

MANUFACTURING

# Energy

*A look at how people create and use energy*



EDUCATIONAL IN NATURE®

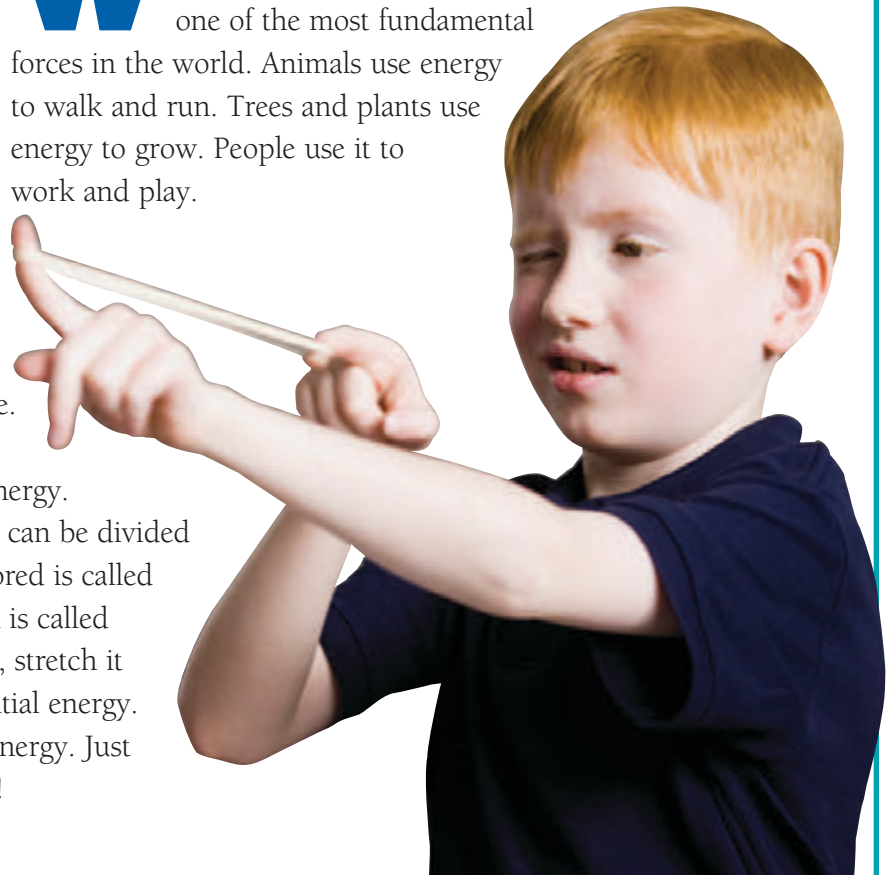


# Energy

**W**hen you turn on the television, tie your shoelace or drive to the store, you're using energy. Energy is one of the most fundamental forces in the world. Animals use energy to walk and run. Trees and plants use energy to grow. People use it to work and play.

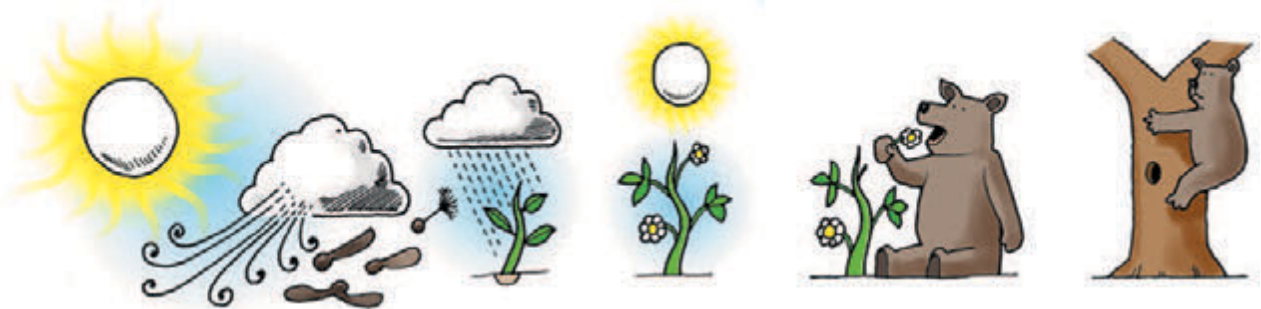
Energy is everywhere in nature – in the light of the sun, in the wind, in the forest, in falling water and erupting volcanoes. Without energy, there is no life. We use our own energy constantly – and we continually make use of all kinds of energy.

Energy makes everything happen and can be divided into two different types. Energy that is stored is called potential energy. Energy that is in motion is called kinetic energy. If you have a rubber band, stretch it out. The stretched rubber band has potential energy. If you let it go, it moves and has kinetic energy. Just don't shoot anyone with the rubber band!



## THE ENERGY CHAIN

**Did you know that bears can climb trees because of the sun?**



Energy from the sun creates wind and rain. The wind helps scatter seeds for new plant and tree growth. Rain provides needed water. Trees and plants grow because they take energy from the sun and convert it to chemical energy through a process called photosynthesis. The

chemical energy is stored in the plant as potential energy. When a bear eats a plant, the stored energy from the plant is converted to muscle energy – and the bear can climb a tree! So the sun allows the tree to grow and gives the bear the energy to climb it!

# Powerful Resources

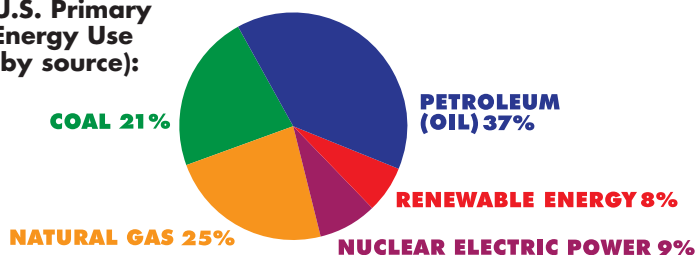
We use energy from a variety of resources to fuel our cars, create electricity, make products and heat our homes.



## ANCIENT ENERGY?

The gasoline in the car or bus you rode in to school today was created millions of years ago, when the dinosaurs were still alive. Back then, like today, plants and animals used the sun's energy. When they died, their decomposed remains gradually changed under pressure over the years into types of potential energy such as coal, oil and natural gas. We call these energy sources fossil fuels.

### U.S. Primary Energy Use (by source):



Source: Energy Information Administration, 2010

## YOU'RE ALL WET

The kinetic energy of moving or falling water is a powerful source of energy. This energy, known as hydropower, is used to generate electricity. Hydroelectric dam



Old Faithful Geyser, Yellowstone National Park

## FROM THE CENTER OF THE EARTH

"Geo" means earth and "thermal" means heat. So, geothermal means "earth heat." This heat comes from inside the earth, which is made up of rock so hot that it's melted. The hot rocks make underground water boil, producing steam. We can capture this steam with pipes and use the steam to create electricity.

## BLOWING IN THE WIND

You can't see the wind, but when it blows you can feel it push against your body. When the wind blows against big blades on windmills, the movement of the spinning blades can pump water or produce electricity.

Windmill



## THE ORIGINAL ENERGY SOURCE

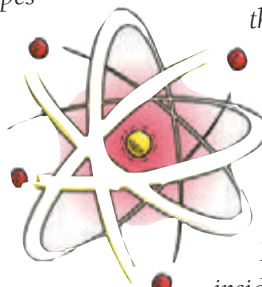
The sun has been an energy source since the beginning of time. The sun warms the earth and gives us light. We can capture the sun's energy and use it directly in a solar cell, or use the heat from the sun to boil water and create steam used in making electricity.

Solar energy, heat from the sun, can even cook food.



## FUEL FROM THE FOREST

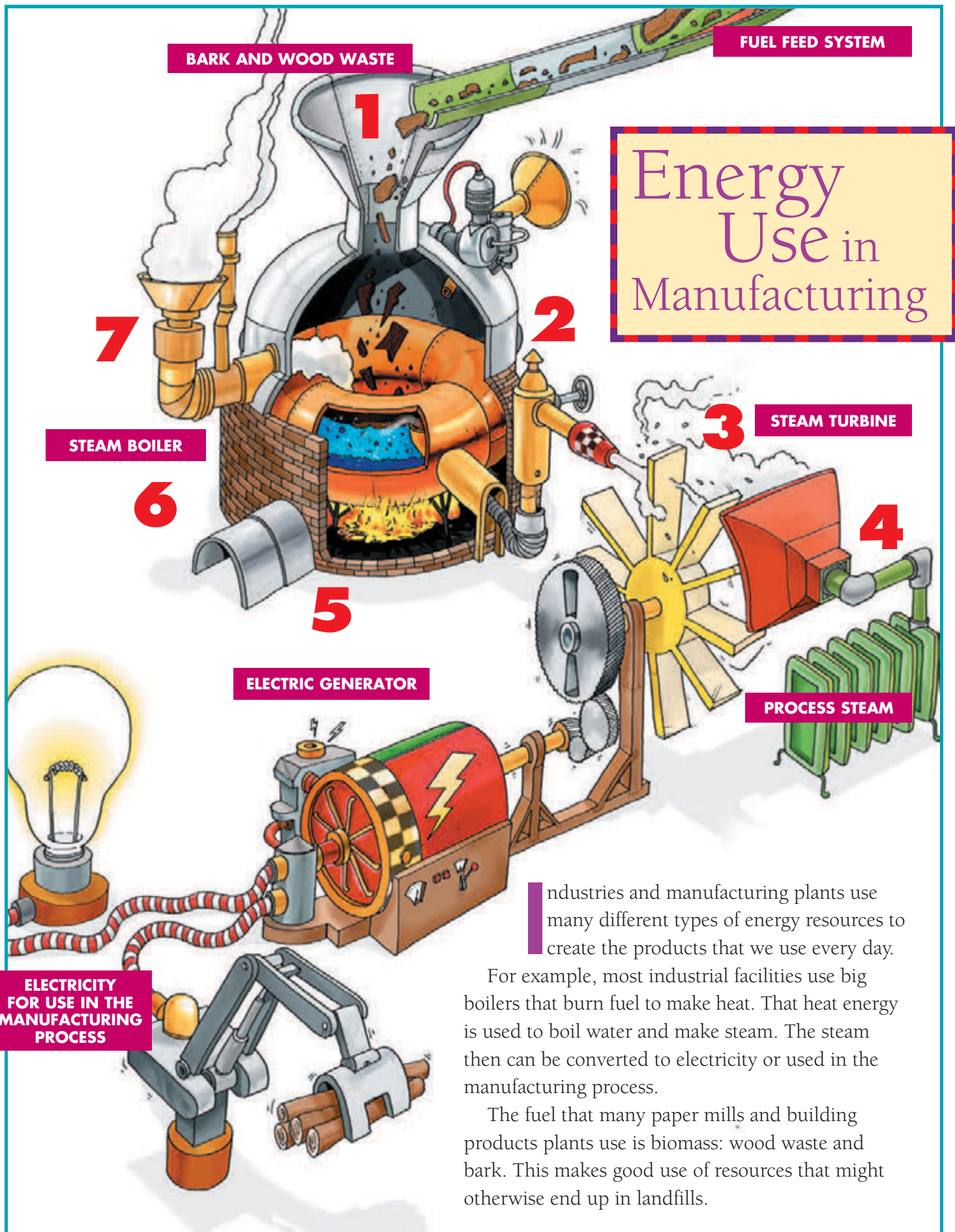
Biomass is organic material such as trees, tree branches, yard clippings and leftover bark and sawdust from lumber mills that can be burned to produce energy. Wood from trees is the largest source of biomass energy. The energy from the sun is stored in trees. This means we can use wood as fuel to create heat and electricity.



## A LOT OF ENERGY FROM A TINY SOURCE

Nuclear energy is energy "trapped" inside each atom. When atoms are split apart, they release a tremendous amount of energy in the form of heat. This energy boils water to make the steam required to turn a turbine and generate electricity.





Industries and manufacturing plants use many different types of energy resources to create the products that we use every day.

For example, most industrial facilities use big boilers that burn fuel to make heat. That heat energy is used to boil water and make steam. The steam then can be converted to electricity or used in the manufacturing process.

The fuel that many paper mills and building products plants use is biomass: wood waste and bark. This makes good use of resources that might otherwise end up in landfills.

# The Steps of Energy Use in Manufacturing

- 1** Bark and other wood waste is fed into the boiler and burned to create heat. Burning wood releases its stored energy.
- 2** Above the fire is a series of pipes with water running through them. The hot air heats the water until it boils, creating steam. The pressure of the steam forces it to expand out of the boiler, just like steam will escape around the lid when you're boiling a pot of water on the stove.
- 3** The steam is directed into a turbine, which has many blades. When the steam hits the blades, they turn a shaft attached to the bottom of the blades.
- 4** Two things happen next: the steam is sent into the plant and used for energy in the production process (for example, to dry paper in a paper mill) and the rotating turbine shaft drives an electric generator to create electricity.
- 5** The ash created from burning the wood drops through a grate and is removed. This ash is used in other products such as bricks and concrete. Since it still contains some of the wood's stored energy in the form of nutrients, it is also used as a fertilizer for the forest to help new trees and plants grow.
- 6** When wood is burned, the energy created converts it to ash and gases – mainly carbon dioxide and water vapor. If you've ever noticed that the air is a bit wavy when you watch a campfire, then you've seen these gases before. You probably also see some ash floating in that air. The same thing happens in a boiler. Before this mixture is released into the air, pollution control devices scrub these gases clean so there is almost no solid material going out of the stacks into the air.
- 7** The white plume of smoke you see coming out of the stacks is not smoke at all – it is mostly water vapor and some carbon dioxide.

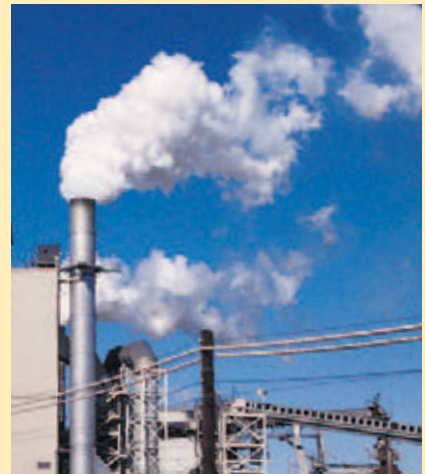
## What's Coming Out of Those Stacks?

**W**hen you drive by a manufacturing plant, like a paper or lumber mill, you often see what looks like white smoke coming out of the stacks.

Just what is that? Because of the efficient pollution control devices we have today, it is mostly water vapor (steam) and carbon dioxide.

### BUT HOW IS IT CREATED?

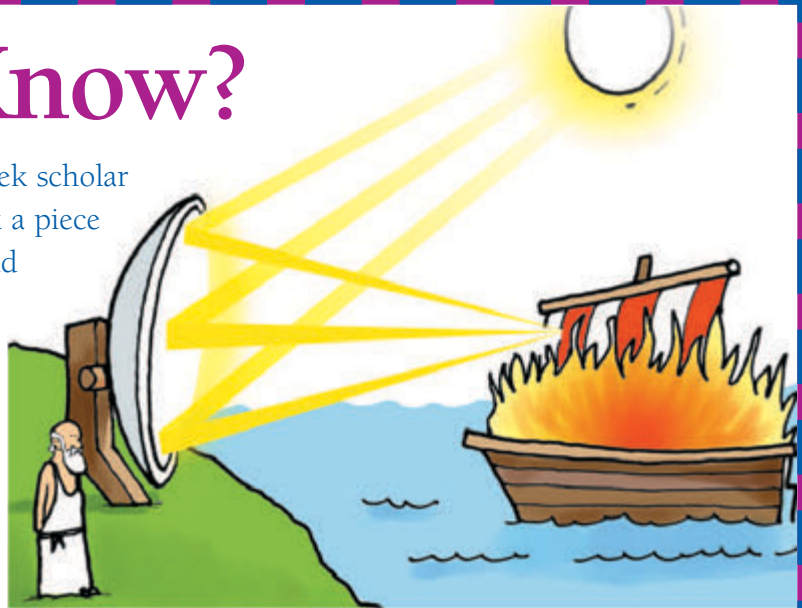
One of the most useful things about energy is that it can be changed from one form to another. A mill uses materials like wood as fuel to create heat. This heat is used to boil water and create steam. As the wood is converted to heat, it releases both carbon dioxide stored in the wood and water vapor. Because these materials are not used in either the mill's production process or to create electricity, they are released into the air through the stacks.





# Did You Know?

In the sixth century B.C., the Greek scholar Thales of Miletus discovered that a piece of amber rubbed with wool would attract light objects, such as pieces of straw. This is now known as static electricity. The name electricity comes from the Greek word *elektron*, which means amber.



According to legend, the great Greek inventor and mathematician Archimedes harnessed the energy of the sun to defend his city during a war. He made a huge mirror and concentrated the sun's rays on the ships. The concentrated heat caused the ships to catch on fire.

## Energy Conversions

One of energy's greatest benefits is that it can be converted from one form to another. That allows us to do work. Here are some other ways energy is changed from one form to another.



**Stored energy in a flashlight's batteries becomes light energy when turned on.**

**A television changes electrical energy into light and sound energy.**

**When you talk on the phone, your voice is changed to electrical energy. The phone on the other end changes the electrical energy into sound energy.**

**A car uses stored chemical energy in gasoline to move. The engine changes the chemical energy into heat and kinetic energy to power the car.**

**The food you eat contains energy stored as a chemical with potential energy. Your body uses the stored energy to do work – kinetic energy.**

**If you overeat, the food's energy is stored as potential energy in fat.**

**A toaster changes electrical energy into heat energy.**



Source: California Energy Commission

# Energy

## ACTIVITIES & Extras

### The Greenhouse Effect

The glass windows of a greenhouse let in sunlight. The sunlight warms objects inside the greenhouse. These objects then give off heat. The glass of the greenhouse, however, does not let the heat out. If the greenhouse lacks ventilation, the heat stays locked inside and the temperature rises.

The Earth and its atmosphere are like a giant greenhouse. Like the glass windows of a greenhouse, the atmosphere lets in the sunlight that heats the Earth. Then, like the glass windows of the greenhouse, the Earth's atmosphere traps the heat that radiates from Earth. This heat-trapping mechanism is called the greenhouse effect and is critical to life on Earth. Without it, the planet would be much colder – too cold to support life as we know it.

### Can You Show the Greenhouse Effect?

#### WHAT TO DO:

1. Pour two cups (500ml) of cold water into each jar.
2. Add five ice cubes to each jar.
3. Wrap one jar in the plastic bag (this is the greenhouse glass).
4. Leave both jars in the sun for at least one hour.
5. Measure the temperature of the water in each jar.

Which is warmer?

What does this indicate about the greenhouse effect?

#### WHAT YOU NEED:

- Two identical glass jars
- One clear plastic bag
- Four cups cold water
- Two thermometers
- 10 ice cubes

#### WORDS TO KNOW

*biomass* - wood and other organic materials used as fuel sources

*chemical energy* - energy released as heat from a chemical reaction

*fossil fuels* - energy sources formed by the decay of plants, animals and other organic materials over millions of years; coal, oil and natural gas are examples of fossil fuels

*hydropower* - electricity from water power

*turbine* - an engine with blades that are turned by water, steam or gas pressure

