Extended Read 1

Remember to annotate as you read.

The Power of Electricity

by Kathy Furgang

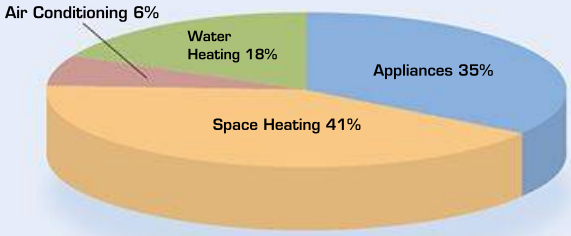
1 Imagine a world without electricity. This world would have no light switches and no lights. There would be no cars, computers, or cell phones. Almost all of the technology Americans take for granted each day would cease to exist. According to the U.S. Energy Information Administration, a U.S. household used "an average of 903 kilowatt hours (kWh) per month." It is estimated that 29 percent of that electricity is used in the kitchen alone.

2 In today's world, most people depend on electricity and technology to live and work. People rely on electricity for light and heat. They need it to cook and clean. They use it to prepare and preserve food. They use it to travel from place to place. They use it to communicate. They even rely on electricity for entertainment.

Notes

In today's world, most people depend on electricity and technology to live and work. (stated) (2)

U.S. Household Electricity Consumption



Source: U.S. Energy Information Administration, Residential Energy Consumption Survey 2011–2012 (based on 2009 usage)

Notes

Electrons on the Move

3 But what is electricity? Most people think of it as the "power" that they use to run all of their appliances. But what causes this "power"? The answer is in the science of atoms.

4 All matter—everything in the universe—is made of tiny building blocks called atoms. And all atoms are made up of particles. Positively charged particles are called protons. Particles with no charge are called neutrons. Negatively charged particles are called electrons. Protons and neutrons are packed tightly in the nucleus, or center, of each atom. Electrons orbit around the nucleus. Sometimes electrons get loose and move to the orbit of another atom. Electricity is the movement, or flow, of electrons from atom to atom.

5 There are two types of electricity. When the electric charge is stationary, or not moving, the result is static electricity. For example, if a person's clothes were to rub against a blanket, they would generate friction. This friction would cause electrons from the blanket to move to the clothing. The result would give the clothing a negatively charged static electricity.

Electrons, which are negatively powered particles, move to create electricity, of which there are two types. (inferred)

Fast Fact

Humans make electricity inside their bodies, too. Every thought or action the body makes is caused by electrical signals from the brain to the cells.

Notes

Advances in electrical technology have made it possible to power the modern world. (stated) (9)

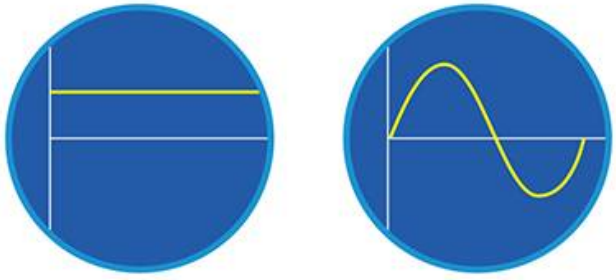
Electric Currents

6 When an electric charge is moving through matter, the result is current electricity.

7 Materials that have a loose hold on their electrons are called conductors. Electrons move through the material easily. A continuous flow of electrons is an electric current.

8 There are two types of currents. When the electrons always flow in the same direction, it is called direct current, or DC. Flashlights and cell phones all use batteries and DC power. A battery has two terminals, one positive and one negative. Electrons flow in the same direction between the two terminals. An alternating current, or AC, reverses, or alternates, direction fifty or sixty times per second. Everything that plugs into an outlet uses AC power. Alternating current is used when high-power voltages are required.

9 Over time, scientists have learned to harness the flow of energy. They have learned how to transfer, convert, and store this energy. These advances in electrical technology have made it possible to power the modern world.



direct current

alternating current

Notes

Pioneers of Electricity

The technologies people use to power their lives were made possible by a series of discoveries and inventions. Each of the key players in electricity added his own spark of genius.

1752 Benjamin Franklin

Lightning in a Bottle
Franklin proved that lightning is a type of electricity, storing it in Leyden jars. In his footsteps, many scientists continued to explore different ways to produce and use electricity efficiently.

1800 Alessandro Volta

The First Battery
Volta placed large plates made of different types of metals into a chemical solution. The combination sent electricity flowing through a wire. He called his invention a voltaic pile.

1831 Michael Faraday

Electric Generator
Faraday found a way to move electrons through a wire without using chemicals. He set electrons free by rotating a copper disc between two magnets, sending electricity flowing through a wire via electromagnetism.

1879 Thomas Edison

Electric Lighting System
Edison created a complete electric lighting system, with generators, power lines, light fixtures, and the first electric lightbulb.

1887 Nikola Tesla

The Induction Motor
Tesla's induction motor generated alternating current (AC). Tesla's technology outmatched Edison's direct current (DC) system. AC still powers the electric grid we use today!

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Generating Electricity

10 Where does the electricity that people consume come from? Energy can be converted, or changed, from one form to another. That means stored or mechanical energy can be converted to electric energy.

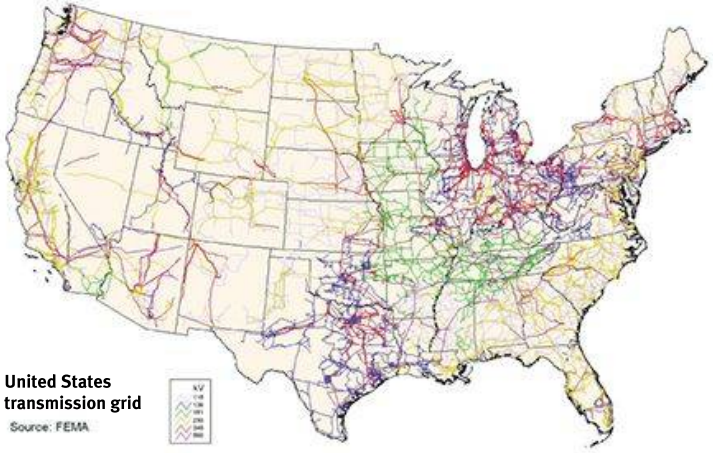
11 According to the U.S. Department of Energy, most power plants in the United States use heat energy to generate electricity. They use the heat that is released from burning fossil fuels (coal, natural gas, or oil) to boil water into steam. The pressure of the steam turns the blades of a turbine. The spinning turbine powers a generator that releases electric energy. Some generators convert nuclear power into electricity. Other generators convert wind or solar energy into electricity. This electricity is transmitted along wires to customers.

12 In the United States, electricity starts at power plants and enters a complex power grid. This grid can be compared to a network of roads. Highways are like the main power lines that come from the power plants. Traffic usually flows fast along the highways until it gets close to major cities. The flow of electricity in the power lines works the same way. As it gets close to its destination, electricity has to be directed.

13 Control centers throughout the electric grid direct power through electric substations. These control centers act like traffic cops, making sure the electricity goes where it is needed. Eventually, electricity makes its way through the network of power lines to its destination—the outlets in homes and businesses. Most of the work to control the flow of electricity is done automatically by computers. This is where trouble can begin.

Blackouts

14 When a computer malfunctions, or breaks, transmission is obstructed, or blocked. The result is a blackout, where the electric power fails in a region. Most of the time, only a small area is affected by a blackout. However, sometimes the effects are catastrophic.



The U.S. electricity transmission system is an interconnected network of more than 150,000 miles of high-voltage power lines.

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15 In 1965, a massive blackout hit the Northeast. It left thirty million people in the dark. The problem was caused by one faulty transmission line. When it stopped working, the electricity overloaded power lines and shut them down. This caused a domino effect throughout a large area. Like falling dominoes, the power lines shut down one after the other.

16 Engineers have improved the power system over the last fifty years, but as the demand for electricity continues to grow, region-wide power failures and blackouts have occurred. Improvements are needed to make sure the lights stay on, but people have different opinions about what these improvements should be.

Conserving Energy for the Future

17 Many people think better technologies are needed to provide electricity. More efficient technologies would help conserve energy resources by reducing waste. Scientists are also developing alternative energy sources such as renewable wind and solar power.

18 The National Aeronautics and Space Administration (NASA) has plans to launch a series of mirrors into space to collect energy from the sun and redirect it to Earth. In the future, NASA may also use kites to capture the wind's energy at high altitudes, far from Earth's surface.

19 Others feel that nonelectric technology is a better answer. Engineer and inventor Yasuyuki Fujimura hopes people will soon avoid the use of electricity. He uses his education in physics to develop new hi-tech nonelectric appliances. Fujimura explains, "There are many interesting home appliances that can be operated without electric power. One example is a nonelectric refrigerator. It uses a phenomenon called radiational cooling together with the natural convection currents of water." Fujimura hopes his inventions will promote a nonelectric lifestyle.

20 Until nonelectric appliances like Fujimura's designs are in every household, the world will continue to rely on electricity. This demand for power will force scientists to improve the technologies that deliver electricity.

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