

Career *currents*

Exploring Today's Energy Careers with the NEED Project

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Extreme Career: Journey Lineman

A career in linework is one of the highest paying and most challenging trades in the electricity industry. It's no typical day at the office. On this job, a **Journey Lineman** perches precariously out of a helicopter door, repairing 345,000-volt high-tension power lines. That's right—this job often involves repairing and maintaining live voltage transmission wires while hanging out of a moving helicopter!



Journey linemen maintain our extensive electric transmission and distribution network through ongoing construction and maintenance of overhead and underground electric lines.

Journey linemen climb power poles and towers that are 35 feet to over 300 feet high to work on energized lines—while carrying tools and equipment weighing up to 50 pounds. They also crawl through small vaults, trenches and manholes only 31-39 inches in diameter. Journey

linemen work in locations throughout the U.S. They work 40-hour weeks in all types of weather.

To get a job in this extreme career requires a high school diploma and specialized training in utility safety and pole-top rescue.

To learn valuable skills and gain utility experience, consider beginning your career as an **Equipment Operator**, **Utility Worker**, or an **Apprentice Lineman** first.



For more information, visit: www.pge.com/careers.

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Career Currents provides educators and students with resources to introduce energy careers. Each issue focuses on a different sector of the energy industry. No single issue is meant to be all-inclusive to either the sector profiled or all careers in energy. This issue focuses on careers in power generation, transmission and distribution.

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Sponsor Spotlight: American Electric Power

American Electric Power (AEP), founded in 1906, is one of the largest electric utilities in the United States, with more than five million customers in 11 states. AEP owns power plants that generate nearly 38,000 megawatts of electricity using coal, natural gas, nuclear, wind and hydropower. Last year, AEP delivered approximately 214 million megawatt-hours of electricity to customers via the nation's largest network of 39,000 miles of transmission lines and 207,000 miles of distribution lines.

To serve their customers, AEP employs 20,400 people in the U.S. What career opportunities are available at AEP?

- If you are interested in business, you could work in the accounting, finance or regulatory affairs departments.
- If you excel in science and mathematics, you could work as an engineer, biologist or chemist. Electrical, mechanical, civil, chemical and nuclear engineers are employed in the power plants, as well as in the field and regional offices.
- If you enjoy working with computers, you could work in several information technology groups that specialize in architecture, operations and support, business management, applications delivery and technical services.
- If you want to work outdoors, you could work on transmission and distribution lines, or on one of the barges that carry coal up and down the Ohio and Mississippi rivers. You could also work at the terminal facilities that transfer the coal to rail cars.
- If you enjoy working with your hands, you could join fleet maintenance operations, performing maintenance on railcars, line trucks or river tug boats and barges.



Next on the horizon at AEP? It plans to build one or more integrated gasification combined cycle (IGCC) plants. IGCC is a clean coal technology that turns coal into gas, and removes the impurities from the gas before it is combusted. Gasifying the coal improves the efficiency of the plant and reduces the emissions of sulfur dioxide, particulate matter and mercury. AEP plans to open the largest commercial IGCC plant in the U.S. in New Haven, West Virginia, by 2012.

For more information about career opportunities with American Electric Power, visit: www.aep.com.

Learn Valuable Electrical Skills Serving in the Army

After graduating from high school, you may choose to serve in the United States Armed Forces. Did you know that every Army Post must produce its own electricity? Electricity is vital to soldiers' communication and basic survival. While out in the field, the Army supplies its own power—carrying and setting up mobile power plants wherever it goes.

As a **Power-Generation Equipment Repairer**, you'll keep the electricity running smoothly by maintaining and repairing electricity-generating equipment in mobile and stationary power plants.

Some of your duties as a power-generation equipment repairer may include:

- Performing maintenance on utility equipment and internal combustion engines.
- Maintaining and repairing motors, generators, switchboards, and control equipment.
- Maintaining and repairing power and lighting circuits, electrical fixtures, and electrical equipment.
- Detecting and locating grounds, open circuits, and short circuits in power distribution cables.
- Connecting emergency power to the main control board from an emergency switchboard.
- Operating electrical and electronic test equipment.
- Reading technical guides and diagrams to locate damaged parts of generators and control equipment.

Training

Job training for a power-generation equipment repairer consists of nine weeks of Basic Training, where you'll learn basic soldiering skills, followed by twelve weeks of Advanced Individual Training, including practice in maintaining electrical power systems. Part of this time is spent in the classroom and part in the field.

During training you will learn about generator and power plant operations; electrical generation and distribution; diesel generator operation, disassembly, inspection and maintenance; and principles of electrical and electronic circuitry.

Further training occurs on the job. As you advance, you may supervise other soldiers while repairing and overhauling starters, alternators, generators, fuel injectors, voltage regulators, switches and control circuits.

The skills you learn as a power-generation equipment repairer will help prepare you for a civilian career as a



Power Plant Electrician at a construction company, manufacturer or utility company.

A high school diploma, or equivalent, is required to serve in the U.S. Army.

For more information, visit www.GoArmy.com.

Career Opportunities in the Electricity Industry

Customer Service Representatives ensure that electric utility customers receive help with their questions and concerns. They often assist customers with opening or closing accounts, starting or stopping electric service, payment of bills and questions regarding accounts. Most customer service representatives use computers and telephones extensively in their work. Workers may be hired directly upon graduation from high school with preference given to candidates who have strong communication and problem-solving skills. Courses in computers, English and business are helpful in preparing for a job in customer service. Most customer service jobs are entry-level and workers receive the training needed prior to beginning work. Pay ranges from \$17,680 to \$44,160.

Electrical Engineers design, develop and test the equipment used by electric utilities to generate, control and transmit electricity. They specialize in areas such as power systems engineering or electrical equipment manufacturing. Most electrical engineers use computers extensively to help produce and analyze designs. Electrical engineers require bachelor's degrees in engineering for entry-level jobs, with additional coursework or graduate degrees common. Pay ranges with education and experience level from \$47,310 to \$108,070.

Electrical Line Installers and **Repairers** install new power lines by constructing utility poles, towers and underground trenches using a variety of construction equipment. They also set up service for customers by connecting homes to the power lines. They periodically travel in trucks, helicopters and airplanes to visually inspect wires and must be comfortable climbing and maintaining balance while working on poles and towers.

Repairs to lines are made regardless of weather conditions. Electrical line installers and repairers may be hired directly after graduating from high school, but most have additional training from one- or two-year technical programs. Additional on-the-job training and apprenticeship programs are common. Workers are paid on an hourly basis, with a range of \$13.31 to \$32.54.

Below, workers repair Pacific Gas and Electric Company electric power transmission lines in Los Altos Hills, California. They are removing the remainder of a pole that snapped during a rainstorm.



Electricians install, connect, test and maintain electrical systems. They often specialize in either construction or maintenance work. Electricians use blueprints to install or upgrade electrical systems, following the National Electric Code and make sure the system complies with state and local building codes. Electricians connect, repair and replace all types of wire, circuit breakers, transformers, outlets and other electrical components. They use testing equipment to ensure proper connections and safety. Most electricians learn their trade after graduating from high school through apprenticeship programs that combine on-the-job

training with classroom instruction or by graduating from a vocational-technical school. Pay is hourly and ranges from \$12.18 to \$33.63.

Industrial Machinery Mechanics are highly skilled workers who maintain and repair machinery in plants or factories. They diagnose and repair problems and perform preventative maintenance on machines as well as install new machinery. Industrial machinery mechanics often learn their trade through four-year apprenticeship programs that include both classroom instruction and on-the-job training. The hourly pay range is \$12.14 to \$27.59, with the highest paid mechanics typically working in electric power generation, transmission and distribution industries.

Labor Relations Managers implement industrial labor relations programs. They interpret and administer union labor contracts with respect to grievances, wages and salaries, employee welfare, healthcare, pensions, and union and management practices. Labor relations managers work with **Mediators** during contract disputes between employers and union employees to ensure that revisions of contracts meet the needs of both sides. Labor relations managers often have four-year degrees in either human resources or labor relations. Additional courses or advanced degrees in labor law, labor economics and labor history are typically required. Pay ranges from \$48,060 to \$136,600.

Power Plant Distributors and **Dispatchers** operate equipment that controls the flow of electricity from power plants through transmission lines to substations that supply customers' needs. They operate converters, transformers, and circuit breakers. Dispatchers monitor the equipment and record readings at pilot boards—maps of the transmission grid system that show the status of circuits and connections with substations and industrial plants.



Above, a technician runs a power control console.

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. They also handle emergencies such as line failures and route electricity around the affected areas. In addition, dispatchers operate and monitor the equipment in substations. They step up or step down voltage and operate switchboard levers that control the flow of power in and out of the substations.

Workers can be hired directly after graduating from high school, with computer proficiency high on the list of skills needed. Most entry-level workers start as helpers or laborers, with on-the-job training and experience required for advancement to fully qualified power plant distributors and dispatchers. Pay ranges from \$38,220 to \$83,030.

Power Plant Operators control machinery that generates electric power. They control and monitor boilers, turbines, and generators, and adjust controls to distribute power demands among the generators. They also monitor the instruments that regulate the flow of electricity from the plant. When the demand for power changes, they start or stop the generators, and connect or disconnect them from the circuits. Many operators use computers to keep records of switching operations, to track the loads on generators and lines, and to prepare reports of unusual incidents, malfunctions and repairs that occur during their shifts.

Workers can be hired directly after graduating from high school, with computer proficiency high on the list of skills needed. Most entry-level workers start as helpers or laborers, with on-the-job training and experience required for advancement to full-fledged power plant operators. Pay ranges from \$34,500 to \$70,330.

Stationary Engineers and **Boiler Operators** start up, regulate, repair and shut down the equipment used to generate electricity. They ensure that the equipment operates safely, economically and within established limits by monitoring meters, gauges and computerized controls. They use sophisticated test equipment to help monitor the systems. Stationary engineers and boiler operators usually acquire their skills through formal four-year apprenticeship programs. Additional education from a trade and technical school is often necessary. Pay ranges from \$27,010 to \$66,570.

Utilities Meter Readers walk or drive specific routes to read electric, gas, water or steam consumption meters and record the volume used. They also inspect meters for damage and defects, turn service on for new residents, and turn service off for nonpayment of charges. Meter readers work outdoors in all types of weather. Workers

can be hired directly after graduating from high school. Meter readers will often work initially with more experienced readers until they feel comfortable with their new routes and responsibilities. Pay ranges from \$18,550 to \$47,830.

Source: Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2006-07 Edition, www.bls.gov.

Nuclear Power

Power plant operators working in nuclear power plants often need previous experience before they are hired. But where can you get experience working with nuclear energy?

In the military, **Nuclear Power Plant Operators** gain experience monitoring and controlling nuclear reactors that produce electricity to power ships and submarines. Military personnel receive at least one year of training consisting of classroom instruction and hands-on practice. Power plant operators that do not come from military backgrounds can work in nuclear power plants after gaining experience in fossil fuel power plants.

All civilian nuclear power plant operators must be licensed by the Nuclear Regulatory Commission (NRC) and take annual exams to maintain their licensure. **Reactor Operators** are authorized to control equipment that affects the power of the reactor. There is also an NRC-licensed **Senior Reactor Operator** on duty during all shifts. Pay for workers in nuclear power plants is slightly higher than their fossil fuel power plant counterparts. Pay ranges from \$49,690 to \$82,220.

Below, the control room at a U.S. nuclear power plant.



Career Chats

Meet Karalee Browne, the **Charitable Contributions Program Officer**, and Solar Schools and Solar Habitat Program Manager, for the Pacific Gas & Electric Company in San Francisco, California.

Career Currents (CC): Hi Karalee. Thanks for talking with us. Please tell us what you do.

Karalee: I manage three large signature programs within our charitable contributions program: The Solar Schools Program, The Solar Habitat Program and the REACH Program. PG&E's goal is to be the leading corporate citizen in the diverse communities we serve. We want to share our energy expertise and resources to promote innovative solutions to problems faced by our customers. My job is to help expand our partnerships to create more economically viable and educated communities.

CC: How did you get interested in working with electricity and power generation?

Karalee: My educational and professional background is actually in news media. I graduated from the University of Southern California with a degree in broadcast journalism. I worked my way up from a production assistant to the 5:00 PM news producer at the CBS affiliate in Sacramento. At age 26, I had already climbed the ladder as far as it would go, so I took a new job at a media marketing firm. When that firm went out of business, I took a job at PG&E in their customer service department (to get my foot in the door). PG&E is a fabulous company that offers job training opportunities. Within two years, I was in the Charitable Contributions Department.

CC: What is a typical day of work like for you?

Karalee: There is no typical day. Some days I am "out in the field" hosting community events such as solarbrations or employee volunteer days. Others, I am crunching numbers from behind my desk. Because I manage several large programs, I do a lot of analysis and constantly seek ways to improve our programs to ensure we are providing the best resources to the communities we serve.

CC: What is the most rewarding part of your job?

Karalee: The most rewarding part of my job is seeing that the programs I manage are making a difference to our customers and in our communities. The solar schools program provides teachers with curriculum about renewable energy. When I see students turn off the lights, start recycling projects or just tell their friends about the value of our natural resources, it is very rewarding. These programs are changing behavior, which is

benefitting our environment and the vision of future generations.

CC: How much does your job interact with the public?

Karalee: The entire existence of my job is to find ways to benefit the communities we serve. PG&E is focusing on aligning our giving more closely with our core business operations. Our grants are concentrated in five basic areas: *Environmental and Energy Sustainability, Emergency Preparedness, Economic Development, Education and Emergency Energy Assistance.*

CC: What advice can you give to a young person considering a career in an energy industry?

Karalee: Go for it! This is such a dynamic industry that faces many challenges and opportunities. It is vital to almost everything we do. A large percentage of the workforce is entering retirement age, so we are investing in workforce development projects.

CC: Anything else you would like to share with us?

Karalee: Employees say a lot about a company. I find myself in many meetings with employees who have worked for PG&E for 15-30 years...and many of them have several family members who work for the company too. This is something you rarely see these days. It makes me proud to work for a company that has such employee dedication.

CC: Thanks for sharing your career with us, Karalee.



Jay Myers, **Assistant Superintendent** for Cuyahoga Falls Electric System in Cuyahoga Falls, Ohio, shares his career with us.

Career Currents (CC): How did you get interested in the electric generation and distribution industry?

Jay: Honestly, the money is good. I started working in the field after graduating with a two-year degree in electronics technology. My first job was building switch gear, which is equipment used in substations for control of power.

CC: What do you do now?

Jay: Every day is a little bit different. Overall, I am responsible for design, drafting and purchasing.

CC: Which means?

Jay: Depending on what types of jobs are in the hopper, it could involve designing service for a large customer, laying out the distribution system for a new housing development or damage control during storms and/or other outages. The job also entails a lot of paperwork,

especially during budget time and preparation for the annual purchase of materials.

CC: What advice can you give to a young person considering a career in an energy industry?

Jay: Hit the math and science books.

CC: How does your job interact with or affect the public?

Jay: We're always available to take calls from the public, plus we're very active working with our schools to promote energy education, and with our commercial/industrial customers to promote energy efficiency and to help them with power quality and technical issues.

CC: What is the most rewarding part of your job?

Jay: Working with schools and customer support.

CC: What is the most interesting thing that has happened to you due to your work?

Jay: There have been a lot of interesting things, but one that sticks out in my mind is the time we had to completely rewire the control section of a substation after a lightning strike.

The blizzard of 1978 was also interesting because we were working in horrible conditions—zero visibility, hurricane force winds, and -100° wind chill factor. During all this, we had customers coming out of their homes to bring us hot soup, coffee and sandwiches! We worked for 36 hours straight to get people back in service. The wind damage from that storm was just incredible!

CC: Thanks for sharing your career with us, Jay.



Above, a transmission substation boosts the voltage of electricity so that it can travel farther. It also re-routes power to other transmission lines that serve local markets.

Electric Utilities

The 3,170 electric utilities in the U.S. are all unique, but each can be put into one of four categories: investor-owned electric utilities, publicly owned electric utilities, electric cooperatives and Federal electric utilities.

Investor-owned electric utilities are privately owned. As private companies, the objective of investor-owned electric utilities is to produce profits for their investors while providing electric service to their customers. Most investor-owned electric utilities provide generation, transmission and distribution of electricity. They represent only eight percent of the total number of electric utilities, yet generate approximately 75 percent of the electricity.

Publicly owned electric utilities are nonprofit local government agencies established to provide electric service to their communities and nearby consumers at cost, returning excess funds to consumers in the form of community contributions, increased economies and efficiencies in operations, and reduced rates. Publicly owned electric utilities include municipals, public power districts, irrigation districts, state authorities and other state organizations. Most municipal electric utilities simply distribute power, although some large ones produce and transmit electricity as well. There are 2,009 publicly owned electric utilities in the U.S. They represent about 63 percent of the number of electric utilities and supply approximately 10 percent of electricity generation.

Cooperative electric utilities are owned by their members and established to provide electricity to those members. They typically operate in rural areas with low concentrations of consumers. Cooperatives are incorporated under state laws and are run by managers who are chosen by and report to elected boards of directors. There are 912 cooperatives operating in 47 U.S. states. Cooperative electric utilities represent about 29 percent of the total number of electric utilities and around four percent of electric generation.

Federal electric utilities operate within several agencies of the U.S. government. The electricity they generate is primarily sold for resale to municipal and cooperative electric utilities and to other nonprofit preference consumers, as required by law. Federal power is sold not for profit, but to recover the costs of operations. Federal electric utilities operate approximately 180 power plants, most of which are hydroelectric projects initially designed for flood control and irrigation purposes. Federal electric utilities represent less than one percent of all electric utilities and provide approximately 10 percent of electricity generation.

For more information on electric utilities, visit: www.eia.doe.gov.

Bird Streamer Flashovers

Unintended electrical faults on transmission lines are major sources of power disturbances and blackouts. Any unplanned power outage is a major problem for utility companies and their customers. Faults have a variety of causes, including fires, lightning, insulator pollution, and equipment failure. An unintended fault is known as a flashover.

Scientists have studied unplanned outages for many years and discovered an unexpected cause—birds. Bird excrement (a super-long stream of fluid white bird poop) is known as a streamer. When a hawk or eagle perches on a power-line pole and “nature calls”, a streamer squirts from the bird’s cloaca onto a power-line insulator ten feet below. The insulator doesn’t conduct electricity but is shorted out because the streamer acts like a new extra wire. It links the line to the pole for a second. Electricity flashes across it, causing a bird streamer flashover.

A bird streamer flashover may cause a blackout and often kills the bird that caused it. Power companies are working with **Wildlife Biologists** to find solutions to bird streamer flashover problems. One solution involves installing special anti-perching devices known as bird guards.

For more information, visit: <http://extension.osu.edu/~news/story.php?id=3675>.

Above, hawks often use transmission towers as nesting habitats. Biologists are researching and building custom nest platforms on transmission towers. They hope to entice hawks to breed in these safer locations equipped with mock nesting habitats.

