A Selected Timeline of U.S. Energy

This history of energy in the United States is deeply interwoven with technology, economics, political policies, consumer concerns, and worldwide events. Sources of energy both compete with, and complement, each other depending on the prevailing circumstances. This is a brief outline of key dates and events marking America's development of various sources of energy. Use this as a guide. More comprehensive histories are available for each of these categories.

Coal

1673–74: The first record of coal in the United States was shown on a map prepared by Louis Joliet. The map notes charbon de terra (coal of the earth) along the Illinois River in northern Illinois.

1701: Coal was discovered near Richmond, Virginia.

1736: The location of several "cole mines" were recorded on a map. The mines were located along the upper Potomac River, near what is now the border of Maryland and West Virginia.

1748: The first commercial U.S. coal production began near Richmond, Virginia.

1750s: Coal was reported in Pennsylvania, Ohio, Kentucky, and what is now the state of West Virginia.

1758: The first commercial coal shipment in the United States was recorded.

1762: Pennsylvania's anthracite deposits were found. Coal was used to manufacture shot, shell, and other military materials.

1769: James Watt patented the modern-day steam engine. Coal was used to produce steam for early steam engines.

1800s: Coal became the principal fuel used by steam-powered trains (locomotives). As the railroads branched into the coal fields, they became a vital link between mines and markets.

1816: Baltimore, Maryland, became the first city to light streets with gas made from coal.

1866: The practice of strip-mining (mining in strips of land) began near Danville, Illinois. Horse-drawn plows and scrapers were used to remove the top layer of dirt or rocks so that the coal could be dug and hauled away.

1875: Coal coke replaced charcoal as the chief fuel for iron-blast furnaces.

1877: A steam-powered shovel excavated some 10 feet of overburden (earth covering a coal deposit) from a 3-foot-thick coal bed near Pittsburg, Kansas.

1880s: Coal-cutting machines became available (before that, coal was mined underground by hand).

1882: The first practical coal-fired electric generating station, developed by Thomas Edison, went into operation in New York City to supply electricity for household lights.

1907: 362 men and young boys were killed in an underground explosion at the Monongah Mine in West Virginia.

This was the worst mining accident in United States history.

1910: The U.S. Bureau of Mines was created to help reduce accidents in mines.

1940: Surface mining with auger machines was introduced.

1950s: Most coal was used by industry. Many homes were still heated by coal. Coal was used by steam-driven trains and ships.

1960s: Most coal was used for generating electricity. (Today, more than 90% of coal is used for electricity generation.)

1971: Surface mines replaced underground mines as the leading source of coal produced in the United States. The importance of surface mining has continued to grow since that time.

1973–74: The OPEC oil embargo focused attention on the energy crisis and resulted in an increase in demand for U.S. coal.

1977: The Surface Mining Control and Reclamation Act of 1977 was passed by Congress. The purpose of the Act was to reduce the environmental impact of surface mining. The Act required surface mines no longer being used to be "reclaimed" or restored to their natural state.

1980: The National Acid Precipitation Assessment Program (NAPAP) study began. Industries spent over $1 billion on air pollution control equipment.

1986: The Clean Coal Technology Act passed.

1988: Wyoming displaced Kentucky as the leading coal-producing state.

1990: United States coal production topped 1 billion tons a year.

2003: The United States sponsored a $1 billion, 10-year demonstration project to create the world's first coal-based, zero-emissions electricity and hydrogen power plant.

2005: Congress passed the Energy Policy Act of 2005, promoting the use of coal through clean coal technologies.

2013: Electricity from power plants increasingly relies on natural gas rather than coal. This shift is due in part to cost and in part to environmental concerns.

Oil

1859: Although the use of oil in Europe and China dates back centuries, oil in America was first discovered when a homemade rig drilled down 70 feet and came up coated with oil. This rig was near Titusville (in northwestern Pennsylvania) and was owned by "Colonel" Edwin L. Drake.

1890s: Mass production of automobiles began creating demand for gasoline. Before this, kerosene used for heating had been the main oil product.

1920: With 9 million automobiles in the United States, gas stations were opening everywhere.

1950–present: With the growing use of automobiles, oil became our most used energy source .

1960: The Organization of Petroleum Exporting Countries (OPEC) was formed by Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela. The group has since grown to include 11 member countries.

1970: Production of petroleum (crude oil and natural gas plant liquids) in the U.S. lower 48 states reached its highest level at 9.4 million barrels per day. Production in these contiguous states has been declining ever since.

1973: Referred to as the Arab Oil Embargo, several Arab OPEC nations embargoed, or stopped selling, oil to the United States and Holland to protest their support of Israel in the Arab-Israeli "Yom Kippur" War. Later, the Arab OPEC nations added South Africa, Rhodesia, and Portugal to the list of countries that were embargoed. Arab OPEC production was cut by 25 percent, causing some temporary shortages and the tripling of oil prices. Some filling stations ran out of gasoline, and cars had to wait in long lines for gasoline.

1973: In reaction to the Arab Oil Embargo of 1973, Congress passed laws that tried to protect consumers from gasoline shortages and high prices. The price controls of the Emergency Petroleum Allocation Act of 1973 were generally considered a failure, and they were later repealed.

1975: Congress passed the Energy Policy and Conservation Act of 1975 aimed at increasing oil production by giving price incentives. This act also created the Strategic Petroleum Reserve (SPR) and required an increase in the fuel efficiency (miles per gallon) of automobiles.

1978–80: The Iranian Revolution, which began in late 1978, resulted in a drop of 3.9 million barrels per day of crude oil production from Iran from 1978 to 1981. At first, other OPEC countries made up for the drop in Iranian production. In 1980, the Iran-Iraq War began, and many Persian Gulf countries reduced output as well. By 1981, OPEC production was about one-fourth lower than it had been in 1978, and prices had doubled.

1980–85: OPEC kept prices high by producing less oil. Saudi Arabia acted as a "swing producer," cutting more production than any other OPEC country. But high prices caused less oil to be used. For example, cars became smaller, using less gasoline. The drop in oil consumption meant that less oil needed to be produced. Thus, oil production from Saudi Arabia fell from 9.9 million barrels per day in 1980 to 3.4 million barrels per day in 1985.

1981: The U.S. Government responded to the oil crisis of 1978-1980 by removing price and allocation controls on the oil industry. For the first time since the early 1970s, market forces (supply and demand) set domestic crude oil prices.

1986: In 1986, Saudi Arabia stopped holding back production, and other OPEC members increased production. This caused an oil glut, and prices were almost cut in half. Oil consumption grew quickly in the late 1980s because prices remained low.

1988: Alaska's production at Prudhoe Bay peaked at 2.0 million barrels per day and fell to 1.0 million barrels per day in 1999. By then, U.S. total output had dropped to 7.8 million barrels per day, 31% below its peak.

1990–91: Iraq invaded Kuwait on August 2, 1990, causing crude oil and product prices to rise suddenly and sharply. Prices rose even higher when the United Nations (UN) limited the amount of oil that could be purchased from these countries. Between the end of July and August 24, 1990, the world price of crude oil climbed from about $16 per barrel to more than $28 per barrel. The price rose even higher in September, reaching about $36 per barrel. As UN troops began seeing military successes in Iraq, concerns about long-term supply problems were eased and oil prices dropped again.

1990: The Clean Air Act Amendments of 1990 required many changes to gasoline and diesel fuels to make them pollute less. The use of these cleaner fuels was phased-in during the 1990s. Since 1995, "reformulated" gasoline has been used in places with the worst pollution problems.

Since 1993: For the first time, the United States imported more oil and refined products from other countries than it produced — owing to growing petroleum demand and declining U.S. production.

1997–98: The Asian financial crisis that occurred in 1997 had worldwide economic effects. As the Asian economies shrank, their demand for petroleum products declined. The slow demand for petroleum, along with the reluctance of OPEC to cut its production quotas, led to the plummet of oil prices in 1998.

2001: The nation's petroleum production measured an average of 11.0 barrels of oil per day per well, 41% below the 1972 peak. U.S. petroleum consumption reached 19.7 million barrels per day, an all-time high. Of every 10 barrels of petroleum consumed in the United States, more than 4 barrels were consumed in the form of motor gasoline. The transportation sector alone accounted for two-thirds of all petroleum used in the United States. To meet demand, crude oil and petroleum products were imported at the rate of 11.9 million barrels per day, while exports measured 1.0 million barrels per day. Net imports (imports minus exports) of crude oil and petroleum products more than doubled between 1985 and 2001. The five leading suppliers of petroleum to the United States that year were Canada, Saudi Arabia, Venezuela, Mexico, and Nigeria.

2005: The record-setting hurricane season of 2005 caused massive damage to the U.S. petroleum and natural gas infrastructure. The Gulf of Mexico, one of the nation's largest sources of oil and gas production, was dealt a one-two punch by Hurricanes Katrina and Rita during August and September. The Energy Policy Act of 2005 was passed. It required increased use of renewable fuels for transportation and new measures to reduce pollution from gasoline and diesel. Gasoline prices broke $3.00 per gallon for the first time.

2006: Refineries began using more ethanol, a renewable fuel, in response to the Energy Policy Act.

2008: For the first time, crude oil price broke $100 per barrel and gasoline prices broke $4.00 per gallon.

2010: On April 20, 2010, an explosion and fire occurred on the offshore drilling rig Deepwater Horizon, which had been drilling an exploratory well in the Gulf of Mexico. The accident killed 11 crewmembers and left oil leaking from the unfinished well into the ocean for months. On May 27, 2010, Secretary of the Interior Salazar announced a 6-month hold or "moratorium" on deepwater drilling.

2014: The use of hydraulic fracturing, of "frakking," is significantly increasing the supply of domestic oil from already known reserves. This, in turn, is reducing the dependence on foreign oil. Projections suggest the U.S. could become an oil exporting nation within 30 years.

Electricity

1752: Ben Franklin tied a key to a kite string during a thunderstorm, and proved that static electricity and lightning were the same thing.

1800: Alessandro Volta (Italy) invented the first electric battery. The term volt is named in his honor.

1808: Sir Humphry Davy (England) invented the first effective lamp. The arc lamp was a piece of carbon that glowed when connected by wires to a battery.

1821: Michael Faraday (England) discovered the principle of electro-magnetic rotation that would later be the key to developing the electric motor.

1826: Georg Ohm (Germany) defined the relationship between power, voltage, current and resistance in Ohms Law.

1831: Using his invention the induction ring, Michael Faraday (England) proved that electricity can be induced (made) by changes in an electromagnetic field. Faraday's experiments about how electric current works led to the understanding of electrical transformers and motors.

1832: Using Faraday's principles, Hippolyte Pixii (France) built the first dynamo, an electric generator capable of delivering power for industry. Pixii's dynamo used a crank to rotate a magnet around a piece of iron wrapped with wire.

1835: Joseph Henry (United States) invented the electrical relay, which could send electrical currents long distances.

1837: Thomas Davenport (United States) invented the electric motor, an invention that is used in most electrical appliances today.

1844: Samuel Morse (United States) invented the electric telegraph, a machine that could send messages long distances across wires.

1876: Charles Brush (United States) invented the open coil dynamo (or generator) that could produce a steady current of electricity.

1879: After many experiments, Thomas Edison (United States) invented an incandescent light bulb that could be used for about 40 hours without burning out. By 1880, his bulbs could be used for 1,200 hours. Electric lights (Brush arc lamps) were first used for public street lighting in Cleveland, Ohio. California Electric Light Company, Inc. in San Fransisco was the first electric company to sell electricity to customers.

1882: Thomas Edison opened the Pearl Street power station in New York City. The power station was one of the world's first central electric power plants and could power 5,000 lights. It used a direct current (DC) power system, unlike the power systems that we use today which use alternating current (AC). The first hydroelectric station opened in Wisconsin. Edward Johnson first put electric lights on a Christmas tree.

1883
Nikola Tesla (U.S. immigrant from Austrian Empire) invented the Tesla coil, a transformer that changed electricity from low voltage to high voltage, making it easier to transport over long distances.

1888: Tesla demonstrated the first polyphase alternating current (AC) electrical system. His AC system included all units needed for electricity production and use: generator, transformers, transmission system, motor (used in appliances) and lights. George Westinghouse, the head of Westinghouse Electric Company, bought the patent rights to the AC system. Charles Brush (United States) was the first to use a large windmill to generate electricity. He used the windmill to charge batteries in the cellar of his home in Cleveland, Ohio.

1895–96: The Niagara Falls hydropower station opened. It originally provided electricity to the local area. One year later, when a new alternating current (AC) powerline was opened, electric power from Niagara Falls was sent to customers over 20 miles away in Buffalo, New York.

1903: The world's first all turbine station opened in Chicago.

1908: J. Spangler (United States) invented the first electric vacuum cleaner.

1911: W. Carrier (United States) invented electric air conditioning.

1913: A. Goss invented the electric refrigerator.

1920: The Federal Power Commission (FPC) was established for licensing hydroelectric projects.

1921: Lakeside Power Plant in Wisconsin became the world's first power plant to burn only pulverized coal.

1933: The Tennessee Valley Authority (TVA) was created. It was the first Federal power authority and was designed to provide regional power.

1935: Some of the New Deal legislation passed during the Roosevelt Administration was designed to regulate public utilities and to bring electricity to rural America. The Public Utility Holding Company Act of 1935, which was designed to break up powerful holding companies that had bought up many smaller electric companies. Creation of the Securities and Exchange Commission

1936: Boulder (later renamed Hoover) Dam was completed. A 287 kilovolt power line stretched 266 miles from the dam in Boulder City, Nevada, to Los Angeles, California. The Rural Electrification Act of 1936 was aimed at bringing electricity to farms across the country.

1942: Owing to rural electrification, almost half of American farms had electricity, compared with 11 percent in

1950: Almost all American farms had electricity.

1954: The Atomic Energy Act of 1954 was passed. It allowed private ownership of nuclear reactors. Chaplin, Fuller, and Pearson (United States) working for Bell Labs, invented the first solar cell.

1957: The Shippingport reactor in Pennsylvania was the first nuclear power plant to provide electricity to customers in the United States.

1961: The first commercially available integrated circuits were produced by the Fairchild Semiconductor Corporation (United States). All computer manufacturers started using chips instead of the individual transistors and their accompanying parts.

1962: The Communications Satellite Act of 1962 encouraged the development of satellite communications. Steve Russell (United States) invented Spacewar! — the first game intended for computer use.

1964: International Business Machines Corporation (now IBM) used light emitting diodes (LEDs) on circuit boards in an early mainframe computer.

1972: The arcade game Pong was created by Nolan Bushnell.

1973: Scelbi, the first personal computer, designed by Nate Wadsworth and Bob Findley (United States), came with 1K of programmable memory, with an additional 15K of memory available. Dr. Martin Cooper (United States) invented the first portable handset phone.

1976: The first commercial fiber optic cable is installed in Chicago for telephone signals.

1977: The first network of automated teller machines (ATMs) was developed.

1998: Ericsson, IBM, Intel, and Nokia cooperated to develop Bluetooth technology that allows wireless communication between mobile phones, laptops, PCs, printers, digital cameras, and video game consoles.

2001: The iPod, a portable media player, was launched by the Apple Corporation.

2004: With the full color range of the high-power LEDs, more advanced architectural designs and stage and studio lighting were developed. Colored LEDs reduce power consumption.

Hydropower

1880: Michigan's Grand Rapids Electric Light and Power Company generated DC electricity, using hydropower at the Wolverine Chair Factory. A dynamo belted to a water turbine at the factory generated electricity to light 16 brush-arc lamps in the store front.

1881: Street lamps in the city of Niagara Falls were powered by hydropower (direct current).

1882: The world's first central DC hydroelectric station provided power for a paper mill in Appleton, Wisconsin.

1888: About 200 electric companies relied on hydropower for at least part of their generation.

1893: The Austin Dam, near Austin, Texas, was completed. It was the first dam specifically designed for generating hydropower.

1899: The Rivers and First Federal Water Power Act required special permission for a hydroelectric plant to be built and operated on any stream large enough for boat traffic.

1901
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1902: The Reclamation Act of 1902 created the United States Reclamation Service, later renamed the U.S. Bureau of Reclamation. The Reclamation Service was formed to manage water resources and was given the authority to build hydropower plants at dams.

1905: The Reclamation Service installed a hydropower plant at the Arizona construction site of the Theodore Roosevelt Dam. The power plant was originally built to provide electricity for constructing the dam, but sales of extra electricity helped pay for the project and improved life in the local community.

1933: The Tennessee Valley Authority (TVA) was established to take charge of the hydroelectric potential of the Mississippi River in the Tennessee Valley. Construction of the Grand Coulee Dam began on the Columbia River. Originally built to meet irrigation needs, it had more electric generating capacity than any other dam in North America.

1936: Boulder Dam (later renamed the Hoover Dam) began operating on the Colorado River. The hydropower plant produced up to 130,000 kilowatts of electricity.

1937: The Army Corp of Engineers finished the Bonneville Dam on the Columbia River.

1941: Grand Coulee, the Nation's largest hydroelectric dam, began operation.

1949: Almost one-third of the Nation's electricity came from hydropower.

1961: The Columbia River Treaty was signed between the United States and Canada. Under the treaty, Canada built two dams for storage and one dam for generation. This resulted in greater power and flood control, which benefited U.S. facilities downstream.

1977: The Federal Power Commission was disbanded by Congress. A new agency was created, the Federal Energy Regulatory Commission (FERC), to regulate energy production and transmission.

1978: Congress passed the Public Utility Regulatory Policies Act (PURPA) of 1978. The Act required utilities to purchase electricity from qualified independent power producers. Portions of the Act stimulated growth of small-scale hydro plants to help meet the nation's energy needs.

1980: Conventional hydropower plant capacity nearly tripled in United States since 1940. Poor salmon runs in the Columbia River system prompted Congress to pass the Pacific Northwest Power Planning and Conservation Act of 1980. These laws resulted in a more complex, expensive process to obtain a license for a hydroelectric facility.

2006: The United States ranked among the Top 4 countries in the world for hydroelectric generation, along with China, Canada, and Brazil. These countries generated 44% of the world's electricity from hydropower.

Today: Between 6% and 10% of U.S. electricity comes from hydropower, depending on water supply and annual rainfall. In total, the United States has about 80,000 megawatts of conventional capacity and 18,000 megawatts of pumped storage capacity.

Ethanol

1826: Samuel Morey developed an engine that ran on ethanol and turpentine.

1860: German engine inventor Nicholas Otto used ethanol as the fuel in one of his engines. Otto is best known for his development in 1876 of a modern internal combustion engine (referred to as the Otto Cycle).

1896: Henry Ford built his first automobile, the quadricycle, to run on pure ethanol.

1908: Henry Ford produced the Model T. As a flexible fuel vehicle, it could run on ethanol, gasoline, or a combination of the two.

1917–18: During World War I, the need for fuel drove up ethanol demand to 50–60 million gallons per year.

1920s: Gasoline became the motor fuel of choice. Standard Oil began adding ethanol to gasoline to increase octane and to reduce engine knocking.

1930s: Fuel ethanol gained a market in the Midwest. Over 2,000 gasoline stations in the Midwest sold gasohol, which was gasoline blended with 6% to 12% ethanol.

1941–45: Ethanol production for fuel use increased, owing` to a massive wartime increase in demand for fuel, but most of the increased demand for ethanol was for non-fuel wartime uses.

1945–78: Once World War II ended, with reduced need for war materials and with the low price of fuel, ethanol use as a fuel was drastically reduced. From the late 1940s until the late 1970s, virtually no commercial fuel ethanol was available anywhere in the United States.

1974: The first of many legislative actions to promote ethanol as a fuel, the Solar Energy Research, Development, and Demonstration Act of 1974 led to research and development of the conversion of cellulose and other organic materials (including wastes) into useful energy or fuels.

1975: The United States begins to phase out lead in gasoline. Ethanol becomes more attractive as a possible octane booster for gasoline. The Environmental Protection Agency (EPA) issued the initial regulations, requiring reduced levels of lead in gasoline in early 1973. By 1986 no lead was allowed in motor gasoline.

1978: The term gasohol was defined, for the first time, in the Energy Tax Act of 1978. Gasohol was defined as a blend of gasoline with at least 10 percent alcohol by volume, excluding alcohol made from petroleum, natural gas, or coal. For this reason, all ethanol to be blended into gasoline is produced from renewable biomass feedstocks. The Federal excise tax on gasoline at the time was 4 cents per gallon. This law amounted to a 40-cents-per-gallon subsidy for every gallon of ethanol blended into gasoline.

1979: The marketing of commercial alcohol-blended fuels began by the Amoco Oil Company, followed by Ashland, Chevron, Beacon, and Texaco.

1980–84: The first U.S. survey of ethanol production was conducted. The survey found fewer than 10 ethanol facilities existed, producing about 50 million gallons of ethanol per year. Congress enacted a series of tax benefits to ethanol producers and blenders. These benefits encouraged the growth of ethanol production. The Energy Security Act of 1980 offered insured loans for small ethanol producers (less than 1 million gallons per year), up to $1 million in loan guarantees for each project that could cover up to 90% of construction costs on an ethanol plant; price guarantees for biomass energy projects; and purchase agreements for biomass energy used by Federal agencies. Congress placed an import fee (tariff) on foreign-produced ethanol. Previously, foreign producers, such as Brazil, were able to ship less expensive ethanol into the United States.

1983: The Surface Transportation Assistance Act of 1982 (signed in early 1983) increased the ethanol subsidy to 50 cents per gallon.

1984: The number of ethanol plants in the United States peaked at 163. The Tax Reform Act of 1984 increased the ethanol subsidy to 60 cents per gallon.

1985: Many ethanol producers went out of business, despite the subsidies. Only 74 of the 163 commercial ethanol plants (45%) remained operating by the end of 1985, producing 595 million gallons of ethanol for the year.

1988: Ethanol was first used as an oxygenate in gasoline. Denver, Colorado, mandated oxygenated fuels containing oxygen) for winter use to control carbon monoxide emissions.

1990: The Omnibus Budget Reconciliation Act of 1990 decreased the ethanol subsidy to 54 cents per gallon of ethanol. Ethanol plants began switching from coal to natural gas for power generation and adopting other cost-reducing technologies. An expanding market and the high cost of fructose corn syrup encouraged expansion of wet mill plants that produce the syrup as a by-product of the ethanol production process.

1995–96; With a poor corn crop and the doubling of corn prices in the mid–1990s to $5 a bushel, some States passed subsidies to help the ethanol industry.

1997: Major U.S. auto manufacturers began mass production of flexible-fueled vehicle models capable of operating on E-85, gasoline, or both. Despite their ability to use E-85, most of these vehicles used gasoline as their only fuel because of the scarcity of E-85 stations.

1998: The ethanol subsidy was extended through 2007 with a gradual reduction from 54 cents per gallon to 51 cents per gallon in 2005.

2002: U.S. automakers continued to produce large numbers of E-85-capable vehicles to meet Federal regulations that required a certain percentage of fleet vehicles capable of running on alternative fuels. Over 3 million of these vehicles were in use. At the same time, several States were encouraging fueling stations to sell E-85. With only 169 stations in the United States selling E-85, most E-85 capable vehicles are still operating on gasoline instead of on E-85.

2005: The Energy Policy Act of 2005 was responsible for regulations that ensured gasoline sold in the United States contained a minimum volume of renewable fuel, called the Renewable Fuels Standard. The regulations aimed to double, by 2012, the use of renewable fuel, mainly ethanol made from corn.

2007: The Energy Independence and Security Act of 2007 expanded the Renewable Fuels Standard to require that 36 billion gallons of ethanol and other fuels be blended into gasoline, diesel, and jet fuel by 2022. In 2007, the United States consumed 6.8 billion gallons of ethanol and 0.5 billion gallons of biodiesel. An Argonne National Laboratory study compared data on water, electricity, and total energy usage from 2001 and 2006. During this period, America's ethanol industry achieved improvements in efficiency and resource use while it increased production nearly 300%.

2008: U.S. ethanol production capacity was at 7.2 billion gallons, with an additional 6.2 billion gallons of capacity under construction.

2011: More than 200 ethanol plants produce 13.5 billion gallons.

Geothermal

1904: The first dry steam geothermal power plant was built in Italy. The plant today provides power to about 1 million households.

1960: The first commercial-scale development tools were placed in California at The Geysers, a 10-megawatt unit owned by Pacific Gas & Electric.

1970: Re-injection of spent geothermal water back into the production reservoir was introduced as a way to dispose of waste water and to extend reservoir life.

1972: Deep well drilling technology improvements led to deeper reservoir drilling and to access to more resources.

1974: Scientists began to develop the first hot dry rock (HDR) reservoir at Fenton Hill, New Mexico. An HDR power facility was tested at the site in 1978 and started to generate electricity two years later.

1978: U.S. Department of Energy (DOE) funding for geothermal research and development was increased substantially. The Public Utility Regulatory Policies Act (PURPA) of 1978 was enacted to promote greater use of renewable energy, cogeneration and small power projects.

1980s: California's Standard Offer Contract system for PURPA-qualifying facilities provided renewable electric energy systems a relatively firm, stable market for output, allowing the financing of capital-intensive technologies like geothermal energy facilities.

1982: Geothermal (hydrothermal) electric generating capacity, reached a new high of 1,000 megawatts.

1984: Utah's first commercial geothermal power plant began operating at Roosevelt Hot Springs with a 20 megawatt capacity. Nevada's first geothermal binary power production plant began operating at Wabuska Hot Springs.

1989: DOE and the Electric Power Research Institute operated a 1-megawatt, geopressured power demonstration plant in Texas, extracting methane and heat from brine liquids.

1990: DOE funding for geothermal energy research and development declined throughout the 1980s and reached a low of $15 million.

1992: The Puna field of Hawaii began electrical generation at a 25 megawatt geothermal plant.

1994: California Energy became the world's largest geothermal company through its acquisition of Magma Power.

1995: Worldwide geothermal capacity reached 6,000 megawatts. At Empire Nevada, a food-dehydration facility processed 15 million pounds of dried onions and garlic a year, using geothermal resources. A DOE low-temperature resource assessment of 10 Western States identified nearly 9,000 thermal wells and springs and 271 communities with a geothermal resource greater than 50°C.

1999: California's geothermal power plants provided 54.9% of the state's electricity.

2000: The DOE and industry worked together on the Geothermal Resource Exploration and Definition Program. It was a cooperative effort to find, evaluate, and define additional geothermal resources throughout the western United States.

2004: Geothermal energy costs dropped from 10 to 16 cents per kilowatt hour to 5 to 8 centers per kilowatt hour.

2006: The U.S. geothermal industry became a $1.5 billion a year business that involved electricity generation and thermal energy in direct use such as indoor heating, greenhouses, food drying, aquaculture. Alaska installed a 200 kilowatt power plant that used low-temperature (74°C) geothermal water along with cooling water (4°C).

2008: Idaho's first commercial geothermal power plant began operating.

Natural Gas

1626: French explorers discovered Native Americans burning gases that were seeping into and around Lake Erie.

1816: Natural gas was used in Baltimore to fuel street lamps. During the 19th century, natural gas was used in Europe and in North America as a lighting fuel. Most of the natural gas produced at that time was manufactured from coal and not extracted from the earth, as it is today.

1821: In Fredonia, New York, William Hart dug the first successful well that was intended to produce natural gas.

Hart dug a 27-foot well to try and bring a larger flow of gas to the surface. Expanding on Hart's work, the Fredonia Gas Light Company was eventually formed, becoming the first American natural gas company.

1859: Edwin Drake drilled the first commercial well and hit oil and natural gas at 69 feet below the earth's surface. A 2-inch diameter pipeline was built, running 5½ miles from the well to the village of Titusville, Pennsylvania. This milestone may be considered the beginning of the natural gas industry in America.

1885: Robert Bunsen invented what is now known as the Bunsen burner. The Bunsen burner produced a flame that could be safely used for cooking and heating by mixing the right proportion of natural gas and air. The invention of thermostatic devices allowed the flame's temperature to be adjusted and monitored.

1890s: Electricity began to replace natural gas for lighting purposes.

1891: One of the first lengthy pipelines was constructed, which was 120 miles long, and carried natural gas from wells in central Indiana to the city of Chicago. This early pipeline was not very efficient.

1925: The first all-welded pipeline, over 200 miles in length, was built — from Louisiana to Texas.

1937: Natural gas distributors began adding mercaptan, with its rotten-egg smell, to the otherwise odorless natural gas — so that leaks can be easily detected.

1906–1970: U.S. residential demand for natural gas grew fifty times.

1940s–1960s: The nation began a massive expansion of its pipeline network, which led to rapid growth of natural gas markets. During the 1950s and 1960s, thousands of miles of pipeline were constructed throughout the United States. Today, the U.S. interstate pipeline network, laid end-to-end, would stretch almost 12 times around the earth.

1971: Gas well productivity peaked at 435 thousand cubic feet per well per day.

1973: U.S. natural gas production reached a record-high of 21.7 trillion cubic feet before starting a long period of decline.

1983: The cost of natural gas for residential users set a record high of $10.06 per thousand cubic feet (measured in constant 2004 dollars).

1986–present: Consumption of natural gas began to grow faster than production. Net imports, as a share of natural gas consumption, more than tripled. These imports nearly all came by pipeline from Canada. Small shipments were brought by tanker as liquefied natural gas from Algeria and, in recent years, from a few other countries. New drilling technology made offshore sites more important. Over the next 20 years, about one-fifth of all U.S. production came from offshore sites.

1990: The New York Mercantile Exchange (NYMEX) issued the first natural gas futures contract. A futures contract is an agreement today on the price of a commodity (or financial instrument) to be paid for and delivered in the future. The Clean Air Act Amendments required many changes to fossil fuels to make them pollute less. The use of these cleaner fuels was phased-in during the 1990s. Natural gas was promoted as cleaner burning fuel in power generation and transportation, increasing the use of natural gas.

1998: About 5.1 billion cubic feet of natural gas were reported as being used for vehicles.

2000: Natural gas consumption peaked at 23.3 trillion cubic feet.

2001: The share of natural gas coming from imports peaked at 16.2%.

2003: After years of decline, gas well productivity reached a record low at 124 thousand cubic feet per day. The average natural gas well produced only 29% as much as in 1971.

2004: Over one-fourth of U.S. production came from Texas.

2005: The record-setting hurricane season of 2005 caused massive damage to the U.S. natural gas and petroleum infrastructure. The Gulf of Mexico, one of the nation's largest sources of oil and gas production, was dealt a one-two punch by Hurricanes Katrina and Rita. Many Gulf of Mexico wells, terminals, processing plants, and pipelines went off-line. U.S. residential natural gas prices were the highest ever recorded in September, reaching $16.66 per thousand cubic feet.

2006: A record 31,687 natural gas wells were drilled.

2007: U.S. imports of liquefied natural gas (LNG) reached a record level of 771 billion cubic feet.

2010: On April 20, 2010, an explosion and fire occurred on the offshore drilling rig Deepwater Horizon, which had been drilling an exploratory well in the Gulf of Mexico. The accident killed 11 crew members and left oil leaking from the unfinished well into the ocean for months. On May 27, 2010, Secretary of the Interior Salazar announced a 6-month hold or "moratorium" on deepwater drilling.

Nuclear

1905: Albert Einstein (U.S. immigrant from Germany) wrote the special theory of relativity. He created a new era of physics when he unified mass, energy, magnetism, electricity, and light. One of the most significant events of the 20th century was Einstein's developing the formula of E=mc2 (that is, energy equals mass times the square of the speed of light).

1915: The general theory of relativity was published by Albert Einstein (U.S. immigrant from Germany). He proposed that gravity, as well as motion, could affect the intervals of time and space.

1919: Rutherford (United Kingdom) bombarded nitrogen gas with alpha. The transmutation of nitrogen into oxygen was the first artificially induced nuclear reaction.

1929: Ernest O. Lawrence (United States) conceived the idea for the first cyclotron, a device used to produce high-energy beams for use in nuclear physics experiments. He was awarded the 1939 Nobel Prize in Physics for this invention and for results obtained with it.

1932: James Chadwick (United Kingdom) discovered the neutron as well as studied the deuterium, known as heavy hydrogen and used in nuclear reactors.

1934: Enrico Fermi (U.S. immigrant from Italy) irradiated uranium with neutrons. He believed he had produced elements beyond uranium, not realizing that he had split the atom, thus achieving the world's first nuclear fission. He won the Nobel Prize in Physics for this discovery in 1938.

1938: The process of splitting uranium atoms, called nuclear fission, was demonstrated by scientists Otto Hahn and Fritz Strassman (Germany).

1939: President Roosevelt received a letter from Albert Einstein on the possibility of a uranium weapon.

1940: German troops occupied Norway, and seized what was then the world's only heavy-water production plant. Philip Abelson and Edwin McMillan (United States) demonstrated that neutrons captured by uranium-238 lead to the creation of elements 93 and 94, neptunium and plutonium. A new element (atomic number 94), was found and named plutonium. American physicists confirmed that plutonium was fissionable, thus usable for a bomb.

1942: The Manhattan Project was formed in the United States to secretly build the atomic bomb for use in World War II. The first self-sustaining, controlled nuclear chain reaction led by Enrico Fermi (U.S. immigrant from Italy) and other scientists at the University of Chicago.

1945: The first test of a nuclear weapon, code-named Trinity,occurred at Alamogordo, New Mexico.
The United States dropped an atomic bomb on Hiroshima, Japan, and three days later dropped another one on Nagasaki, Japan. Japan surrendered less than two weeks later, ending World War II.

1946: The Atomic Energy Act (AEA) of 1946 was passed, establishing the United States Atomic Energy Commission (AEC) to control nuclear energy development and to explore peaceful uses of nuclear energy. First demonstrations against nuclear testing were held in Times Square, New York. The Joint Congressional Committee on Atomic Energy was established to oversee all civilian and military nuclear affairs.

1951: An experimental breeder reactor (EBR Reactor I, or EBR-I) in Idaho produced the first usable electric power from the atom, lighting four light bulbs. Scientists had already known that nuclear power could produce electricity. The purpose of the experimental EBR was to prove that a breeder reactor could produce more fuel than it used.

1953: The first nuclear-powered submarine, the U.S.S. Nautilus, was launched. Eisenhower's Atoms for Peace Program proposed an international agency to develop peaceful nuclear technologies. The first Boiling Reactor Experiment reactor was built in Idaho. It demonstrated that steam bubbles in the reactor core did not cause an instability problem. It was, instead, a rapid, reliable, and effective mechanism for limiting power. This could protect a reactor against "runaway" events.

1954: The Atomic Energy Act of 1954 was passed. It was the first major amendment of the original Energy Act, which gave the civilian nuclear energy program further access to nuclear technology.

1955: The AEC announced the beginning of a cooperative program between government and industry to develop nuclear power plants. Arco, Idaho, (population 1,000) became the first U.S. town powered by nuclear energy. The power was provided by an experimental reactor, BORAX III, at the Idaho National Energy Laboratory.

1957: The first time that power was generated from a commercial nuclear plant, at Santa Susana, California. The Price-Anderson Act enacted. This legislation was designed to limit the financial risk of nuclear plant owners in the event of an accident. The first full-scale nuclear power plant (Shippingport, Pennsylvania) began service.

1960: The AEC published its 10-year plan for nuclear energy. Small nuclear power generators were first used in remote areas to power weather stations and to light buoys for sea navigation.

1964: President Lyndon Johnson signed the Private Ownership of Special Nuclear Materials Act of 1964, which allowed the nuclear energy industry to own the fuel for its units. After June 30, 1973, private ownership of the uranium fuel became mandatory.

1970: The First Earth Day was celebrated. Electricity "brownouts" hit the Northeast during a heat wave. A "brownout" is a reduction or cutback in electric power, especially as a result of a shortage, mechanical failure, or overuse by consumers.

1973: President Nixon proposed replacing the Atomic Energy Commission with the Energy Research and Development Administration and the Nuclear Regulatory Commission. The Arab Oil Embargo occurred, in which several Arab nations in the Organization of Petroleum Exporting Countries (OPEC) embargoed, or stopped selling, oil to the United States and Holland to protest their support of Israel in the Arab-Israeli "Yom Kippur" War. Arab OPEC production was cut by 25%, which caused some temporary shortages and helped oil prices to triple. This contributed to an increased interest in alternatives to petroleum, including nuclear power.
U.S. utilities ordered 41 nuclear power plants, a one-year record.

1974: The first 1,000-megawatt nuclear plant went into service (Commonwealth Edison's Zion Nuclear Power Plant, Unit 1). The Atomic Energy Commission was abolished, and the Nuclear Regulatory Commission (NRC) was created to regulate the nuclear industry. The Joint Congressional Committee on Atomic Energy was also abolished.

1975: The Energy Research and Development Administration began operating.

1977: President Carter combined the Energy Research and Development Administration with the Federal Energy Administration, creating the Department of Energy.

1979: The accident at the Three Mile Island Unit 2 (TMI-2) nuclear power plant near Middletown, Pennsylvania, on March 28, 1979, was the most serious in the U.S. nuclear power plant industry's operating history. Equipment malfunctions, design-related problems, and human error led to led to a partial meltdown of the TMI-2 reactor core but only very minute releases of radioactivity. Although no deaths or injuries resulted, the accident brought about sweeping changes in emergency response planning, reactor operator training, human factors engineering, radiation protection, and many other areas of nuclear power plant operations. These changes enhanced the safety of the industry. Completing a process begun by President Ford, President Carter banned the use of reprocessed uranium in nuclear fuel. The ban's purpose was to prevent the used fuels from falling into the wrong hands and being used for nuclear weapons.

1980: For the first time, nuclear energy generated more electricity than oil in the United States.

1981: President Ronald Reagan lifted the ban on reprocessing used nuclear fuel.

1983: The Nuclear Waste Policy Act of 1982 was signed, approving the development of a high-level nuclear waste repository. Nuclear energy generated more electricity than natural gas.

1984: Nuclear replaced hydropower as the second-largest source of electricity in the United States, after coal.

1986: The Perry power plant in Ohio became the 100th U.S. nuclear power plant in operation. The world's worst nuclear power accident happened at the Chernobyl plant in the former USSR (now Ukraine).

1986: A catastrophic nuclear accident at a power plant in Chernobyl in the Ukraine (the former Soviet Union) releases radioactive particles in the atmosphere that prevailing winds carry over northern Europe. The event highlights the unique safety concerns of using nuclear power and calls into question the training of employees who work at the plants, as well as safety procedures and equipment variations from nation to nation.

1987: Congress selected Yucca Mountain in Nevada for study as the first high-level nuclear waste repository site, although the location has yet to be used.

1989: Nuclear power plants provided 19% of the electricity used in the United States; 46 units entered service during the 1980s.

1993: Two decades after the first oil embargo, the 109 nuclear power plants operating in the United States provided about one-fifth of the nation's electricity.

1994: The Nuclear Regulatory Commission (NRC) issued final design approval for the first two of four advanced nuclear power plant designs — General Electric's Advanced Boiling Water Reactor (ABWR) and ABB Combustion Engineering's System 80+.

1996: The NRC granted the Tennessee Valley Authority (TVA) a full-power license for its Watts Bar 1 nuclear power plant. This was the last unit to be licensed in the United States in the 20th century. Kashiwazaki-Kariwa 6, the world's first Advanced Boiling Water Reactor, began commercial service in Japan.

1998: Baltimore Gas and Electric Co. submitted an application to renew the license of its two-unit Calvert Cliffs nuclear power plant—the first U.S. company to apply for a 20-year extension of its 40-year license.

2000: The NRC issued the first-ever license renewal to Constellation Energy's Calvert Cliffs Nuclear Power Plant, allowing an additional 20 years of operation. The NRC approved a 20-year extension to the operating license of Duke Energy's three-unit Oconee Nuclear Station.

2001: The National Energy Plan was published in May 2001. The Plan included a significant role for nuclear power in meeting energy demand and for reducing air pollution levels.

2002: The Nuclear Power 2010 Program, developed in 2002, was a joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop and bring to market advanced nuclear plant technologies, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes. On April 30, the oldest nuclear power plant in the world, Obninsk (located in Russia), closed down its sole reactor. Nuclear power provided about 16% of the world's electricity.

2003: On August 14, the Nation's largest-ever power outage left much of the Northeast and parts of Canada without electricity for several days. A transmission line in Ohio strained the electrical system so much that plants all over the grid, including nine U.S. and eight Canadian commercial nuclear reactors, were shut down.

2005: On January 3, Lithuania, the world's most nuclear-dependent nation, began the complete and final shutdown of one-half of its nuclear capacity. Lithuania's nuclear reactors are being shutdown owing to safety concerns. They have the same design as the reactors at Chernobyl, the site of the world's worst nuclear accident. The Polish Government decided to build the Nation's first nuclear power plant. President Bush signed the Energy Policy Act of 2005, which included measures to encourage the nuclear industry to build new nuclear power plants. (No construction of a nuclear plant has begun since 1971.)

2006: A survey, in the United States, found a high level of support for nuclear energy among the public; with 68% favoring nuclear energy as one way to generate electricity and 49% stating a need to build more nuclear plants.

2007: Browns Ferry Nuclear Power Plant Unit 1 was the first U.S. nuclear reactor to come online in the 21st century. Shut down in 1985, the Tennessee Valley Authority (TVA) decided in 2002 to restart the unit. It had the capacity to supply electricity to about 650,000 homes.

2011: An earthquake and subsequent tsunami caused severe damage to the nuclear power plant at Fukushima, Japan. The event renewed discussion on the safety of nuclear power plants.

Photovoltaic

1905: Albert Einstein published a paper on the photoelectric effect. He would win 1921 Nobel Prize in Physics for these theories.

1950s: Inventors at Bell Labs (Daryl Chapin, Calvin Fuller, and Gerald Pearson) developed a more efficient PV cell (6%) made from silicon. This was the first solar cell capable of generating enough power from the sun to run everyday electrical equipment.

1955: Western Electric began to sell commercial licenses for silicon photovoltaic technologies. Early successful products included PV-powered dollar bill changers and devices that decoded computer punch cards and tape.

1958: Federal support for photovoltaic technology was initially tied to the space program to provide power for the Vanguard satellite.

1973: Spurred by the oil embargo, interest in space applications of photovoltaics grew.

1970s: By the late 1970s, a program for the development of distributed photovoltaics was established by the U.S. Government at the Massachusetts Institute of Technology, focusing on design and demonstration issues for the buildings sector.

1978: The Energy Tax Act of 1978 established a 10-percent investment tax credit for photovoltaic applications. The Solar Photovoltaic Energy, Research, Development and Demonstration Act of 1978 committed $1.2 billion, over 10 years, to improve photovoltaic production levels, reduce costs, and stimulate private sector purchases. Photovoltaic energy commercialization program accelerated the procurement and installation of photovoltaic systems in Federal facilities.

1980: The Carlisle house (Massachusetts) was completed with participation from MIT, DOE, and Solar Design Associates. It featured the first building-integrated photovoltaic system, passive solar heating and cooling, superinsulation, internal thermal mass, earth-sheltering, daylighting, a roof-integrated solar thermal system, and a 7.5-peak-watt photovoltaic array of polycrystalline modules from Solarex. The Crude Oil Windfall Profit Tax Act of 1980 was enacted, raising the residential tax credit to 40% of the first $10,000 for photovoltaic applications, and the business tax credit to 15%. The Act also extended the credit to the end of 1981.

1989: The Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 sought to improve the operational reliability of photovoltaic modules, increase module efficiencies, decrease direct manufacturing costs, and improve electric power production costs. PV for Utility Scale Applications (PVUSA), a national public-private partnership program, was created to assess and demonstrate the viability of utility-scale photovoltaic electric generating systems. PVUSA participants include the DOE and other agencies, the Electric Power Research Institute, the California Energy Commission, and Pacific Gas & Electric (PG&E) and eight other utilities.

1992: The University of South Florida fabricated a 15.89% efficient thin-film cell, breaking the 15% barrier for the first time

1993: Pacific Gas and Electric completed the installation of the first grid-supported photovoltaic system in Kerman, California. The 500-kilowatt system was the first effort aimed at "distributed power," whereby a relatively small amount of power is carefully matched to a specific load and is produced near the point of consumption. New world-record efficiencies in polycrystalline thin film and in single-crystal devices, approaching 16% and 30%, respectively, were achieved in 1993.

1994: The National Renewable Energy Laboratory (NREL) developed a solar cell made of gallium indium phosphide and gallium arsenide; it was the first one of its kind to exceed 30% conversion efficiency.

1999: Construction was completed on Four Times Square in New York, New York. The office building had more energy-efficient features than any other commercial skyscraper and included building-integrated photovoltaic panels on the 37th to 43rd floors, on the south- and west-facing facades, to produce part of electricity needed for the building. Spectrolab, Inc., and the NREL develop a 32.3% efficient solar cell. The high efficiency resulted from combining three layers of photovoltaic materials into a single cell. Worldwide, installed photovoltaic capacity reached 1,000 megawatts.

2001: BP and BP Solar announced the first BP Connect gasoline retail and convenience store in the United States. The Indianapolis, Indiana, service station features a solar-electric canopy. The canopy contains translucent photovoltaic modules made of thin-film silicon integrated into glass.

2007: The 40% conversion efficiency barrier is broken, making it twice as efficient as a typical silicon cell.

Solarthermal

1947: Energy was scarce during World War II so passive solar buildings became popular in the United States. Libbey-Owens-Ford Glass Company published a book titled, Your Solar House, which profiled 49 of the nation's greatest solar architects.

Mid–1950s: Frank Bridgers (United States) designed the world's first commercial office building that features solar water heating and passive design. The Bridgers-Paxton Building is listed in the National Historic Register as the world's first solar-heated office building.

1973: The University of Delaware built "Solar One," a PV/thermal hybrid system. Roof-integrated arrays fed surplus power through a special meter to the utility during the day; power was purchased from the utility at night. In addition to providing electricity, the arrays were like flat-plate thermal collectors; fans blew warm air from over the array to heat storage bins.

1974: The Solar Energy Industries Association (SEIA) was formed. The organization represents the interests of the solar industry and acts as a lobbying group in Washington, DC.

1977: The Solar Energy Research Institute (SERI) was formed (now the National Renewable Energy Laboratory [NREL]), a national laboratory that provides research and development support for solar and photovoltaic technologies.

1978: The Public Utility Regulatory Policies Act (PURPA) of 1978 mandated the purchase of electricity from qualifying facilities that meet certain standards on energy source and efficiency. A 15% energy tax credit was added to an existing 10% investment tax credit, providing incentive for capital investment in solar thermal generation facilities for independent power producers.

1981: California enacted a 25% tax credit for the capital costs of renewable energy systems.

1982: Solar One, a 10-megawatt central receiver demonstration project, was first operated and established the feasibility of power tower systems. In 1988, the final year of operation, the system achieved an availability of 96%.

1983: California's Standard Offer Contract system provided renewable electric energy systems with a relatively firm, stable market for their output. This system allowed the financing of capital-intensive technologies such as solar thermal-electric. The SEGS I plant (13.8-megawatt) was installed, the first in a series of Solar Electric Generating Stations (SEGS). SEGS I used solar trough technology to produce steam in a conventional steam turbine generator. Natural gas was used as a supplementary fuel for up to 25% of the heat input.

1992: A 7.5-kilowatt dish prototype system became operational, using an advanced stretched-membrane concentrator, through a joint venture of Sandia National Laboratories and Cummins Power Generation.
The Energy Policy Act of 1992 restored the 10% investment tax credit for independent power producers, using solar technologies.

1994: The first solar dish generator, using a free-piston Stirling engine, was tied to a utility grid. The Corporation for Solar Technology and Renewable Resources, a public corporation, was established to facilitate solar developments at the Nevada Test Site. 3M Company introduced a new silvered plastic film for solar applications.

2000: A 12-kilowatt solar electric system, in Colorado, was the largest residential installation in the United States to be registered with the U.S. Department of Energy's Million Solar Roofs Initiative. The system provided most of the electricity for the family of eight's 6,000-square-foot home.

2001: Home Depot began selling residential solar power systems in three stores in San Diego, California.
NASA's solar-powered aircraft, Helios, set a new world altitude record for non-rocket-powered craft: 96,863 feet (more than 18 miles).

2002: Students from the University of Colorado built an energy-efficient solar home for the Solar Decathlon, a competition sponsored by the Department of Energy. Student teams integrated aesthetics and modern conveniences with maximum energy production and optimal efficiency.

2013: Awaiting final regulatory approval, the Blythe Solar Power Project in southeast California will have the capacity to produce 1,000 megawatts of electricity – enough to power roughly 800,000 homes. When completed, the Blythe plant would nearly double the current 585 megawatts of installed commercial-scale solar generation nationwide and would have a capacity to generate nearly three times the electricity produced at the country's largest solar facility – the nine-unit, 354-megawatt Solar Energy Generating Systems plant in Kramer Junction, Calif.

Transportation

1787: John Fitch (United States) successfully tested his invention, a 45-foot steamboat, in the Delaware River.

1832–39: Robert Anderson (Scotland) built the first electric car.

1840: The railroad was just getting started with only 3,000 miles of track in the entire country.

1860: The railway system in the United States had grown to over 30,000 miles of track.

1870: By 1870, railroads had been built from coast to coast. Railroad companies continued to build hundreds of thousands of miles of new tracks over the next 30 years. Railroads provided a connection between rural areas and cities, and allowed farmers to sell their produce in far away places.

1880–1905: Electric street car and trolley systems were built in Washington, DC, and in other U.S. cities. Streetcars made it easier for people to travel farther distances and encouraged the development of new suburbs.

1893: The Duryea brothers, Charles and Frank, started the first U.S. car company. Their company produced a gasoline-powered limousine until 1920.

1908: Henry Ford first produced the Model T car. It was designed to use ethanol, gasoline, or any combination of the two fuels. Cities began switching from streetcars to buses for public transportation.

1918: The U.S. Post Office used airplanes to move the mail in order to establish an air transportation system. On May 15, Lt. James Edgerton flew the mail from Philadelphia to Washington during the first scheduled air mail flight.

1920: As Americans now owned 8 million cars, the Ford Motor Company manufactured the Model T in large numbers.

1927: The airline business got its start when the U.S. Post Office turned over air mail delivery to private companies.

1944: Rail travel grew during World War II, reaching a record 98 billion passenger-miles.

1950
With Americans now owning 50 million cars, oil surpassed coal as the country's number one fuel source.

1955: More Americans traveled by air than by train.

1956: Malcom McLean, a trucking magnate, loaded trailers onto a ship and sent them by sea for less than the cost of trucking them overland. He was credited with shipping the first load of containers (truck trailers) aboard a cargo ship, from New Jersey to Texas. President Eisenhower signed the Federal-Aid Highway Act of 1956, which established the Interstate Highway System.

1958: Pan American ushered in the Jet Age with the Boeing 707. The Jet Age began when airline companies began replacing propeller planes with jet planes. Jet engines had far fewer moving parts; so they were more reliable, safer, and cheaper to operate. They used kerosene, which was less expensive than gasoline, and produced tremendous thrust for their weight.

1969: 80% of working men and 61% of working women could drive.

1970: The Boeing 747 was the first "jumbo jet" with 4 engines and 400 seats. Freight moved by train surpassed the World War II peak of 771 billion ton-miles.

1971: Congress relieved railroads of the costs of running passenger trains. Amtrak, the National Railroad Passenger Corporation, started operations in 1971, taking over long-distance train service from nearly all of the rail carriers.

1974: President Richard Nixon signed the Emergency Highway Energy Conservation Act of 1974, part of a nationwide effort to reduce oil consumption.

1975: Congress passed the Energy Policy and Conservation Act, which among various mandates, required car makers to begin building more fuel efficient cars. By 1985, the Act required new cars and trucks to meet an average Corporate Average Fuel Economy (CAFÉ) Standard of 27.5 miles per gallon.

1978: The Energy Tax Act of 1978 established a gas guzzler tax, a tax ranging from $1,000 to $7,700 per vehicle on gas-guzzling automobiles. President Jimmy Carter signed the Airline Deregulation Act of 1978, which increased competition among airlines.

By 1985: New cars and light trucks were required to meet a Corporate Average Fuel Economy (CAFE) Standard for fuel economy of 27.5 miles per gallon.

1995: 80% of households had at least one vehicle per driver.

1999: The first hybrid electric vehicle, powered by both a rechargeable battery and gasoline, became available in the United States.

2000: Americans owned 220 million cars.

2001: A total of 98.8 million households (92%) owned or possessed a light-duty vehicle (car, small truck, or motorcycle).

2003: Sport utility vehicles (SUVs) accounted for 27% of all light-duty vehicle sales, up 6.8% from 1990.

2005: Trucking accounted for 65% of energy used for transporting freight. Water transportation accounted for 18%, natural gas pipelines for 9%, and Class I railroads for 8%.

2007: The Energy Independence and Security Act of 2007 set a new corporate average fleet efficiency (CAFE) standard for cars and light trucks. The new standard requires car makers to meet a fleet wide average of at least 35 miles per gallon by 2020, a 40% increase over the old standard. The Energy Independence and Security Act also set renewable fuel standards requiring an increase in the use of ethanol blended into gasoline. National Highway Traffic Safety Administration finalized new CAFE standards for light trucks, to be phased in by 2011.

2013: A record 31.2 million passengers traveled on Amtrak, whose 300 daily trains serve 46 states. Amtrak's Acela train linking Washington, D.C., New York and Boston runs at speeds up to 150 mph.

Wind

1850s: Daniel Halladay and John Burnham worked to build and sell the Halladay Windmill, designed for the American West. It had an open tower design and thin wooden blades. They also started the U.S. Wind Engine Company.

Late 1880s: Thomas O. Perry conducted over 5,000 wind experiments trying to build a better windmill. He invented the mathematical windmill, which used gears to reduce the rotational speed of the blades. This design had greater lifting power and smoother pumping action, and the windmill could operate in lighter winds. Perry also started the Aermotor Company with LaVerne Noyes. The development of steel blades made windmills more efficient. Six million windmills sprang up across America as settlers moved west. Homesteaders purchased windmills from catalogs or traveling salesmen or, otherwise, built their own. Mills were used to pump water, shell corn, saw wood, and mill grain.

1888: Charles F. Brush used the first large windmill to generate electricity in Cleveland, Ohio. Windmills that produce electricity started to be called wind turbines. In later years, General Electric acquired Brush's company, Brush Electric Co.

1893: In Chicago, Illinois, the World's Columbian Exposition (also known as the Chicago World's Fair) highlighted 15 windmill companies that showcased their goods.

Early 1900s: Windmills in California pumped saltwater to evaporate ponds. This provided gold miners with salt.

1941: For several months during World War II, the Smith-Putnam wind turbine supplied power to the local community at “Grandpa’s Knob,” a hilltop near Rutland, Vermont. Its blades were 53 meters (175 feet) in diameter.

1950s: Most windmill companies in the United States went out of business.

1973: The Organization of Petroleum Exporting Countries (OPEC) oil embargo caused the prices of oil to rise sharply. High oil prices increased interest in other energy sources, such as wind energy.

1974–82: With funding from the National Science Foundation and the U.S. Department of Energy, the National Aeronautics and Space Administration (NASA) led an effort to increase wind power technology at the Lewis Research Center in Cleveland , Ohio. NASA developed 13 experimental wind turbines with four major designs: the MOD-0A (200 kilowatts); the MOD-1 (2 megawatts, the first turbine in 1979 over 1 megawatt); the MOD-2 (2.5 megawatts) and the MOD-5B (3.2 megawatt).

1978: Congress passed the Public Utility Regulatory Policies Act (PURPA) of 1978 to encourage the use of renewable energy and cogeneration facilities (plants that have another purpose besides producing electricity). PURPA requires utility companies to buy extra electricity from renewable and cogeneration facilities that meet certain qualifications, called qualifying facilities (QFs). The amount that a utility pays must be equal to the cost that it would have taken the utility to produce the same amount of electricity, called the avoided cost.

1979: The first wind turbine rated over 1 megawatt (MOD-1), began operating; MOD-1 had a 2-megawatt capacity rating. The cost of electricity from wind generation was about 40 cents per kilowatt hour.

1980: The Crude Oil Windfall Profits Tax Act of 1980 further increased tax credits for businesses that used renewable energy. The Federal tax credit for wind energy reached 25%, rewarding those businesses choosing to use renewable energy.

1983: Because of a need for more electricity, California began using a contract system that allowed certain renewable and cogeneration facilities (or in other words, QFs) to lock into rates that would make electricity generated from renewable technologies, like wind farms and geothermal plants, more cost competitive. Prices were based on the costs saved by not building planned coal plants.

1985: Many wind turbines were installed in California in the early 1980s to help meet growing electricity needs and to take advantage of government incentives. By 1985, California wind capacity exceeded 1,000 megawatts, enough power to supply 250,000 homes. These wind turbines were very inefficient.

1987: The MOD-5B was the largest wind turbine operating in the world — with a rotor diameter of nearly 100 meters (330 feet) and a rated power of 3.2 megawatts.

1988: Many of the hastily installed turbines of the early 1980s were removed and later replaced with more reliable models.

1989: Throughout the 1980s, DOE funding for wind power research and development declined, reaching its low point in 1989.

1990: More than 2,200 megawatts of wind energy capacity was installed in California — more than half of the world’ s capacity at the time.

1992: The Energy Policy Act of 1992 called for increased energy efficiency and renewable energy use and authorized a production tax credit of 1.5 cents per kilowatt hour for wind-generated electricity. It also reformed the Public Utility Holding Company Act to help make smaller utility companies more able to compete with larger ones.

1993: U.S. Windpower developed one of the first commercially available variable-speed wind turbines, the 33M-VS. The development was completed over five years, with the final prototype tests completed in 1992. The $20-million project was funded mostly by U.S. Windpower, but also involved Electric Power Research Institute (EPRI), Pacific Gas & Electric, and Niagara Mohawk Power Company.

1995: In a ruling against the California Public Utility Commission, the Federal Energy Regulatory Commission (FERC) refused to allow utilities to pay qualifying renewable facilities (QFs) rates that were higher than the utilities’ avoided cost, the amount that it would cost the utility to produce the same amount of electricity.
The U.S. Department of Energy’s (DOE) Wind Energy Program lowered technology costs. DOE’s advanced turbine program led to new turbines with energy costs of 5 cents per kilowatt hour of electricity generated.

Mid-1990s: Ten-year Standard Offer contracts written during the mid-1980s (at rates of 6 cents per kilowatt hour and higher) began to expire. The new contract rates reflected a much lower avoided cost of about 3 cents per kilowatt hour and created financial hardships for most qualifying renewable and cogeneration facilities (QFs). Kenetech, the producer of most of the U.S.-made wind generators, faced financial difficulties; it sold off most of its assets and stopped making wind generators.

1999: Wind generated electricity reached the 2,000 megawatt mark.

1999–2000: Installed capacity of wind-powered, electricity-generating equipment exceeded 2,500 megawatts. Contracts for new wind farms continued to be signed. The cost of electricity from wind generation was from 4 to 6 cents per kilowatt hour.

2003: Installed capacity of wind-powered, electricity-generating equipment was 4,685 megawatts.

2004: The cost of electricity from wind generation was 3 to 4.5 cents per kilowatt hour.

2005: The Energy Policy Act of 2005 strengthened incentives for wind and other renewable energy sources.

2006: DOE’s budget for wind subsidies was about $500 million — about 10 times as much as the 1978 level.

2007: Wind power provided 5 percent of the renewable energy used in the United States. U.S. wind power produced enough electricity, on average, to power the equivalent of over 2.5 million homes. Installed capacity of wind-powered, electricity-generating equipment was approaching 17,000 megawatts — more than four times the capacity in 2000.

2013: U.S. production exceeds 60,000 megawatts. Wind turbine fields are common sights across the nation’s heartland, western states, and northeast.

Wood

1860: Wood was the primary fuel for heating and cooking in homes and businesses, and was used for steam in industries, trains, and boats.

1890: Coal had replaced much of the wood used in steam generation.

1900: Ethanol was competing with gasoline to be the fuel for cars.

1910: Most rural homes were still heated with wood. In towns, coal was displacing wood in homes.

1930: Over half of all Americans lived in cities in buildings heated by coal. Rural Americans still heated and cooked with wood. Diesel and gasoline were firmly established as the fuel for trucks and automobiles. Street cars ran on electricity. Railroads and boats used coal and diesel fuel.

1950: Electricity and natural gas had replaced wood heat in most homes and commercial buildings.

1974: Some Americans used more wood for heating because of higher energy costs. Some industries switched from coal to waste wood. The paper and pulp industry also began to install wood and black liquor boilers for steam and power, displacing fuel oil and coal.

1984: Burlington Electric (Vermont) built a 50-megawatt, wood-fired plant with electricity production as the primary purpose. This plant was the first of several built since 1984.

1990: The capacity to generate electricity from biomass (not including municipal solid waste) reached 6 gigawatts. Of 190 biomass-fired, electricity-generating facilities, 184 were non-utility generators, mostly wood and paper.

1994: Successful operation of several biomass gasification tests identified hot gas cleanup as key to widespread adoption of the technology.