

Renewable Energy & Wind Power Teacher Lesson

Objectives:

The Goal of this lesson is to explore what your students know about energy sources that generate electricity and renewable energy concepts. You should explain to the students why conserving electricity is important, what types of renewable energies there are, and why renewable energies like wind power are good for the environment.

Time Required:

~ 20-30 minutes

Activity Materials:

Paper and Pencil/Pen
Tape
5-Two Liter Plastic Bottles
Food Coloring

The Activity:

The objective of this activity is to demonstrate to the students the percentage of different energy sources used to generate electricity in the U.S. (Note: this does not include fuel for transportation, which would include oil being the greatest source). Fill a bottle for each of the 5 categories. Use food coloring to create different colors for each energy source. Reserve the color "Green" for Renewable Energy. On a piece of paper right the energy source names and tape them to the top of the bottle.

50 % Coal	Fill Bottle ~ ½ full
16% Natural Gas	*
3% Oil	*
20% Nuclear (uranium)	Fill Bottle ~ ¼ full
11% Renewable Energy	*

* fill to the approximate percentage level

Continue the lesson by working through the student activity sheet.

***Included in the lesson packet are several fact sheets on wind power that can be shared with the students.**

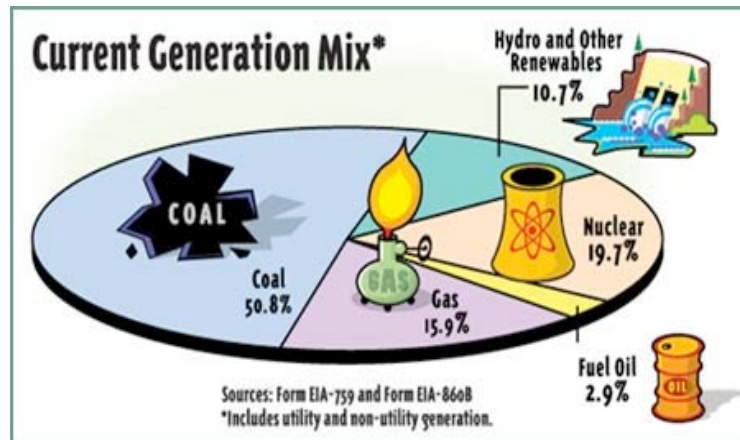


Being a kid takes a lot of energy! Watching cartoons, playing games, running around outside—and that’s even after school and homework are done!



The lifestyle you live is driven by energy. A large amount of this energy is in the form of electricity. Electricity powers the lamps that light up your homework, TVs that bring you the newest episode of your favorite show, and powers batteries needed to use remote control cars and MP3 players. Adults use electricity to heat your home, keep your refrigerator cool, and to heat up your lunch. **But have you ever wondered where electric energy comes from?**

Question 1: What other daily activities use electricity?



Much of the electricity is created using coal and natural gas. These are natural resource found underground and are brought to the surface and burned to produce energy. There is only a limited amount of natural resources available to use for energy.



“Renewables” are energy sources with unlimited amounts. These natural resources do not need to be burned in order to get energy. Examples include hydropower, solar power, geothermal power, and wind energy.

Question 2: Can you think of some dangers with using limited energy sources for most of your energy needs?

Global warming.

a

Peak production.

non-

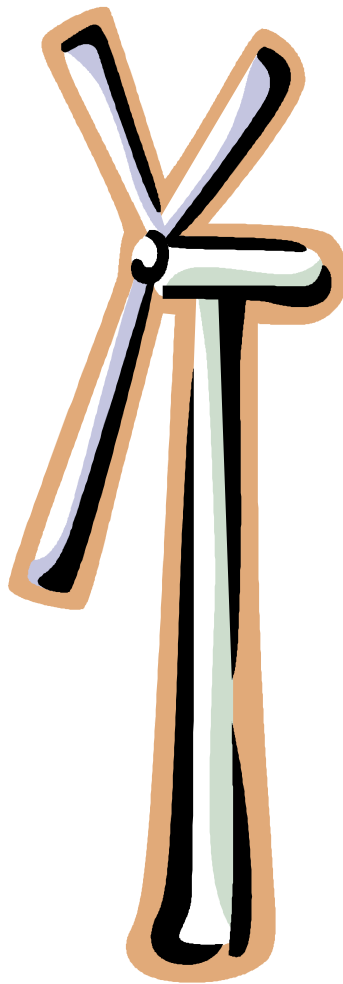
You hear them in the news, but what do they

natural

mean for you?

Coal and natural gas must be burned to produce energy. Burning them releases harmful particles into the atmosphere. These particles pollute the atmosphere and may be causing our planet to grow warmer.

There are only limited amounts of coal and natural gas. As demand for these resources rise, their cost also rises—for example heating and cooling your homes becomes more expensive.



from entering the air per year.

Also, the cost of

*Question 3:
Why is
pollution bad?*

Wind energy is

renewable,

**polluting
alternative to
coal and**

gas.

Wind is an unlimited energy source—it will never run out!

Wind energy does not pollute. In fact, one wind turbine can prevent 5,000 tons of pollutants

wind energy is constant. In fact, after the initial cost of the wind turbine parts and installation, wind is free!



Wind Power is the fastest growing of the renewable energies.

How does wind power work?

Large machines called turbines have long blades that are turned by the wind. As the blades turn electricity is generated. This electricity can then move down power lines and to your home.



Draw or write next to the arrows six things in your home that could be powered with electricity from wind turbines.

Can you think of reasons why wind power is a good source of electricity?

1.

2.

3.

Wind Power in Oklahoma:

Oklahoma is windy! Oklahoma is ranked 9th in the country for wind power. Oklahoma already has 5 wind farms. The electricity generated at these wind farms can power 175,000 homes.

Conservation of energy is just as important as using renewable sources of energy.

What Can You Conserve?



Turn off the TV or DVD player when not using them.



Encourage your parents to buy energy saving home appliances with the Energy Star Label.



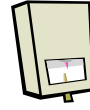
Replace light bulbs with compact fluorescent bulbs. They use less energy and last longer too!



Turn off the lights before you leave a room.



Close your window blinds in the afternoon on hot summer days and open them during winter afternoons. The sunlight will heat the room.



Turn down the thermostat by just a few degrees in the winter and up a few degrees in the summer.



Photo Courtesy of Stephanie Buway

Weatherford Wind Energy Center (WVEC)

Owner: Florida Power & Light (FPL)

Location: Custer County

- ◆ Began commercial operation in May 2005
- ◆ Total of 147 MW
- ◆ 98 GE 1.5 MW wind turbines
- ◆ Enough power for approximately 44,000 homes
- ◆ Electricity purchased by AEP/Public Service Company of Oklahoma (PSO)
- ◆ FPL expects to contribute \$17 million to the Weatherford community over the next 2 decades

“During the construction, the amount of people working on the project greatly helped the local economy.”

Debbie Gentry, Woodward County Assessor

FPL Energy Sooner Wind, LLC

Owner: Florida Power & Light (FPL)

Location: Harper & Woodward Counties

- ◆ Began commercial operation in September 2003
- ◆ Total of 102 MW
- ◆ 68 GE 1.5 MW wind turbines
- ◆ Enough power for approximately 30,000 homes
- ◆ Electricity purchased by Oklahoma Municipal Power Authority (OMPA) & Oklahoma Gas & Electric (OG&E)
- ◆ Employment
 - 8 full-time employees
 - 150 employees during construction
- ◆ Estimated payroll & benefits for full-time employees

2004 - \$300,000	2005 - \$450,000
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- ◆ Estimated payments made to landowners from FPL

2004 - \$280,000	2005 - \$290,000
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- ◆ \$400,000 collected in ad valorem taxes
 - equivalent to taxes collected if 208 \$250,000 homes were built in the community



Photo Courtesy of Dixie Johnson

Blue Canyon Wind Power, LLC: Phase I

Owner: Horizon Wind Energy
Location: Comanche & Caddo Counties

- ◆ Began commercial operation in December 2003
- ◆ Total of 74.25 MW
- ◆ 45 NEG Micon 1.65 MW wind turbines
- ◆ Enough power for approximately 20,000 homes
- ◆ Electricity purchased by Western Farmer Electric Cooperative (WFEC)
- ◆ Employment
 - 8 fulltime employees
 - 100 employees during construction
 - 50 employees contracted to run transmission lines



Photo Courtesy of Stan Whitford



Photo Courtesy of Stan Whitford

Centennial Wind Farm

Owner: OG&E
Location: Harper County

- ◆ Developed by Invenergy LLC.
- ◆ Expected to be online by December 31, 2006
- ◆ Total of 120 MW
- ◆ 80 GE 1.5 MW turbines
- ◆ Enough power for approximately 36,000 homes
- ◆ Electricity purchased by OG&E

Sleeping Bear Wind Farm

Owner: Edison Mission Group
Location: Harper County

- ◆ Developed by Chermac Energy Corporation
- ◆ Expected to be online by Spring of 2007
- ◆ Total of 94.5 MW
- ◆ Enough power for approximately 28,000 homes
- ◆ Electricity purchased by PSO
- ◆ Expected employment to be at least 110 construction and full time jobs

Blue Canyon Wind Power, LLC: Phase II

- ◆ Began commercial operation in December 2005
- ◆ Total of 151.5 MW
- ◆ 84 Vestas 1.8 MW wind turbines
- ◆ Enough power for approximately 41,000 homes
- ◆ Electricity purchased by AEP/PSO

Wind Turbine Facts

GE 1.5 MW wind turbine—The most common turbine in Oklahoma

Nacelle

- ⤴ **Weight:** 115,000 lbs.
(57.5 tons)

Rotor (Hub & Blades)

- ⤴ **Weight:** 74,000 lbs.
(37 tons)
- ⤴ **Diameter:** 77 m (253 ft)
- ⤴ **Speed:** 10.1 - 20.4 rpm

Tower

- ⤴ Consists of **3** sections:
Base - 87,000 lbs.
(43.5 tons)
Middle - 55,000 lbs.
(27.5 tons)
Top - 45,000 lbs.
(22.5 tons)
- ⤴ **Total Weight:** 187,000 lbs.
(93.5 tons)
- ⤴ **Tower Height:** 80 m
(260 ft)
- ⤴ **Base Diameter:** 14 ft (4 m)
- ⤴ **Top Diameter:** 7.5 ft (2 m)

Hub

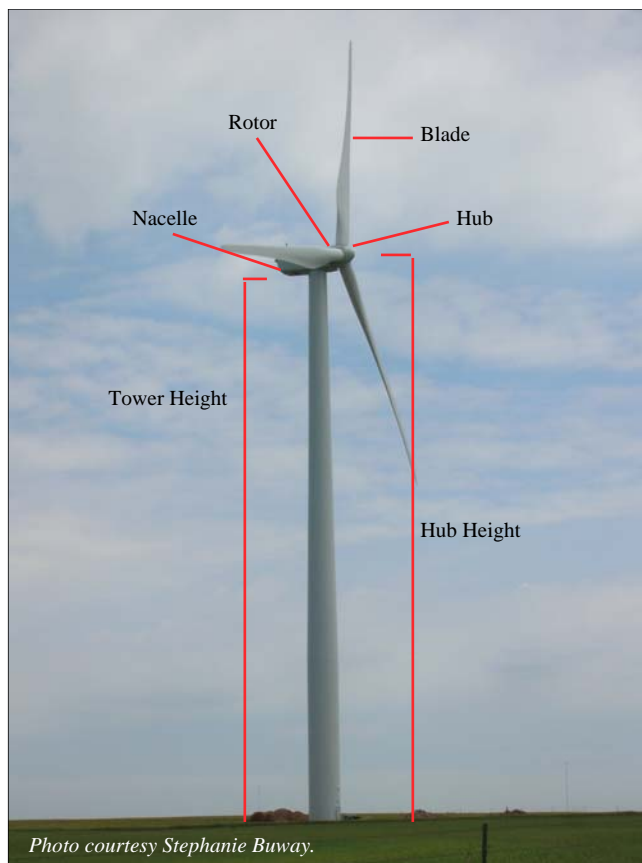
- ⤴ **Weight:** 22,000 lbs.
(11 tons)
- ⤴ **Hub Height:** 80 m
(262 ft)

Foundations

- ⤴ **Type:** gravity foundation
- ⤴ **Diameter:** 15 m (48 ft)
- ⤴ **Depth:** 2 m (7-8 ft)
- ⤴ **Concrete:** 7 m³ (250 ft³)

Blades

- ⤴ **Length:** 37 m (121 ft)
- ⤴ **Weight:** 12,000 lbs.
(6 tons)
- ⤴ **Composed of:** hand-laid
fiberglass
- ⤴ **Feathering:** changing
the angle of the turbine
blades so that they do not
turn in high wind speeds
(> 45 mph)



Fun Facts

- ⤴ About two wind turbines can fit on one acre of land, depending on the size of the turbine.
- ⤴ There are 420 wind turbines in Oklahoma.
- ⤴ At the maximum speed of 20 revolutions per minute, the tips of the blades are moving at 180 miles per hour.
- ⤴ One 1.5 MW turbine can power 300 Oklahoma homes.
- ⤴ Wind turbines are tested to withstand wind speeds of over 150 mph.
- ⤴ The tower sections are made of 2 inch thick steel.



Left: Sean Kissinger stands next to the gear that turns wind turbine blades to feather against the wind.

**For more information, contact
The Oklahoma Wind Power Initiative
at (405) 447-8412 or visit our website at
<http://www.ocgi.okstate.edu/owpi>**