilingual staff)
- Engineers (electrical, mechanical, civil)
- Power Mechanics/Mechanics at Substations
- Plant Operators
- Instrumentation and Control/Relay Technicians

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Critical utility skills ranged from technical literacy, computer literacy, and bilingual speaking ability to coding procedures, math knowledge, and diversity training.

The *Ready for the Job* report on the New Jersey utilities industry was disseminated widely, and is available online at www.heldrich.rutgers.edu.¹

Since 2004, the Heldrich Center has collaborated with various energy companies and utility organizations to present findings from its workforce development studies. Center staff have participated in both conference and planning sessions for the following groups:

- **The Center for Energy Workforce Development (CEWD)**, a consortium of U.S. energy utilities and associations based in Washington, D.C., is developing solutions to the energy sector's workforce challenges.
- **Electric Power Research Institute (EPRI)** is a non-profit organization that conducts research and development on technology, operations, and the environment for the global electric power sector. EPRI's members represent more than 90% of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, CA, Charlotte, NC, Knoxville, TN, and Lenox, MA.
- **EUCI (Electric Utility Consultants, Inc.)** of Denver, CO, is a leading provider of conferences, seminars, workshops, and courses designed exclusively for the energy industry. Its events address critical areas such as fossil, renewable, and nuclear power generation, power delivery and end use, and the environment.
- **Gulf Power Economic Symposium** is an annual economic development forum in northwestern Florida hosted by Gulf Power Company, an electric utility subsidiary of the Southern Company of Atlanta, GA.
- **The New Jersey Utilities Association (NJUA)**, a trade association based in Trenton, NJ, represents 16 investor-owned companies providing the state's electric, natural gas, telecommunications, water, and sewerage services.
- **Utility Business Education Coalition (UBEC)** was a nationwide partnership of more than 50 leading energy utilities that developed business-education partnerships for training skilled industry workers prior to the establishment of the Center for Energy Workforce Development in 2006.

In September 2007, Heldrich Center Director Dr. Carl Van Horn led members of the National Council on Competitiveness in a discussion of trends and technologies that are reshaping the energy sector workforce. The Council's Energy Security, Innovation, and Sustainability Initiative is examining private-sector demand for sustainable energy solutions and supporting the creation of new industries, markets, and jobs. Participants in this event included leading corporate chief executive officers, university presidents, and labor leaders.²

It was also in 2007 that the Heldrich Center began an in-depth study of the New Jersey energy sector's specific skill needs — *The Workforce Needs of the New Jersey Energy Industry* — to update its earlier utility research. The project examined industry data at the state and national level, and interviewed utility executives on possible strategies for meeting their demand for qualified workers. The interview process is described in Appendices A and B.

Profiles of the Client Companies

Research for this report was conducted in 2007 and 2008 with the support of a consortium of New Jersey energy utilities comprised of New Jersey Resources, Public Service Enterprise Group (PSEG), South Jersey Industries, and Atlantic City Electric Company.

New Jersey Resources

New Jersey Resources (NJR) is a Fortune 1,000 company providing retail and wholesale energy services to customers in New Jersey, Canada, and selected states in the eastern United States. Its subsidiaries include:

- **New Jersey Natural Gas**, its principal subsidiary, serves more than 482,000 customers in Middlesex, Monmouth, Morris, and Ocean counties.
- **The NJR Service Corporation** provides NJR subsidiaries with shared support services including communications, financial, administrative, auditing, legal, and technological expertise in central and northern New Jersey.
- **NJR Energy Services** provides wholesale energy services and management of natural gas storage and capacity assets. Services include natural gas supply and pipeline capacity, as well as storage management in the Gulf Coast, Appalachia, Mid-Continent, and Canada.
- **NJR Home Services** offers retail customers heating, air conditioning, and appliance services. Home appliance service, sales, and installations are provided to customers in Middlesex, Monmouth, Morris, and Ocean counties. NJR technicians install, service, and repair natural gas furnaces, hot water heaters, grills, outdoor lights, and electric central air conditioning equipment.³

In 2007, NJR was the first business to commit to Governor Jon Corzine's goal of reducing carbon emissions in New Jersey by 20% by the year 2020. The company's 800 employees will pursue significant reductions in its own emissions by converting its fleet to hybrid and dual-fuel vehicles, improving the energy-efficiency of NJR facilities, purchasing 100% of its electricity through the state's CleanPower Choice program, and investing in efforts to plant more trees statewide.⁴

Public Service Enterprise Group

PSEG is a diversified energy firm headquartered in New Jersey, and one of the 10 largest electric companies in the United States. It has annual revenues of nearly \$13 billion and employs 10,500 workers.⁵ Its principal subsidiaries are:

- **Public Service Electric and Gas Company** engages in the transmission and distribution of gas and electricity to nearly three quarters of New Jersey's population: 2.1 million electric customers and 1.7 million natural gas customers.⁶ Other products and services include appliance repair, business relocation assistance programs, and energy conservation programs.
- **PSEG Power** is a major supplier of electric energy in northeastern and mid-Atlantic states, with three main subsidiaries: PSEG Fossil, PSEG Nuclear, and PSEG Energy Resources and Trade.
- **PSEG Energy Holdings** manages financial investments in the energy industry.

PSEG supports cleaner and renewable energy options through New Jersey's CleanPower Choice Program, and offers businesses special hourly rates based on time of day.⁷ PSEG Energy Holdings also created a new company in 2008 to explore compressed air storage as a means of sustaining wind power sources whenever natural winds subside.⁸

South Jersey Industries

South Jersey Industries (SJI) provides energy-related services and products through its South Jersey Gas utility and its unregulated businesses. SJI businesses generated \$950 million in revenues in 2007 and employed 600 workers.⁹

South Jersey Gas, one of the fastest growing natural gas utilities in the nation, serves 335,000 residential, commercial, and industrial customers in 112 municipalities

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spanning over 2,500 square miles (one-third of the geographic area of New Jersey). The service area includes all of Atlantic, Cape May, Cumberland, and Salem counties, and parts of Burlington, Camden, and Gloucester counties. More than 90% of its customer base is residential.¹⁰

SJI's unregulated businesses include:

- **South Jersey Energy** acquires and markets natural gas and electricity for retail customers throughout New Jersey and also provides businesses with energy services to reduce their energy costs.
- **South Jersey Resources Group** provides wholesale commodity marketing and risk management services in the mid-Atlantic region.
- **South Jersey Energy Service Plus** installs, maintains, and services heating, air conditioning, and water heating systems. It also services appliances, provides solar installation, and conducts energy audits.
- **Marina Energy** develops and operates on-site, energy-related projects including thermal facilities serving hot and chilled water for casinos and landfill gas-to-electricity facilities.

Energy efficiency is a top corporate goal, and the Conservation Incentive Program rewards customers who purchase energy-efficient equipment and make other energy-saving investments. SJI companies are undertaking several major projects in Las Vegas and Atlantic City that will incorporate new “green” technology into large-scale casino expansion projects.¹¹

Atlantic City Electric

Atlantic City Electric, a subsidiary of Pepco Holdings, Inc. is a regulated electric utility providing transmission and distribution services to more than 540,000 homes and businesses in a 2,700 square-mile area comprising eight counties in southern New Jersey. The company employed 1,150 workers in 2007.¹²

Recognizing the impact of rising energy costs for consumers, the parent company of Atlantic City Electric — Pepco Holdings, Inc. — hosted more than 150 social service agency representatives from the mid-Atlantic region in October 2007. The summit gave service providers information and tools to better assist low-income electricity customers, many of whom have difficulty paying their energy bills.¹³

Findings: New Jersey's Energy Workforce Needs

The Changing Energy Sector Workforce

New Jersey's energy sector is facing a number of workforce challenges, including an aging workforce, lack of qualified applicants, and new-hire training issues.

Finding #1: New Jersey's energy utility workforce is aging, becoming more diverse, and providing energy services with fewer employees.

All across the United States, electric and natural gas utilities are experiencing significant changes in the profile of their 550,000-member workforce. Within five years, up to **half** of the skilled utility employees will be eligible to retire. More than 30,000 technicians and a similar number of line workers will be needed to replace employees from the "Baby Boom" generation whose 78-million members were born between 1946 and 1964.¹⁴

The utilities are already feeling the effects of the aging workforce; in 2008, workers age 45 and higher will rise to 40% of the nation's labor force.¹⁵ The challenge is to place enough qualified workers alongside older workers before they retire, in order to capture as much critical inside knowledge as possible.

Finding qualified young recruits has grown more difficult as vocational and technical school enrollment has fallen nationwide, and entry-level education requirements have risen. Shortages have been aggravated further as job seekers increasingly avoid jobs that are physically demanding and involve shift work, such as utility work.¹⁶

The challenge of mentoring a new generation of utility workers before more veteran employees retire is made greater by the sector's inability to recruit enough qualified young trainees. The generation gap that must be bridged to preserve important institutional knowledge among utility workers may be accompanied by differences in race, ethnicity, and gender, and by the increase in more diverse religious backgrounds as a result of the hiring of more foreign-born workers. Minority groups and women will play a much larger role in the future workforce. For example, 67% of the New Jersey students participating in PSEG utility technology degree programs are minorities.¹⁷

In New Jersey, the energy sector workforce is not simply aging and becoming increasingly diverse, it is also shrinking. Between December 2002 and December 2007, the number of employees engaged in power generation and supply statewide fell nearly 17% from 9,028 to 7,528 while the number of natural gas workers dropped 10% from 4,103 to 3,694.¹⁸ As a consequence, future workers in this sector must be more productive in order to service growing energy demand with fewer colleagues to provide support.

The Impact of Energy Sector Technology and State Energy Policy

Growth in energy usage, and public policies targeting transformative climate change, are two factors affecting the size and skill needs of New Jersey's energy workforce.

The loss of veteran energy sector talent will hit New Jersey as America's demand for energy continues to rise, driven in part by expanded use of business and consumer tech-

nology — from laptop computers and high-tech manufacturing equipment to phones and video games. The U.S. Energy Information Administration (EIA) predicts nationwide demand for electricity will grow 30% to 40% by the year 2030.¹⁹ The EIA 2008 annual outlook called that increase in U.S. electricity consumption the equivalent of adding 13 New York metro areas to the nation's power grid.²⁰

Natural gas, meanwhile, represents 25% of all the energy consumed nationwide. Both gas and electric employers expect to feel the impact of widespread retirements before other industry sectors are affected.²¹

Finding #2: Energy technology trends will compel New Jersey's utility workers to service a wide range of renewable and non-renewable power options.

The next generation of skilled utility workers recruited in the next five years will enter a sector that is being transformed by new energy technologies. The Electric Power Research Institute (EPRI), for example, projects that aggressively pursuing a range of wind, hydro, and nuclear power options — while capturing and storing some coal-generated CO₂ emissions — can create an electric supply that is largely CO₂-free by the year 2050.²²

The EPRI analysis, known as the PRISM analysis, assumes that economy-wide emissions are held at 2010 levels until the year 2020 after which releases fall by 3% each year. It embraces a full portfolio of energy options that would limit total electric price increases to 45% through 2050 — compared to a 260% price hike that results by pursuing only a limited number of energy sources.²³

If implemented, EPRI's full portfolio would significantly alter the 2007 mix of sources for U.S. electricity generation within 20 years. For example, by the year 2030, nuclear power's contribution to total electric output would rise from 21% to 29%, non-hydro renewable sources would increase from 2% to 9%, and new methods of capturing coal carbon emissions would reduce traditional coal power generation from 51% to 39%.²⁴

Finding #3: The rising interest in "green" technology, and new state energy policies, will create more jobs focused on energy efficiency and renewable energy.

Green jobs in renewable energy and energy efficiency are generating great interest among government and business leaders. On the demand side, technology advancements in the areas of energy efficiency, conservation, and demand response require a multi-skilled workforce. On the supply side, green generation, or the shift from conventional fuels like coal and oil, to renewable fuels, such as wind and solar, is increasing as the cost of green technology falls and the price of traditional fuels rise.

Several important state policies recently introduced or enacted are shaping the number and types of green jobs in the state. New Jersey's Energy Master Plan and participation in the Regional Greenhouse Gas Initiative include ambitious plans for energy conservation and low-/zero-carbon central station power generation. The Governor's Executive Order 54 would reduce emissions to 1990 levels, a reduction of 46 million tons of CO₂ annually by 2020.²⁵ New Jersey also seeks to reduce demand for electricity and non-electric heat by 20% and to generate 30% of its electricity from renewable resources by 2020.²⁶

The Heldrich Center's report, *Green Jobs in New Jersey's Energy Sector*, prepared for the State Employment and Training Commission, outlines the types of occupations and skills needed in the clean energy sector. The report can be found online at www.heldrich.rutgers.edu.

A New Generation of High-Demand Energy Skills

The combined impact of a loss of veteran energy workers, a lack of qualified replacement workers, new state energy policies, and ongoing technology advances are compelling New Jersey's reduced utility workforce to become more productive in the face of growing demand for gas and electricity statewide.

Many workers will be expected to strengthen and expand their skills.

According to the New Jersey utility managers interviewed for this study, their difficulty recruiting and retaining qualified workers in these important job categories is due largely to **retirements by veteran employees** and **an inability to attract enough younger job applicants with critical basic skills**. Other factors driving demand include **turnover** by employees who fail once hired and **expansion of new services**.

New Jersey's energy sector managers have concluded that more must be done to strengthen the common "basic skill" capacities of all utility workers, while addressing the specific skill requirements of selected high-demand occupations. Technical staff will be required to understand not only traditional power sources but a new generation of alternative energy sources as well. Workers in less technical positions, such as customer service representatives, will also need to understand and be able to communicate the differences between a wider array of utility products and services.

The importance of basic skill competencies is reflected in the specific workforce concerns identified by New Jersey's gas and electric utilities:

- A lack of basic skills, such as math, among job seekers attempting to pass utility pre-employment tests;
- An inability among certain applicants and incumbent workers to speak and understand English in a safety-sensitive position;
- Applicants who lack work-readiness skills and good work ethic; and
- Inadequate knowledge of current energy career options, particularly those careers that do not require a four-year college degree.²⁷

The concern over basic skills is not limited to New Jersey. Energy companies throughout the United States are working to redefine their core skill requirements through nationwide initiatives, such as the sector's Center for Energy Workforce Development. In recent years, CEWD member utilities have worked together to outline a framework of competencies, from entry-level occupations up through the most advanced specialists in the gas and electric industries. The complete "Framework of Competencies for the Energy Generation, Transmission, and Distribution Industry" is listed in Appendix C.

Finding #4: All energy sector workers must embrace a number of common "foundation" skills, regardless of their specific occupation.

The first three tiers of CEWD's five-tier framework detail a set of skills that all utilities expect from even their entry-level employees. Mastering these competencies — in personal effectiveness, academic skills, and workplace preparedness — is an essential step for any worker hoping to move up into better-paying technical jobs.

Tier 1-Personal Effectiveness calls for:

- Interpersonal skills, involving respect for others and ability to communicate;
- Integrity, demonstrating fair and ethical behavior on the job;
- Professionalism, in temperament and appearance;
- Motivation to complete assignments;
- Dependability;
- Self-development and adaptability to change;
- Flexibility; and
- Ability to learn new tasks and processes.

Tier 2-Academic Skills emphasizes:

- Math,
- Reading,
- Writing clearly,
- Listening carefully,
- Speaking English coherently,
- Basic engineering and technology, and
- Critical and analytic thinking.

Tier 3-Workplace Preparedness stresses:

- Business fundamentals, including understanding role in the organization;
- Teamwork;
- Following directions;
- Scheduling and prioritizing tasks;
- Decision-making and problem-solving; and
- Mastering basic tools and technology.²⁸

Finding #5: Beyond the need to strengthen workers' foundation skills, New Jersey energy utilities are struggling to recruit and retain qualified workers with skills in specific sector jobs.

In 2007-2008, the Heldrich Center interviewed top managers at New Jersey Resources, South Jersey Industries, PSEG, and Atlantic City Electric to identify specific occupations where qualified candidates are in greatest demand, and their related skill requirements. The skill needs associated with these high-demand jobs can give New Jersey policymakers and educators a clearer indication of which additional education and training programs are needed statewide.

Customer service representatives and plant operators and dispatchers are sought by gas and electric utilities statewide. **Relay technicians** at electric utilities are also in demand throughout New Jersey.

Openings for other jobs are concentrated in specific regions of the state. **Gas appliance**

service technicians and installers are needed in central and southern New Jersey. **Electric line workers** and **substation/underground electricians** are in demand in southern New Jersey. **Power mechanics** and **skilled construction laborers** are needed in northern New Jersey.²⁹

Table 1 highlights the number of New Jersey workers engaged in a number of these key occupations in 2006, when the total gas and electric workforce was just over 12,000 employees statewide. Line workers represented 13% of the energy sector workforce, plant operators and dispatchers were 7%, customer service representatives were 5%, relay technicians were 4.5%, and home appliance repair employees were less than 1%.³⁰

The Heldrich Center interviews placed special emphasis on the specific skill requirements of the jobs frequently cited by industry executives in New Jersey as being the most difficult to fill in the next few years. The following occupation profiles summarize the critical tasks that successful job applicants must be able to perform.

Customer Service Representatives

Utility customer service representatives (CSRs) are a high-demand occupation at three of the four companies participating in this study. According to the employers surveyed, demand for CSRs is due in part to normal retirements, but also to the high turnover common to customer service representative jobs in many industries. Demand for CSRs in New Jersey is also driven by growth of a utility's service territory, the addition of new services, and changing industry regulations, all of which can result in increased phone volume and the need for additional CSR staff.

The New Jersey utilities reported that it is difficult to find CSRs who have relevant experience and in-depth knowledge of utility companies. Successful applicants must also demonstrate an ability to cope with the job's stresses.

Table 1. Key Energy Jobs in New Jersey, 2006

Industry	Title	Employment, 2006
Electric Power Generation, Transmission, and Distribution	Total, All Occupations	8,203
Natural Gas Distribution	Total, All Occupations	3,860
Total		12,063
Electric Power Generation, Transmission, and Distribution	Customer Service Representatives	150
Natural Gas Distribution	Customer Service Representatives	487
Total: Customer Service		637
Electric Power Generation, Transmission, and Distribution	Power Plant Operators	744
Natural Gas Distribution	Power Plant Operators	2
Electric Power Generation, Transmission, and Distribution	Gas Plant Operators	9
Natural Gas Distribution	Gas Plant Operators	74
Total: Plant Operators and Dispatchers		829
Electric Power Generation, Transmission, and Distribution	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	352
Natural Gas Distribution	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	51
Electric Power Generation, Transmission, and Distribution	Electrical and Electronics Repairers, Commercial and Industrial Equipment	64
Electric Power Generation, Transmission, and Distribution	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	517
Natural Gas Distribution	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	18
Total: Electric Relay Technicians		1,002
Natural Gas Distribution	Home Appliance Repairers	77
Total: Appliance Service Technicians		77
Electric Power Generation, Transmission, and Distribution	Electrical Power-Line Installers and Repairers	1,520
Natural Gas Distribution	Electrical Power-Line Installers and Repairers	49
Total: Line Workers		1,569

Source: New Jersey Department of Labor and Workforce Development, *New Jersey Utilities Employment by Occupation 2006*.

Note: Although the energy industry employed 12,063 workers in 2006, this table focuses on those jobs that are discussed in this report.

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Primary Responsibilities

The primary responsibility of a customer service representative is to provide quality customer service in a fast-paced call center environment. Key tasks associated with CSRs include:

- Receiving and investigating customer inquiries and complaints,
- Knowing how to find and direct information,
- Being able to respond both verbally and in writing,
- Referring customers to other staff as necessary,
- Setting appointments for service work,
- Electronically generating work orders,
- Contacting customers for collection of overdue payments,
- Training other customer service representatives, and
- Performing assorted clerical duties as needed.

CSRs often handle customer billing tasks, such as conducting credit reviews for new accounts and accepting customer payments. They need specific knowledge about company policies, rates, tariffs, and service options to answer customer questions. They must also be able to remain focused, calm, and patient while handling calls during emergency situations and service interruptions.

Educational and Other Requirements

The preferred qualifications for the CSR job include a high school degree or equivalent, and in most cases, a minimum of two to three years of customer service experience in a call center or other high customer contact environment. One employer noted that additional education beyond high school **does not** necessarily improve the prospects for success

on the job. Prior work experience is valued, especially if it shows an ability to perform in a stressful, high-volume call environment.

Candidates are generally required to pass the Edison Electric Institute (EEI) customer service representative pre-employment test. The four-hour test includes a job skills section that assesses the accuracy and speed of a candidate in entering text using an electronic keyboard. The test simulates customer phone calls regarding orders for new service or service changes, and inquiries about power outages and billing. A second part of the test is interactive, with conversations between the test-taker and a “live” customer. The candidate must demonstrate professionalism and efficiency in handling calls as well as an ability to listen carefully, solve problems, perform calculations, and communicate with the customer.

Candidates must have good customer service skills, oral and written communications skills, and organizational skills. Keyboarding and computer skills (including the ability to use programs such as Microsoft Excel and Word, SAP System) are especially important.

Customer service representatives must be able to multitask in a fast-paced environment. CSRs also must exercise analytical ability and use good judgment in responding to customers’ concerns. The ability to interact patiently, politely, and diplomatically with customers is particularly important. They may need to work overtime in emergencies. Being bilingual is increasingly a plus.

Technology upgrades — such as new phone and customer information systems — add to the complexity of the job, but these improvements ultimately make it easier for CSRs to find and distribute information.

Employer Recruitment and Hiring Challenges

- Some job candidates have difficulty passing the EEI customer service representative test. Even experienced candidates may not type fast enough to pass the keyboarding sections of the test. On the

other hand, candidates who demonstrate the required typing skills may lack experience with other aspects of the job.

- Across the board, employers interviewed said they prefer candidates with experience and in particular, those with utility-specific knowledge such as tariffs, procedures, and scheduling. In the highly regulated energy industry, CSRs also must stay current as regulations change. It is a challenge to find applicants with a broad enough understanding of the entire utility to respond to calls. (An appliance service person, by contrast, does not need to know the whole range of services a company offers — just how to fix a specific appliance.) One employer interviewed said its best source for new CSR candidates is another utility company.
- As with CSRs in all industries, turnover is an extensive problem. One utility has newly hired CSRs go through six to eight weeks of training to ensure that they understand the business, and how to find information on the company's system. Another employer conducts 16 weeks of training spread out over two years. One firm's CSR jobs are a union progression that takes new hires two years to complete; the company does not consider CSRs experienced until they have completed those two years.
- Turnover remains a problem even for longer term employees. Some workers see the CSR position as a way to "get a foot in the door" at the company, not as an end in itself. Many candidates often lack an adequate understanding of the position's requirements. As Andy Morris of New Jersey Resources observed, "People come in and say they love doing customer service. If you're at a credit card company or doing sales, it's very different. Here, you need a lot of information, and you're in a pressure situation, which can include emergency phone calls and high-volume periods. If there's an outage somewhere, it may not necessarily be an emergency but there will be a peak in stressful calls. There are also bill complaints. It's not an easy job."
- Finding candidates who can handle the stress level associated with CSR jobs is a key employer concern. One employer said it was not the basic skills that new recruits were lacking but rather the **ap-titude** to handle pressure, which can be difficult to gauge in advance of hiring. Another employer noted that one phone call after another with angry customers can be extremely stressful. Overall, employers said it was difficult to effectively screen candidates for their ability to handle stress.
- Utility employers face competition with other area employers and call centers that also need customer service representatives; some of these other jobs involve less stress including fewer emergency situations, and require less detailed technical knowledge than utilities customer service. (On the other hand, one employer noted that utility companies tend to pay better than other call centers.)
- New strategies are needed to improve hiring and retention, such as the development of improved screening techniques and benchmarking of skills. Both the amount of information a CSR must know and the amount of technology involved are expected to increase with time.³¹

Current Recruitment Efforts

Outreach to applicants for CSR positions has been through traditional print ads in newspapers and trade journals, as well as through company websites. Local schools and colleges are also made aware of these openings. One company will soon be using an outside firm to give aptitude testing on both hard and soft skills. At the same time, the company will be doing in-house testing and evaluating of successful current CSRs to see if they can develop their own benchmarks and indicators of what leads to success.

Plant Operators and Dispatchers

Power plant operators and gas plant operators control and repair machinery for power generation, and regulate the flow and pressure of

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gas to heating and steam generating equipment. They take the lead in safety training, and maintain processes at required levels. There may be upwards of 50 to 100 systems that need to be monitored in a power plant.

Primary Responsibilities

Electric power plant operators maintain and repair distribution machinery with hand tools and testing devices. Gas plant operators adjust the temperature, pressure, vacuum, level, flow, and transfer rate of gas. Both require the ability to observe and to analyze information in order to avoid or address problems in power distribution. Detailed data work is a significant part of the job.

Power plant operators control and monitor boilers, turbines, generators, and auxiliary equipment in power-generating plants. Operators distribute power demands among generators, combine the current from several generators, and monitor instruments to maintain voltage and regulate electricity flows from the plant. When power requirements change, these workers start or stop generators, and connect or disconnect them from circuits. They often use computers to keep records of switching operations and loads on generators, lines, and transformers. Operators also may use computers to prepare reports of unusual incidents, malfunctioning equipment, or maintenance performed during their shift.

Electric power distributors and dispatchers (also called load dispatchers) control the flow of electricity through transmission lines to industrial plants and substations that supply residences. They monitor and operate current converters, voltage transformers, and circuit breakers. Dispatchers also monitor other distribution equipment, and record the status of transmission circuits and connections with substations and industrial plants.

Dispatchers also anticipate power needs, such as those caused by changes in the weather. They call control room operators to start or stop boilers and generators in order to bring energy production into balance with

demand. Dispatchers handle emergencies such as transformer or transmission line failures, and route current around affected areas. In substations, they also operate and monitor equipment that increases or decreases voltage, and operate switchboard levers to control the flow of electricity in and out of the substations.

Key skills include keen powers of observation, attention to detail, ability to concentrate for long periods of time despite noisy conditions, and patience. Decision-making ability and good judgment under pressure are also important traits. An ability to communicate with field staff and greater use of computers are important for dispatchers.

Educational and Other Requirements

Power plant operators, dispatchers, and distributors generally need a combination of education, on-the-job training, and experience. Candidates with strong computer and technical skills are generally preferred.

Common requirements are academic knowledge sufficient to pass pre-employment tests, a state boiler operator license, and any other required certificates on the local, state, or federal levels. A New Jersey stationary engineer license is sometimes preferred, as is an EEI plant operator assessment.

Employers often seek recent high school graduates for entry-level operator, distributor, and dispatcher positions. Workers with college or vocational school degrees will have more advancement opportunities, especially in nuclear power plants. Although it is not a prerequisite, many senior reactor operators have a Bachelor's degree in engineering or the physical sciences.

Several years of training and experience are required for a worker to become a fully qualified control room operator or power plant distributor. Most workers are given periodic refresher training, especially the nuclear power plant operators. Refresher training usually is taken on plant simulators designed specifically to replicate procedures

and situations that might be encountered at the trainee's plant.

Job prospects are best for people with computer skills and a basic understanding of science and mathematics.

Employer Recruitment and Hiring Challenges

- A large number of retiring operators and dispatchers must be replaced. During the 1990s, the emphasis on cost cutting among utilities led to hiring freezes and layoffs of younger workers. The result is an aging workforce, half of which is expected to retire within the next 10 years.
- Utilities project an increased demand for energy, and electric utilities are expected to build new power plants in response to subsidies provided by the Energy Policy Act of 2005. This poses a workforce challenge for energy companies that have not built new power generation facilities for several decades; the only incumbent workers with direct experience in such major construction efforts may be close to retirement age.
- Although new power plants will require fewer workers than their older counterparts, the machinery in new plants will be more technologically complex and environmental regulations will require much closer attention to emissions, so workers will be required to have higher skill levels.
- Too few candidates for these jobs in New Jersey have the proper math and mechanical skills.³²

Current Recruitment Efforts

Internet postings are supplemented by employee referrals and union hall contacts. It is anticipated that the establishment of utility degree programs at local community colleges will increase the likelihood that these business-education partnerships will eventually serve as consistent new sources of qualified candidates.

Electric Relay Technicians

Relay technicians maintain and repair substation relay and control systems. They test relay equipment and circuits to identify malfunctions, using wiring diagrams and testing devices such as ohmmeters, voltmeters, or ammeters.

Primary Responsibilities

Relay technicians consult manuals, wiring diagrams, and engineering personnel in order to troubleshoot equipment problems. They typically open and close switches to isolate defective relays, and then perform adjustments or repairs. Setting relay boxes properly is very technical work.

Test data must be analyzed and recorded in order to diagnose malfunctions and to evaluate the effects of system modifications. The technicians must also determine whether the equipment is operating in compliance with relevant laws, regulations, or standards.

Key skills include knowledge of machines and tools, as well as arithmetic, algebra, geometry, calculus, statistics, and their applications. An awareness of safety issues is important, as is a working knowledge of engineering and physics principles. Active listening and critical thinking skills are useful as well.

Educational and Other Requirements

Relay technicians are trained through apprenticeships or vocational schools, along with related on-the-job experience. Advanced training at the Associate's or Bachelor's degree level is also possible. An electronics degree is valuable preparation, although internships and apprenticeships are just as important as time in the classroom.

An EEI technician's test must be passed. Math, problem-solving, and an ability to interpret diagrams correctly are key skills.

Employer Recruitment and Hiring Challenges

- Many applicants in New Jersey have inadequate math skills and often fail to pass the Edison Electric Institute tests on the first attempt. No more than 40% to 50% of relay technician candidates at various utilities passed the math test.³³
- Too many job candidates are also unable to pass tests of other basic communication and technology skills. In the future, mastery of English and computer literacy will be even more important than today.
- Vacancies occur too often due to retirement by veteran technicians or due to promotion to a new function.³⁴

Current Recruitment Efforts

Relay technicians require special training. One employer reported a successful effort to recruit qualified candidates who are leaving military service with a technical background. One resource is the Helmets to Hard Hats program (www.helmetstohardhats.org), which helps military personnel transition to private-sector careers.

Appliance Service Technicians

The technician category includes job titles under the generation, transmission, and distribution sides of the utilities business.

Primary Responsibilities

Appliance service technicians repair and replace parts for heating-ventilation-air conditioning (HVAC) systems as well as other major gas and electric appliances for residential customers. Candidates with a background in refrigerants, plumbing, technical school, or prior HVAC or appliance repair are preferred.

The ability to disassemble appliances and reassemble gas appliances is needed to diagnose problems and make repairs. Technicians must be able to trace electrical circuits, follow diagrams, and conduct tests with circuit testers and other equipment to locate shorts and grounds. Worn and defective parts such

as switches, bearings, transmissions, belts, gears, circuit boards, or defective wiring must be replaced properly. It is also important to record maintenance and repair work and be able to estimate the approximate cost of repair versus replacement of the appliance.

Educational and Other Requirements

Applicants must hold a valid driver's license, and have a minimum of three to five years field experience. Utilities require a high school degree or higher, with technical training in the HVAC field. Companies seek candidates with U.S. Environmental Protection Agency certification type II, universal preferred, with certification in at least one HVAC discipline (preferably two or more) from North American Technician Excellence, Inc.

Key skills workers need to perform well in this job include the ability to speak and write clearly and concisely, use computers and associated software programs, work independently or as part of a team, make decisions on job sites, handle conflict resolution, solve complicated technical problems, and improvise repairs using available parts.

Other key skills include: being able to read and understand wiring diagrams; troubleshoot various appliances regardless of make or manufacturer; use of a laptop computer; above-average customer relation skills; and ability to use test equipment such as voltmeter, ammeters, pressure gauges, etc. Safety consciousness and safe driving ability are important.

Employer Recruitment and Hiring Challenges

- The practice of recruiting HVAC employees from competitors cannot be sustained. There must be more qualified HVAC workers to fill job opportunities.
- All of the companies raised issues stemming from the lack of awareness about career opportunities in the utilities and the companies' efforts to get to career fairs and vo-tech centers and high

schools. Counselors are not educated about the opportunities either, and maintain a constant focus on college

- Training for this job will become more technical in nature as manufacturers increase the use of solid state circuit boards, variable speed motors, internet access to controls, and two-stage compressors. Federal refrigerant regulations will force additional changes.
- Facilities and courses for technical training are too few.
- Recruiting for entry-level technical positions often involves hiring the children and relatives of existing workers. The human resources representatives interviewed for this study reported a need for greater outreach, including more career fairs, more career information to distribute, and more utility courses worked into regional vo-tech curriculum. One company representative said that it may be better to recruit high school students since those in community college programs will focus on completing a college degree before seeking full-time work.³⁵

Current Recruitment Efforts

Appliance service candidates have been recruited through websites, newspaper ads, and employee referrals, as well as vocational-technical schools. PSEG has established a utility degree program through several New Jersey county colleges (Essex, Mercer, Middlesex, Passaic), which introduces young trainees to the appliance service option, among other positions. It is also exploring a new career pathway program in several high-demand positions for seniors at the Mercer and Essex county vocational-technical high schools. Trenton High School and Newark's Technology High School are also partners that are seen as potential sources of qualified candidates in the future.³⁶

Line Workers

According to the 2007 Center for Energy Workforce Development (CEWD) survey on gaps in the energy workforce pipeline, over a quarter of line workers will be eligible to retire in five years.³⁷ The U.S. Department of Energy predicts that closer to half of line workers will soon leave some organizations. Line workers fill about one-third of transmission and distribution jobs.³⁸

Primary Responsibilities

Line workers have responsibility for installation and repair of overhead and underground lines, poles, transformers, and other equipment. CEWD includes the following job titles in the line worker category: line installer, underground mechanic, underground specialist, and towerman. Safety awareness is a top concern, as the job risks include electrocution, falls, and burns. The Occupational Safety and Health Administration reports that the injury rate for line workers remains on the same level as many less hazardous professions due in large part to this emphasis on caution. An ability to climb and work at certain heights is as important as the technical skills.

Educational and Other Requirements

One of the challenges in replacing line workers is the lengthy training period required before achieving journeyman status. It typically takes five years or longer before a worker is able to work independently without supervision. Another challenge is that the work is physically demanding, which may account for why the number of line workers declines after age 47, as compared to age 52 for other job categories included in the recent CEWD survey.

Several of the New Jersey utilities interviewed indicated that they use the Edison Employment Institute pre-employment aptitude tests. George Bleazard of Pepco estimated that 80% to 85% of applicants pass the test used for linemen. Math, reading and mechanical concepts are stressed.

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Employer Recruitment and Hiring Challenges

- The U.S. Department of Energy projects a significant shortage of qualified line workers by 2010, due to retirements from this demanding position. A loss of institutional knowledge is aggravated by the lack of young trainees to learn from veteran staff prior to retirement.
- One company reported that it does not have excessive difficulty in filling entry-level positions. Becoming a line worker requires a four-year apprenticeship, followed by another two or more years to become an accomplished journeyman. This long training period makes it hard to replace people in a timely fashion.
- For overhead linemen, one company now performs two days of physical abilities testing before hiring anyone, which helps eliminate those not suited for the work. Before the screening program, the company used to lose people six months into training. Today, only one apprentice has failed to complete the program in the past

five years. Another utility did not hold its physical test at the start of screening and later found that the pass rate for people tested to climb poles was low (50%).³⁹

- Hiring experienced journeyman line workers is difficult in the view of an electric utility manager. One company said it tried to recruit equal numbers of entry-level and journeymen line workers, but the journeymen were not available. The company outsources some of the work, but there are times when contractors cannot find qualified talent either. (One employer has been able to permanently hire line workers away from outside contractors, since many employees prefer a regular job with an established utility to working for a contractor.)⁴⁰

Current Recruitment Efforts

Jersey Central Power and Light Company/First Energy has created an Associate's degree program in Electric Utility Technology at Brookdale Community College in Monmouth County that seeks to train new line workers.

Recommendations and Model Programs

The workforce problems identified by New Jersey utility managers suggest that solutions must be found at all skill levels — from the youngest trainees to upper-level technicians working with advanced energy technology. Examples of effective training programs can be found both in New Jersey and nationwide.

Key challenges in creating a reliable “pipeline” of new talent for New Jersey utilities include:

- **Inadequate basic skills.** Young job seekers lack fundamental academic knowledge in areas — such as math, science, and information technology — vital to technical jobs. Many also lack the basic verbal skills to succeed as customer service representatives.
- **Lack of fluency in English.** A significant percentage of applicants in the energy sector still require English as a Second Language training in order to communicate effectively with co-workers and to understand safety warnings and instructions.
- **Poor work readiness skills.** Many entry-level job seekers lack discipline, organizational skills, a strong work ethic, and an ability to follow directions. Too many fail company drug screening tests, fail to obtain a required driver’s license, or fail to provide documents required for employment. Others lack the flexibility needed to fill industry jobs that do not follow a standard nine-to-five schedule, or to adapt to ever-changing technology.
- **Lack of industry knowledge.** Many applicants do not have a basic understanding of the energy sector, nor of the specific job requirements of the positions for which they are applying.⁴¹

If energy sector trends nationwide affect New Jersey as expected, shortages of experienced workers will hit jobs related to power generation hardest. Technicians and power plant operators, in particular, may see higher rates of turnover as the war for talent increases within the industry.⁴²

Recommendation #1: New Jersey’s energy companies should adopt a joint energy utility action strategy for filling critical jobs in the sector.

New Jersey energy utilities have followed their industry’s nationwide example by taking a collaborative approach to solving their common workforce challenges. This coordinated strategy is one reason the gas and electric sector has made far greater progress toward creating a new talent pipeline for the future than other industries.

The New Jersey energy sector can also benefit by jointly adopting an action strategy for meeting a shared need for more customer service representatives and other high-demand jobs. A central step would be to examine model programs nationwide that could be adapted as part of an overall plan to generate qualified candidates for the New Jersey utility industry’s hard-to-fill occupations. Examples of successful utility programs are highlighted in the recommendations that follow.

Recommendation #2: Expand training partnerships with New Jersey vocational-technical high schools and colleges.

Many energy utilities, including South Jersey Industries and PSEG, have already established ties to local vocational-technical high schools. The experience of gas and electric utilities nationwide, however, suggests that reaching out to students in high school or earlier is a worthwhile way to build career interest in the energy industry.

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Managers interviewed for this study cited the example of the Southern Company's acclaimed Gulf Power Academy in Florida. Its program is located directly inside Pensacola's West Florida High School for Advanced Technology. It uses a small school environment to combine traditional secondary school subjects with utility-specific technical training and work-readiness skills including ethics. Qualified graduates in industrial electricity have the opportunity to join Gulf Power as a full-time employee.

At the community college level, PSEG has played the lead role in establishing energy utility technology degree programs in Essex, Mercer, Middlesex, and Passaic counties. The two-year program combines classroom training with hands-on technical apprentice level training. Students work toward earning an Associate's degree in applied sciences, and qualified graduates are offered positions at PSE&G.

Brookdale Community College in Monmouth County and Raritan Valley Community College in Somerset County have programs as well, with input from JCP&L/First Energy. Brookdale's Power Systems Institute, for

example, combines general courses (in math, communications, and computer literacy) with technical courses (such as electrical system design) and a paid 14-week field experience over the summer.⁴³

These programs are natural building blocks for an extended statewide training network aimed at a wider range of high-demand energy sector jobs. A statewide coalition has achieved progress of this kind through a variety of institutions in Washington State. Their efforts have already gained a national reputation for the broad range of industry-specific programs now offered in support of the energy utility sector.

The energy sector can also consider creating accelerated training programs similar to those established by other New Jersey industries. Working with state and local schools, employers seek to move students more quickly from high school to a full-time job. Known as "articulation agreements," the accelerated education programs enable schools and colleges to reduce the training time for students by offering joint recognition for a shared core curriculum.

Started in 2001, Gulf Power Academy is a three-year curriculum — including traditional high school academic courses — that prepares students for a career in the electric utility industry. The program has given Gulf Power a pool of well-educated, well-trained job candidates who understand the nature of utility industry work to help meet their critical workforce needs.

Beginning in the 10th grade, students spend 90 minutes a day on the basic concepts of a vertically integrated electric utility through Gulf Power guest instructors and field trips to Gulf Power facilities. During junior year, students are matched in a one-on-one mentoring relationship with a Gulf Power employee in a career of interest to students. In senior year, students work toward acceptance into the ACE (Advanced Career Experience) Program where they report to Gulf Power work locations on alternating days.

Students are tested on the Edison Electric Institute pre-employment tests during their senior year and become eligible for 15 hours of "articulation credit" toward the Engineering Electronics Technology A.A.S. degree at nearby Pensacola Junior College. There is no commitment on Gulf Power's part to hire graduates, and students are not forced to make a decision about education following high school until they near graduation — even as they keep their employment options open.⁴⁴

Centralia College's Center of Excellence for Energy Technology offers a Power Operations Certificate of Proficiency and Customer Operations Certificates of Completion.

The **Clark College** Power Utilities Technology Certificate Program prepares students for various entry-level positions in electric utilities, firms servicing the utilities, and industrial firms using power-level electrical equipment in their operations. Clark graduates will be competitive candidates for entry-level positions such as:

- Utility Lineman Apprentice
- Utility Electrician Apprentice
- Utility Meter/Relay Technician Apprentice
- Utility Project Cost Estimator Trainee
- Utility Substation Apprentice
- Industrial Electrician Apprentice

Gonzaga University School of Engineering and Applied Science collaborated with practicing utility engineers to offer a Certificate Program in Transmission and Distribution Engineering that consists of five three-credit courses.

Seattle's **Shoreline Community College** offers a range of new renewable energy courses aimed at promoting "zero energy" buildings.⁴⁵

An example of an articulation agreement in action is provided by the health care sector, which has established an agreement in Union County that links the regional vocational-technical school, Union County College, and Rutgers University. Graduates of the vocational-technical school complete enough college credits in high school to receive their high school diploma and an Associate's degree at the same time. Rutgers University immediately grants these graduates junior year status, enabling them to complete a health-related Bachelor's of Science degree two years earlier than usual. Similar fast-track programs could be established in energy sector disciplines.

PSEG has already launched a training program that links Trenton Central High School, Mercer County Community College, and Thomas Edison State College, in order to develop the nation's first baccalaureate degree program in energy utility technology. The Bachelor's of Science degree in energy utility technology consists of 120 credits focused on applied science and technology, and complements on-the-job training at PSEG facilities. The program is designed to give students the technical knowledge, problem-solving ability, management expertise, and hands-on skills needed to design, install, evaluate, operate, and maintain utility systems for electric, gas, water, and telecommunications.⁴⁶

Throughout the United States, utility-led business-education partnerships are an avenue to recruiting qualified younger workers into the electric power industry. For example, **Pacific Gas and Electric** headquartered in San Francisco, has created an outreach program to provide training to young people for careers in the electric power industry. The Power Pathway initiative was launched in January 2008 with pilot programs in four locations in the company's service territory. The program collaborates with community colleges, workforce investment boards, community-based organizations such as Job Corps, and unions to reach, assess, train, and case manage can-

didates through the pre-employment process. Candidates undergo a 12-week unpaid training program at the local community college, where they focus on reading comprehension, math, spatial reasoning, soft skills, physical conditioning, and industry-specific technical knowledge. Interest in the program was high as over 4,300 people applied for the 100 Power Pathway training slots available.⁴⁷

In Arizona, Arizona Public Service (APS) decided that it would invest in a program to develop a qualified talent pool in-house. It acquired warehouse space for classrooms, hired retirees as instructors, gained the support of a local vocational institute and a community college, and transformed numerous high school students into highly skilled and successful entry-level electric power plant workers.

Thus far, 95% of students taking part in this program — a joint partnership between APS, Northern Arizona Vocational Institute of Technology (NAVIT) and Northland Pioneer College (NPC) — have gone on to accept jobs in the energy industry or to pursue a higher education. Over the past five years, the utilities in the area have hired 60 graduating NAVIT/NPC students as full-time workers in operations and maintenance. Many are now earning more than \$50,000 per year.⁴⁸

Similar education programs, with a special concentration on energy sector skills, could be created in areas of New Jersey that do not yet have utility degree options.

Recommendation #3: Explore expanded opportunities for apprenticeship and pre-apprenticeship training.

The number of job candidates passing the Edison Electric Institute pre-employment tests could be increased by adopting a pre-apprenticeship model that has worked for construction companies in northern New Jersey. Targeted training has helped even low-skill job seekers improve their ability to meet skill standards for entry-level positions.

An in-depth Heldrich Center evaluation of the pre-apprenticeship training program by the Newark/Essex Construction Careers Consortium (N/ECCC) showed that low-skill, low-income adult graduates earned significantly higher wages after completing the program. Managed by the New Jersey Institute for Social Justice in collaboration with over 20 community partners, N/ECCC trains low-income, minority, and female residents of the City of Newark and Essex County to obtain apprenticeships in the construction industry. It seeks to improve the employment prospects and earnings of Essex County's low-income residents.

Individuals selected as Newark/Essex trainees face significant barriers to employment. For three years prior to enrolling in the N/ECCC program, for example, no more than half of the adult participants were employed. The 10-week program provides these students with intensive academic preparation in math, reading, and critical thinking.⁴⁹ The program also offers instruction in life skills and introduces students to the building trades through hands-on work and site visits. After completing the program, graduates apply for apprenticeships with the building trades.

The New Jersey Utilities Association and its energy sector members should consider the N/ECCC model as it looks to increase the number of applicants able to pass the pre-employment tests for critical technical jobs. If N/ECCC was able to improve the performance of its highly challenged trainees, the utilities may have even greater success with its pool of applicants.⁵⁰

The need for appliance service technicians with HVAC skills might also be met by establishing a regional apprenticeship program sponsored by the Air Conditioning Contractors of America (ACCA). ACCA is exploring the development of a new program in eastern Pennsylvania and southern New Jersey that is similar to successful apprenticeship programs in other chapters nationwide. Apprenticeship HVAC programs have been successfully developed in cooperation with local schools and contractors in central Maryland,

St. Louis, MO, and western Pennsylvania. In addition, ACCA and several partner organizations have developed a new four-year HVAC textbook series that can be used by schools, chapters, and contractors for apprentices, entry-level technicians, and students.⁵¹

Apprenticeship models such as these may be adapted for use by New Jersey energy sector employers as well.

Recommendation #4: New Jersey utilities should explore industry-wide initiatives to create new curriculum and training options in the state.

Working through the New Jersey Utilities Association, interested member utilities should look to adopt some of the joint career awareness strategies undertaken by the Center for Energy Workforce Development's Southern Regional Group. In addition to publicizing CEWD's "Getting Into Energy" website for students, the regional group has worked to address common issues such as creating industry-specific education programs, on-the-job mentorship for knowledge transfer from retiring veteran staff and younger staff, and apprenticeships that advance training in the sector's key competencies.

Many New Jersey utilities already engage in outreach and career awareness through job fairs, guest speakers, site tours, guest lectures at schools and colleges, and programs to promote workforce diversity. A joint regional career awareness effort that benefits all energy employers seems to be a natural next step.⁵²

Another industry initiative in New Jersey that may serve as a workforce development model for the energy sector is provided by the region's retailers. Retail employers have benefited from the establishment of a retail skills center aimed at creating a pool of trainees prepared especially for work in that sector. Their success could serve as a guide for similar facilities statewide tailored to the specific customer service needs of the state's energy providers.

The New Jersey retail skills center in Elizabeth has provided state-of-the-art customer service training for more than 10,000 area residents. Through a comprehensive curriculum developed by a nationwide partnership of Fortune 500 employers and the National Retail Federation, the center offers free "customer-focused" sales and service customized training. Its placement services provide a reliable supply of trained staff to both large and small employers.

The center trains, certifies, and places its graduates in careers through a four- to six-week customer service and retail sales training program. Career development workshops are also provided on job search strategies, resume writing, conflict management, time management, and communication skill building. The center can also strengthen trainee resumes by offering a National Professional Certification in Customer Services, and give foreign-born trainees English as a Second Language instruction.

Retail and service employers benefit from having access to pre-screened and qualified job applicants, and job posting and recruitment help, all at no cost. More than 400 businesses have taken advantage of the center's employer programs to date.

A customized customer service representative program for the energy sector could produce job applicants with a deeper understanding of the industry's special needs. If a customer service program of this kind proved successful, the energy sector could explore the creation of a broader utility work readiness program that would raise applicant skill levels to the standards established in the Center for Energy Workforce Development's Tier 1, 2, and 3 Framework Competencies.⁵³

The oil industry also offers a training model that the energy sector could adopt. The Center for the Advancement of Process Technology (CAPT) created a standardized curriculum for workers in the refinery sector. It has helped community colleges build degree

programs around the industry course outline. CAPT was formed by companies in the Texas, Louisiana, and the Mississippi Gulf Coast region, home to the largest complex of petrochemical industries in the nation, to address an emerging shortage of process technicians. One of the first goals was to standardize the core technical components of the degree program in process technology. By 1998, all of the necessary curriculum materials were developed with the input from more than 60 major petrochemical and refining facilities, along with 23 community and technical colleges in 10 states.

To date, New Jersey utilities have developed individual internal training curricula that differ company to company. A standardized curriculum would benefit all companies by ensuring that trainees from any region in the state would have certain skills in line with any New Jersey utility's needs.⁵⁴

Recommendation #5: Use technology to train new job applicants or incumbent workers.

Internet technology is increasingly used to reach and train a larger pool of energy sector trainees. For example, prominent members of the electric utilities industry, including Pepco, Exelon, Entergy, Reliant-MidAtlantic, Florida Power & Light, and IBEW locals, have formed a training partnership called EPCE (**Energy Providers Coalition for Education**). Its goal is to provide online learning opportunities designed specifically for the utilities industry.

EPCE is administered by the Council for Adult and Experiential Learning (www.cael.org). It has developed an industry-specific, online learning program for the skilled electric utility technicians needed to run power plants now and in the future. The federal government's call to build 1,300 new power plants and the expected loss of approximately 30% of the workforce to retirement is expected to create tens of thousands of openings in the coming years.⁵⁵

EPCE courses are delivered via instructor-led, online learning. Students can access their classes from the Internet 24 hours a day, seven days a week, from home or from work. New Jersey energy utilities should review the EPCE curriculum and determine if more employees and job seekers could benefit from distance learning options of this kind.

Conclusion

New Jersey's energy employers have a wide range of options available for strengthening their talent pipeline statewide. To gain some degree of consensus on which alternatives should be pursued, the Heldrich Center encourages the industry to work with educators, community-based training providers, and state policymakers to adopt a coordinated approach to meeting the workforce needs of the vital utility sector.

The Heldrich Center recommends several steps toward developing common ground for a public/private-sector partnership that collaborates on a clear strategy for meeting the workforce needs of the important energy sector:

Step #1: Convene a 21st-century energy and green jobs workforce summit.

To facilitate an industry-wide discussion of which workforce options make sense for the New Jersey energy sector, the Heldrich Center will work with energy employer partners to host a **21-st Century Energy and Green Jobs Workforce Summit** in spring 2009. All leading industry employers will be invited to participate along with top state policymakers, educators, and union leaders. The primary focus of the summit will be to stimulate key public/private partnerships and to lay the groundwork for the development of a well-coordinated education and training infrastructure that is aligned with the industry's specific high-demand skill needs.

Step #2: Develop a workforce strategy for New Jersey's energy sector.

Energy employers should look to work in partnership with the New Jersey Departments of Labor and Workforce Development, and Education; the Commission on Higher Education; the State Employment and Training Commission; and other relevant state agencies to draft a comprehensive plan to address current and emerging energy sector workforce needs on a statewide basis. The strategy should focus on the priority energy employer workforce needs outlined in this and related reports, such as the Heldrich Center's report, *Green Jobs in New Jersey's Energy Sector*.

The purpose of the workforce strategy would be to articulate clear goals and objectives for workforce development and other education and training programs focused on addressing the skill needs of the state's energy employers. The strategy could suggest specific proposals for strengthening New Jersey's education and training programs, improving service coordination and public/private partnerships in the state, and developing new programs based on best practices used in other states, several of which are discussed in this report.

Step #3: Launch a 21st-century energy and green jobs talent network.

Using the talent network model developed for New Jersey's transportation, logistics, and distribution sector, a similar energy/green jobs talent network could involve the establishment of a voluntary collaboration of energy employers, state agencies, and workforce intermediaries, as well as education and training institutions. Key goals for the talent network could be to:

- Identify emerging workforce needs of the energy sector through ongoing employer engagement activities;
- Improve information about the workforce needs of the sector and disseminate that information to students, job seekers, job/career counselors, and job developers;

- Coordinate existing efforts to address priority industry workforce needs;
- Assist individuals who seek to obtain employment in the industry, with a focus on unemployed and underemployed individuals and on students;
- Strengthen career ladders in the sector to the benefit of employees and employers; and
- Improve incumbent worker training that enables employers to adjust to new technologies and assist employees to obtain new skills.

An energy/green jobs talent network could serve as the forum to address core workforce concerns of energy employers. Existing resources that could serve as the foundation for the network include:

- **Industry Workforce Advisory Councils (IWACs).** Originally developed and implemented by the New Jersey Department of Labor and Workforce Development, these councils bring employers together with education and training stakeholders on a periodic basis to discuss priority industry workforce needs and to obtain feedback on existing efforts. IWACs play an ongoing role in workforce activity planning and implementation through the network.
- **REDI Green Jobs Development Activities.** The New Jersey Department of Labor and Workforce Development recently awarded a grant to the Middlesex Workforce Investment Board to coordinate the green job development activities of One-Stop Career Centers, community colleges, and non-profit agencies statewide. The grant will pay for the hiring of a green jobs coordinator that will interface with employers, including ongoing management of a green jobs Industry Workforce Advisory Council for the energy sector.
- **Innovation Partnership Institutes.** The Commission on Higher Education has awarded grants to consortia of education-

al institutions to develop new curricula to address the emerging skill needs associated with green and clean energy jobs in the utility industry.

- **Existing Utility-Driven Training Programs.** The PSEG and JCP&L energy training programs at community colleges and vocational-technical schools throughout the state are a logical platform for expanding sector training into all regions of the state.
- **Existing Union-based Training Programs.** The International Brotherhood of Electrical Workers has developed a green jobs curricula for its union workers nationwide to enhance their ability to perform green jobs in the energy industry.
- **Local Green Jobs Initiatives.** Isles, a community development corporation in Trenton, and Lincoln Park, a similar organization in Newark, are launching education and training initiatives to prepare inner-city residents to perform green jobs associated with energy efficiency retrofits and other growth areas. They plan to assist energy employers seeking to upgrade the skills of their current workforce in order to perform new job tasks involving renewable energy and energy efficiency.

In addition to better coordinating existing statewide workforce development and training initiatives as noted above, the talent network could implement new initiatives based on the goals articulated in the workforce strategy. These goals may include, but are not limited to, best practices from other states, such as dedicated training centers providing access to quality hands-on training with the latest energy equipment.

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Appendix A.

Methodology and Survey Questions

Methodology

In 2007-2008, key executives at four New Jersey energy utilities were interviewed about their current and projected workforce needs: New Jersey Resources, South Jersey Industries, Public Service Enterprise Group, and Atlantic City Electric. Special attention was placed on critical jobs where the largest number of openings is projected to occur, and where employers report the greatest difficulty in attracting and retaining qualified candidates.

The interviews revealed an ongoing need for customer service representatives with specific understanding of energy sector services. Line workers, power plant operators, appliance service technicians and installers, relay technicians, and instrument/control process technicians were also in demand at one or more of the utilities surveyed.

The Heldrich Center also conducted an extended survey of workforce organizations and model programs to identify potential solutions to the critical skills needs of New Jersey's energy sector. Inquiries were made online, and through professional contacts in groups such as the Center for Energy Workforce Development and the Council for Adult and Experiential Learning.

The John J. Heldrich Center for Workforce Development gratefully acknowledges the sponsorship of this report by Atlantic City Electric, New Jersey Resources, Public Service Enterprise Group, and South Jersey Industries. The Heldrich Center, however, takes sole responsibility for the study's findings, conclusions, and recommendations.

Heldrich Center Energy Sector Occupational Survey Questions

General Job Requirements: Current and Future

1. What are the key tasks and activities associated with this job? Please provide a copy of a job description.
2. What are the educational requirements of this occupation: particular degrees, certifications, apprenticeships, on-the-job training, work experience?
3. What are the key skills workers need to perform well in this job?
4. In what ways, if any, do you predict that the skill and/or education requirements for this job will change in the next 5-10 years? What trends or other factors are driving these changes?

Occupation-specific Workforce Challenges and Causes

1. Demand for the job: Roughly how many (of this occupation) do you foresee hiring in the next year? In the next five years?
2. What is causing the demand? (retirements, expansion of services, competition with contractors who need the same positions)
3. Do new or current employees lack key skill sets, competencies, or educational credentials/preparation? If so, which ones? Basic skills? Core utility skills? Utility job-specific skills?

4. Is there a lack of awareness about the occupation and/or its requirements? Are too few people applying? Or too few qualified people?
5. Do you anticipate any additional workforce challenges in this occupation over the next 5-10 years? If so, what types of challenges do you expect to occur and why?

Existing and Potential Solutions to Workforce Challenges

1. How does your company currently find qualified workers for this occupation? Do you employ a different recruitment approach for this occupation than for others to compensate for the challenges?
2. Are there existing training programs in your area that prepare people for this position? If not, do you know of existing training programs in other areas of the state or region that would be suitable?
3. Are you involved in any special partnerships with community colleges, high schools, vo-techs, One-Stops, or other education and training providers?
4. What other company or industry-wide efforts are you aware of that attempt to address the workforce challenges you mentioned? (industry-education partnerships, industry marketing campaign, etc.)
5. In your opinion, what else can be done to address the challenges the industry is facing in this occupation, by your company? Industry? State agencies? Educational providers?

Appendix B.

Utility Management Interviews, 2007-08

South Jersey Industries

Philip Mitcheli, General Manager - Appliance Services, South Jersey Energy Service Plus
Donna Nelson-Lee, Diversity Officer, South Jersey Industries
Joseph A. Rodio, Director, Customer Service, South Jersey Gas Company
Edward Unger, General Manager - System Delivery and Control, South Jersey Gas

New Jersey Resources

Andy Morris, Manager, Employee Relations
Deborah G. Zilai, Vice President, Corporate Services

Atlantic City Electric

George A. Bleazard, PSHR Regional Business Partner, Atlantic Region, Pepco Holdings Inc.

PSEG

Lina Hollman, Outreach Specialist and Program Manager
Sally Nadler, University Relations Manager
Rosa Schmidt, Human Resource Services Manager

Appendix C.

Framework of Competencies for the Energy Generation, Transmission, and Distribution Industry

Tier 1: Personal Effectiveness

1. **Interpersonal Skills:** *Displaying skills to work with people*

- Demonstrates concern for others by being sensitive to their needs and feelings
- Shows understanding of others' behavior by demonstrating appropriate responses
- Demonstrates respect for the opinions, perspectives, customs and individual differences of others by including others in problem-solving and decision-making
- Maintains open communication with others
- Recognizes and accurately interprets the verbal and nonverbal behaviors of others
- Demonstrates flexibility and open-mindedness when dealing with a wide range of people
- Listens to and considers others' viewpoints and alters own opinion when it is appropriate

2. **Integrity:** *Displaying accepted social and work behaviors*

- Treats all in a fair and equitable manner
- Behaves ethically through responsible use of company time and property
- Reports unethical behavior demonstrated by others to supervision
- Does not steal or misuse company property or time

3. **Professionalism:** *Maintaining a professional presence and adhering to ethical standards*

- Demonstrates self-control by maintaining composure and keeping emotions in check even in difficult situations
- Maintains a professional appearance by dressing appropriately for the job and maintaining personal hygiene
- Uses professional language when speaking with supervisor, co-workers and customers
- Is free from substance abuse
- Maintains a positive attitude
- Takes pride in one's work and the work of the organization

4. **Motivation:** *Demonstrating a commitment to effective job performance*

- Ensures that job is done accurately, completely and safely
- Identifies new and better processes or procedures
- Follows instructions and direction from supervisor and co-workers
- Takes responsibility for completing one's own work assignment

5. **Dependability/Reliability:** *Displaying responsible behaviors at work*

- Comes to work when scheduled and on time
- Complies with company policies
- Does not attend to personal business while on the job

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- Manages stressful situations effectively
 - Fulfills obligations of the job
- 6. Self-Development:** *Demonstrating a commitment to self-development and improvement*
- Identifies goals and career interests
 - Demonstrates an interest in learning
 - Seeks opportunities to learn new skills and tasks
 - Participates in training to learn new skills and to refine current skills
 - Adapts quickly to changes in process or technology
 - Accepts help from supervisors and co-workers
- 7. Flexibility and Adaptability:** *Adjusting to changing work requirements*
- Adjusts to changing priorities
 - Identifies logical stopping points in work
 - Refocuses attention to new assignment quickly
 - Quickly learns new assignments
 - Shifts gears and changes direction when working on multiple projects
 - Anticipates and accepts changes in work
- 8. Ability to Learn:** *Incorporating classroom and on the job training into work requirements*
- Uses material taught in classroom and on the job training in work situations
 - Applies information provided in training to work tasks
 - Is able to learn new assignments, procedures and technologies
- Takes measurement of time, temperature, distance, length, width, height, perimeter, etc.
 - Correctly converts from one measurement to another
 - Translates practical problems into useful mathematical expressions and uses appropriate mathematical formulas and techniques
 - Solves simple algebraic equations
 - Is able to determine slope, midpoint, and distance
 - Calculates perimeters, areas and volumes of basic shapes and solids
 - Reads, tracks, and calculates gauge measurements

2. Locating, Reading and Using Information: *Knowing how to find information and identifying essential information*

- Sorts through distracting information
- Scans written material for subject of interest
- Is able to identify main ideas in written material
- Correctly interprets written material
- Integrates what is learned from written materials with prior knowledge
- Applies what is learned from the written material to complete specific tasks
- Draws conclusions based on one or more related graphic

3. Writing: *Using standard business English to write messages to co-workers and reports to managers and associates*

- Creates documents such as work orders or memos
- Uses standard syntax and sentence structure, correct spelling, punctuation and capitalization and appropriate grammar
- Writes clearly and concisely in a professional and courteous manner
- Writes effectively for a variety of audiences
- Communicates thoughts, ideas, information which may contain technical material in a logical, organized and coherent manner

Tier 2: Academic Competencies

- 1. Mathematics:** *Using mathematics to solve problems*
- Adds, subtracts, multiplies and divides with whole numbers, fractions, decimals and percents; calculates averages, ratios, proportions and rates

- Clearly develops ideas and elaborates on them with relevant supporting examples and specific details
 - Shows insight, perception and depth in writing
- 4. Listening:** *Listening carefully in order to incorporate information into work activities*
- Listens carefully to others
 - Correctly interprets information provided by others
 - Is able to incorporate information into actions
- 5. Speaking:** *Communicating in spoken English well enough to be understood by supervisors, co-workers and customers*
- Uses standard sentence structure and appropriate grammar
 - Speaks clearly, in precise language and in a logical organized and coherent manner
 - Keeps language simple and appropriate for the audience's level of knowledge of the subject
- 6. Engineering and Technology:** *Possessing an appropriate mastery of knowledge, techniques, skills, modern tools and advanced technology*
- Applies basic engineering principles
 - Applies the appropriate technical solution
 - Applies principles of engineering science and technology, techniques, procedures and equipment to the design and production of various goods and services
 - Applies the basics of electricity including its relationship to the nature of matter to the specific discipline
 - Identifies and selects the appropriate hand or small electric tools or diagnostic equipment for the work
 - Solves problems where a variety of mechanical, electrical, thermal or fluid faults could be the reason for the problem

- 7. Critical and Analytical Thinking:** *Using logical thought processes to analyze information and draw conclusions*
- Identifies inconsistent or missing information
 - Critically reviews, analyzes, synthesizes, compares and interprets information
 - Draws conclusions from relevant and/or missing information
 - Tests possible hypotheses to ensure the problem is correctly diagnosed and the best solution is found

Tier 3: Workplace Competencies

- 1. Business Fundamentals:** *Knowledge of business and management principles; the knowledge and skills that enable individuals to understand the relationship between own job and goals and operations of company and industry*
- Is able to articulate the organization's mission and functions and its position in the marketplace
 - Recognizes one's role in the functioning of the company
 - Applies interpersonal skills to work environment
 - Complies with applicable laws and rules governing work and reports loss, waste or theft of company property to appropriate personnel
 - Acts in the best interest of the company, community and environment
- 2. Teamwork:** *Developed capacities used to work with others*
- Accepts membership in the team
 - Identifies with the goals, norms, values and customers of the team
 - Uses a group approach to identify problems and develop solutions based on group consensus
 - Effectively communicates with all members of the team to achieve goals
 - Develops constructive and cooperative working relationships with others

- Shows sensitivity to the thoughts and opinions of others
 - Responds appropriately to positive and negative feedback
 - Encourages others to express their ideas and opinions
 - Learns from other team members
 - Applies interpersonal skills to help team achieve goals
 - Gives full attention to what others are saying, taking time to understand the points being made, asking questions as appropriate and not interrupting at inappropriate times
 - Keeps all parties informed of progress and all relevant changes to project timelines
 - Demonstrates loyalty to the team
- 3. Following Directions:** *Receiving, understanding and carrying out assignments with minimal supervision*
- Receives, interprets, understands and responds to verbal messages and other cues
 - Picks out important information in verbal messages
 - Interprets complex instructions and their relevance to the work assignment
 - Asks questions to clarify unclear directions
 - Acts upon the instruction to complete an assignment
- 4. Planning/Organizing/Scheduling:** *Demonstrating the ability to work within a schedule using prescribed procedures*
- Prioritizes various competing tasks and performs them quickly and efficiently according to their urgency
 - Finds new ways of organizing work area or planning work to accomplish work more efficiently
 - Estimates resources needed for project completion; allocates time and resources effectively
 - Anticipates obstacles to project completion and develops contingency plans to address them; takes necessary corrective action when projects go off-track
- Plans and schedules tasks so that work is completed on time
 - Makes arrangements that fulfill all requirements as efficiently and economically as possible
 - Responds to the schedules of others affected by arrangements; informs others of arrangements, giving them complete, accurate and timely information
 - Keeps track of details to ensure work is performed accurately and completely
 - Takes steps to verify all arrangements; recognizes problems, generates effective alternatives and takes corrective action
 - Effectively coordinates the transition of employees at the beginning and end of each work shift; disseminates crucial information in an organized manner to rapidly bring employees up to speed at the start of their shifts
- 5. Problem-solving/Decision-making:** *Applying problem-solving and critical-thinking skills to help grow the business and/or to resolve workplace conflict*
- Anticipates or recognizes the existence of a problem
 - Identifies the true nature of the problem by analyzing its component parts
 - Effectively uses both internal and external resources to locate and gather information; examines information obtained for relevance and completeness; recognizes important gaps in existing information and takes steps to eliminate those gaps; recalls previously learned information that is relevant to the problem; organizes information as appropriate to gain a better understanding of the problem
 - Integrates previously learned and externally obtained information to generate a variety of high quality alternative approaches to the problem; skillfully uses logic and analysis to identify the strengths and weaknesses, the costs and benefits and the short and long-term consequences of different approaches

- Skillfully uses logic and analysis to identify the strengths and weaknesses, the costs and benefits and the short and long-term consequences of different approaches
- Decisively chooses the best solution after contemplating available approaches to the problem; makes difficult decisions even in highly ambiguous or ill-defined situations; quickly chooses an effective solution without assistance when appropriate
- Commits to a solution in a timely manner and develops a realistic approach for implementing the chosen solution; observes and evaluates the outcomes of implementing the solution to assess the need for alternative approaches and to identify lessons learned
- Uses scientific rules and methods to solve problems

6. Working with Basic Hand and Power Tools and Technology: *Having capability to operate and troubleshoot electric and electronic equipment, mechanical and electrical products*

- Selects and applies appropriate tools or technological solutions to frequently encountered problems
- Carefully considers which tools or technological solutions are appropriate for a given job and consistently chooses the best tool or technological solution for the problem at hand
- Demonstrates an interest in learning about new and emerging tools and technologies; seeks out opportunities to improve knowledge of tools and technologies that may assist in streamlining work and improving productivity
- Knows how to maintain and troubleshoot tools and technologies
- Uses basic computer technology to receive work orders, report progress and maintain records

Tier 4: Industry-wide Technical Competencies

1. Industry Principles and Concepts: *Knowledge of the basic and emerging principles and concepts that impact the energy industry, including: energy production, energy transmission and alternative energy technologies*

- Is able to explain the flow of energy from generation through distribution to the customer
- Is able to explain the role of regulators and unions in the industry
- Demonstrates an awareness of alternative and renewable energy technologies, including geothermal energy, solar energy, wind energy, water energy and biofuel

2. Safety Awareness: *Compliance with the procedures necessary to ensure a safe and healthy work environment*

- Is cognizant of the environment and potential hazards
- Follows established safety procedures
- Evaluates changes in the environment with respect to their impact on safety of self and others
- Promotes effective local, state or national security operations for the protection of people, data, property and institutions
- Complies with safety procedures and proper ways to perform work
- Understands potential threats created by deviation from safety procedures and improper use of tools and equipment
- Follows safety procedures and uses safety equipment as specified by user manuals and safety training
- Uses personal protection equipment including safety glasses, work boots, hard hats
- Keeps personal safety equipment in good working order
- Uses tools and equipment in compliance with user manuals and training
- Calls attention to potential and actual hazardous conditions as they arise

- Alerts co-workers and supervisory personnel to hazardous conditions and deviations from safety procedures in a timely manner
- Demonstrates first aid or first response procedures
- Demonstrates knowledge of lock/tag out practices
- Notifies supervisor of unsafe work conditions
- Stops the job if there are unsafe working conditions

3. **Environmental Laws and Regulations:** *Compliance with relevant local, state, and federal environmental laws and regulations that impact the energy industry*

- Demonstrates professional responsibility for maintaining all policies and standards for health, safety and the environment
- Complies with all relevant environmental laws issued by federal agencies, including EPA
- Follows energy standards produced by industry organizations, such as ANSI, API, NACE, and NFPA
- Identifies appropriate jurisdiction for local, state, and federal regulatory agencies as they pertain to the energy industry
- Maintains current knowledge of regulatory procedures governing operations

4. **Quality Control/Continuous Improvement:** *Demonstrates the ability to design, analyze and effectively use systems, components and methods with a framework of quality and continuous improvement*

- Conducts tests and inspections of products, services or processes to evaluate quality or performance
- Incorporates new information into both current and future problem-solving and decision-making
- Monitors/assesses performance of self, other individuals or organizations to make improvements or take corrective action

- Determines how a system should work and how changes in conditions, operations and the environment will affect outcomes
- Uses logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems

5. **Troubleshooting:** *Diagnoses and corrects abnormalities and malfunctions in equipment and production processes*

- Monitors equipment to ensure maintenance schedules are adhered to
- Demonstrates knowledge of the equipment operation (how the individual pieces of equipment relate to each other) in order to spot potential equipment problems before they occur
- Determines causes of operating errors and decides what to do about them

Tier 5: Industry-specific Technical Competencies

Energy Generation, Transmission and Distribution

1. **Nuclear Generation:** *Technical skills and knowledge necessary for nuclear power plant personnel*

Electrical Science:

- Explains and uses the fundamental concepts associated with electricity (e.g., electric charge, electric current)
- Understands the components of electrical systems including switchyard construction, transformers, relays, circuit breakers, motors

Reactor Theory and Operations:

- Explains the general design overview of the basic reactor types
- Demonstrates understanding of reactor startup and shutdown procedures

- Explains the fission process including the construction of fission product barriers

Operations and Repair:

- Operates, repairs and tests machines, devices and equipment based on electrical or mechanical principles in order to diagnose machine malfunctions
- Operates basic hand and small electric tools and equipment and understands the system components involved in electricity production
- Conducts tests and inspections of products, services or processes to evaluate quality or performance
- Determines the kind of tools and equipment needed to do a job
- Watches gauges, dials or other indicators to make sure a machine is working properly
- Is able to read, understand and create basic prints used in the design, operation and maintenance of electrical including engineering drawings, diagrams and schematics - documentation diagrams, single line diagrams

Additional Academic Requirements:

- **Physics:** Explains and uses physics terms, units, definitions and basic concepts including mechanical principles (laws of motion, energy, conditions of equilibrium) and units (pressure, temperature, flow, volume)
- **Basic Atomic and Nuclear Physics:** Explains the basic atomic and nuclear physics terms, unit, definitions and basic concepts including atomic structure, nuclear interactions and reactions, sources of residual heat/decay heat and reactor operation
- **Chemistry:** Explains the chemistry terms, units, definitions and basic concepts and applies the concepts successfully on the job, including fundamentals of chemistry (molecules, mixtures, solutions and compounds, corrosion control), water chemistry control, reactor water chemistry and the corrosion process

- **Mathematics:** Has experience and knowledge in scientific notation, dimensional analysis, geometry, trigonometry, graphs and control charts, nomograms, exponents and logarithms and basic statistics

2. **Non-Nuclear Generation:** *Technical skills and knowledge necessary for gas, oil, coal or hydro power plant personnel*

Electrical Science:

- Explains and uses the fundamental concepts associated with electricity (e.g., electric charge, electric current).
- Explains the components of electrical systems including switchyard construction, transformers, relays, circuit breakers, motors
- Explains the differences and similarities of power generation, including use of different fuel types, different plant uses (i.e., peaking, load following)

Equipment Operation, Maintenance and Repair:

- Operates, repairs and tests machines, devices and equipment based on electrical or mechanical principles in order to diagnose machine malfunctions
- Operates basic hand and small electric tools and equipment and understands the system components involved in electricity production
- Conducts tests and inspections of products, services or processes to evaluate quality or performance
- Determines the kind of tools and equipment needed to do a job
- Watches gauges, dials or other indicators to make sure a machine is working properly
- Is able to read, understand and create basic prints used in the design, operation and maintenance of electrical including engineering drawings, diagrams and schematics - documentation diagrams, single line diagrams

Problem-solving and Decision-making:

- Observes, obtains and analyzes information to identify and solve problems
- Diagnoses malfunctioning systems apparatus and components using test equipment and hand tools to locate the cause of a breakdown and correct the problem
- Uses computers to enter and analyze data and provide reports to supervision

3. Electric Transmission and Distribution:
Knowledge and skills necessary for the transmission and distribution of electricity from the power plant to the end customer

Electrical Science:

- Explains and uses the fundamental concepts associated with electricity (e.g., electric charge, electric current)
- Understands the components of electrical systems including switchyard construction, transformers, relays, circuit breakers, motors

Operations and Repair:

- Maintains and repairs electrical distribution and transmission systems, including conduits, cables, wires and related equipment such as transformers, circuit breakers and switches
- Inspects and tests power lines and auxiliary equipment to locate and identify problems, using reading and testing instruments
- Is able to read, understand and create basic prints used in the design, operation and maintenance of electrical networks including engineering drawings, diagrams and schematics - documentation diagrams, single line diagrams.

Teamwork:

- Displays a good natured cooperative attitude with crew members on the job
- Maintains composure controlling anger and avoiding aggressive behavior

Customer Focus:

- Interacts directly with the public listening to and understanding customer needs and concerns
- Keeps the public informed of work and disruptions

4. Gas Transmission and Distribution:
Knowledge and skills necessary for the transmission and distribution of natural gas from the refinery to the end customer

Fundamentals of Natural Gas:

- Understands and applies the fundamental concepts of natural gas
- Understands the components and workings of the gas transmission and distribution network, including metering and regulating stations

Operations and Repair:

- Lays out, assembles, installs and maintains pipe systems and pipe supports for use in the transmission and distribution of natural gas
- Reads, understands and creates basic prints used in the design, operation and maintenance of gas networks including engineering drawings, diagrams and schematics
- Selects pipe sizes and types and related materials, such as supports, hangers and hydraulic cylinders according to specification
- Assembles and secures pipes, tubes, fittings and related equipment according to specification by welding, brazing cementing, soldering or threading joints
- Inspects, examines and tests installed systems and pipe lines using pressure gauges, hydrostatic testing, observation and other methods
- Digs trenches to desired or required depths by hand or using trenching tools
- Grades and levels trench bases using tamping machines or hand tools

Customer Focus:

- Interacts directly with the public listening to and understanding customer needs and determining how to address them
- Keeps the public informed of work and disruptions

Source: Center for Energy Workforce Development, www.cewd.org.

Appendix D.

Online Program Information

Energy Partnerships with Vocational Training Schools and Colleges

PSEG (New Jersey) Utility Technology Degree
www.pseg.com/career/utilitytechnology

Thomas Edison State College — Utility Technology
www.tesc.edu

Brookdale Community College
www.brookdalecc.edu

Centralia College (WA) Center for Excellence
www.centralia.edu/coe

Clark College (WA) — Power Utilities Technology Program
www.clark.edu/academics/programs/electronics

Gonzaga University (WA) — Transmission and Distribution Certificate
www.eng.gonzaga.edu/tandd

Shoreline Community College (WA) “Zero Energy” Construction Courses
www.shoreline.edu

Arizona Public Service — Northern Arizona C vocational Institute of Technology Project
www.navit.k12.az.us

PG&E Business Development — Power Pathway Initiative
Email valueadd@pge.com

Industry Curriculum Models

Center for Energy Workforce Development
www.cewd.org

Energy Career Website
www.getintoenergy.com

New Jersey Retail Skills Center
www.retailskillscenter.net

Oil Industry Center for the Advancement of Process Technology
www.capttech.org

Apprenticeships and Pre-Apprenticeships

Air Conditioning Contractors Association
www.acca.org/apprenticeship

Newark/Essex Construction Careers Consortium, New Jersey Institute for Social Justice
www.njsj.org/ecccp.html

Energy Distance Learning Options

Council for Adult and Experiential Learning
www.cael.org

Energy Providers Coalition for Education
www.epceonline.org

