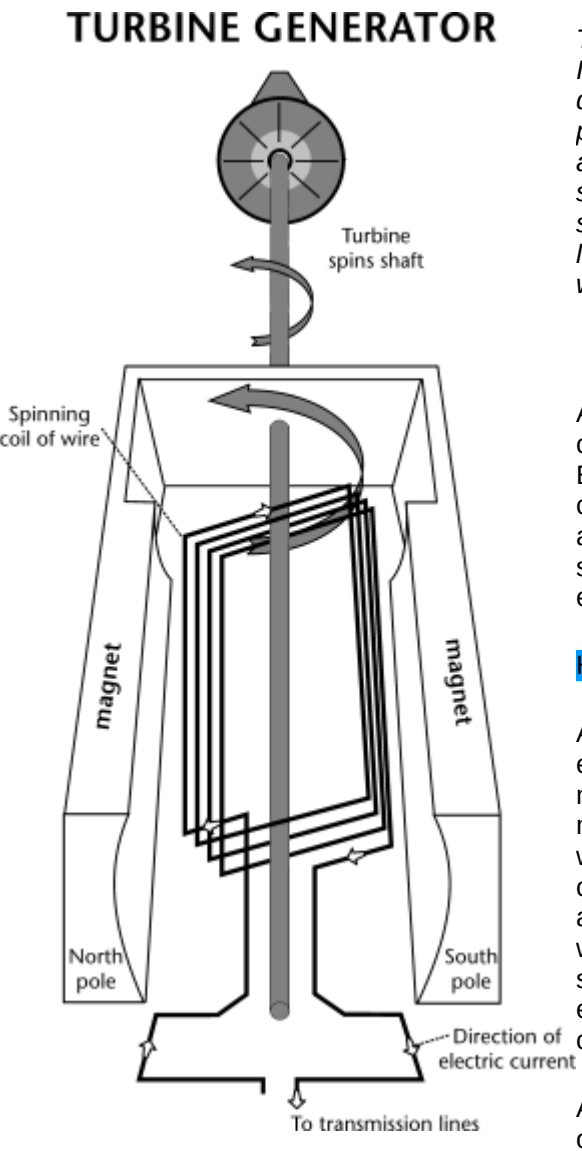
Electricity Basics



The information contained within this section has been provided by the Energy Information Administration (EIA), the US government's agency that collects data on all aspects of energy. Each category was compiled from various publications, reports and data that the EIA publishes either weekly, monthly or annually. Much of the basic information was pulled from the EIA's Energy 101 series. Where possible, Apache Corp. has updated several graphs, maps and statistics to reflect the most current data available from the EIA. If you would like further information regarding the EIA, please visit their website: www.eia.doe.gov.

A form of energy characterized by the presence and motion of elementary charged particles generated by friction, induction, or chemical change. Electricity is a secondary energy source which means that we get it from the conversion of other sources of energy, like coal, natural gas, oil, nuclear power and other natural sources, which are called primary sources. The energy sources we use to make electricity can be renewable or non-renewable, but electricity itself is neither renewable or non-renewable.

HOW ELECTRICITY IS GENERATED

An electric generator is a device for converting mechanical energy into electrical energy. The process is based on the relationship between magnetism and electricity. When a wire or any other electrically conductive material moves across a magnetic field, an electric current occurs in the wire. The large generators used by the electric utility industry have a stationary conductor. A magnet attached to the end of a rotating shaft is positioned inside a stationary conducting ring that is wrapped with a long, continuous piece of wire. When the magnet rotates, it induces a small electric current in each section of wire as it passes. Each section of wire constitutes a small, separate electric conductor. All the small currents of individual sections add up to one current of considerable size. This current is what is used for electric power.

An electric utility power station uses either a turbine, engine, water wheel, or other similar machine to drive an electric generator or a device that converts mechanical or chemical energy to generate electricity. Steam turbines, internal-combustion engines, gas combustion turbines, water turbines, and wind turbines are the most common methods to generate electricity. Most power plants are about 35 percent efficient. That means that for every 100 units of energy that go into a plant, only 35 units are converted to usable electrical energy.

Most of the electricity in the United States is produced in steam turbines. A turbine converts the kinetic energy of a moving fluid (liquid or gas) to mechanical energy. Steam turbines have a series of blades mounted on a shaft against which steam is forced, thus rotating the shaft connected to the generator. In a fossil-fueled steam turbine, the fuel is burned in a furnace to heat water in a boiler to produce steam.

Coal, petroleum (oil), and natural gas are burned in large furnaces to heat water to make steam that in turn pushes on the blades of a turbine. Did you know that coal is the largest single primary source of energy used to generate electricity in the United States? In 2003, more than half (51%) of the country's 3.9 trillion kilowatthours of electricity used coal as its source of energy.

Natural gas, in addition to being burned to heat water for steam, can also be burned to produce hot combustion gases that pass directly through a turbine, spinning the blades of the turbine to generate electricity. Gas turbines are commonly used when electricity utility usage is in high demand. In 2003, 16% of the nation's electricity was fueled by natural gas.

Petroleum can also be used to make steam to turn a turbine. Residual fuel oil, a product refined from crude oil, is often the petroleum product used in electric plants that use petroleum to make steam. Petroleum was used to generate about three percent (3%) of all electricity generated in U.S. electricity plants in 2003.

Nuclear power is a method in which steam is produced by heating water through a process called nuclear fission. In a nuclear power plant, a reactor contains a core of nuclear fuel, primarily enriched uranium. When atoms of uranium fuel are hit by neutrons they fission (split), releasing heat and more neutrons. Under controlled conditions, these other neutrons can strike more uranium atoms, splitting more atoms, and so on. Thereby, continuous fission can take place, forming a chain reaction releasing heat. The heat is used to turn water into steam, that, in turn, spins a turbine that generates electricity. Nuclear power was used to generate 20% of all the country's electricity in 2003.

Hydropower, the source for almost 7% of U.S. electricity generation in 2003, is a process in which flowing water is used to spin a turbine connected to a generator. There are two basic types of hydroelectric systems that produce electricity. In the first system, flowing water accumulates in reservoirs created by the use of dams. The water falls through a pipe called a penstock and applies pressure against the turbine blades to drive the generator to produce electricity. In the second system, called run-of-river, the force of the river current (rather than falling water) applies pressure to the turbine blades to produce electricity.

Geothermal power comes from heat energy buried beneath the surface of the earth. In some areas of the country, enough heat rises close to the surface of the earth to heat underground water into steam, which can be tapped for use at steam-turbine plants. This energy source generated less than 1% of the electricity in the country in 2003.

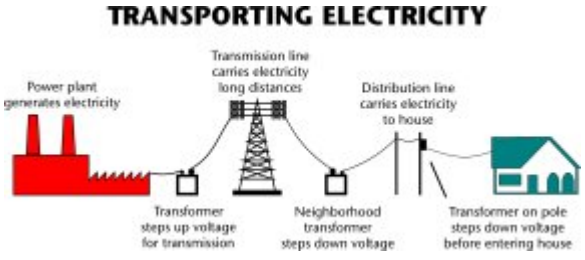
Solar power is derived from the energy of the sun. However, the sun's energy is not available full-time and it is widely scattered. The processes used to produce electricity using the sun's energy have historically been more expensive than using conventional fossil fuels. Photovoltaic conversion generates electric power directly from the light of the sun in a photovoltaic (solar) cell. Solar-thermal electric generators use the radiant energy from the sun to produce steam to drive turbines. In 2003, less than 1% of the nation's electricity was based on solar power.

Wind power is derived from the conversion of the energy contained in wind into electricity. Wind power, less than 1% of the nation's electricity in 2003, is a rapidly growing source of electricity. A wind turbine is similar to a typical wind mill.

Biomass includes wood, municipal solid waste (garbage), and agricultural waste, such as corn cobs and wheat straw. These are some other energy sources for producing electricity. These sources replace fossil fuels in the boiler. The combustion of wood and waste creates steam that is typically used in conventional steam-electric plants. Biomass accounts for about 2% of the electricity generated in the United States.

THE TRANSFORMER - MOVING ELECTRICITY

To solve the problem of sending electricity over long distances, George Westinghouse developed a device called a transformer. The transformer allowed electricity to be efficiently transmitted over long distances. This made it possible to supply electricity to homes and businesses located far from the electric generating plant.



The electricity produced by a generator travels along cables to a transformer, which changes electricity from low voltage to high voltage. Electricity can be moved long distances more efficiently using high voltage. Transmission lines are used to carry the electricity to a substation. Substations have transformers that change the high voltage electricity into lower voltage electricity. From the substation, distribution lines carry the electricity to homes, offices and factories, which require low voltage electricity.

MEASURING ELECTRICITY

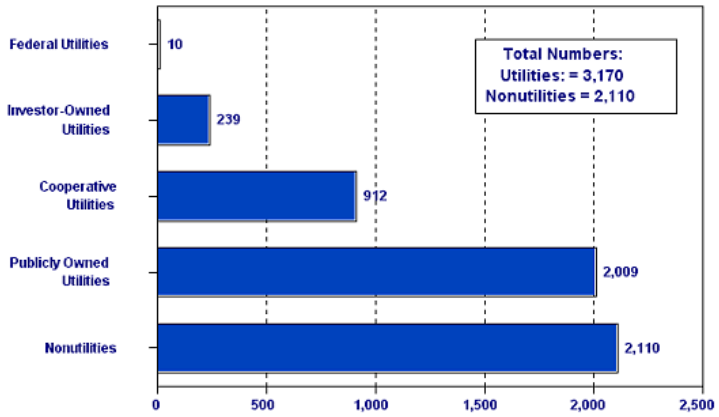
Electricity is measured in units of power called watts. It was named to honor James Watt, the inventor of the steam engine. One watt is a very small amount of power. It would require nearly 750 watts to equal one horsepower. A kilowatt represents 1,000 watts. A kilowatthour (kWh) is equal to the energy of 1,000 watts working for one hour. The amount of electricity a power plant generates or a customer uses over a period of time is measured in kilowatthours (kWh). Kilowatthours are determined by multiplying the number of kW's required by the number of hours of use. For

example, if you use a 40-watt light bulb 5 hours a day, you have used 200 watts of power, or 0.2 kilowatthours of electrical energy.

Electric Power Industry Overview

Electricity is an integral part of life in the United States. It is indispensable to factories, commercial establishments, homes, and even most recreational facilities. Lack of electricity causes not only inconvenience, but also economic loss due to reduced industrial production. Various aspects of the electric power industry are provided in this overview.

Figure 1. Composition of the Electric Power Industry in the United States, 1998



Notes: •Data are final. •Power marketers, Puerto Rico, and U.S. Territories are not included. •Nonutilities represent the number of generating facilities, as these facilities are generally incorporated, and each is required to file Form EIA-860-B.
Source: Energy Information Administration, *Electric Power Annual 1998 Volume II*, page 1.

Traditional Electric Utilities

The more than 3,170 traditional electric utilities in the United States are responsible for ensuring an adequate and reliable source of electricity to all consumers in their service territories at a reasonable cost. Electric utilities include investor-owned, publicly owned, cooperatives, and Federal utilities. Power marketers are also considered electric utilities--these entities buy and sell electricity, but usually do not own or operate generation, transmission, or distribution facilities. Utilities are regulated by local, State, and Federal authorities.

Generally, interstate activities (those that cross State lines) are subject to Federal regulation, while intrastate activities are subject to State regulation. Wholesale rates (sales and purchases between electric utilities), licensing of hydroelectric facilities, questions of nuclear safety and high-level nuclear waste disposal, and environmental regulation are Federal concerns. Approval for most plant and transmission line construction and retail rate levels are State regulatory functions.

State public service commissions have jurisdiction primarily over the large, vertically integrated, investor-owned electric utilities that own more than 75 percent of the Nation's generating and transmission capacity and serve about 75 percent of ultimate consumers. There are 239 investor-owned electric utilities, 2,009 publicly owned electric utilities, 912 consumer-owned rural electric cooperatives, and 10 Federal electric utilities. Approximately 20 States regulate cooperatives, and 7 States regulate municipal electric utilities; many State legislatures, however, defer this control to local municipal officials or cooperative members.

Nonutility Power Producers

The approximately 2,110 nonutility power producers in the United States include:

- facilities that qualify under the Public Utility Regulatory Policies Act of 1978 (PURPA);
- cogeneration facilities that produce steam and electricity, but that are engaged in business activities other than the sale of electricity;
- independent power producers that produce and sell electricity on the wholesale market at nonregulated rates, but do not have franchised service territories; or
- exempt wholesale generators under the Energy Policy Act of 1992 (EPACT).

The U.S. electric power industry is composed of traditional electric utilities, including power marketers, and nonutility power producers.

Traditional Electric Utilities

Consumer Sectors. Utility service territories are geographically distinct from one another. Each territory is usually composed of many different types of consumers. Electricity consumers are divided into classes of service or sectors (residential, commercial, industrial, and other) based on the type of service they receive. Sectorial classification of consumers is determined by each utility and is based on various criteria such as:

- demand levels,
- rate schedules,
- North American Industry Classification System (NAIC) Codes,
- distribution voltage,
- accounting methods,
- end-use applications, and
- other social and economic characteristics.

Electric utilities use consumer classifications for planning (for example, load growth and peak demand) and for determining their sales and revenue requirements (costs of service) in order to derive their rates. Utilities typically employ a number of rate schedules for a single sector. The alternative rate schedules reflect consumers' varying consumption levels and patterns and the associated impact on the utility's costs of providing electrical service. Reclassification of consumers, usually between the commercial and industrial sectors, may occur from year to year due to changes in demand level, economic factors, or other factors.

The residential sector includes private households and apartment buildings where energy is consumed primarily for:

- space heating,
- water heating,
- air conditioning,
- lighting,
- refrigeration,
- cooking, and
- clothes drying.

The commercial sector includes nonmanufacturing business establishments such as:

- hotels,
- motels,
- restaurants,
- wholesale businesses,
- retail stores, and
- health, social, and educational institutions.

Sometimes the commercial sector includes small manufacturing facilities as well.

The industrial sector includes:

- manufacturing,
- construction,
- mining,
- agriculture,
- fishing, and
- forestry establishments.

An electric utility may classify commercial and industrial consumers based on either NAIC codes or demand and/or usage falling within specified limits, set by the electric utility based on different rate schedules.

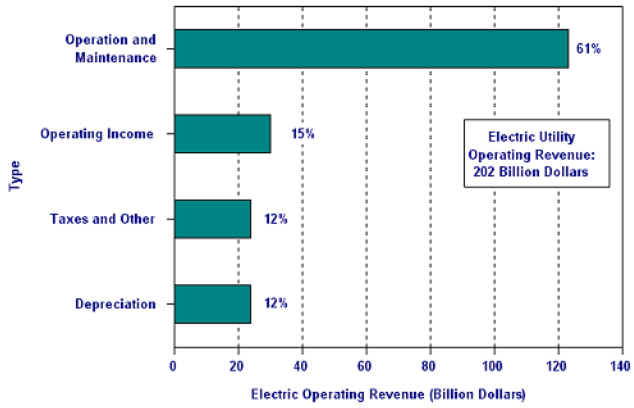
The other sector includes:

- public street and highway lighting,
- railroads and railways,
- municipalities,
- divisions or agencies of State and Federal Governments under special contracts or agreements, and other utility departments, as defined by the pertinent regulatory agency and/or electric utility.

Revenue. The revenue associated with sales to ultimate consumers is the operating revenue reported by the utility. Operating revenue includes energy charges, demand charges, consumer service charges, environmental surcharges, fuel adjustments, and other miscellaneous charges. Among other costs of service, utility operating revenues include State and local taxes, Federal income taxes, and other taxes paid by the utility. State and local authorities tax the value of plants (property taxes), the amount of revenues (gross receipts taxes), purchases of materials and services (sales and use taxes), and a potentially long list of other items that vary extensively by taxing authority. Federal taxes are for the most part "payroll" taxes. Taxes deducted from employees' pay, such as Federal income taxes and employees' share of Social Security taxes are not a part of the utility's "tax costs," but are paid to the taxing authorities in the name of the employees. These taxes are included in the electric utility's costs of service (for example, revenue requirements) and are included in the amounts recovered from consumers in rates and reported in operating revenues.

Electric utilities, like other business enterprises, are required by various taxing authorities to collect and remit taxes assessed on their consumers. In this regard, the utility serves as an agent for the taxing authority. Taxes assessed on consumers, such as sales taxes, are called "pass through" taxes. These taxes do not represent a cost to the utility and are not recorded in the operating revenues of the utility. However, taxing authorities differ on whether a specific tax is assessed to the utility or to the consumer, a difference that in turn determines whether or not the tax is included in the electric utility's operating revenues.

Figure 2. Allocation of the Revenue Dollar from Electric Operations for Major U.S. Investor-Owned Electric Utilities, 1998

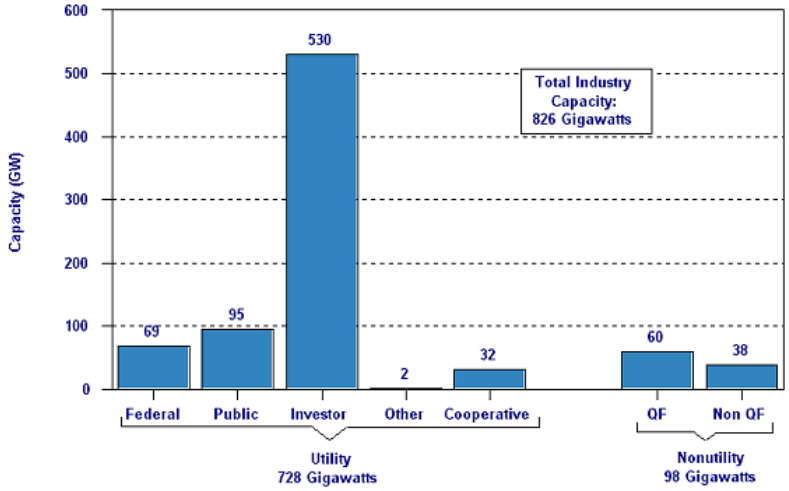


Notes: •Depreciation includes amortization and depletion. •Totals may not equal sum of components because of independent rounding. •Data are preliminary. • The 1998 data are edited by Navigant Consulting, Inc.
Source: Energy Information Administration, *Electric Power Annual 1998 Volume II*, page 29.

Average Revenue per Kilowatthour (Price). Average revenue per kilowatthour is defined as the cost per unit of electricity sold (a reasonable proxy for price) and is calculated by dividing retail electric revenue by the corresponding sales of electricity. The average revenue per kilowatthour is calculated for all consumers and for each sector (residential, commercial, industrial, and other). The average revenue per kilowatthour discussed in this primer represents a weighted average of consumer revenue and sales within each sector and across sectors for all consumers. Average revenue per kilowatthour is affected by changes in the rate schedules used by the electric utilities and by changes in the volume of electricity sales. Because fixed charges remain constant regardless of the volume of sales, average revenue per kilowatthour decreases as the volume of sales increases. A change in average revenue per kilowatthour may occur when the volume of electricity sales changes (because of an increase/decrease in the use of electricity by individual consumers or an increase/decrease in the number of ultimate consumers) across all sectors or within a specific sector. Generally, the rate schedules used by electric utilities are designed so that as the volume of sales increases, the revenue increases at a slower rate, lowering the average revenue per kilowatthour. Average revenue per kilowatthour is also affected by class of utility ownership and by class of service (sector).

Classes of Ownership. The electric utility industry in the United States includes 3,170 investor-owned, publicly owned, cooperative, and Federal electric utilities. Historically, investor-owned electric utilities have been most successful in serving large, consolidated markets where economies of scale afford the lowest prices. However, publicly owned, cooperative, and Federal electric utilities all have a role in producing, transmitting, and distributing electricity.

Figure 3. Electric Industry Generating Nameplate Capacity by Type, 1998



Source: Energy Information Administration, • Utility: *Inventory of Electric Utility Power Plants in the United States 1999*, Table E3, page 344; • Nonutility: *Electric Power Annual 1998 Volume II*, Table 55, page 91.

Investor-owned electric utilities are privately owned entities. They represent 8 percent of the total number of electric utilities and approximately 75 percent of electric utility generating capability, generation, sales, and revenue in the United States. Like all private businesses, investor-owned electric utilities have the fundamental objective of producing a return for their investors. These utilities either distribute profits to stockholders as dividends or reinvest the profits. Investor-owned electric utilities are granted service monopolies in certain geographic areas and are obliged to serve all consumers. As franchised monopolies, these utilities are regulated and required to charge reasonable prices, to charge comparable prices to similar classifications of consumers, and to give consumers access to services under similar conditions. Most investor-owned electric utilities are operating companies that provide basic services for the generation, transmission, and distribution of electricity. The majority of investor-owned utilities perform all three functions. They operate in all States except Nebraska, where electric utilities consist primarily of municipal systems and public power districts.

Publicly owned electric utilities are nonprofit local government agencies established to provide 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,
- State authorities,
- irrigation districts, 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 United States. They represent about 63 percent of the number of electric utilities, supply approximately 10 percent of generation and generating capability, and account for about 15 percent of retail sales and 14 percent of revenue. They obtain their financing from municipal treasuries and from revenue bonds secured by proceeds from the sale of electricity. Public power districts and projects are concentrated in Nebraska, Washington, Oregon, Arizona, and California. Voters in a public utility district elect commissioners or directors to govern the district independent of any municipal government. State authorities, like the Power Authority of the State of New York or the South Carolina Public Service Authority, are agencies of their respective State governments. Irrigation districts may have other forms of organization. In the Salt River Project in Arizona, for example, votes for the board of directors are apportioned according to the size of landholdings.

Cooperative electric utilities are owned by their members and established to provide electricity to those members. These electric utilities operate in rural areas with low concentrations of consumers because these areas historically have been viewed as uneconomical operations for investor-owned utilities. There are 912 cooperatives operating in 47 States; none operate in Connecticut, Hawaii, Rhode Island, or the District of Columbia. Cooperative electric utilities represent about 29 percent of U.S. electric utilities, 9 percent of sales and revenue, and around 4 percent of generation and generating capability. Cooperatives are incorporated under State laws and are usually directed by an elected board of directors, which in turn selects a manager. The Rural Utilities Service (formerly the Rural Electrification Administration), the National Rural Utilities Cooperative Finance Corporation, the Federal Financing Bank, and the Bank for Cooperatives are important sources of debt financing for cooperatives.

The 10 Federal electric utilities in the United States are part of several agencies in the U.S. Government:

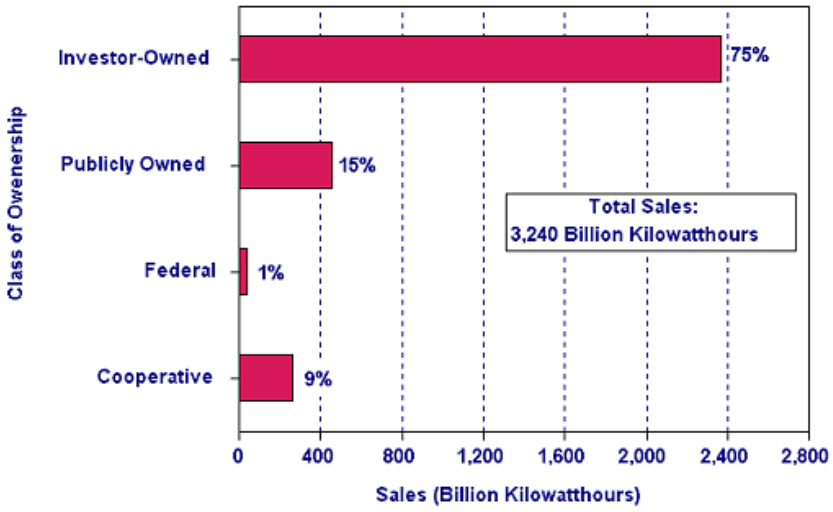
- the Army Corps of Engineers in the Department of Defense,
- the Bureau of Indian Affairs and the Bureau of Reclamation in the Department of the Interior,
- the International Boundary and Water Commission in the Department of State,
- the Power Marketing Administrations in the Department of Energy (Bonneville, Southeastern, Southwestern, and Western Area), and
- the Tennessee Valley Authority (TVA).

Three Federal agencies operate generating facilities:

- TVA, the largest Federal producer;
- the U.S. Army Corps of Engineers; and
- the U.S. Bureau of Reclamation.

The TVA markets its own power while generation by the U.S. Army Corps of Engineers (except for the North Central Division, for example, Saint Mary's Falls at Sault Ste. Marie, Michigan) and the U.S. Bureau of Reclamation is marketed by the Federal power marketing administrations: Bonneville, Southeastern, Southwestern, and Western Area. The four power marketing administrations also purchase energy for resale from other electric utilities in the United States and Canada. Alaska, the fifth power marketing administration, owned and operated two hydropower facilities (Eklutna and Snettisham). On November 28, 1995, President Clinton signed a bill authorizing the sale of these projects. Final transfer of title to the State of Alaska and three Alaskan utilities occurred August 1998 after which the Alaska Power Administration ceased to exist. Federal electric utilities represent less than 1 percent of all electric utilities, provide approximately 10 percent of all generating capability and generation, and account for about 1 percent of total sales to ultimate consumers and less than 1 percent of the associated revenue. Federal electric utility generation 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 the power plants are Federal hydroelectric projects initially designed for flood control and irrigation purposes.

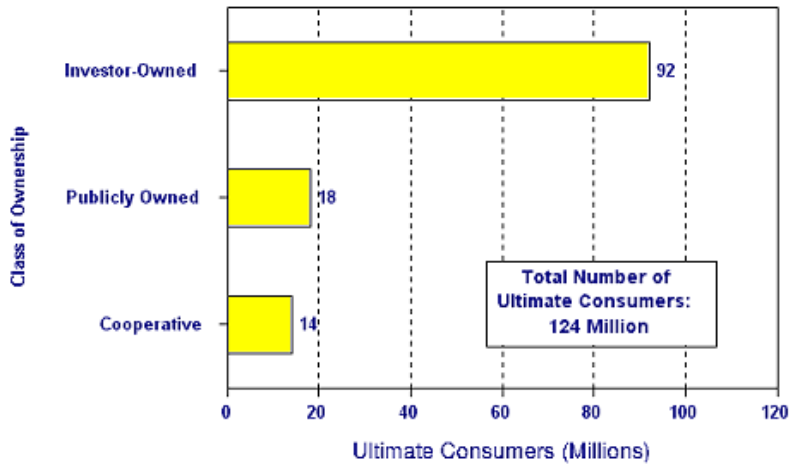
Figure 4. U.S. Electric Utility Sales to Ultimate Consumers by Class of Ownership, 1998



Notes: •Data are final. •Totals may not equal sum of components because of independent rounding.

Source: Energy Information Administration, *Electric Power Annual 1998 Volume II*, page 7."

Figure 5. Number of Ultimate Consumers Served by U.S. Electric Utilities by Class of Ownership, 1998

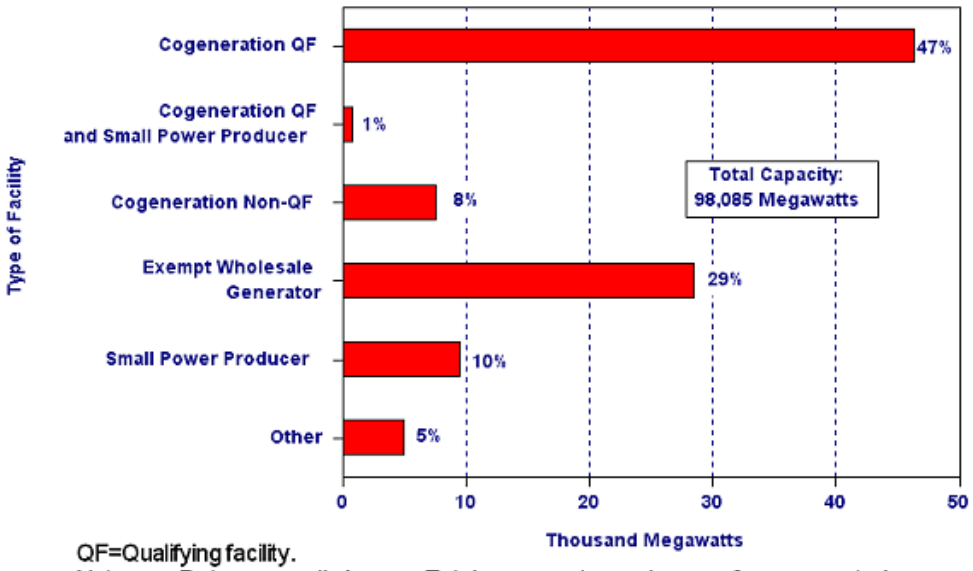


Notes: •Data are final. •The number of ultimate consumers served by Federal electric utilities is approximately 34,000. The number of ultimate consumers is an average of the number of consumers at the close of each month. •Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, *Electric Power Annual 1998 Volume II*, Table 5, page 20.

Nonutility Power Producers

Figure 6. Installed Capacity at U.S. Nonutility Generating Facilities by Type of Facility, 1998



QF=Qualifying facility.

Notes: • Data are preliminary. •Totals may not equal sum of components because of independent rounding.

Source: Energy Information Administration, *Electric Power Annual 1998 Volume II*, page 11.

Qualifying Facilities. PURPA facilitated the emergence of a group of nonutility electricity-generating companies called qualifying facilities or QFs. Under PURPA, small power producers and cogenerators receive status as a QF by meeting certain requirements for ownership, operating methods, and efficiency. Those requirements were established by the Federal Energy Regulatory Commission (FERC).

Cogenerators. Facilities which produce electricity and another form of useful thermal energy through the sequential use of energy (usually heat or steam for industrial processes or heating/cooling purposes) are called cogenerators--many of which have status as QFs. Cogenerators

are primarily engaged in business activities (such as, agriculture, mining, manufacturing, transportation, education). The electricity that they do generate is mainly for their own use, but any excess is sold to the host utility.

Independent Power Producers. These facilities (known as IPPs) must use renewable energy as a primary source for generation of electricity. IPPs operate within the franchised territories of host utilities. They do not possess transmission facilities or sell electricity on the retail market (that is, all their sales are wholesale or sales for resale). By definition, a facility that has QF status is not an IPP.

Exempt Wholesale Generators. EPACT modified the Public Utility Holding Company Act (PUHCA) and created another class of nonutility power producers: exempt wholesale generators (EWGs). EPACT exempted EWGs from the corporate and geographic restrictions imposed by PUCHA. With this modification, public utility holding companies are allowed to develop and operate independent power projects anywhere in the world.

Electric Power Versus Electric Energy

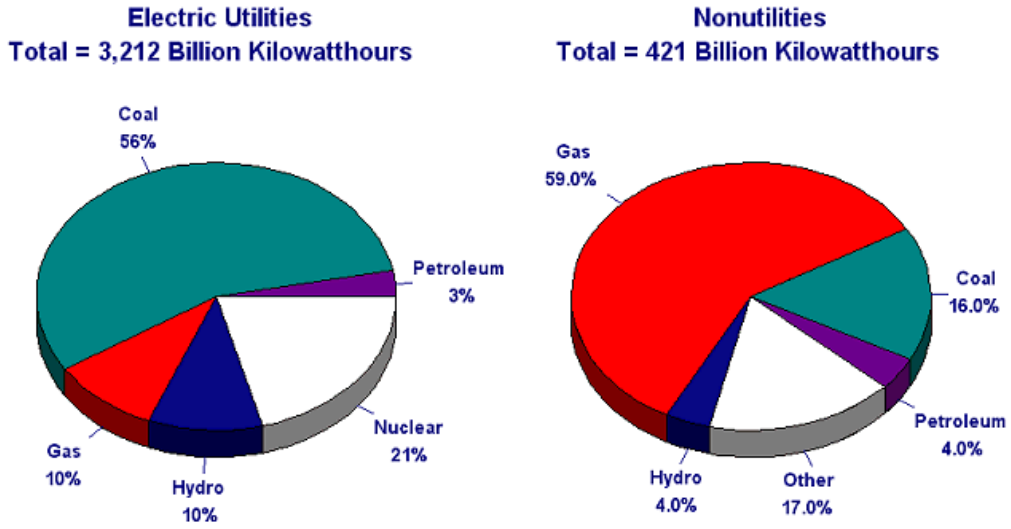
Electric power is the rate at which electricity does work--measured at a point in time, that is, with no time dimension. The unit of measure for electric power is a watt. The maximum amount of electric power that a piece of electrical equipment can accommodate is the capacity or capability of that equipment.

Electric energy is the amount of work that can be done by electricity. The unit of measure for electric energy is a watthour. Electric energy is measured over a period of time and has a time dimension as well an an energy dimension. The amount of electric energy produced or used during a specified period of time by a piece of electrical equipment is referred to as generation or consumption.

Energy Sources Used To Generate Electricity

Various sources of energy can be converted into electric energy or electricity. The major or dominant sources include fossil fuels, uranium, and water.

Figure 7. Electric Power Industry Generation by Energy Source, 1998



Notes: "Other" energy sources include geothermal, wind, biomass, solar thermal, and photovoltaic. See text for a list of biomass sources. For utilities, "other" energy sources contribute less than 1 percent. For nonutilities, there are no nuclear units.

Source: Energy Information Administration, *Electric Power Annual 1998 Volume II*, Table 1, pages 12-13.

Fossil fuels supply about 70 percent of the energy sources for the generation requirements of the Nation. Coal, petroleum, and gas are currently the dominant fossil fuels used by the industry. Other sources of energy can also be converted into electricity, including:

- geothermal energy,
- solar thermal energy,
- photovoltaic energy, and
- biomass, includes
    - wood,
    - wood waste,
    - peat,
    - wood liquors,
    - railroad ties,
    - pitch,
    - wood sludge,
    - municipal solid waste,
    - agricultural waste,
    - straw,
    - tires,
    - landfill gases,
    - fish oils, and
    - other waste materials.

Environmental Aspects

When fossil fuels are burned to generate electricity, a variety of gases and particulates are formed. If these gases and particulates are not captured by some pollution control equipment, they are released into the atmosphere. This overview provides a brief summary of the gaseous emissions from U.S. electric utilities and the methods employed to reduce or eliminate their release into the atmosphere. Among the gases emitted during the burning of fossil fuels are sulfur dioxide (SO2), nitrogen oxides (NOx), and carbon dioxide (CO2).

Electric Power Transactions & The Interconnected Networks

Power Transactions

An electric power system is a group of generation, transmission, distribution, communication, and other facilities that are physically connected and operated as a single unit under one control. The flow of electricity with the system is maintained and controlled by dispatch centers. It is the responsibility of the dispatch center to match the supply of electricity with the demand for it. In order to carry out its responsibilities, the dispatch center is authorized to buy and sell electricity based on system requirements. Authority for those transactions has been preapproved under interconnection agreements signed by all the electric utilities physically interconnected or with coordination agreements among utilities that are not connected.

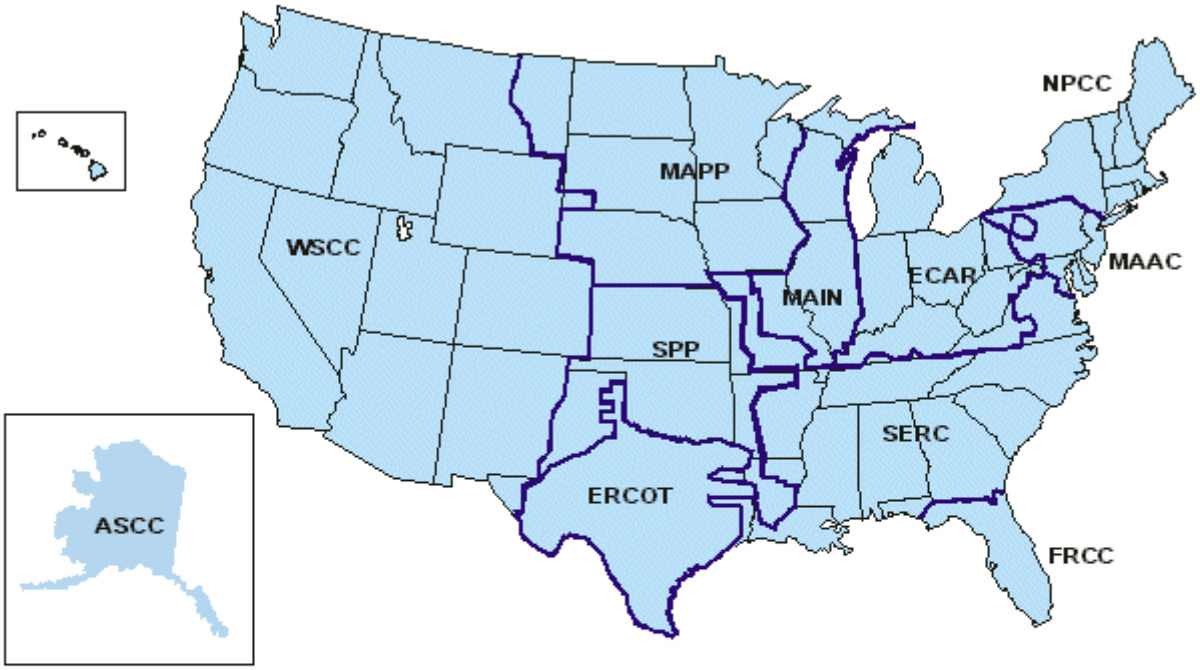
The Interconnected Networks

The U.S. bulk power system has evolved into three major networks (power grids), which also include smaller groupings or power pools. The major networks consist of extra-high-voltage connections between individual utilities designed to permit the transfer of electrical energy from one part of the network to another. These transfers are restricted, on occasion, because of a lack of contractual arrangements or because of inadequate transmission capability. The three networks are:

- the Eastern Interconnected System,
- the Western Interconnected System, and
- the Texas Interconnected System.

The Texas Interconnected System is not interconnected with the other two networks (except by certain direct current lines). The other two networks have limited interconnections to each other. Both the Western and the Texas Interconnect are linked with different parts of Mexico. The Eastern and Western Interconnects are completely integrated with most of Canada or have links to the Quebec Province power grid. Virtually all U.S. utilities are interconnected with at least one other utility by these three major grids. The exceptions are in Alaska and Hawaii. The interconnected utilities within each power grid coordinate operations and buy and sell power among themselves. The bulk power system makes it possible for utilities to engage in wholesale (for resale) electric power trade. Wholesale trade has historically played an important role, allowing utilities to reduce power costs, increase power supply options, and improve reliability. Historically, almost all wholesale trade was within the National Electric Reliability Council (NERC) regions, but utilities are expanding wholesale trade beyond those traditional boundaries. U.S. international trade is mostly imports. Normally, most imports are from Canada and the remainder are from Mexico.

Figure 8. North American Electric Reliability Council Regions for the Contiguous United States, Alaska and Hawaii



ECAR - East Central Area Reliability Coordination Agreement
ERCOT - Electric Reliability Council of Texas
FRCC - Florida Reliability Coordinating Council
MAAC - Mid-Atlantic Area Council
MAIN - Mid-America Interconnected Network
MAPP - Mid-Continent Area Power Pool
NPCC - Northeast Power Coordinating Council
SERC - Southeastern Electric Reliability Council
SPP - Southwest Power Pool
WSCC - Western Systems Coordinating Council

Note: The Alaska Systems Coordinating Council (ASCC) is an affiliate NERC member.
Source: North American Electric Reliability Council.

Overall reliability planning and coordination of the interconnected power systems are the responsibility of NERC, which was voluntarily formed in 1968 by the electric utility industry as a result of the 1965 power failure in the Northeast. NERC's nine regional councils cover the 48 contiguous States, part of Alaska, and portions of Canada and Mexico. The councils are responsible for overall coordination of bulk power policies that affect the reliability and adequacy of service in their areas. They also regularly exchange operating and planning information among their member utilities. The boundaries of the NERC regions follow the service areas of the electric utilities in the region, many of which do not follow State boundaries. At present, the industry is in transition. Steady progress toward competitive wholesale markets for electric power recently has been accelerated by FERC Order 888, which opens access to transmission lines and encourages greater wholesale trade.

The Changing Electric Power Industry

The electric power industry is evolving from a highly regulated, monopolistic industry with traditionally structured electric utilities to a less regulated, competitive industry. PURPA opened up competition in the generation market with the creation of qualifying facilities. EPACT removed some constraints on ownership of electric generation facilities and encouraged increased competition in the wholesale electric power business.

The EPACT amended the Federal Power Act (FPA) such that any electric utility can apply to the FERC for an order requiring another electric utility to provide transmission services (wheeling). Prior to EPACT, the FERC could not mandate that an electric utility provide wheeling services for wholesale electric trade. This change in the law permits owners of electric generating equipment to sell wholesale power (sales for resale) to noncontiguous utilities.

In April 1996, the FERC issued two final rules, 888 and 889, implementing EPACT's provisions for open access to transmission lines. Rule 888 addresses equal access to the transmission grid for all wholesale buyers and sellers, transmission pricing, and the recovery of stranded costs. Stranded costs are investments, mostly in generation, made by utilities under the regulated environment that are presently recovered in cost-based rate structures and may not be recoverable in a competitive environment with market-based rates. Rule 889 requires jurisdictional utilities that own or operate transmission facilities to establish electronic systems to post information about their available transmission capacities.

In response to these rulemakings, utilities are proposing to form Independent System Operators (ISOs) to operate the transmission grid, regional transmission groups, and open access same-time information systems (OASIS) to inform competitors of available capacity on their lines. The provision for open transmission access in EPACT has also facilitated the creation of new participants in the electric power industry, power marketers and power brokers. Power marketers are entities engaged in buying and selling wholesale electricity and fall under the jurisdiction of the FERC, since they take ownership of electricity and are engaged in interstate trade. Power brokers, who do not take ownership of electricity, are not regulated by the FERC. A growing number of power marketers have filed with the FERC and had rates approved. Power marketers generally do not own generation or transmission facilities or sell power to retail customers. However, continuing deregulation of the industry is allowing power marketers the possibility of entering retail electricity markets.

Many State legislatures and the Congress are considering legislation that will allow competition in retail sales of electric power. In 1996, Rhode Island and California passed bills that will allow end-use customers in their States to choose among competitive generation suppliers. The plans allowed retail choice for some consumers as early as 1997, and will phase in retail choice for all consumers by 2001. Transmission and distribution will remain regulated functions with rules to assure open access to lines for all competitors. Pilot programs for retail wheeling are underway in New Hampshire and at major utilities in several States. This interest in retail competition points to an increasingly competitive electric power industry. Presently, electric rates are based on embedded historical costs. Future electric rates are likely to be dynamic, reflecting the current cost of providing service. In a competitive environment, unbundling of electric power services and pricing that reflects time-of-day and seasonal variations may become more common. Continuing deregulation at both Federal and State levels is transforming the historically monopolistic electric power industry into a competitive industry that will eventually increase competition in its generation and service components, and change the nature of the way electricity is priced, traded, and marketed in the United States.