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ENERGY fact sheet

Key Terms

- Fossil Fuel
- Nonrenewable
- Mining
- Surface Mining
- Deep Mining
- Continuous Mining Machines
- Acid Rain
- Global Warming
- Anthracite
- Bituminous
- Subbituminous
- Lignite

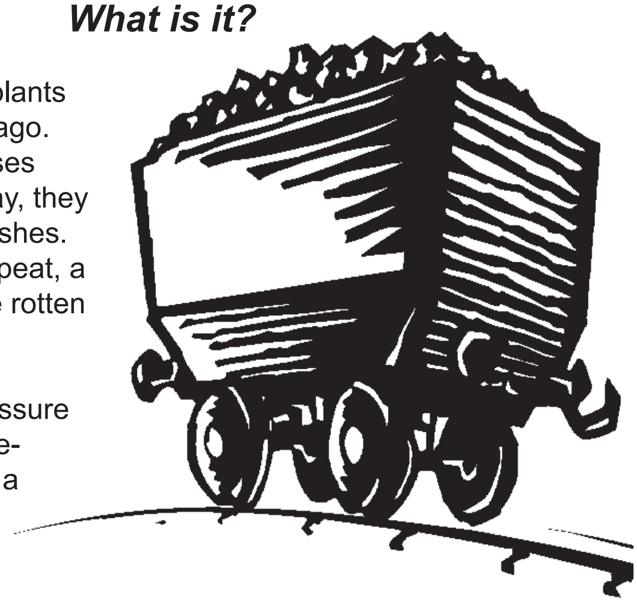
Coal Facts

- The coal industry employs 120,000 Americans.
- Wyoming is the largest coal producing state.
- Coal is by far the cheapest source of power fuel per million Btu, averaging less than half the price of petroleum and natural gas.
- China, the United States, the Russian Federation, Poland and India are among the world's largest coal producers and consumers.

SOURCE: National Mining Association

Coal

What is it?



Coal began as swamp plants living 350 million years ago. As giant ferns and mosses died and started to decay, they fell to the bottom of marshes. Eventually they formed peat, a fuel that looks much like rotten wood.

Over time, heat and pressure turned peat into coal. Geologists estimate it took a layer of swamp plants 20 feet thick to form a one-foot seam of coal. Coal is called a fossil fuel because it was made from plants that were once alive. The energy in coal came from the sun.

Coal is nonrenewable.

The coal we use today took millions of year to form. We can't make more in a short time. That's why it is called nonrenewable. There is a lot of coal in the U.S. – enough to last at least 300 years.

Types of Coal

There are four basic types of coal. Each type of coal corresponds to a "grade." Grades represent the amount of carbon in coal. The higher the grade, the more carbon. And the more carbon, the greater the energy in the coal.

The top grade of coal is *anthracite. Bituminous* coal is the second highest grade. *Subbituminous* coal, having less carbon, is a lower grade of coal than bituminous. Least rich in carbon and energy is *lignite* coal.

Continued on back

Where is coal found?

Coal is found throughout the world. Russia, China, Australia, India and Indonesia are especially rich with coal reserves. So too is the U.S. The National Energy Foundation estimates that in the U.S. alone, there may be 4 trillions tons of coal.

Where do we get coal?

Most coal is buried under the ground. Since coal is found in a solid form, we must dig it out or *mine it.* If coal is near the surface, miners dig it up with huge machines. First, they scrape off the dirt and rock, then dig out the coal. This is called *surface mining.* After the coal is mined, they put back the dirt and rock. They plant trees and grass and the land can be used again.

If the coal is deep in the ground, tunnels called mine shafts are dug down to the coal. *Continuous mining machines* are used to dig the coal and carry it to the surface. Some mine shafts are 1,000 feet deep. This is called *deep mining.*

How coal is used?

Coal was once the most important of all the fossil fuels. Until World War II, coal supplied two-thirds of the nation's energy needs. It was used to warm homes, fuel trains and operate factories.
With America's growing love for the automobile, petroleum replaced coals as our fuel of choice for transportation Other fuels also proved to be more useful for heating and cooling. Today, coal supplies slightly less than one-quarter of our energy needs.

After the coal is mined it is cleaned and sent by trains to power plants and factories. The main use of coal today is in the production of electricity. Power plants bum the coal to make the electricity.

Coal and the Environment

Over time, we have learned that mining carries with it environmental responsibilities. Wastes from underground mining can pollute waters. The digging of mines can make land sink or shift. When this happens, nearby roads, sewers and buildings can collapse. Strip mining also removes ground water. This can cause wells to dry up and affects the animals and plants living in the area.

When coal is burned, it can pollute the air. Two major threats to our environment – acid rain[1] and global warming[2] – are thought to be aggravated by burning coal. To help ease these environmental concerns factories dean the coal before they burn it and they use scrubbers to clean the smoke before it goes into the air.

To combat these threats to the environment, many laws have been passed requiring heavy coal users to lower their levels of pollution.

Coal and South Carolina

Today, coal is one of the most important energy sources. It accounts for half of the electricity we use and one fourth of our total energy used in the United States. In the U.S. 36 of the 50 states have some coal reserves.

There are no coal reserves in South Carolina. However, coal is used in more than one-third of all power plants in South Carolina. Many South Carolina industries also use coal to run factories.

1. When coal is burned, sulfur in the coal combines with oxygen in the air to form sulfur dioxide. Sulfur dioxide is thought to be the principal cause of acid rain. As its name implies, acid rain is precipitation that has an unusually high acidity. The acid in this rain (or snow, fog, hail or dew) causes buildings and roads to erode.

2. Burning coal also releases carbon dioxide into the air. Increased carbon dioxide is believed to keep heat trapped within the Earth's atmosphere. This causes the climate to get continually warmer, a condition known as global warming.

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ENERGY fact sheet

Key Terms

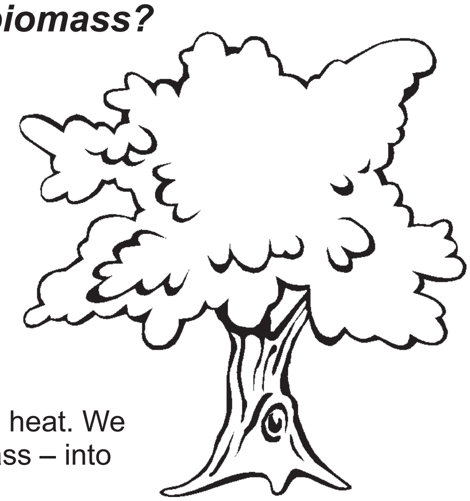
- Renewable
- Methane
- Methanol
- Ethanol
- Landfill

Biomass Facts

- In 1999, about 44 percent of all renewable energy consumed in the United States came from biomass.
- Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel. Its advantage is that it can be used to generate electricity with the same equipment or power plants that are now burning fossil fuels.
- Biomass is an important source of energy and the most important fuel worldwide after coal, oil and natural gas.
- In countries like Finland, the USA and Sweden, the per capita biomass energy used is higher than it is in India, China or in Asia.

Biomass

What is biomass?



Biomass is anything that is alive. It is anything that was alive a short time ago. Trees, crops, garbage and animal waste are all biomass.

Biomass gets its energy from the sun. Plants store the sun's energy in their leaves and roots. When we eat biomass, we use the energy to move and grow. When we burn biomass, we use the energy to make heat. We also can change the energy in biomass – into gas and liquid fuels.

Biomass is renewable.

Biomass energy is *renewable.* That means we can make more. We can always grow more plants. We should plant new trees when we cut old ones down. We need to take care of the soil in which our crops grow.

We use biomass everyday.

People and animals get their energy from biomass. The energy in everything we eat comes from plants. Hamburgers were once cows that ate grass.

Until about 150 years ago, biomass gave people most of the energy they used. The cave dwellers and settlers burned wood for heat. They burned wood to cook food. In many poor countries, wood is still used for most energy needs. People also burn corn cobs and straw. In places without trees, people burn the waste from cows and pigs.

Biomass can make electricity.

Biomass can be used to make electricity. Many towns burn their garbage in waste-to-energy plants. Instead of putting garbage in landfills, it is burned to make electricity. This saves landfill space and gives us energy, too.

Burning biomass doesn't cause as much pollution as burning coal or oil. But, many people don't like to burn waste near their towns. It can smell bad!

Wood and Other Biofuels

Biofuels have their origin in plants. During photosynthesis, the sun's energy is turned into biomass - chemical potential energy. Biomass can be used as it is, turned into a gas or processed into fuels such as methane, ethanol or methanol.

Wood

Wood is one of the most plentiful forms of biomass on the planet. More than 30 percent of the earth is covered by trees. Wood itself accounts for more than 4/5 of the biomass fuels used in the U.S.

Wood was once our chief source of energy. From the time of the caveman it has been used as fuel. People learned that burning wood could be used to keep warm, ward off animals, light up the darkness and cook food. Wood became the basis for early civilization. Wood was the main source of energy in the U.S. until the early 1900s. The use of fossil fuels as an energy source abruptly put an end to wood's popularity. The ease with which fossil fuels could be used made wood seem old fashioned.

The one economic sector that still makes use of wood energy is industry. The paper and lumber producing industries together account for almost all of the wood energy used today. Both of these industries use wood for steam, heat and to produce electricity.

Methane and Methanol

Biomass can be used to make a gas called *methane.* Methane is like the natural gas we use in our stoves and furnaces.

In China, many farmers use all their garbage, even human waste, to make methane. They use the gas to cook food and light their homes. The ashes that are left can be used as fertilizer.

When crude oil, natural gas and coal are heated they let off *methanol* and *ethanol.* Methanol can also be obtained by gasifying wood. Methanol can be used as a transportation fuel.

Ethanol

Biomass can also be turned into a fuel like gasoline. Just as apples can be made into cider, corn and grains can be made into *ethanol.* Ethanol is made by *fermenting* corn or grains like milo, sorghum, barley and oats. Fermentation involves turning the starch in the corn or grains into sugar.

Ethanol is frequently added to gasoline to form *gasohol.* Ethanol costs more than gasoline to use but it is cleaner and it is also renewable.

Biomass and the Environment

Biomass can pollute the air when it is burned, though not as much as fossil fuels. Growing plants from biomass fuel may reduce greenhouse gases, since plants use carbon dioxide and produce oxygen as they grow.

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ENERGY fact sheet

Geothermal Energy

Key Terms

- Core
- Crust
- Emissions
- Fumaroles
- Geyser
- Lava
- Mantle
- Magma
- Plates
- Reservoir
- Volcano

Geothermal Facts

- There amount of geothermal energy stored deep in the earth is much greater than the amount of energy we will use even if we stay on earth until the sun turns into a red giant star, billions of years from now. But that energy is not easily accessible.

- There are some mines that go a few miles into the ground where it is too hot to work unless it is cooled by air from the surface. Temperatures in these mines reach 150^0 F.

- The average efficiency of American geothermal power plants is about 16 percent.

What is geothermal energy?

The word Geothermal comes from the Greek words geo (earth) and therme (heat). Geothermal energy is heat inside the earth. The inside of the earth is very hot. We can use this heat to warm our houses. We can make electricity with it.

The earth is not a solid ball.

The earth is made in layers, like an egg. At the center is a *core* of iron. Around that is an outer core of iron and rock so hot the rock is melted. This liquid rock is called *magma.* The next layer is a mixture of rock and magma called the *mantle.* The shell of the earth – with oceans and mountains – is called the *crust.*

Where is geothermal energy?

Geothermal energy is everywhere under the ground, but sometimes it is hard to reach. In most places, the crust is miles thick. Magma is near the surface in only a few places.

Earthquakes and *volcanoes* are signs that magma is near the surface. The *lava* from volcanoes has magma in it. Most of the geothermal energy in the United States is found on the West Coast and in Hawaii.

Geothermal energy is generated in the earth's core, almost 4,000 miles beneath the earth's surface. The hot temperatures of the magma are continuously produced by the slow decay of radioactive particles. This process is natural in all rocks.

The mantle is about 1,800 miles thick. The crust can be three to five miles thick under the oceans and 15 to 35 miles thick on the continents.

Continued on back

The crust is broken into pieces called *plates.* Magma comes close to the earth's surface near the edges of the plates. This is where volcanoes occur. Deep underground, the rocks and water absorb the heat from the magma and lava.

We can dig wells and pump the heated, underground water to the surface. People around the world use geothermal energy to produce electricity.

Geothermal energy is renewable.

Geothermal Energy is a renewable energy source because the water is replenished by rainfall and the heat is continuously produced deep within the earth. We won't run out of geothermal energy. Future generations will still have geothermal energy.

Geothermal energy can make electricity.

Power plants use steam from geothermal dry steam wells or hot water wells to make electric power. The steam is used to turn turbines to make electricity. We can use these resources by drilling wells into the earth and piping the steam or hot water to the surface. The wells are one to two miles deep. The power plants are built close to the wells. Geothermal energy produces only a small percentage of our electricity – about half of one percent of the electricity produced in the U.S.

The History of Geothermal Energy

Geothermal energy was used by ancient people for heating and bathing. Even today, hot springs are used worldwide for bathing and many people believe hot mineral waters have natural healing powers.

Using geothermal energy to produce electricity is a new industry. A group of Italians first used it in 1902. The Italians used the natural steam erupting from the earth to power a turbine generator.

The first successful American geothermal plant began operating in 1960 at The Geysers in northern California. There are now 64 geothermal power plants in the United States.

Finding Geothermal Energy

What does geothermal energy look like? Some of the visible features of geothermal energy are volcanoes, hot springs, *geysers* and *fumaroles***.** But, you cannot see most geothermal resources. They are deep underground. There may be no clues above ground that a geothermal reservoir is present below.

Geologists use different methods to find geothermal reservoirs. The only way to be sure there is a *reservoir* is to drill a well and test the temperature deep underground.

Geothermal Energy and the Environment

Geothermal energy does little damage to the environment. Another advantage is that geothermal plants don't have to transport fuel, like most power plants. Geothermal plants sit on top of their fuel source. Geothermal power plants have been built in deserts, in the middle of crops and in the mountains forests.

Geothermal plants produce almost no *emissions* because they do not burn fuel to produce electricity. And it is cheap - new plants can make electricity for about the same price as coal plants.

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ENERGY fact sheet

Key Terms

- Fusion
- Generator
- Hydrogen
- Penstocks
- Radiant
- Turbines
- Water Cycle
- Water Vapor

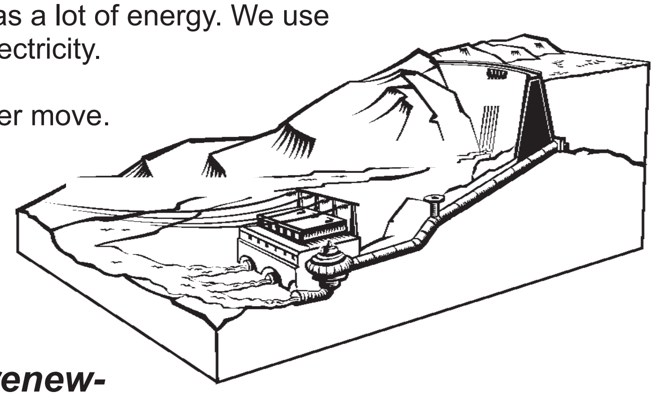
Hydropower Facts

- Worldwide, about 20 percent of all electricity is generated by hydropower.
- Hydropower provides about 10 percent of the electricity in the United States.
- The United States is the second largest producer of hydropower in the world. Canada is number one.
- In the U.S., hydropower produces enough electricity to serve the needs of 28 million residential customers. This is equal to all the homes in Wisconsin, Michigan, Minnesota, Indiana, Iowa, Ohio, Missouri, Nebraska, Kansas, North and South Dakota, Kentucky, and Tennessee.

Hydropower

What is Hydropower?

Hydro means water. Hydropower is the energy we make with moving water. Moving water has a lot of energy. We use that energy to make electricity.



Gravity makes the water move. Gravity pulls the water from high ground to low ground. The rain that falls in the mountains flows down the valleys to the oceans.

Hydropower is renewable.

The sun heats the water in the oceans, turning it into *water vapor.* The warm vapor rises into the sky. It turns into clouds when it reaches the cold air above the earth. The clouds release the water as rain or snow. This water flows back to the oceans and rivers and the cycle starts again. This is called the *water cycle.*

The water cycle will keep going forever. The water on earth will always be there. We will not run out of it. That's why it is a renewable energy source.

History of Hydropower

Water has been used as a source of energy for centuries. The Greeks used water wheels to grind wheat into flour more than 2,000 years ago. In the early 1800s, American and European factories used water wheels to power machines. The water wheel is a simple machine. The wheel picks up water in buckets located around the wheel. The weight of the water causes the wheel to turn. Water wheels convert the energy to grind grain, drive sawmills or pump water.

In the late 1800s, the force of falling water was first used to generate electricity. The first hydroelectric plant was built at Niagara Falls in 1879. In the years that followed, many more hydropower dams were built. By the 1940s, the best sites in the United States for large dams had been developed.

At about the same time, fossil fuel power plants began to be popular. These plants could make electricity more cheaply than hydropower plants. It wasn't until the price of oil skyrocketed in the 1970s that people became interested in hydropower again.

Hydropower Dams

It is easier to build a hydro plant on a river where there is a natural waterfall. That's why the first hydro plant was built at Niagara Falls. Dams, which produce artificial waterfalls, are the next best way.

Dams are built on rivers where the terrain of the land will produce a lake or reservoir. Today there are about 80,000 dams in the U.S., but only three percent have equipment to generate electricity.

Most of the dams in the U.S. were built to control flooding or irrigate farmland, not for electricity production. We could increase the amount of hydropower produced in this country by putting equipment to generate electricity on many of the existing dams.

Hydropower Plants

Hydropower plants use modern turbine generators to produce electricity just as coal, oil or nuclear power plants do. The difference is the fuel. A typical hydro plant has three parts:

- an electric plant where the electricity is produced;
- a dam with gates that can be opened or closed to control water flow; and
- a reservoir where water can be stored.

A hydro plant uses the force of falling water to produce electricity. A dam opens gates at the top to allow water from the reservoir to flow down a large tube call a *penstock.* At the bottom of the penstock, the fast-moving water spins the blades of a turbine.

The turbine is attached to a *generator* to produce electricity. The electricity is then transported along huge transmission lines to a utility company.

Storing Energy

One of the biggest advantages of hydropower dams is their ability to store energy. After all, the water in a reservoir is stored energy.

Water can be stored in a reservoir and released when electricity is needed. During the night, when people use less electricity, the gates can be closed and water held in the reservoir. Then, during the day, when people need more electricity, the gates can be opened so that the water can flow through the plant to generate electricity.

Hydropower and the Environment

Hydropower is a clean energy source, but it does change the environment. Damming rivers may disturb or damage the wildlife and natural resources of an area. Farms, roads and sometimes whole towns may have to be moved when a dam is built, because the reservoir that is created could flood many acres of land.

On the positive side, hydropower's fuel supply (flowing water) is clean and replenished by snow and rainfall. In addition, hydro plants do not emit any pollutants because they burn no fuel. The dams also control floodwater and reservoirs provide lakes for boating, swimming and fishing.

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ENERGY fact sheet

Key Terms

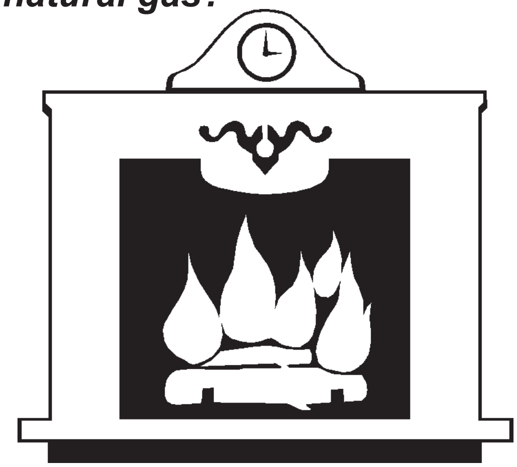
- Coal Bed
- Methane
- Fossil Fuel
- Industry
- Natural Gas
- Nonrenewable
- Residences

Natural Gas Facts

- The United States is the second largest producer and the largest consumer of natural gas.
- In a single year, the average U.S. home uses 84,000 cubic feet of natural gas.
- Americans use about 62 billion cubic feet of natural gas every day.
- Almost 8,000 U.S. companies produce natural gas.
- When natural gas was first discovered, it was discarded because it was thought to be a just useless by-product of oil.
- Since the 1970s natural gas consumption has grown faster than any other fossil fuel.

Natural Gas

What is natural gas?



Natural gas is a fossil fuel. Natural gas is called a fossil fuel because most scientists believe that it was formed from the remains of ancient sea plants and animals.

Natural gas is trapped in underground rocks much like a sponge traps water in pockets. Natural gas is really a mixture of gases. The main ingredient is methane. Methane has no color, odor or taste. As a safety measure, natural gas companies add an odorant, mercaptan, to the gas so that leaking gas can be detected (it smells like rotten eggs). People use natural gas mostly for heating. Natural gas should not be confused with gasoline, which is made from petroleum.

Natural gas is nonrenewable.

Natural gas is almost always considered a nonrenewable energy source. That means we cannot make more in a short time. There are some renewable sources of methane that are discussed later.

The History of Natural Gas

The ancient people of Greece, Persia and India discovered natural gas many centuries ago. The people were mystified by the burning springs created when natural gas seeped from cracks in the ground and was ignited by lightning. They sometimes built temples around these eternal flames and worshipped the fire.

In 1816, natural gas was first used in America to fuel street lamps in Baltimore. Soon after, in 1821, William Hart dug the United States' first successful natural gas well in Fredonia, New York. It was just 27 feet deep, quite shallow compared to today's wells. Today, natural gas is the country's third largest supplier of energy, after petroleum and coal.

Producing Natural Gas

Natural gas can be hard to find since it is trapped in porous rocks deep underground. Scientists use many methods to find natural gas deposits. They may look at surface rocks to find clues about underground formations. They may set off small explosions or drop heavy weights on the surface to record the sound waves as they bounce back from the rock layers underground. Natural gas can be found in pockets by itself or in petroleum deposits. Natural gas wells average 5,000 feet deep!

After natural gas comes out of the ground, it is sent to a plant where it is cleaned of impurities and separated into its various parts. Natural gas is mostly methane, but also contains a small amount of other gases such as propane and butane.

Natural gas also can come from several other sources. One source is the gas found in coal beds. Until recently, coal bed methane was considered just a safety hazard to miners, but now it is a valuable source of natural gas. Another source of natural gas is the gas produced in landfills. Landfill gas is called a renewable source of natural gas since it comes from rotting garbage.

Today natural gas is produced in 32 states, though just three states – Texas, Louisiana and Oklahoma – produce 59 percent of the total supply. Scientists estimate we have enough natural gas to last for at least 50 years.

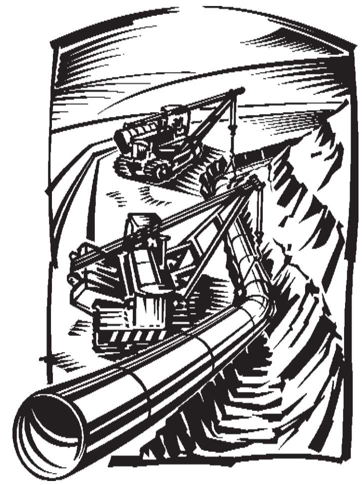
Who uses natural gas?

Just about everyone in the U.S. uses natural gas. *Industry* is the biggest user. Industry bums natural gas for heat to manufacture goods. Natural gas is also used as an ingredient in fertilizer, glue, paint, laundry detergent and many other items.

Residences, or homes, are the second biggest users of natural gas. Six in ten homes use natural gas for heating. Like residences, commercial buildings use natural gas mostly for heating. Commercial users include stores, offices, schools, churches and hospitals.

Natural gas also can be used to make electricity. Just as the chemical energy in coal is used to make electricity, so can the energy in natural gas.

Shipping Natural Gas



Natural gas is usually shipped by pipeline. More than one million miles of underground pipelines link natural gas fields to major cities across the U.S. Natural gas is sometimes transported thousands of miles in these pipelines to its final destination.

Natural Gas and the Environment

Burning any fossil fuel, including natural gas, releases emissions into the air, as well as carbon dioxide – a greenhouse gas.

Natural gas and propane are the most clean burning fossil fuels. Because it is a clean source of energy, scientists are looking for new sources of natural gas and new ways to use it.

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ENERGY fact sheet

Key Terms

- Fossil fuel
- Jobbers
- Kerosene
- Nonrenewable
- Oil derrick
- Oil refinery
- Oil rig
- Refined

Petroleum Products

- Aspirin
- Balloons
- Cameras
- Contact lenses
- Crayons
- Deodorant
- Detergents
- Footballs
- Glue
- Golf balls
- Hand lotion
- Paint brushes
- Pajamas
- Perfumes
- Shampoo
- Shoe polish
- Sunglasses
- Tires
- Toothbrushes
- Toothpaste
- Trash bags

Petroleum

What is petroleum?

Petroleum is a fossil fuel. It is a fossil fuel because it was formed from the remains of tiny sea plants and animals that died millions of years ago.

When the plants and animals died, they sank to the bottom of the oceans. Here, they were buried by thousands of feet of sand and silt. As the layers increased, they pressed harder and harder on the decayed remains at the bottom. The heat and pressure changed the remains, and eventually, petroleum was formed.

Petroleum deposits are locked in porous rocks almost like water is trapped in a wet sponge. When crude oil comes out of the ground, it can be as thin as gasoline or as thick as tar.

Petroleum is nonrenewable.

Petroleum is called a nonrenewable energy source because it takes millions of years to form. We cannot make new petroleum reserves. Petroleum is often called crude oil or oil.

The History of Oil

People have used petroleum since ancient times. The ancient Chinese and Egyptians burned oil to light their homes.

Before the 1850s, Americans used whale oil to light their homes. When whale oil became scarce, people skimmed the oil that seeped to the surface of ponds and streams. The demand for oil grew, and in 1859, Edwin Drake drilled the first oil well near Titusville, Pennsylvania.

At first, the crude oil was *refined* or made into *kerosene* for lighting. Gasoline and other products made during refining were thrown away because people had no use for them. This all changed when Henry Ford began mass producing automobiles in the 1890s. Everyone wanted an automobile, and they all ran on gasoline. Today, Americans use more petroleum than any other energy source, mostly for transportation.

Producing Oil

Geologists look at the types of rocks and the way they are arranged deep within the earth to determine whether oil is likely to be found at a location. Even with new technology, oil exploration is expensive and often unsuccessful. Of every 100 new wells drilled, only about 44 produce oil.

When scientists think there may be oil in a certain place, a petroleum company brings in a drilling rig and raises an oil derrick that houses the tools and pipes they need to drill a well. The typical oil well is about one mile deep. If oil is found, a pump moves the oil through a pipe to the surface.

Nearly one-fifth of the oil the U.S. produces comes from offshore wells. Some of these wells are a mile under the ocean. Some of the rigs used to drill these wells float on top of the water. It takes a lot of money and technology to find oil and drill under the ocean.

Texas produces more oil than any other state, followed by Alaska, California, Louisiana and Oklahoma - in that order. Americans use much more oil than we produce. Today, the U.S. buys almost two-thirds (65 percent) of the oil it uses from foreign countries.

From Well to Market

We can't use crude oil as it comes out of the ground. We must change it into fuels that we can use. The first stop for crude oil is at an *oil refinery.* A refinery is a factory that processes oil.

The refinery cleans and separates the crude oil into many fuels and products. The most important one is gasoline. Some other petroleum products are diesel fuel, heating oil and jet fuel.

Shipping Petroleum

After the refinery, most petroleum products are shipped out through pipelines. There are about 230,000 miles of underground pipeline in the U.S. Pipelines are the safest and cheapest way to move big shipments of petroleum. It takes about 15 days to move a shipment of gasoline from Houston, Texas to New York City.

Special companies called *jobbers* buy petroleum products from oil companies and sell them to gasoline stations and to other big users such as industries, power companies and farmers.

Oil and the Environment

Petroleum products - gasoline, medicines, fertilizers and other - have helped people all over the world. But there is a trade-off. Petroleum production and petroleum products may cause air and water pollution.

Drilling for oil may disturb fragile land and ocean environments. Transporting oil may endanger wild life if it's spilled on rivers and oceans. Burning gasoline to fuel our cars pollutes the air. Even the careless disposal of motor oil drained from the family car can pollute streams and rivers.

The petroleum industry works hard to protect the environment. Oil companies have cleaned up their refineries. Gasolines and heating oils have been changed to burn cleaner. And oil companies are making sure that they drill and transport oil as safely as possible.

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ENERGY fact sheet

Key Terms

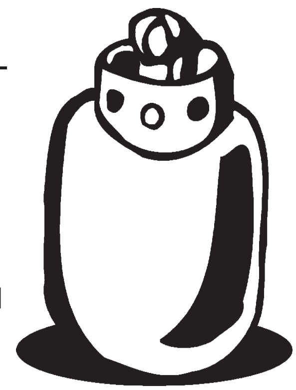
- Bulk tank
- Distribution terminal
- Fossil fuel
- Liquefied petroleum

Propane Facts

- Propane is a nontoxic gas. It is released as a gas and will not contaminate soil or groundwater supplies. Therefore, propane is exempt from the U.S. Environmental Protection Agency's tough underground storage regulations.
- Propane is considered a safe motor fuel by the federal government. School buses run on propane.
- About 97 percent of the U.S. propane supply is produced in North America, and 88 percent of that is produced in the United States.
- The U.S., Canada and Mexico have extensive natural gas reserves. The majority (75 percent) of imported propane comes from Canada.

Propane

What is propane?



Propane is an energy-rich gas that is related to petroleum and natural gas. Propane is usually found mixed with deposits of natural gas and petroleum underground. Propane is called a *fossil fuel* because it was formed millions of years ago from the remains of tiny sea animals and plants.

Propane is one of the many fuels that are included in the *liquefied petroleum* (or LP-gas) family. In the U.S., propane and LP-gas often mean the same thing, because propane is the most common type of LP gas used.

Just as water can be a liquid or a gas (steam), so can propane. Under normal conditions, propane is a gas. But under pressure, propane becomes a liquid.

Propane is stored as a liquid fuel in pressurized tanks because it takes up much less space in that form. Gaseous propane takes up 270 times more space than liquid propane. A thousand gallon tank holding gaseous propane would provide a family enough cooking fuel for one week. The same tank holding liquid propane would provide enough cooking fuel for over five years. Propane becomes a gas when it is released to fuel gas appliances.

Propane is nonrenewable.

Propane is very similar to natural gas. Like natural gas, propane is colorless and odorless. An odor is added to propane so escaping gas can be detected. And like all fossil fuels – coal, petroleum and natural gas – propane is a nonrenewable energy source.

The History of Propane

Propane has been around for millions of years, but it wasn't discovered until 1912. Scientists were trying to find a better way to store gasoline, which evaporated when stored.

Continued on back

An American scientist, Dr. Walter Snelling, discovered that propane gas could be changed into a liquid and stored at moderate pressure. Just one year later, the commercial propane industry began heating American homes with propane.

Producing Propane

Propane comes from natural gas and petroleum wells. Forty-six percent of the propane used in the U.S. comes from raw natural gas. Raw natural gas is about 90 percent methane, about five percent propane and about five percent other gases. The propane is separated from the other gases at a natural gas processing plant.

Forty-five percent of propane supplies come from petroleum and nine percent is imported. Petroleum is separated into various fuels at an oil refinery. Petroleum's most important product is gasoline – and propane is another.

Transporting Propane

How does propane get to the people who use it? Propane is usually moved through underground pipelines to distribution terminals across the nation. *Distribution terminals* are like warehouses that store merchandise before shipping it to stores. Sometimes in the summer, when people need less energy for heating, propane is stored in large underground caverns.

From the distribution terminals, propane goes by railroad, trucks, barges and supertankers to bulk plants. A *bulk plant* is where local propane dealers come to fill their small tank trucks.

How is propane used?

Propane provides the U.S. with almost two percent of its energy. Propane is used by homes, farms, business and industry – mostly for heating. It is also used as a transportation fuel.

- **Homes** - Propane is mostly used in rural areas that do not have natural gas service. Homes use propane for heating, hot water, cooking and clothes drying. Many families have barbecue grills fueled by propane gas. Some families have recreational vehicles equipped with propane appliances.

- **Farms** - Half of America's farms rely on propane to meet their energy needs. Farmers use propane to dry crops, power tractors and to heat greenhouses and chicken coops.

- **Business** - Businesses like office buildings, laundromats, fast-food restaurants and grocery stores - use propane for heating and cooking.

- **Industry** - Certain industries find propane well-suited to their special needs. Metal workers use small propane tanks to fuel cutting torches. Portable propane heaters give construction and road workers warmth in cold weather.

  Propane also is used to heat asphalt for highway construction and repairs. And because propane burns so cleanly, forklift trucks powered by propane can operate safely inside factories and warehouses.

- **Transportation Fuel** - Propane has been used as a transportation fuel for many years. Today, many taxicab companies, government agencies and school districts use propane instead of gasoline to fuel their fleets of vehicles. Propane has several advantages over gasoline. First, propane is clean- burning and leaves engines free of deposits. Second, engines that use propane emit fewer pollutants into the air than engines that use gasoline.

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ENERGY fact sheet

Solar Energy

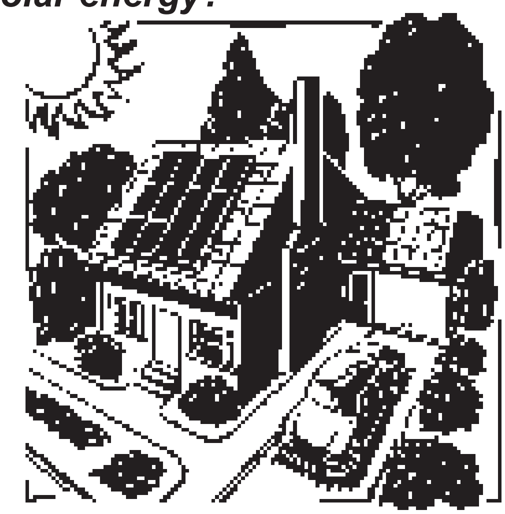
Key Terms

- Active solar home
- Photovoltaic electricity
- Silicon
- Solar thermal system
- Solar collector
- Space heating
- Solar collectors

Solar Energy Facts

- Did you know that solar energy is dependent upon nuclear power? Solar energy's nuclear power plant, though, is 93 million miles away.
- The earth receives more energy from the sun in just one hour than the world uses in a whole year.
- New York Governor George Pataki recently mandated that state facilities purchase at least 10 percent of their power needs from renewable sources by 2005, and 20 percent by 2010.
- As mandated by state law, Nevada utilities will be required to buy 5 percent of their power from geothermal, wind, solar and biomass sources by 2003 and 15 by 2013.

What is solar energy?



Everyday, the sun radiates (sends out) an enormous amount of energy. It radiates more energy in one second than the world has used since time began. This energy comes from within the sun itself. Like most stars, the sun is a big gas ball made up mostly of hydrogen and helium gas. The sun makes energy in its inner core in a process called nuclear fusion.

Only a small part of the solar energy that the sun radiates into space ever reaches the earth, but that is more than enough to supply all our energy needs. Every day enough solar energy reaches the earth to supply our nation's energy needs for a year. It takes the sun's energy just a little over eight minutes to travel the 93 million miles to earth. Solar energy travels at a speed of 186,000 miles per second, the speed of light. Today, people use solar energy to heat buildings and water and to generate electricity.

Heating with solar energy is not as easy as you might think. Capturing sunlight and putting it to work is difficult because the solar energy that reaches the earth is spread out over a large area. The sun does not deliver that much energy to any one place at any one time. The amount of solar energy an area receives depends on the time of day, the season of the year, the cloudiness of the sky and how close you are to the earth's equator.

A *solar collector* is one way to capture sunlight and change it into usable heat energy. A closed car on a sunny day is like a solar collector. As sunlight passes through the car's windows, it is absorbed by the seat covers, walls and floor of the car. The absorbed light changes into heat. The car's windows let light in, but they don't let all the heat out. A closed car can get very hot.

Solar Space Heating

Space heating means heating the space inside a building. Today, many homes use solar energy for space heating. A passive solar home is designed to let in as much sunlight as possible. It is like a big solar collector.

Sunlight passes through the windows and heats the walls and floor inside the house. The light can get in, but the heat is trapped inside. A passive solar home does not depend on mechanical equipment, such as pumps and blowers to heat the house.

An *active solar home,* on the other hand uses special equipment to collect sunlight. An active solar house may use special collectors that look like boxes covered with glass. These collectors are mounted on the rooftop facing south to take advantage of the winter sun. Dark-colored metal plates inside the boxes absorb sunlight and change it into heat. (Black absorbs sunlight more than any other color.) Air or water flows through the collector and is warmed by the heat. The warm air or water is distributed to the rest of the house, just as it would be with an ordinary furnace system.

Solar Hot Water Heating

Solar energy can be used to heat water. Heating water for bathing, dish washing and clothes washing is the second biggest home energy cost. A solar water heater works a lot like a solar space heater. In our hemisphere, a solar collector is mounted on the south side of a roof where it can capture sunlight. The sunlight heats water in a tank. The hot water is piped to faucets throughout a house, just as it would be with an ordinary water heater. Today, more than 1.5 million homes in the U.S. use solar water heaters.

Solar Electricity

Solar energy can also be used to produce electricity. Two ways to make electricity from solar energy are photovoltaics and solar thermal systems.

- **Photovoltaic Electricity** - Photovoltaic comes from the words photo, meaning light, and volt, a measurement of electricity. Sometimes photovoltaic cells are called PV cells or solar cells for short. You are probably familiar with photovoltaic cells. Solar- powered toys, calculators and roadside telephone call boxes all use solar cells to convert sunlight into electricity. Solar cells are made up of *silicon,* the same substance that makes up sand. Silicon is the second most common substance on earth. Solar cells can supply energy to anything that is powered by batteries or electrical power. Electricity is produced when sunlight strikes the solar cell, causing the electrons to move around. The action of the electrons starts an electric current. The conversion of sunlight into electricity takes place silently and instantly. There are no mechanical parts to wear out.

- **Solar Thermal Electricity** - Like solar cells, *solar thermal systems* use solar energy to produce electricity, but in a different way. Most solar thermal systems use a solar collector with a mirrored surface to focus sunlight onto a receiver that heats a liquid. The super-heated liquid is used to make steam to produce electricity in the same way that coal plants do. Solar energy has great potential for the future. Solar energy is free and its supplies are unlimited. It does not pollute or damage the environment. It cannot be controlled by any one nation or industry. If we can improve the technology to harness the sun's enormous power, we may never face energy shortages again.

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ENERGY fact sheet

Hydrogen

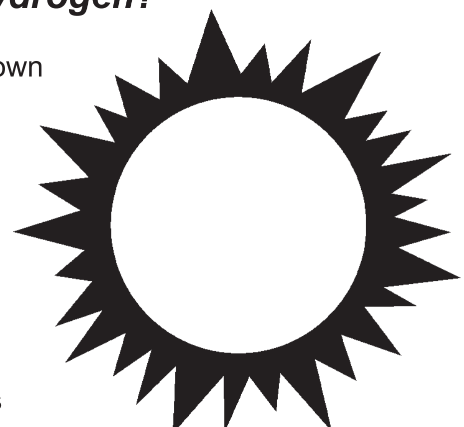
Key Terms

- Energy carriers
- Fuel cell
- Fusion
- Radiant
- Renewable

Hydrogen Facts

- Hydrogen is a nontoxic, colorless, odorless, and tasteless gas.
- Hydrogen, bound in organic matter and water, makes up 70 percent of the Earth's surface. It is the most common element in the universe.
- Hydrogen is about one-fourth as dense as air.
- It burns cleanly. When hydrogen is burned with oxygen, the only by-products are heat and water. When burned with air, which is about 68 percent nitrogen, some oxides of nitrogen are formed.
- Most of the hydrogen produced in the United States is made by steam reforming, which is currently the most cost-effective way to produce hydrogen.

What is hydrogen?



Hydrogen is the simplest element known to man. An atom of hydrogen has only one proton and one electron. It is also the most plentiful gas in the universe.

The sun's energy comes from hydrogen. The sun is a giant ball of hydrogen and helium gases. Inside they sun, hydrogen atoms combine to form helium atoms. This process is called *fusion* and it gives off *radiant* energy. This radiant energy sustains life on earth. It gives us light and makes plants grow. It makes the wind blow and rain fall. It is stored in fossil fuels. Most of the energy we use today comes from the sun.

Hydrogen as a gas (H_2) doesn't exist on earth. It is always mixed with other elements. Combined with oxygen, it is water (H_2O) Combined with carbon, it makes different compounds such as methane (CH_4), coal and petroleum. Hydrogen is also found in all growing things – biomass.

Hydrogen can store energy.

Most of the energy we use today comes from fossil fuels. Only seven percent comes from renewable energy sources. But people want to use more renewable energy. It is usually cleaner and is replenished in a short period of time. Renewable energy sources – like solar and wind – can't make energy all the time. The sun doesn't always shine. The wind doesn't always blow. They don't always make energy when or where we need it. Hydrogen can store that energy until it's needed and move it to where it's needed.

Hydrogen As An Energy Carrier

Everyday we use more energy, mostly coal, to make electricity. Electricity is a secondary source of energy. Secondary sources of energy – sometimes called energy carriers – store, move and deliver energy to consumers. We convert energy to electricity because it is easier for us to move and use.

Electricity gives us light, heat, hot water, cold food, TVs and computers. Life would be really hard if we had to burn the coal, split the atoms or build our own dams. Energy carriers make life easier.

Hydrogen is an energy carrier for the future. It is a clean, renewable fuel that can be used in places where it's hard to use electricity. Sending electricity a long way costs four times as much as shipping hydrogen by pipeline.

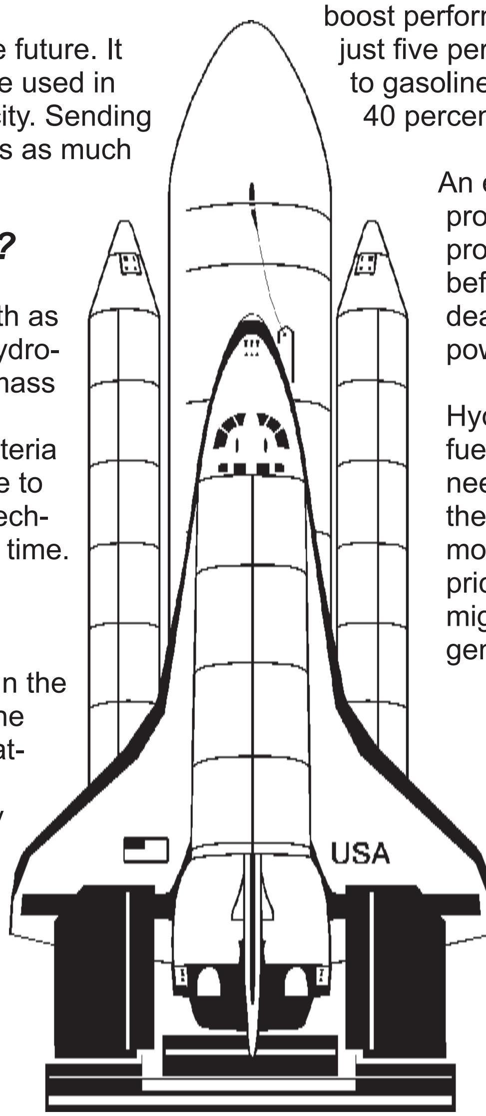
How is hydrogen made?

Since hydrogen doesn't exist on earth as a gas, we must make it. We make hydrogen by separating it from water, biomass or natural gas. Scientists have even discovered that some algae and bacteria give off hydrogen. It's very expensive to make hydrogen right now, but new technologies are being developed all the time.

Uses of Hydrogen

NASA has used hydrogen for years in the space program. Hydrogen fuel lifts the space shuttle into orbit. Hydrogen batteries – called *fuel cells* – power the shuttle's electrical systems. The only by-product is pure water, which the crew uses as drinking water.

Hydrogen fuel cells (batteries) make electricity. They are very efficient, but expensive to build. Some day, small fuel cells could power electric cars. Large fuel cells could provide electricity in remote areas.



Hydrogen as a Fuel

Because of the cost, hydrogen power plants won't be built for quite a while. Hydrogen soon may be added to natural gas to reduce pollution from existing plants. Soon hydrogen will be added to gasoline to boost performance and reduce pollution. Adding just five percent hydrogen to gasoline can lower emissions by 30 to 40 percent.

An engine that burns pure hydrogen produces almost no pollution. It probably will be 20 years, though, before you can walk into your local car dealer and drive away in a hydrogen-powered car.

Hydrogen would also be a great jet fuel. It's high in energy, so jets would need less fuel. And it weighs less than the fuel used today, so jets could carry more cargo. It's also nonpolluting. If the price of jet fuel continues to rise, you might see planes converting to hydrogen in the near future.

The Future of Hydrogen

Before hydrogen can take its place in the U.S. energy picture, many new systems must be built. We will need systems to make hydrogen, store it and move it. We will need pipelines and fuel cells And consumers will need the technology and the education to use it.

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ENERGY fact sheet

Key Terms

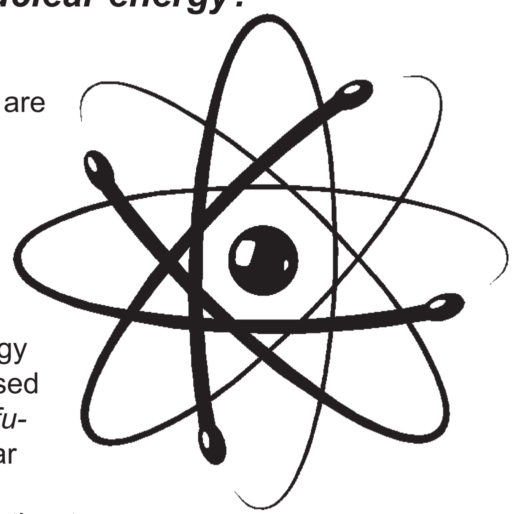
- Ceramic pellets
- Chain reaction
- Cooling tower
- Core
- Fuel assembly
- Generator
- Neutron
- Nucleus
- Nuclear energy
- Nuclear fission
- Nuclear fusion
- Proton
- Reactor
- Turbine
- Uranium

Nuclear Energy Facts

- Nuclear energy provides 22 percent of all electricity generated in the United States. In France, nuclear energy is responsible for about 70 percent of that country's electricity.
- One ton of natural uranium can produce more than 40 million kilowatt-hours of electricity. This is equivalent to burning 16,000 tons of coal or 80,000 barrels of oil.

Nuclear Energy

What is nuclear energy?



Nuclear energy is energy in the *nucleus* (core) of an atom. Atoms are tiny particles that make up every object in the universe. There is enormous energy in the bonds that hold atoms together.

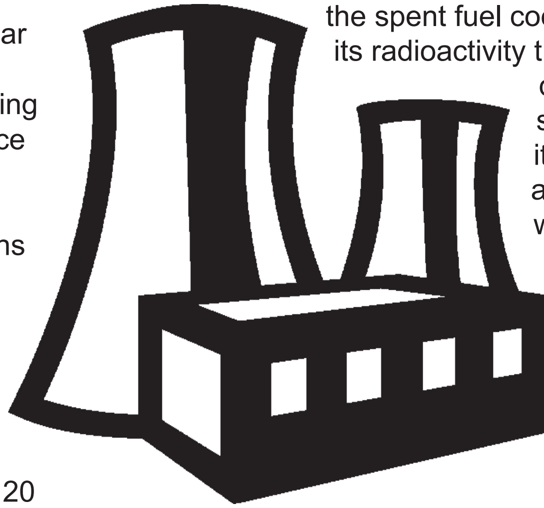
Nuclear energy can be used to make electricity. But first the energy must be released. It can be released from atoms in two ways: *nuclear fusion* and *nuclear fission*. In nuclear fusion, energy is released when atoms are combined or fused together to form a larger atom. This is how the sun produces energy. In nuclear fission, atoms are split apart to form smaller atoms, releasing energy. Nuclear power plants use nuclear fission to produce electricity. During nuclear fission, a small particle called a neutron hits the *uranium* atom and it splits, releasing a great amount of energy as heat and radiation. Neutrons also are released. These neutrons go on to bombard other uranium atoms, and the process repeats itself over and over again. This is called a *chain reaction.*

The History of Nuclear Energy

Compared to other energy sources, nuclear energy is a very new way to produce energy. It wasn't until the early 1930s that scientists discovered that the nucleus of an atom is made up of particles called *protons* and *neutrons.* A few years later, scientists discovered that the nucleus of an atom could be split apart by bombarding it with a neutron - the process we call fission. Soon they realized that enormous amounts of energy could be produced by nuclear fission.

Under the dark cloud of World War II, nuclear fission was first used to make a bomb. After the war, nuclear fission was used to generate electricity. Today, it provides almost 19 percent of the electricity used in the United States.

How does a nuclear power plant work?



Most power plants burn fuel to produce electricity, but not nuclear power plants. Instead, nuclear plants use the heat given off during fission as fuel. Fission takes place inside the *reactor* of a nuclear power plant. At the center of the reactor is the *core,* which contains the uranium fuel.

The uranium fuel is formed into *ceramic pellets.* The pellets are about the size of your fingertip, but each one produces the same amount of energy as 120 gallons of oil. These energy-rich pellets are stacked end-to-end in 12-foot metal fuel rods. A bundle of fuel rods is called a *fuel assembly.*

Fission generates heat in a reactor just as coal generates heat in a boiler. The heat is used to boil water into steam. The steam turns huge *turbine* blades. As they turn, they drive *generators* that make electricity. Afterward, the steam is changed back into water and cooled in a separate structure at the power plant called a *cooling tower.* The water can be used again and again.

Nuclear Waste

Every few years, the fuel rods must be replaced. Fuel that has been removed from the reactor is called *spent fuel.* Nuclear power plants do not produce a large quantity of waste, but the waste is highly *radioactive.*

The spent fuel is usually stored near the reactor in a deep pool of water called the spent fuel pool. Here, the spent fuel cools down and begins to lose most of its radioactivity through a natural process called radioactive decay. In three months, the spent fuel will have lost 50 percent of its radiation; in a year, it will have lost about 80 percent; and in ten years, it will have lost 90 percent. Nevertheless, because some radioactivity remains for as long as 1,000 years, the waste must be carefully isolated from people and the environment.

Nuclear Energy and the Environment

Nuclear power plants make very little impact on the environment. Nuclear plants produce no air pollution or carbon dioxide, because no fuel is burned. Using nuclear energy may be one way to solve air pollution problems.

The major problem with nuclear power is storage of the radioactive waste. Many people also worry that an accident at a power plant could cause widespread damage.
People are using more and more electricity. Some experts predict we will have to use nuclear energy to produce the amount of electricity people need at a cost they can afford. Whether or not we should use nuclear energy is a decision our society will have to make.

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ENERGY fact sheet

Key Terms

- Mountain gaps
- Wind breaks
- Wind farms

Wind Facts

- The highest surface wind recorded was 231 m.p.h. at Mt. Washington, New Hampshire on April 1934.
- At Commonwealth Bay, Antarctica, winds may gust to 200 m.p.h..
- There is evidence that wind energy was used to propel boats along the Nile River as early as 5000 B.C.
- In the United States, millions of windmills were erected as the American West was developed during the late 19th century. Most of them were used to pump water for farms and ranches.
- The largest wind turbines, such as the one built in Hawaii, have propellers that span the more than the length of a football field and stands 20 building stories high, and produces enough electricity to power 1,400 homes.

Wind

What is wind?

Wind is simply air in motion. It is caused by the uneven heating of the earth's surface by the sun. Since the earth's surface is made up of land and water, desert and forest, the surface absorbs the sun's heat differently. During the day, the air above the land heats up more quickly than air above water. The warm air over the land expands and rises, and the heavier, cooler air rushes in to take its place, creating winds.

In the same way, the large atmospheric winds that circle the earth are created because the land near the earth's equator is heated more by the sun than land near the North and South Poles. Today, people use wind energy to make electricity. Wind is called a renewable energy source because the wind will blow as long as the sun shines.

The History of Wind Machines

Since ancient times, people have harnessed the wind's energy. Over 5,000 years ago, the ancient Egyptians used the wind to sail ships on the Nile River. Later, people built windmills to grind wheat and other grains. The early windmills looked like paddle wheels.

Centuries later, the people in Holland improved the windmill. They gave it propeller-type blades. Holland is still famous for its windmills.

In this country, the colonists used windmills to grind wheat and corn, to pump water and to cut wood at sawmills. Today, people occasionally use windmills to grind grain and pump water, but they also use new wind machines to make electricity.

Wind is renewable.

As long as the sun shines, there will be winds on the earth. We will never run out of wind energy. It is a renewable energy source. It is also free, since no one can own the sun or the air.

Wind Machines Today

Like old-fashioned windmills, today's wind machines use blades to collect the wind's kinetic energy. Wind machines work because they slow down the speed of the wind. The wind flows over the blades causing lift, like the effect on airplane wings, causing them to turn. The blades are connected to a drive shaft that turns an electric generator to make electricity.

The new wind machines still have the problem of what to do when the wind isn't blowing. They usually have a battery to store the extra energy they collect when the wind is blowing hard.

Wind Power Plants

Wind power plants, or *wind farms,* are clusters of wind machines used to produce electricity. A wind farm usually has hundreds of wind machines in all shapes and sizes.

Unlike power plants, most wind plants are not owned by public utility companies. Instead they are owned and operated by business people who sell the electricity produced on the wind farm to electric utility companies.

Operating a wind power plant is not as simple as just building a windmill in a windy place. Wind plant owners must carefully plan where to locate their machines. One important thing to consider is how fast and how much the wind blows. As a rule, wind speed increases with height and over open areas with no *wind breaks.* Good sites for wind plants are the tops of smooth, rounded hills, open plains or shorelines and *mountain gaps* where the wind is funneled. The three biggest wind plants in California are located at mountain gaps.

Wind speed varies throughout the country. It also varies from season to season. In Tehachapi, California, the wind blows more during the summer than in the winter. This is because of the extreme heating of the Mojave desert during the summer months. The hot desert air rises, and the cooler, denser air from the Pacific Ocean rushes through the Tehachapi mountain pass to take its place. In Montana, on the other hand, the wind blows more in the winter. Fortunately, these seasonal variations match the electricity demands of the different regions. In California, people use more electricity during the summer months for air conditioning. In Montana, people use more electricity during the winter months, for heating.

How much energy do we get from wind?

Every year, wind energy produces enough electricity to serve 300,000 households, as many as in a city the size of San Francisco or Washington, D.C. This is only a small amount of the electricity this country uses.

One reason wind plants don't produce more electricity is that they can only run when the wind is blowing 14 mph or more. In most places, the wind is only right for producing electricity about 25 percent of the time. But, wind machines are clean and they don't cause air or water pollution.

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