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Science Standard
6.6.a.

Student Edition

California Education and the Environment Initiative

Energy: It's Not All the Same to You!

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency
California Natural Resources Agency
Office of the Secretary of Education
California State Board of Education
California Department of Education
California Integrated Waste Management Board

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Key Partners:

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None required for this lesson.

Powered by Electricity

Imagine a state without electricity. Would you want to live there? There would be no TV. No video games. No computer. No microwave to heat up snacks and no ice cream in the freezer. And no way to charge your cell phone or MP3 player.

So you've decided not to live without electricity. But how much do you understand about electricity? What exactly is electricity? How does a power plant work? What is "green energy"? If we use renewable sources, why do we need to think about conserving electricity?

Wind turbine

Electricity Contains Energy

Energy is all around us. In fact, our world would not exist without energy. Some kinds of energy you can see—such as Sun and moving water. Others you can feel, like heat, wind, and sound. Some forms of energy are invisible—electricity is one of them. Without energy, there would be no plants, no animals, and no life. Your body needs energy, too; your "fuel" comes from food. A power plant works like your

Old Faithful Geyser, Yellowstone National Park, Wyoming

body because it turns fuel into usable energy.

People don't actually make energy like electricity. They take one form of energy and convert it into another. Picture a pinwheel spinning. Imagine that you are blowing on it to make it turn. How else could you make it turn? Could you use other forms of energy, like steam from a teapot or water from a hose? If you hooked up a whole bunch of pinwheels spinning together, you could create electricity. All you would need to do is harness the energy in their motion. You would not create much electricity, but it could happen. Let's look inside a power plant to see how it makes electricity.

Inside a Power Plant

A power plant is like the pinwheels, just on a bigger scale. The power plant generates electricity by spinning a turbine. The turbine is like a huge pinwheel—water or steam pushes the turbine's blades. Moving turbines are used to generate just about every form of electric power. The turbine is connected to a generator. The spinning within the generator converts to an electric current. Wires then carry the electric current to homes, businesses, schools, and other facilities.

People can also get steam from natural sources. When geothermal activities heat groundwater beneath Earth's surface, it can shoot out as steam through broken rock and vents (natural openings in Earth). This is called a geyser. Power plants can harness the steam to turn a generator and create electricity. The largest natural steam power plant in the world, The Geysers, is in Northern California. The Geysers takes steam directly from the ground and uses it to create electricity.

You can still create steam without a natural geyser. Many power plants use natural gas, like the gas that powers the stoves in many people's homes. The plant burns gas to heat water, creating steam. This steam then turns the turbine. Coal, oil, natural gas, or even trash can serve as the fuel to create this steam. Actually, anything that burns can be used to make steam.

Some power plants use nuclear reactions to convert steam. Large nuclear power plants provide electricity to our homes; small nuclear reactors power submarines and aircraft carriers.

Green Energy

Most energy used to create electricity comes from fossil fuels. Fossil fuels—coal, oil, and natural gas—formed from living organisms that died millions of years ago. These fuels are not renewable. Once burned, they are gone. Other sources of energy, such as wind, solar energy, water power, and bioenergy are renewable. People call these "green energy" because their sources are clean and renewable.

A wind turbine is like a giant pinwheel. But, a wind turbine is a bit more reliable. The wind spins the large blades and turns all this motion into electricity. Another example of green energy is solar power. Large panels made of photovoltaic cells capture sunlight. These cells are like small power plants. They turn sunlight, or solar energy, into electricity. The chemical process used to create electricity from sunlight is renewable. Water can generate electricity, too. The Shasta Dam in Northern California is an example of a plant that supplies electricity by hydropower. "Large" hydropower plants require dams to be built that cause large areas of land to be covered with water. "Small" hydropower plants generate electricity from moving water without the use of dams. Because of this, California law only considers small hydropower to be classified as a renewable resource.

Using green energy produces less pollution than burning fossil fuels. Californians are creative about using renewable resources. They use wind,

Shasta hydroelectric dam, California

Power plant cooling towers near Clay Station, California

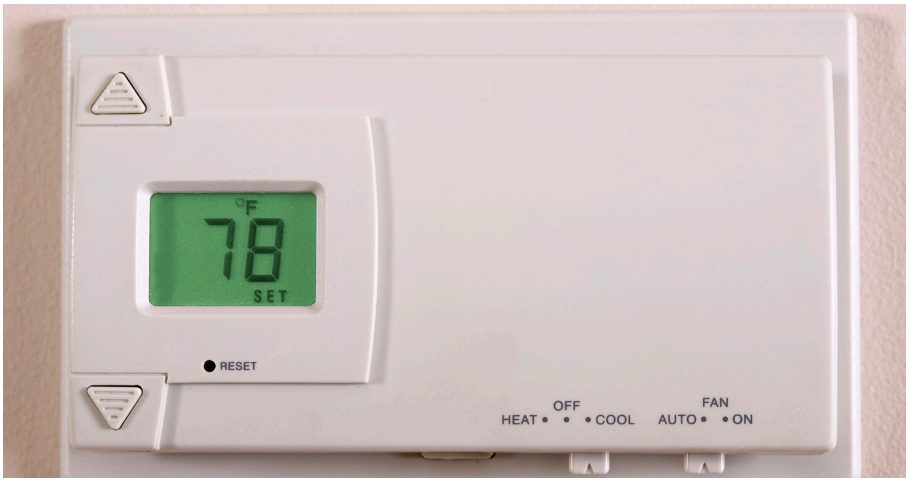
solar, geothermal, hydro, and biomass energy. Since the start of the California Solar Initiative in 2007, our state has led the nation in using renewable sources of energy.

From the power plant, electricity flows through long wires like water through a hose. These wires are called transmission lines. The current flows first to substations which reduce the voltage to smaller, usable levels. From there, the electricity flows to homes, businesses, schools, and other facilities. Finally, smaller wires carry the power to all the outlets you see in walls. The wires carrying electricity form a large grid. That grid feeds the entire state, and country, with power. The system is impressive. It is usually very reliable. But sometimes there are problems. Storms and wildfires can bring down power lines. Car accidents can bring down poles. People's use of too much power on hot days can place a huge strain on the grid. But there are simple things you can do to help keep our power supply stable.

A Smart Power Supply Is a Stable Power Supply

Simple choices made by millions of people can strain the power supply. For example, on very hot days everyone uses air conditioners at the same time. We can all make smarter choices—even in our own homes! Just because we have power does not mean we have to use it. Decreasing our use of power is called "conservation."

You can help conserve power by turning off lights. You can keep the refrigerator door closed while you think about what to eat. Long, hot showers also use electricity. In fact, as much as one-third of the energy going into homes goes to heating water. This water is often pumped from



Thermostat set to 78 degrees

Energy Source	Percent of Total
Natural Gas	45.2%
Coal	16.6%
Nuclear	14.8%
Large Hydro	11.7%
Renewable Sources	
Geothermal	4.5%
Small Hydro	2.8%
Wind	2.3%
Biomass	2.1%
Solar	0.2%
Total	**100%**

Table 1: California Energy Sources—2007
Source: California Energy Commission

up to 400 miles away. Saving water saves electricity. On a hot day, set the thermostat a few degrees higher, to 78, for example. Your air conditioner will not have to work as hard.

Another way to conserve energy is by buying products that use less electricity. Using less energy to do a job is called energy efficiency. New compact fluorescent lightbulbs use 75% less energy than old-fashioned incandescent lightbulbs. Newer models of kitchen appliances are also energy efficient. They carry the Energy Star label that indicates that the product uses less energy, saves money, and helps the environment. An Energy Star refrigerator uses less energy than an older model the same size.

Our state uses many of the available energy sources to produce the electricity we need. Renewable sources of energy create less pollution and are plentiful in our state. Our state is working to increase the use of renewable sources of energy. We can keep our energy supply stable by making better everyday choices. We can turn off lights, take shorter showers, use the air conditioner less, and choose more efficient products.

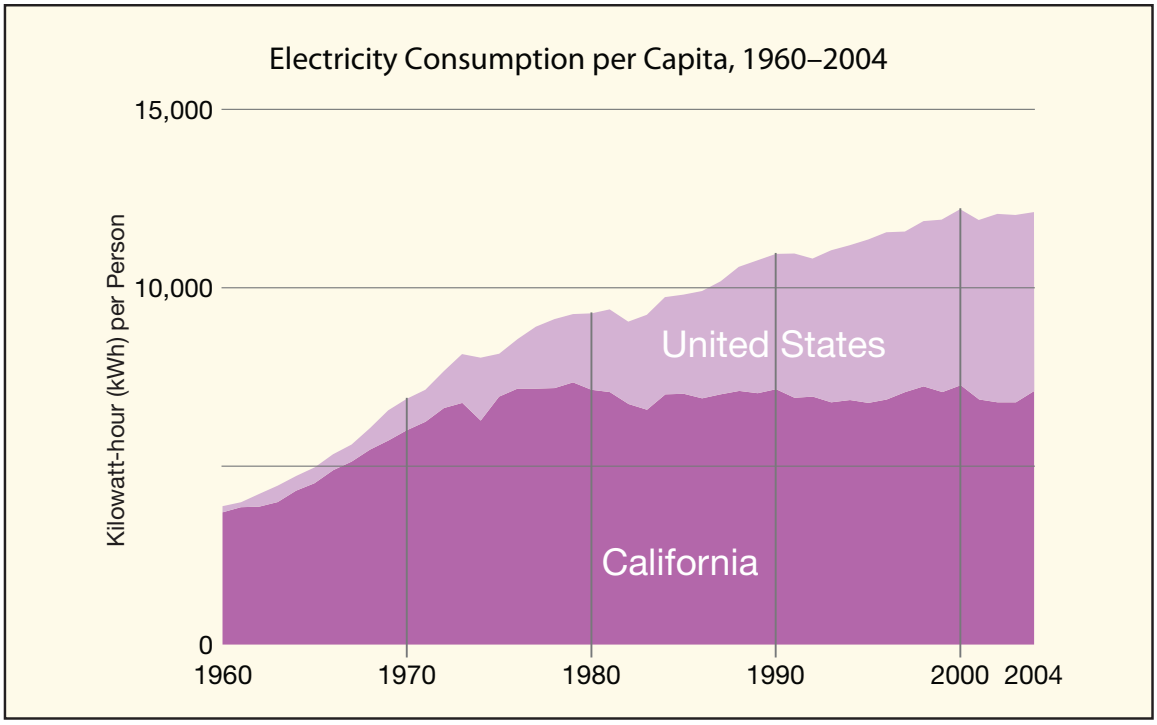
Energy Source	Percent of Total
Coal	48.3%
Natural Gas	21.3%
Nuclear	19.2%
Hydropower	6.9%
Renewable Sources	2.7%
Other Nonrenewable	1.6%
Total	**100%**

Table 2: U.S. Energy Sources (Electricity)—2007. Source: U.S. Energy Information Administration

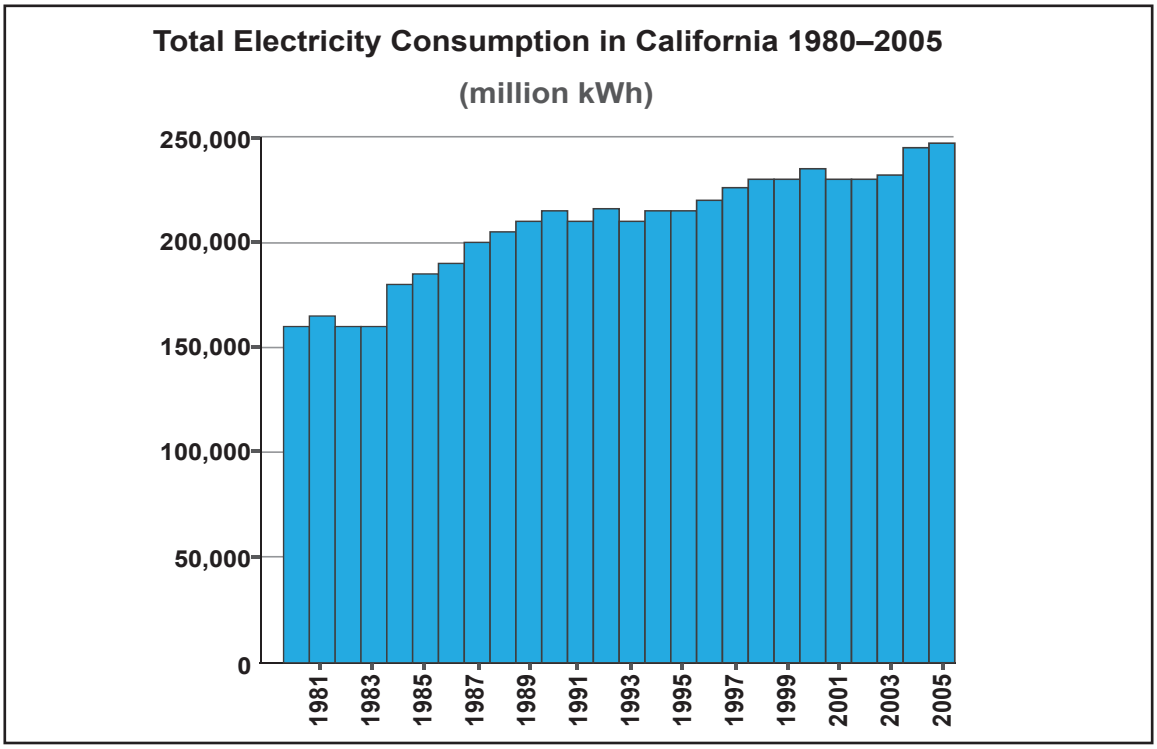
The less energy we use, the fewer byproducts produced. This gives us the benefit of a healthier environment, with less air pollution. Also, there will be fewer power plants built, and lots of money saved.

Sheets drying on a clothesline

Instructions: Read the graphs below. What do they tell you about electricity use in California?



Source: California Energy Commission



Source: U.S. Department of Energy

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