



# Wind Energy

## Wind Energy Through Time:

In which ways have humans used the following wind power to make their lives easier?

- A. grind grain      B. pump water      C. saw lumber      D. generate electricity

**Answer:** All of the above. Humans have been documented using wind energy for hundreds of years.

## History:

The earliest known use of wind power was the sailboat. Early designs of windmills, dating back to the 10th century, ground grain and pumped water. The windmill design was refined in many countries around the world. It was not until the 20th century that the world's first electric wind turbine was invented in Cleveland, Ohio by Charles Brush.

## What is the difference between a windmill and a wind turbine?

Windmills harness wind for mechanical power such as pumping water, while wind turbines use wind to generate electricity.

## Glacier Ridge Wind Turbine:

### When was the turbine put up at Glacier Ridge?

November 18, 2002

### Why Glacier Ridge?

Glacier Ridge is a suitable area because of the large amount of open land and evidence of strong winds.

### Does this wind turbine generate electricity?

Electricity is generated for part of the park.

Thank you to the following agencies and companies for supporting the Glacier Ridge Turbine project:

Green Energy Ohio for providing planning and design guidance and financial support of the project

Scotts Company for supporting the creation of energy-related education materials

Third Sun Solar & Wind Power for providing planning and design guidance

Vanner Incorporated for providing technical engineering design and equipment

# Workings of a Wind Turbine

## How does a wind turbine create electricity?

A wind turbine works the opposite of a fan. A fan uses electricity to create wind. A wind turbine on the other hand, uses wind to create electricity. Simply, in a wind turbine the wind begins to spin the blades, like a plane's propeller. The blades spin a shaft connected to a generator resulting in electricity.

**Anemometer:** The anemometer's job is to register the wind speed and send data to the controller inside the main body of the turbine.

**Controller:** Stops and starts the turbine's blades. It is the on and off switch for the blade's rotor.

**Blades:** The blades of the wind turbine start when wind speeds reach 8 to 16 mph and shuts off the rotor at winds speeds about 65 mph. If wind speed reach above 65 mph, the **generator** responsible for creating the electricity, could over heat and burn up. How does the **controller** stop the blades from spinning? Through the turn or **pitch** of the blades. An adjustment of the blade pitch will keep the **rotor** from turning when winds are too high or too low.

**Low-speed shaft:** Large pipe rotated by the blades at only 30-60 rpm (revolution per minute). Unfortunately 30-60 rpm is not enough power to generate electricity. Somehow the wind turbine needs to have a shaft spin faster (increase the rpm) to create electricity. How can the wind turbine increase the rpm to create electricity? By using the same fundamental rules of a 10-speed bike. A 10-speed bike has two different sized round gears, a larger gear for slower speeds and a smaller gear for faster speeds. The smaller the gear the faster and more turns (revolutions) it can make in one minute. The wind turbine uses the same rules to increase the rpm to generate electricity through a gearbox.

**Gearbox:** Small box which houses a smaller gear for energy transfer. Energy is transferred from the low-speed shaft to the attached smaller gear inside the gearbox. The gearbox transfers the energy from only 30-60 rpm to an amazing 1200 to 1500 rpm.

**Generator:** Creates electricity. The electricity created can be used immediately or stored in batteries.

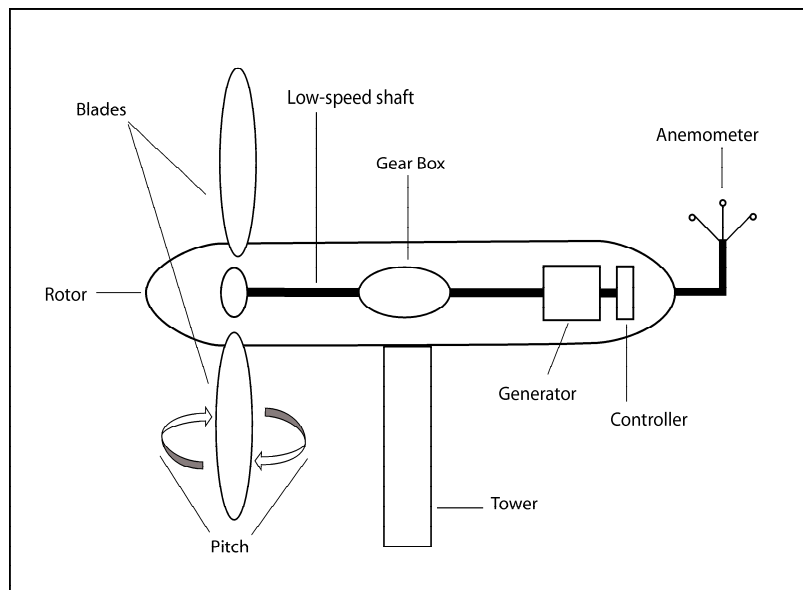
## Should I put a wind turbine in my backyard?

Residential wind turbines should be placed in open rural areas with enough wind to make the turbine cost effective. Currently, non-renewable fuel sources (gas and coal) are more cost effective in Ohio when compared to the long-term investment in wind turbines. In the future, new technology will lower the price of wind turbines. New government incentives, including net-metering, continue to allow wind energy to become more competitive.

## Clean Fuel

Wind energy is considered a clean fuel, because it does not pollute or emit emissions into the air.

Wind is one of earth's renewable energy sources, including solar power, and cannot be used up.



# Kid Page

## Can a change in air temperature create wind?

*Courtesy of Second Nature kids experiment from Alliant Energy*

This experiment shows warm air movement and requires adult supervision.

### Materials needed:

A plastic bottle  
Ice-cold water  
Stopwatch  
Bowl  
Hot water  
Balloon

Fill the bottle with ice-cold water and let it sit for one minute.  
Fill the bowl with hot water. Be sure to ask an adult for help.  
Empty the cold water from the bottle into another container.  
Quickly put the mouth of the balloon over the bottle opening.  
Now carefully place the plastic bottle standing up in the hot water.  
Watch what happens to the balloon.

*What happened to the balloon? What caused the balloon to behave in the way it did?*

The cold water cooled the air in the bottle. When the cool bottle was placed in warm water, the warm air from the bottle rose into the balloon and filled the balloon with air. The wind was created by a change in the air temperature.

### How is wind created?

Wind is simply moving air. The sun and earth's rotation is the engine behind this movement. As the land soaks up the sunshine, the air above the ground heats up and rises. Cooler air is then able to rush in creating wind.

### Resources

#### For Kids:

[www.energyquest.ca.gov/index.html](http://www.energyquest.ca.gov/index.html) (Interactive energy site)  
[www.eia.doe.gov/](http://www.eia.doe.gov/) (U.S. government energy statistics)

#### For Adults and Teachers:

[www.greenenergyohio.org](http://www.greenenergyohio.org) (Information on Ohio wind energy)  
[www.awea.org](http://www.awea.org) (American Wind Energy Association)  
[www.safewind.info](http://www.safewind.info) (Information on bird collisions)  
[www.eere.energy.gov](http://www.eere.energy.gov) (Information on national wind energy)  
[www.ohioenergy.org](http://www.ohioenergy.org) (Ohio Energy Project - information on energy in Ohio)

THANK YOU TO THE SCOTTS COMPANY for the wonderful donation which made this fact sheet possible!



GIVE BACK

# MAKE A PINWHEEL (included is a pattern to cut along)

*How is a pinwheel like a wind turbine? Answer: They both need air to move!*

What happens if you change the size or change paper? Is one pinwheel faster than the other? Test it and find out!

## Instructions:

Cut out the pattern

Decorate the paper

Cut along the diagonal lines from the corners almost to the dot in the center (Hint: Be careful not to cut all the way to the center)

Use a hole punch to make holes in all circles

Bring the corners of the triangles to the center

Push a paper fastener through the middle of each hole and through the center hole

Put the end of the paper fastener through a hole near the top of a straw

Bend the ends of the fastener to make it secure (Hint: don't make it too tight!)

Blow from the side of the pinwheel to make it spin

