Energy Sources: The Pros and Cons

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Written by David L. Dreier

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Table of Contents

The Endless Need for Energy

The United States is a modern society. Like all modern societies, it uses a lot of **energy**. Scientists define energy as the ability to do work.

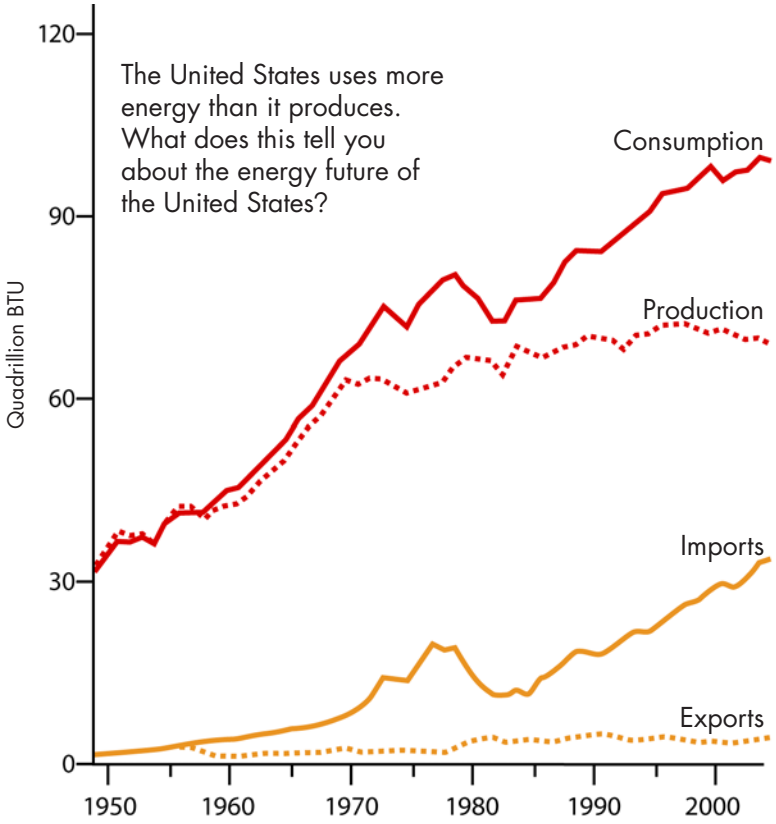
Many kinds of things can be called work. Getting an automobile to move down a road or an airplane to fly is work, and so is producing electricity or running the machinery in a factory.

Machines in this car factory need energy to build cars.

The energy used by the United States and other modern societies comes from many sources. Much of it comes from the burning of fuels, such as coal and gasoline. Other energy comes from the power of flowing water, from the light of the Sun, the wind, or from the splitting of atoms.

All energy sources have their pros and cons—their good points and bad points. Modern societies have to make many decisions about how best to produce energy. The needs of the society have to be balanced against the need to protect the environment. These choices are not always easy to make.

Energy use in the United States, 1949–2005



SOURCE: U.S. Energy Information Administration, Annual Energy Review 2005

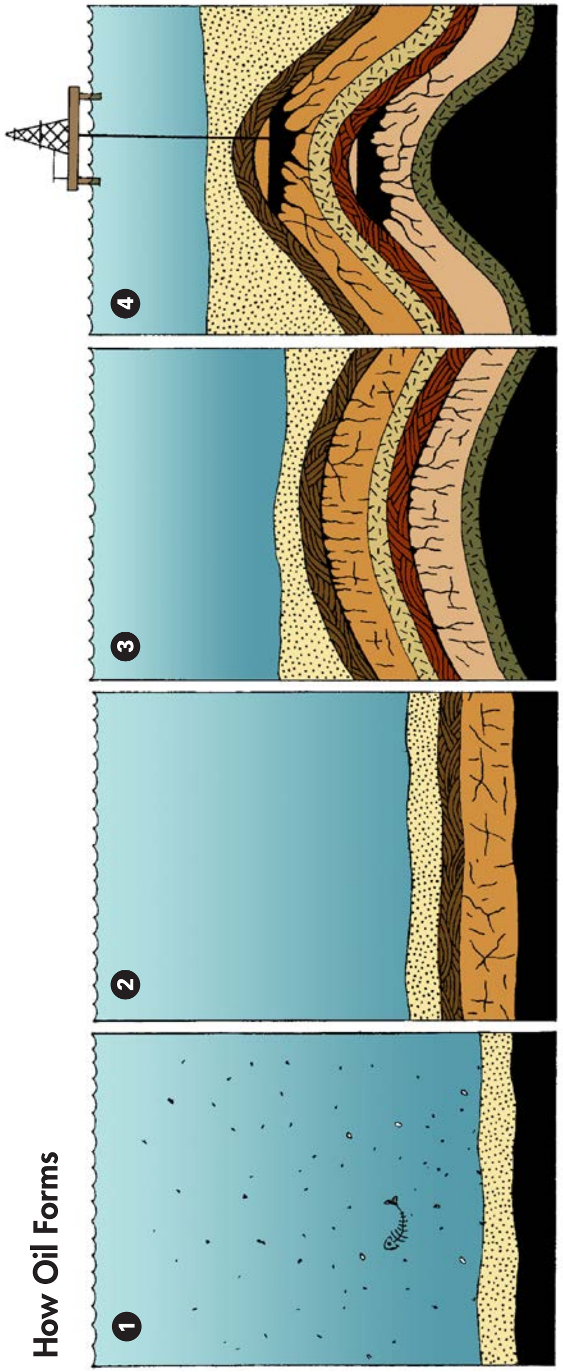
Fossil Fuels

Fossil fuels—coal, oil, and natural gas—are a leading energy source around the world. They are called fossil fuels because they were formed from the remains of plants and animals that died many millions of years ago. Over time, great heat and pressure underground changed the remains into materials we use as fuel.

Gasoline is a common fossil fuel.

About 85 percent of energy used each year in the United States comes from fossil fuels. Coal is burned in many power plants to produce electricity. Fuels made from oil—such as gasoline, diesel fuel, and jet fuel—power our cars, trucks, and airplanes. Most homes use natural gas to provide power for stoves and water heaters.

How Oil Forms



1. Marine plants and animals die and sink to the ocean floor. They mix with dirt and sand to form a sediment layer.

2. Time passes, more layers are added, pressure builds, and the buried plant and animal material changes to kerogen while the sediment forms into sedimentary rock.

3. More time, more layers, and more pressure change the kerogen into oil, which begins to rise through tiny holes in the sedimentary rock.

4. Oil rises until it hits rock it can't pass through. Oil rigs drill through this rock to pump out the collected oil.

A close-up of coal

A pump jack is used for extracting petroleum from an oil well.

PRO

One of the main advantages of fossil fuels is that they are abundant—found in many places and in large amounts. In addition, they contain a lot of usable energy. Coal is especially abundant. The United States has enough coal to last another 200 to 300 years.

A special advantage of natural gas is that it burns very cleanly. When natural gas burns, it produces mostly carbon dioxide and water vapor.

Oil's main advantage is that it burns efficiently—meaning that little is wasted in the change to energy. Also, the refining process that produces gasoline and diesel fuel produces other petroleum products used in crayons, bubble gum, eyeglasses, and even artificial heart valves.

All fossil fuels are essentially nonrenewable energy sources because nature cannot create enough to keep up with demand. Many experts think that the world's oil wells will be empty in a few decades. But, even before then, the oil supply will be too small to meet global demands.

Also, fossil fuels (except for natural gas) produce **pollutants**. Cars, factories, and many power plants release harmful chemicals into the air. Since fossil fuels are burned, air pollution will continue to be a problem.

Pollutants rise into the atmosphere.

Another problem is called the greenhouse effect. Gases released from burning fossil fuels trap more heat in Earth's atmosphere than would be trapped naturally. This heating up of Earth's atmosphere is called **global warming**. Scientists think carbon dioxide contributes most to worsening the greenhouse effect, so even natural gas adds to the problem.

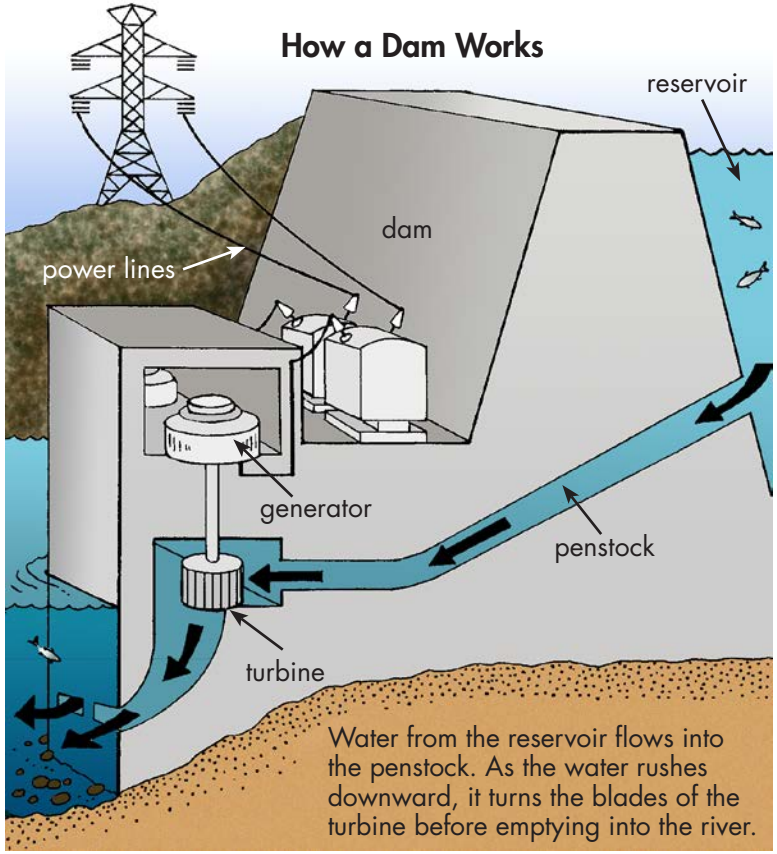
Hydroelectric Power

Water is widely used to produce electricity. You might wonder how electricity can be produced using water. The answer is by building dams. A dam is a huge, wide wall, usually made of concrete. It is built across a river to hold back the river's flow. The river's water then fills up a large area behind the dam, forming a lake or reservoir.

Water from the lake is released through the bottom of the dam. The water moves very fast. It passes through big machines called **turbines**. Fanlike blades inside the turbines spin when water rushes through them. The turbines are connected to other machines, called generators, making them spin too.

Inside a generator, a shaft is surrounded by giant magnets. All around the shaft and magnets is a huge coil of wire. When the turbines spin the shafts and magnets of the generators, they move electrons in the coil of wire. The movement of these electrons creates an electric current. Electricity made at dams is called **hydroelectric** power. *Hydro* is a prefix (first part of a word) that means *water*.

Generators inside a dam



PRO

Dams produce a great deal of needed electricity. There are more than 2,000 hydroelectric dams in the United States. They produce about 10 percent of the nation's electricity. Hydroelectric dams produce about 20 percent of the world's electricity.

Hoover Dam blocks the Colorado River, creating Lake Mead, one of the world's largest artificial lakes.

Dams have many other uses too. They prevent flooding by storing the water from heavy rain and snowmelt, and gradually releasing it later.

Dams also create many opportunities for recreation, such as boating and fishing in the lakes they create. In addition, the lakes provide water for homes and industries as well as provide water for farmers to irrigate their crops during drier times of the year.

Lake Mead's boat docks

CON

Flood prevention is good for people, but not so good for the environment. Rivers are supposed to flood. Flooding produces **sediment**, which is a mixture of gravel, sand, and topsoil. Sediment deposited by floods keeps the soil rich in farmlands located near rivers. When a river is dammed, it cannot renew the soil on the land around it.

Salmon swimming upstream

Dams also block the route for fish that swim up and down rivers. In the U.S. Pacific Northwest, dams have been a serious problem for salmon. Every three to five years, salmon swim from the ocean up rivers to their birthplaces to lay eggs. Dams make it difficult for salmon to swim up and down rivers. As a result, salmon populations have severely declined in the past 100 years.

Solar Energy

Sunlight carries huge amounts of energy. You can feel the Sun's energy when sunlight warms your skin on a summer day. To capture the Sun's energy, scientists have developed solar cells, called photovoltaic (FOE-toe-vole-TAY-ik) cells. These cells convert sunlight into electricity.

When sunlight hits a solar cell, the cell absorbs some of the light energy. Particles in the solar cell move faster, and the movement of these particles creates electricity. In some places, large panels of solar cells harvest sunshine to make electricity for homes and businesses. Solar cells have been placed on cars and appliances, too.

A solar panel is used to provide energy to this phone booth.

This solar water heater is one of many used to heat water for a town.

A solar heat collector uses the Sun's energy to heat water. These solar heat collectors are often placed on rooftops. Water circulates through pipes in the panels, and the Sun's radiant energy heats the water. The heated water is pumped into a building through more pipes. The heat leaves the water and heats the inside of the building. Then the cooled water returns to the rooftop to be heated again.

Rooftop solar panels provide this house with energy.

PRO

In some areas of the world, such as the southwestern United States, there are many sunny days. In these places, solar cells and solar panels can produce lots of electricity and heat. Since the Sun sends abundant free energy streaming toward Earth 24 hours a day, people in many parts of the world, not just the sunniest places, have mounted solar cells and solar panels on the roofs of their houses or businesses to lower their energy costs.

Experts say that huge installations of solar panels in sunny regions could generate enough electricity to supply an entire country. Capturing this energy can help overcome our diminishing energy supply. New ways to capture this energy are being developed all the time to maximize efficiency.

CON

There are two main problems with solar cells. One is that they are very expensive to manufacture. Their cost makes hydroelectric and fossil-fuel power plants a cheaper source of energy. Until inexpensive manufacturing is developed for solar cells, this free energy source will continue to come at a high cost to capture and convert to electricity.

The second problem is that not all areas of the world get abundant sunlight. Other sources of energy would be needed as a backup to the solar cells, which adds to overall energy costs.

Some people who live near houses that use solar cells and solar panels think the rooftop systems are ugly. They believe the look of the solar systems will decrease the value of their homes.

Power plants could serve as backups for solar farms.

Nuclear Power

Nuclear power plants unlock the energy inside atoms to generate electricity. Each splitting of an atom releases energy. An atomic bomb explodes by creating a very rapid chain reaction. A nuclear power plant uses the radioactive element uranium to create a slow, controlled chain reaction.

The energy released by breaking apart uranium atoms is used to heat water into steam. The steam is then used to generate electricity in much the same way that coal power plants produce it.

Cooling towers keep the core of a nuclear power plant at a safe temperature.

PRO

Uranium releases an incredible amount of energy. One kilogram (2.2 lbs) of uranium can produce more energy than 3 million kilograms (6.6 million lbs) of coal. Nuclear power plants have another advantage over coal power plants: They do not produce gases that can pollute the skies or add to global warming.

CON

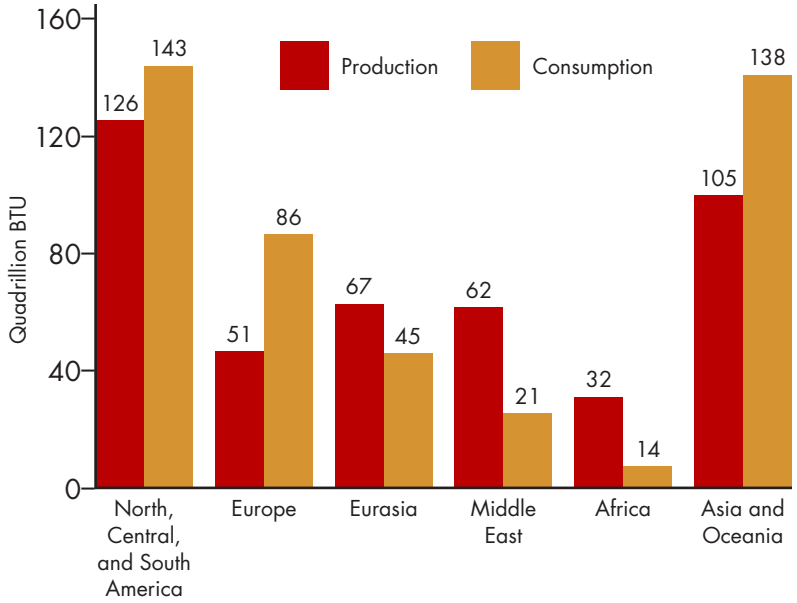
Many people oppose nuclear power because of its dangers. One danger is the possibility of an accident. A nuclear power plant can't explode like an atomic bomb. However, it can have a steam explosion if the core (the area containing the uranium) gets too hot. This would spew out a lot of dangerous radiation. A second danger is the waste material nuclear power plants produce. Even when uranium is no longer useful for generating electricity, it is still highly radioactive. It remains dangerous for thousands of years.

Wind turbines could provide more energy in the future.

Looking to the Future

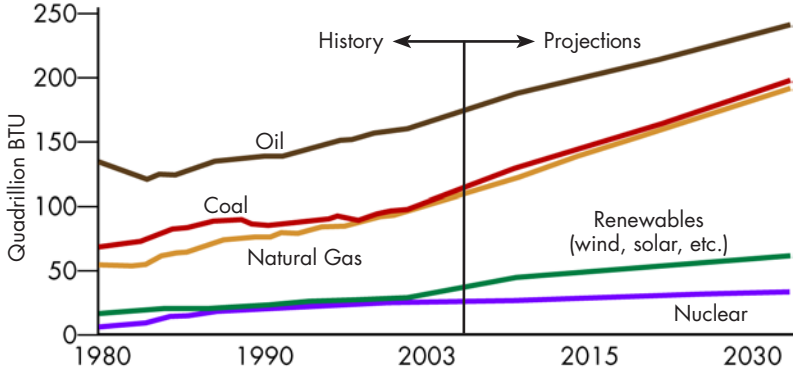
In years to come, we will have to find substitutes for oil. Hydroelectric power may also be replaced, too. Many people are concerned about the environmental effects of dams and would like to see many dams torn down. The use of solar energy will probably continue to grow. Energy experts also say that more nuclear power plants will have to be built to meet growing energy needs.

World Energy Use and Creation by Region, 2004



Three regions of the world use more energy than they create. Why do you think that is the case? Where do these regions find their extra energy sources?

Past and Estimated Future Energy Use by Type, 1980–2030

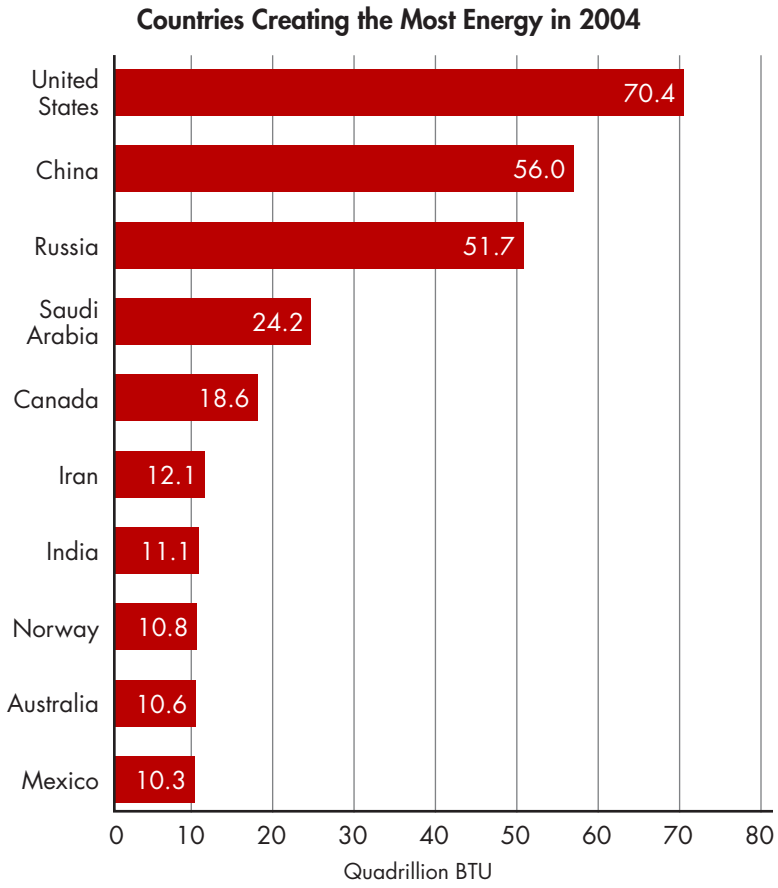


Using current rates as a guide, this chart shows the growth in the world's energy use between now and the year 2030. Experts project that oil will not be available in the decades to come. What does this chart and information tell you about energy use in the future?

SOURCE: U.S. Energy Information Administration, Annual Energy Review 2005

Scientists are also researching other ways to generate energy, such as using wind turbines or geothermal energy. Wind turbines generate electricity when their blades turn in the wind. The turbines require no fuel and don't create pollution, but they are huge and can kill local birds. Geothermal energy comes from deep underground where the Earth is very hot. Water can be circulated down into the ground in pipes to absorb that heat. The hot water can then be used to heat homes and buildings. However, in many areas, the underground heat can be difficult and expensive to reach.

Geothermal plant



Two things are certain. We need energy, and the fossil fuels that supply most of our energy will not last forever. Finding renewable alternatives is key to the world's energy future. Scientists will continue to do research. Each new source of energy will have its pros and cons. Governments, businesses, and **environmentalists** will continue to debate which energy sources are best while our need for energy continues to grow.

Glossary

energy *(n.)* different types of power that people and machines need to do work (p. 4)

environmentalists *(n.)* people concerned with keeping Earth's ecosystems healthy (p. 23)

fossil fuels *(n.)* energy sources taken from the earth, including coal, oil, and natural gas (p. 6)

global warming *(n.)* the worldwide rise of temperatures through air pollution trapping heat (p. 9)

hydroelectric *(adj.)* produced from water as a source of electricity (p. 10)

pollutants *(n.)* harmful chemicals that damage the environment (p. 9)

sediment *(n.)* bits of earth carried by flooding (p. 13)

turbines *(n.)* wheels that spin when the force of water, air, or steam is applied (p. 10)

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