



On the grid: Careers in energy

Electricity is the fuel that powers the modern lifestyle. It eases the burden of daily chores and enhances our enjoyment of leisure activities. In business, electricity is critical to every aspect of manufacturing goods, providing services, and communicating with customers. And the development of new technology and products powered by electricity ensures continued demand into the future.

It's difficult for most of us to imagine what our lives would be like without electricity, but occasional blackouts give us a glimpse. On August 14, 2003, a series of power failures spread across the electrical grid serving much of the northeastern United States and eastern Canada. Suddenly, more than 50 million people faced concerns that ranged from no traffic lights to lack of refrigeration. Many everyday activities came to a halt. By the time electricity was fully restored a few days later, financial losses were estimated at \$6 billion.

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Luckily, such outages are not common, thanks to the efforts of people in the electric power industry. This article gives an overview of the industry. Then, it covers the job duties and other information about the employment, outlook, wages, and training for workers in electric power generation and distribution: line workers, operators and dispatchers, and technicians. The article also includes additional details to help you decide whether you'd like to work in the industry, followed by suggestions for where to find more information about energy careers. A box on page 38, "Renewable energy jobs: Green power," explains a fast-growing segment of the industry.

Why energy?

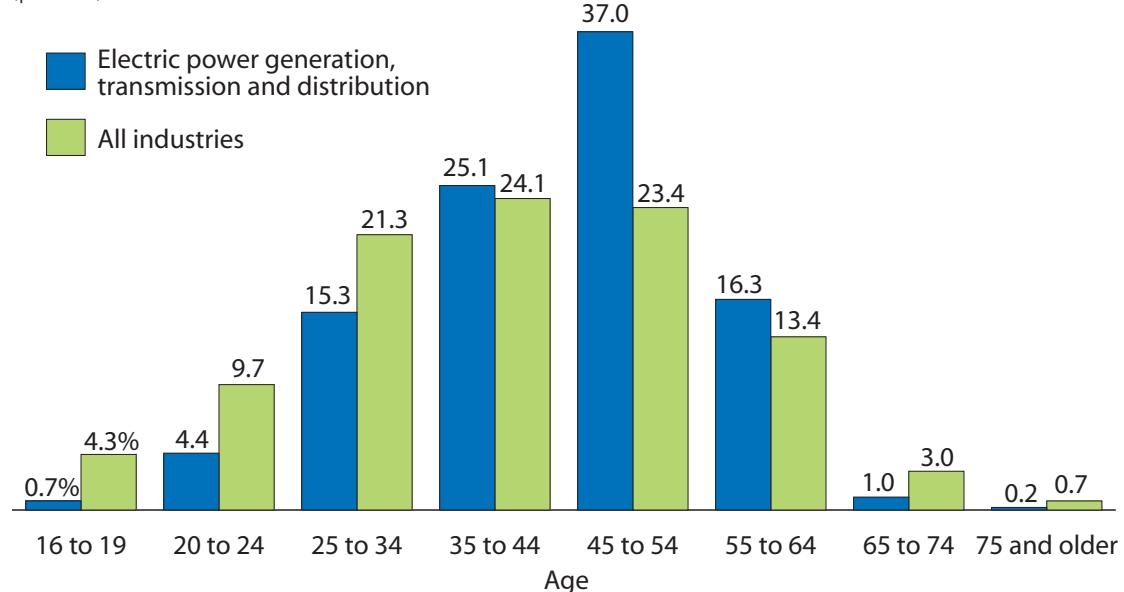
The electric power industry is constantly changing to meet the demands of the 21st-century lifestyle. Electricity use continues to rise each year, and new jobs are being created by a push for renewable energy. For trained professionals and new entrants alike, this growth points to opportunities in the future.

The U.S. Bureau of Labor Statistics (BLS) projects an overall decline in electric power industry employment between 2006 and 2016. Like many industries, however, this one is going through a transition as older workers leave and create openings for workers who will replace them. In fact, data from the 2006 American Community Survey suggest that about 54 percent of workers in the electric power generation, transmission, and distribution industry are aged 45 and older, of whom 17 percent are 55 and older. Many of these workers are expected to retire within the next 10 years. (See chart.)

Good news for career-minded jobseekers: Electric energy occupations pay well above the national median for all occupations, and most offer formal training on the job to workers with a high school diploma. (See table.)

And because nearly every part of the country has electrical power, the jobs exist in just about every location. Most electricity in the United States is produced from coal, natural gas, nuclear energy, or hydro power, but each region has its own way of generating this energy. For example, about three-fourths of the electricity produced in Washington

Electric power industry workforce by age, 2006
(percent)



Source: American Community Survey

Selected occupations in electric power generation, transmission, and distribution, 2007

Occupation	Usual training	Median annual wage, 2007
Electrical power-line installers and repairers	Long-term on-the-job training	\$52,570
Power plant operators	Long-term on-the-job training	56,640
Electrical and electronics repairers, powerhouse, substation, and relay	Postsecondary vocational award	58,970
Power distributors and dispatchers	Long-term on-the-job training	63,320
Nuclear power reactor operators	Long-term on-the-job training	70,410
All occupations	—	31,410

State is hydroelectric; in contrast, none of Delaware's electricity comes from hydro power. And about one-fifth of U.S. electricity comes from nuclear reactors—of which 19 States have none.

What are the occupations?

This section describes the job duties of line workers, power plant operators and dispatchers, and technicians who work primarily in the electric power generation, transmission, and distribution industry.

Line workers

Power lines are essential to the electric power industry. Line workers build and maintain the network of power lines connecting the plants that generate electricity with the customers who use it. Some line workers install new power lines; others repair existing ones.

Workers who install new power lines do many tasks that are similar to those of construction workers. They often operate heavy machinery, including machines that dig holes for utility poles or that excavate trenches and tunnels. Installation work also involves running cables, either on poles or through trenches, between buildings and nearby power lines. After making that connection, line workers check for proper voltage readings.

Line workers responsible for maintenance must monitor and, if necessary, repair or

replace equipment that controls and directs the electrical current, such as transformers, circuit breakers, switches, and fuses. They use sensitive monitoring equipment that automatically detects malfunctions on the network. When they identify a problem, line workers repair or replace the defective equipment.

There is a lot of physical activity in line workers' jobs. They often climb and must maintain their balance while working on high poles and towers. They work outdoors most of the time—including during inclement weather—and not being tied to a desk makes the occupation attractive to some. “I couldn't work at a computer all day,” says Jinx Caparella, a line worker in Aspen, Colorado. “I need to get outside and enjoy the fresh air.”

Employment, outlook, and wages.

According to BLS, there were about 109,990 wage and salary electric power-line installers and repairers in the United States in May 2007. And BLS projects employment growth to be about average for this occupation over the 2006–16 decade. This growth reflects increasing demand for electricity offset, in part, by rising productivity. However, a growing number of retirements is expected to create opportunities for line workers.

The median annual wage for electrical power-line installers and repairers was \$52,570 in May 2007—higher than the median for all occupations. The highest earning 10 percent made more than \$74,300, and the lowest earning 10 percent made less



Line workers must have knowledge of electricity and be comfortable working at heights.

than \$29,780. Many line workers belong to unions, which negotiate wage rates and regulate advancement in the field.

Training. Most starting positions require that line workers have completed high school, which should have included classes in basic mathematics and communications. Additional technical knowledge of electricity or electronics obtained through vocational programs, community colleges, or the Armed Forces is also helpful but may not be necessary.

Electrical power-line installers and repairers receive most of their training on the job, often through formal apprenticeships or other employer training programs. These programs, which take up to 5 years, combine on-the-job training with formal classroom instruction and are sometimes administered jointly by the employer and the union that represents the workers.

Operators and dispatchers

Power plant and nuclear reactor facilities require workers who monitor and maintain the machinery that generates electricity. These workers include power plant operators,

nuclear power reactor operators, and power dispatchers.

Power plant operators control the generating equipment at power plants. They monitor and distribute power demands among the plant's generators, combine current from several generators, and monitor instruments to maintain voltage and regulate electricity flows from the plant. These operators respond to changing power requirements by starting or stopping generators or by connecting or disconnecting them from circuits.

Nuclear power reactor operators control and monitor the equipment in a nuclear power plant. These workers operate controls, inspect and calibrate equipment, and service reactors. They are directly responsible for monitoring power levels and following strict procedures for a reactor's startup and shutdown. And they must ensure safe operation of the plant—and respond to emergencies that may occur.

Power dispatchers monitor and control the complex system of power lines, substations, and transformers between the plants that produce electricity and the customers who use it. To meet demands, these workers analyze information and calculate power flow by considering issues such as load trends and equipment problems.

Dispatchers spend most of their time in offices, where they use computers to monitor systems. Both operators and dispatchers record maintenance, observations, and incidents.

The work is not physically strenuous, but it may be stressful because it requires constant attention. In addition, these workers may spend a fair amount of time working in areas that have loud machinery.

Employment, wages, and outlook. In 2007, there were 34,400 wage and salary power plant operators in the United States, according to BLS. Their median annual wage was \$56,640. The highest earning 10 percent made more than \$79,130, and the lowest earning 10 percent made less than \$37,040.

There were 4,220 wage and salary nuclear power reactor operators in 2007. They had a median annual wage of \$70,410, with 10

percent making more than \$94,190 and 10 percent making less than \$53,730.

Power distributors and dispatchers numbered 9,410 wage and salary workers in 2007. Their median annual wage was \$63,320; the highest earning 10 percent made more than \$83,920, and the lowest paid 10 percent made less than \$42,620.

BLS projects that there will be little or no change in employment of power plant operators, distributors, and dispatchers overall through 2016. Because of the need to replace workers who will be retiring, however, job opportunities are expected to be good.

Training. Entry-level training requirements vary for these occupations. Power plant operators usually must have at least a high school diploma, and many employers prefer to hire candidates who have some postsecondary training. Nuclear power reactor operators usually need a bachelor's degree or specialized training and a license. Power dispatchers should have at least a high school diploma.

Most prospective power plant operators take an aptitude test offered by the Edison Electric Institute. Some operators who enter the occupation have an associate degree in a relevant field, such as electric power technol-

ogy; others have completed training or gained experience in a formal apprenticeship or military program. Entry-level operators also get on-the-job training. They spend at least a year in the classroom to learn the basics of how a power plant works, then start training at the plant. Employers administer written and oral exams throughout the training to make sure that workers are learning the material. For most workers, it takes about 3 years to move from new hire to journey level. Workers usually receive periodic refresher training, too, which involves testing on power plant simulators that replicate situations the worker might encounter on the job.

Nuclear power reactor operators, unlike other power plant operators, usually need a bachelor's degree in physics or engineering to become fully qualified; however, some enter the occupation with nuclear training from the Navy. Because nuclear power is highly regulated in the United States, nuclear power reactor operators must train more extensively than other operators. Most nuclear power reactor operators begin learning the basics of plant operation while helping experienced workers maintain and operate equipment.

After new workers gain experience and

(Continued on page 39.)



Nuclear power is highly regulated in the United States, so training for nuclear power reactor operators is extensive.

Renewable energy jobs: Green power

Electricity generated from renewable sources is one of the fastest growing segments of the electric power industry. Renewable energy is derived from sources that cannot be exhausted, such as the sun or wind. Generally, renewable energy is less harmful to the environment than energy created in traditional ways, such as burning coal and natural gas.

Renewable energy sources are becoming a larger part of U.S. energy generation. As of 2006, according to the Energy Information Administration, about 7 percent of U.S. energy was produced by renewables, but that portion is growing. In 2007, electric production from nonhydro renewables grew by 7 percent. Subsidies and incentives from the Federal, State, and local governments are expected to create more growth. And data from the American Solar Energy Society show that there were about 106,600 jobs in renewable energy industries in 2006.

Renewable energy production differs from State to State. Like traditional energy sources, renewable energy relies on the geography that supports it, but it also relies

Wind. Wind is the fastest growing energy source in the United States. In 2007, wind energy production increased by 21 percent, and a recent report by the U.S. Department of Energy suggests that it could contribute 20 percent of the Nation's electricity by 2030. Although BLS does not collect data specifically on wind energy employment, the American Solar Energy Society estimates that in 2006, there were 16,000 jobs in wind turbine construction and maintenance. These jobs were once confined to a few States that were early promoters of renewable energy, but wind farms—a group of wind turbines connected to a central utility—now operate in 34 States across the country.

Most wind farms are owned by a major utility company that pays a wind energy company to install and maintain turbines. For this reason, many wind energy employees travel extensively. Most of these workers are technicians with a specialty, such as turbine blade repair or electrical work.

Because bigger turbines produce more power, the size of new turbines have grown significantly. For this reason, wind energy workers must be comfortable with heights. Wind turbine technicians also must be able to work in confined spaces and have good manual dexterity.

Information about jobs in wind energy is available from:

American Wind Energy Association
1501 M St. NW, Suite 1000
Washington, DC 20005
(202) 383-2500
www.awea.org

on investment—usually by State and local governments—that makes renewable energy an affordable alternative for utility companies. For example, Texas has invested heavily in wind energy and now has greater wind-energy capacity than any other State.

All this growth is great news for people who are interested in careers that help the environment. A study by the Renewable and Appropriate Energy Laboratory at the University of California in Berkeley finds that renewable energy creates more jobs per kilowatt hour than traditional energy sources.

For those who have already started working in traditional electric power occupations, many skills are transferable. "Jobs in renewable energy are not all that different from jobs in traditional energy sources," says Ann Randazzo, director of the Center for Energy Workforce Development in Washington, D.C. "For example, a person who is trained to work on power lines also has many of the skills to work on wind turbines."

Solar. Solar panel technology has been around for decades, but new incentives from State and local governments are promoting expansion in this industry. Although still a small part of renewable energy production, many State and local governments are increasing incentives for homeowners to get solar panels installed on their roofs. Increased demand is expected to create new jobs across the country.

BLS does not collect data on employment in solar energy, but the American Solar Energy Society estimates that in 2006, there were 7,600 jobs in the solar photovoltaic and solar thermal energy industries. Most of these workers were solar photovoltaic installers. Workers enter the solar energy field from a variety of backgrounds, but most have construction experience. Understanding electricity is helpful but not required for new entrants.

For some workers, solar energy combines different opportunities into one job. "Working in solar energy is a perfect blend—my work helps the environment, but it is also a hands-on, in-the-field job," says Koralie Hill, a project manager at Sun Light and Power in Berkeley, California. "I like climbing on rooftops. You get a different perspective on things from up there."

Information about jobs in solar energy is available from:

American Solar Energy Society
2400 Central Ave., Suite A
Boulder, CO 80301
(303) 443-3130
www.ases.org

(Continued from page 37.)

complete additional training, they are eligible to take an exam administered by the Nuclear Regulatory Commission.

Training for power dispatchers is not as formal as that for operators, but it usually takes at least a year to complete. An associate degree is not necessarily required, but it may be helpful for job candidates seeking to enter the occupation.

Technicians

Technicians working in the electric utility industry are classified by BLS as powerhouse, substation, and relay electrical and electronics repairers. These workers maintain the electrical distribution systems that get power from generating plants to businesses and homes. Technicians primarily inspect, test, maintain,

and repair electrical equipment used in power plants, substations, and relays. Some power plants combine the duties of operators and technicians.

Employment, outlook, and wages.

According to BLS, there were 23,320 wage and salary powerhouse, substation, and relay electrical and electronics repairers employed in the United States in 2007.

Employment for powerhouse, substation, and relay electrical and electronics repairers is projected to decline somewhat over the 2006–16 decade. Improved productivity due to industry consolidation and newer equipment is expected to limit growth. But some opportunities should arise from the need to replace workers who leave the occupation.

The median annual wage for workers in this occupation was \$58,970 in 2007. The

Many skills required for working in traditional electric power occupations are transferrable to those in renewable energy, such as wind or solar power.



highest earning 10 percent made more than \$75,830, and the lowest earning 10 percent made less than \$41,560.

Training. Many prospective technicians take an aptitude test administered by the Edison Electric Institute that is similar to the one for operators. And most technicians have at least an associate degree in electrical engineering or a related field.

In addition, beginning technicians enter an employer-sponsored training program that usually includes about a year of classroom instruction and extensive on-the-job training with senior technicians. Formal training for technicians is similar to that of power plant operators.

What else should you know?

Working safely with electricity requires that you use your hands and your head. You must be good with tools and basic mechanics and should enjoy fixing things. In addition, employers prefer to hire people who understand electricity and have ability in problem-solving, science, and math, including algebra. Communication skills are also essential for writing reports or other documents and, in some occupations, for dealing with customers. And you should be comfortable with other equipment common in the industry, such as computers and gauges.

Some of these occupations have physical requirements because of the nature of the work. Line workers, for example, must be physically fit, coordinated, and comfortable working at heights and in confined spaces; in addition, the ability to distinguish colors is helpful, because wires and cables are sometimes color-coded. Dispatchers must be able to work in confined spaces and occasionally lift objects of 50 to 75 pounds.

Line workers, operators, dispatchers, and technicians work at all hours, including during the night and on weekends, and some must be available on call for emergencies. This is because customers need reliable electrical

power 24 hours a day, 7 days a week. And power failures may require repairs to be made even during storms or other inclement weather, so the ability to work quickly and efficiently under pressure is important.

To prepare workers for these and other occupations, the electric power industry has partnered with community colleges and training centers nationwide. Programs last 1 to 2 years and cover the basics of working with electricity. Most community colleges have career centers that help students find jobs.

Still, much of the learning for new workers happens on the job. Entry-level workers usually start by taking courses and then progress to formal on-the-job training programs. New employees often work with experienced ones, gradually taking on more difficult tasks, until they are fully trained. Most workers must pass exams to become fully qualified.

The emphasis on training is important because of risks associated with occupations in the electric power industry. As Danny Turner, a hydro tech operator with the Tennessee Valley Authority in Knoxville, Tennessee, says about working with energy, "If you are on the job and don't know what you're doing, someone could be hurt or even killed." High-voltage power lines can instantly electrocute a worker who comes into contact with a live cable, for example. Other potential dangers include falls and burns and, for nuclear reactor operators, exposure to radiation.

But routine precautions minimize such risks, with positive results: On average, the utilities industry has fewer injuries than the average for all industries. Federal or State regulations reflect a proactive approach to avoiding accidents. Because of the dangers associated with radioactive accidents, for example, nuclear reactor operators are held to strict standards that include periodic drug and alcohol tests; they must also get a complete medical examination every 2 years.

For more information

This article described occupations focusing on power generation and distribution in the

electric power industry. Other occupations include customer service representatives, electrical engineers, and first-line supervisors and managers of mechanics, installers, and repairers. Learn more about these and other occupations in the electric power industry by doing research at a career counseling center or public library. Find a One-Stop Career Center near you by visiting www.servicelocator.org or calling toll-free, 1 (877) US2-JOBS (872-5627).

Among the sources available at many libraries and career centers are the BLS *Occupational Outlook Handbook* and the *Career Guide to Industries*, which contain more detailed information about the occupations and industry described in this article. Both are also available online: the *Handbook* at www.bls.gov/oco, and the *Career Guide* at www.bls.gov/oco/cg.

Geographically speaking, job opportunities in the utilities industry depend on how each State produces its electricity. To find out about your State, see the State Energy Profiles on the U.S. Department of Energy's Energy Information Administration Web site: <http://tonto.eia.doe.gov/state>.

The following organizations have information for those interested in working in electrical power:

American Public Power Association
1875 Connecticut Ave. NW., Suite 1200
Washington, DC 20009
(202) 467-2900
www.appanet.org

Center for Energy Workforce Development
701 Pennsylvania Ave. NW.
Washington, DC 20004
(202) 638-5802
www.cewd.org

In addition to its general information about the energy workforce, the Center for Energy Workforce Development maintains a career-information Web site, Get Into Energy. This online resource includes a career quiz, videos, and other interactive resources, such as a search engine for locating programs and employers. It is available online at www.getintoenergy.com.

The Edison Electric Institute administers the Plant Operator Selection System exam and the Maintenance Positions Selection System exam for prospective plant operators and technicians, respectively. Both exams measure aptitudes that are necessary for operators and technicians, including reading comprehension, mechanical concepts, spatial ability, and mathematical application. For information about these exams, contact:

Edison Electric Institute
701 Pennsylvania Ave., NW.
Washington, DC 20004
(202) 508-5000
www.eei.org

Information about licensing for nuclear reactor operators is available from:

U.S. Nuclear Regulatory Commission
Washington, DC 20555
Toll free: 1 (800) 368-5642
www.nrc.gov

