

# Pennsylvania

*The Keystone State*

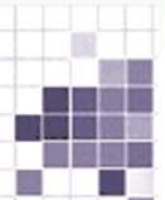


## **Wind Project Lesson Plans**



**Sustainable Energy Fund**  
of Central Eastern Pennsylvania

*Investing to Improve Energy and the Environment*



# WIND EDUCATION PROJECT

## Lesson Plans for Teachers

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# Introduction

Wind energy is the world's fastest growing form of electric power generation. It is the subject of more and more news reports and, where only the environmental community once embraced it, it is now considered "mainstream." Policy makers, the financial community and traditional electric utilities now champion wind energy because of its falling costs, greater efficiencies, and positive environmental impact.

In the last five years we have seen great improvements in technology. Today's wind turbines are as far from the old farmers' windmills as today's jumbo jets are from the Wright Brothers' bi-plane.

The growing popularity of wind energy has been accompanied by a veritable hurricane of information about wind power. Simply exploring these resources on the World Wide Web could take an educator dozens of hours.

Professional journals, like *Wind Energy*, which may have been useful resources for classroom teachers a decade ago, now cater to the wind power technical elite, carrying articles like "Using Wavelet Analysis to Assess Turbulence/Rotor

Interaction." Therefore, we will not be reviewing or recommending professional journals.

Likewise, there are a limited number of video resources available. While they may do an adequate job explaining the unchanging basics, even the most recent of them makes reference to Governor George W. Bush of Texas.



What follows is a compendium and review of various resources available to educators who wish to impart knowledge of wind energy to primary and secondary school students, as well as to adults interested in the subject -- either independently or in a formal continuing education program.

Rather than provide a comprehensive review of all available resources, since some of those available are dated or of little value to the intended audience, this guide focuses on the more useful materials and looks at readily available materials, such as those obtainable at libraries, for purchase, or via the Internet.

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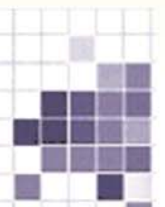
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## **Lesson Plans** Kindergarten - Grade 4



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# K-4 Goals

1. Understands and describes wind characteristics and intensities
  - knows that winds have different intensity from calm to fierce
2. Understands that storms can be dangerous
  - investigates different types of storms: hurricanes, tornadoes and lightning and reports findings to peers
3. Understands wind as an energy source
  - knows and describes people's beginning use of wind
  - shows how wind is used to power sail boats and windmills (parachutes, kites and hang gliders)
4. Understands how the wind affects the world around us
  - knows that man has utilized wind in many ways for pleasure and business
  - explains how windmills have been utilized in the past in different parts of the world
  - synthesizes evidence into explanations of how wind could be an energy force for the future

# Lesson Plan Overview

**Kindergarten through Grade 2:** teachers will assume modeling role.

**Grades 3 and 4:** teachers will encourage students to do their own work.

## Objectives

- Students will describe the characteristics of the wind and its effects.
- Students will understand the intensity of the wind
- Students will explain how people have used wind in the past and how wind can be used as a future energy source.

## Resources

**Computer with Internet access:**

[www.energychampion.org](http://www.energychampion.org)

**Books:** *James and the Giant Peach* by Raold Dahl

*The Wizard of Oz* by Frank Baum (movie in the beginning)

*Night of the Twister* by I. Ruckman

**Glossary of terms**

## Introduction:

K-2 classes will discuss what air is and how we know that it exists, as in breathing, and how large amounts of moving air are called wind, as in the blowing of our hair on a breezy day. Have the students list and/or discuss all the things that they

have seen the wind do.

How do you know wind is there?

Can you see it?

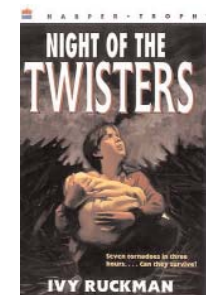
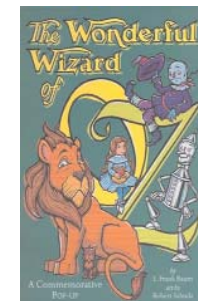
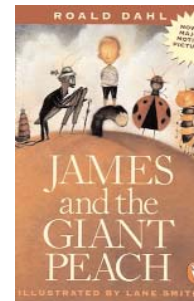
Can you taste it?

Can you feel it?

Can you smell it?

How do we know that it is there?

Grades 3 and 4 may discuss the ways in which people use the wind, as with flying, sailboats, hang gliding, parachutes, and windmills (List as many uses as the students can think of that are legitimate).



# K-4 Activities



## Activity:

Take the K - 2 students outside and have them blow dandelion seeds, watch leaves blow, fly a kite and see how long it flies, see flags flapping in the wind, and watch birds fly or a plane fly.

Upon returning to the classroom, one group can draw what they saw, another group can describe, orally or in writing, what they saw. All should then engage in discussion. The more motivated students may write a story or a simple poem.

## Activity:

Take the students outside on a windy day. Have them run against the wind. Is it difficult? Have some hold a shield in front of them as they run. (A sheet of cardboard or an umbrella will do.) Upon returning to the classroom, some students will draw what they saw, and others will speak or write about it. The teacher will help them understand the intensity variations of wind and resistance, i.e., Why does the shield make it more difficult to run?

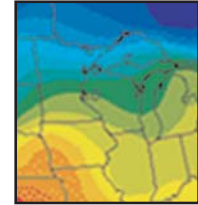
Keyword: **Intensity** - strength or power.

Examples: Turn on a fan and move from low to medium to high settings and use radio sound volume as examples of varied intensities.

## Activity:

Have the students in grades 3 and 4 make a chart or graph of the wind for a period of time. They may chart wind velocity and outdoor temperature. More motivated students may also gather more

information, including wind/weather patterns from other regions, which they will gather from other resources, such as newspapers, television, and the Internet. Some students may also draw pictures showing the effects of wind and write simple words of description.



## Enrichment:

Have students describe the wind in some detail. Each day students will add to the chart or graph to see how windy it is.



## Activity:

Have the students find pictures for a photo gallery of the wind in the classroom.

## Discussion:

Direct the students in the activities noted above to view the wind as a force that can be used to help people do things but that can be dangerous, too, as with a windstorm. Begin to discuss how people have used wind.

# K-4 Activities (continued)

**Activity:**

Make a windmill using "Projects with Air" by John Williams or refer to [www.eya.ca](http://www.eya.ca) (or a simple kite as per the directions at [www.planet-hawaii.com](http://www.planet-hawaii.com)).

**Enrichment:**

Have students make a windsock or a weathervane as an ongoing visual reminder of wind power and presence.

Introduction: Wind as fierce. Read passages from the books and show the beginning of "The Wizard of Oz" or show "The Magic School Bus Kicks Up a Storm."

**Resource:**

Creative Teaching Strategies by Marjorie Wynn



**Activity:**

Have students in grades 3 and 4 research three types of storms: tornadoes, hurricanes and lightning. They may draw a picture of the storm or describe it. After they complete that part of the assignment, they will practice "Prepare, Don't Panic" presentations to the

class. The class will be divided into groups to present this lesson.

After students have presented the "fierce" winds, have groups quiz each other about each wind and what to do in each situation. Have

each group develop a variety of test questions from the information studied.

**Activity:**

After students have completed the work on fierce winds, discuss some of the dangers of other sources of energy that you can't always **see** as a danger: Heat, electricity, moving vehicle, flying objects. Ask the children to recall a time when they or someone they know were harmed or surprised by an unseen energy source.

Move the discussion to the saving of unseen sources of energy. How do we save electricity at school and home? (Turning off [visible] lights, closing the refrigerator door, or by pulling down the shades in warm weather). Seek volunteers for a "Save Energy Committee" to serve for a week by turning off lights and other tasks that you help them to determine. Have the children develop a Save Energy sticker that can be used in their homes and at school to remind people to take the steps needed to save the energy that we cannot see.



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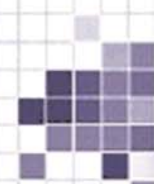
## Lesson Plans

Grades 5 - 8



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# Grades 5-8 Goals

1. Understands that wind energy is a renewable energy
  - Explains why renewable energy is always available, inexpensive, and environmentally safe
  - researches and discusses how different countries have utilized windmills in the past
  
2. Understands and describes how energy can be generated from a turbine
  - conducts scientific research on wind turbines--drawing conclusions on how they work and how they are used.

# Lesson Plan Overview

## Objective

- Students will describe characteristics of windmills of the past.
- Students will identify and describe renewable energy.
- Students will explain the advantages of renewable energy.
- Students will explain the workings of modern wind turbines.

## Resources

### Computer with Internet Access:

[www.energychampion.org](http://www.energychampion.org)

[www.pawindmap.org](http://www.pawindmap.org)

[www.cleanair.org](http://www.cleanair.org)

[www.windenergynow.org](http://www.windenergynow.org) (An outstanding resource for Pennsylvania wind power information.)

### Glossary of terms (See appendix)

## Introduction

Students should be given some background information on windmills of the past. Some background facts:

- Persia (Iran) was the first to use them.
- China had horizontal windmills.
- England used fantail windmills with canvas sails.
- The Netherlands used windmills to grind grain.
- Windmills were especially useful in Denmark because of the nearly constant (300 days per year) winds blowing off of the Jutland.
- The U.S. resumed using windmills as the 1970 oil crisis

came to a head (They had been used earlier but largely abandoned in the face of advancing technology).



# Grades 5-8 Activities

## Activity:

Have students conduct research in the library on the history of people's use of the wind. Topics the students could research include: sailboats of old; when people first began to use wind energy; windmills of the past and present.



Make a poster to go with the research on how people have used wind in the past or windmills from the past and the present.

Describe the basic internal operation of a modern wind turbine.

## Enrichment:

Design on paper a windmill from the past or present or create one for the future.



## Activity:

Divide students into groups and assign them topics on wind power in different parts of the world.

- Denmark (10 times the amount produced by the United States)
- Great Britain
- The Netherlands
- Germany
- United States
- Australia
- Chile

## Activity:

Have students consult [www.earthdog.com](http://www.earthdog.com) or [www.pawindmap.org](http://www.pawindmap.org) or other similar sites on the Internet and discuss renewable resources with the class. Students may ask Earth Dog questions and report these answers to the class; others may compare and contrast Pennsylvania wind power projects to those in other geographic areas; still others may research the American abandonment of wind power and the need to return to its use.



# Grades 5-8 Activities (continued)

## Enrichment:

Have the students become pen pals with students in other schools in order to share information on what projects or activities they are doing with wind power.

## Activity:

At grade level 6 and above, establish and maintain Internet contact with students in a class at another school or with a class in your school that is working on some of the same concepts. Have the students identify the four principal parts of a modern wind turbine (foundation, tower, nacelle, and rotor) and describe briefly how the turbine works.

## Activity:

Divide the class into six groups representing the rotor, generator, nacelle, tower, yaw drive, and controller. On a piece of poster board, chalk board, or smart board, draw an outline of a modern wind turbine. Assign each group the task of preparing a brief description of the function of their part of the turbine; and, as a spokesperson for the group presents that description, another group member will sketch the part on the outline provided by the teacher.

## Activity:

Divide the class into groups and have them decide what problems may be created by a proposal to make a major effort to produce a large amount of energy from wind, even in an area where the wind flow is sufficient to make wind power a viable alternative source of

energy. Who might object to the installation of a forest of wind turbines, and why? Who would pay for the initial construction and operating costs? Who would be the “losers” in such a setting as proposed by wind power advocates, and who would “win”?

The more highly motivated students may research the basis for opposition and advocacy in areas that have already installed or are presently considering the installation to a wind power base and report to the class on their findings from more than one geographic location.



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## Lesson Plans

Grades 9 - 12



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# Grades 9-12 Goals

1. Understands the importance of wind energy and how this can be communicated to others

- designs and communicates the advantages of wind power to the general public in a variety of venues such as: pamphlets, posters, letters or videos

2. Understands that wind farms are a viable source of wind energy for the United States

- Investigates different wind farms throughout the US: draws conclusions and critiques about them

# Grades 9-12 Overview

## Objective:

- Students will use alternative resources to find up-to-date information on wind energy.
- Students will understand wind turbines, their construction and how they work.
- Students will design means to communicate their new-found facts to the general public.

## Resources:

Computer with Internet access.

## Introduction:

Discuss the nature of renewable and non-renewable energy sources and then the advantages and disadvantages of wind-powered energy production in particular. Discuss the possible obstacles - physical, economic, and political - to the adoption of widespread use of wind as an alternative energy source.



# Grades 9-12 Activities

## Activities

Have the students explore different web sites for energy.

[www.awea.org](http://www.awea.org) (good resources for research)

[www.eren.doe.gov/windpoweringamerica](http://www.eren.doe.gov/windpoweringamerica)  
(good for Pennsylvania research)

[www.pennfuture.org](http://www.pennfuture.org)

<http://infinitepower.org>



At the end of the research, have students prepare for a discussion of the wind patterns of Pennsylvania. Have students discuss the current wind farms in Pennsylvania and which areas of the state might be good areas for wind farms in the future.

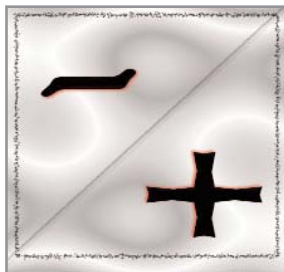
## Enrichment

Have students explore different wind energy web sites in different sections of the country.

[www.windenergy.com](http://www.windenergy.com) (Southwest US)

[www.iowawind.org](http://www.iowawind.org) (Iowa)

[www.wintecenergy.com](http://www.wintecenergy.com) (California)



Have students compare and contrast the wind power programs in these states with Pennsylvania's program. Encourage them to discuss political forces that may be at work promoting or opposing the further development of wind power (in conjunction with a history or economics class, perhaps).

The more motivated students should be divided into group leaders who contact the following state and federal agencies/entities: Pennsylvania Department of Environmental Protection [www.dep.state.pa.us](http://www.dep.state.pa.us); Pennsylvania Wind Map: [www.pawindmap.org](http://www.pawindmap.org); Pennsylvania Public Utility Commission [www.puc.paonline.com](http://www.puc.paonline.com) and the United States Department of Energy [www.energy.gov](http://www.energy.gov), and the United States Department of Energy: Wind Powering America: [www.eren.doe.gov/windpowerinamerica](http://www.eren.doe.gov/windpowerinamerica)).



Students should request information on current bills and legislation that deal with alternative energy and wind power in Pennsylvania.

## Activities:

Divide the students into groups. Have one group discuss the different structures of the wind turbines. Have one group discuss the environmental advantages of the wind farms as a renewable energy source. Have one group discuss the disadvantages of wind power. Pull the groups together after they have made their group presentation and draw conclusions concerning wind power.

Conclusion: The wind turbine is a proper source of energy, is clean, is renewable, and is convenient.

# Grades 9-12 Activities (continued)

## Enrichment

Have students make drawings of modern wind power farms of the future. Design a wind turbine that is efficient and pleasing to the eye. Create an activity pamphlet (in conjunction with the art teacher), a video letter, and a poster.

If a wind power farm operates in your area, or along the route of a planned class or school trip, arrange for a tour and explanation of the facility, e.g., Somerset Wind Farm is visible from the Pennsylvania Turnpike, (old Exit 10, new) Exit 109.9. The students should submit questions in advance of the planned visit.

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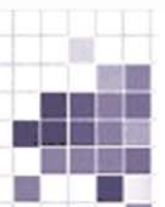


## Lesson Plans Adult



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# Adult Goals

1. Understand and describe energy-producing choices, their sources, and their economic and environmental impacts.

- identify energy types, with particular reference to renewable and non-renewable sources.
- understand the concept of kinetic energy.
- understand and describe the turbine-powered production method, its advantages and its limitations

# Adult Overview

## **Objective:**

- Students will discuss the application of wind energy in the past and the present.
- Students will describe renewable energy and its advantages.
- Students will understand the construction and operation of turbines and will be able to communicate these functions to others.

## **Resources:**

- Computer with Internet access
- Access to research materials on alternative power production
- Prepared discussion questions
- Information sheets

## **Introduction:**

Discuss the nature of renewable and non-renewable energy sources and then the advantages and disadvantages of wind-powered energy production in particular. Discuss also the potential obstacles - physical, economic, and political - to the widespread adoption of wind power technology.



# Adult Activities

## Activity:

Challenge students to develop energy sources and practices for an underdeveloped community in northeastern Pennsylvania. Begin the discussion with the consideration of various types of energy production, including solar, nuclear, oil, gas, coal, geothermal, hydroelectric, and wind.

Discuss the advantages and disadvantages of each type of energy production noted above.

## Activity:

Divide the class into small groups and assign each group an aspect of the use of wind as an energy-producer for the community in question.

One group will research the various economic and environmental advantages and disadvantages of this production method.

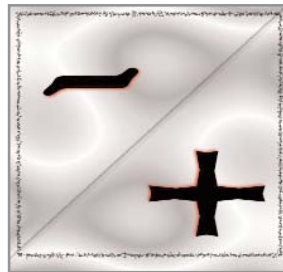
Others will investigate the physical requirements, including 1) turbine construction, 2) site selection and development, 3) maintenance and reproduction. Each group will present its findings to the rest of the class.

## Enrichment:

Assign for a later class meeting the writing of a short statement or essay on the case for building and maintaining a wind-powered

energy source for the community in question. Students should include problems and disadvantages that may arise at the point of generation. Each student should cite at least two resources for further research on the use of wind as a source of energy.

The more motivated students will be assigned to contact their local state representative and senator and request information on recent or current legislative bills that have been introduced and a copy of any that deal specifically with wind energy generation or research or operation. Another participant or group may contact the United States senators and the area congress person with the same request regarding legislative proposals or recently-enacted laws at the federal level. A more thorough effort may include an interview with a senatorial or congressional staff person for a briefing on the subject at the legislator's local office. If a legislator is found (*Legislative Directory*, current edition) to be a member of a relevant committee, such as Rep. Jim Greenwood (8th District) on the Energy and Commerce Committee in the U. S. House, an appearance of the legislator or a legislative staff person to the class would not be out of the question.



# Appendix/Glossary

**Air:**

A gaseous mixture around us that we breathe and that we feel, but which is odorless, colorless and tasteless.

**Breeze:**

The gentle movement of the air that we can feel and that makes leaves rustle in the trees, blows smoke and snow and clouds.

**Circuit:**

The arrangement of wires, boards, and chips through which electricity flows.

**Convection:**

The process of heat energy passing in currents of air and other fluids.

**Dangerous:**

Harmful or hurtful.

**Energy:**

A force or power that creates movement and can do work.

**Fierce:**

Intense, possibly damaging, as in a storm.

**Force:**

Any push or pull on an object.

**Intensity:**

Strength or power (Illustrate with settings of a fan or with radio volume).

**Kite:**

A glider of sorts that stays aloft because of the movement of air against it.

**Nacelle:**

A separate enclosure that houses a machine or motor.

**Parachute:**

A light, usually hemispherical canopy attached by ropes to a harness worn by a person, so that s/he will fall slowly when dropping through the air.

**Sailboat:**

A boat that is powered only by the wind blowing against its sails.

**Turbine:**

Any of various machines in which the kinetic energy of moving fluid is converted to power by impulse or the action of fluid upon a series of blades or paddles placed in an oval or around a circumference.

**Weathervane:**

A flat surface attached to a pole in such a way that it turns with the changing direction of the wind and indicates the wind's direction.

**Windmill:**

A machine powered by the wind's action in blowing against a series of blades which, in turning, put the machine in motion.

**Windstorm:**

A natural destructive force created by air masses of varying temperatures that collide and cause the winds to increase in speed and intensity.

**Wind turbine:**

A turbine powered by the flow of air against blades, as in a windmill.

# Recommendations

## Books

A visit to Barnes & Noble or Amazon.com finds that most of the titles available on wind energy are meant for the homeowner looking for an alternative to connecting to the local power grid, for the energy engineer, or for the serious environmentally conscious architect. There are, however, a handful of books, videotapes, and other resources available from groups like the American Wind Energy Association (AWEA) that best meet the needs of the classroom teacher.

### **Power Surge: Guide to the Coming Energy Revolution by Christopher Flavin and Nicholas Lenssen**

Power Surge is part of the Worldwatch Institute's Environmental Alert Series, which documents the (then) current global revolution in energy systems. After a two-year study of global and regional trends, Worldwatch researchers have developed a more efficient, more decentralized, and cleaner energy system that is expected to be the paradigm for renewables and other alternative energies. This book discusses the turbulent struggle between the large energy companies of today and the more environmentally friendly energy producers of tomorrow.

The above paragraph is adapted from promotional material hawking this book. What the authors of this 1994 tome didn't anticipate was establishment power companies embracing technologies like wind power as the cost came into line with traditional energy sources. Despite this flaw, it provides a solid case for renewable technologies and does a more than adequate job presenting the global environ-

mental case for quick adoption of these more benign technologies.

Paperback, 382 pages, 1994. Available from [www.bn.com](http://www.bn.com), from the Worldwatch Institute ([www.worldwatch.org](http://www.worldwatch.org)), and from [www.awea.org](http://www.awea.org).

### **The Wind at Work by Gretchen Woelfle**

The subtitle of this book is "An Activity Guide to Windmills." It is aptly titled and a volume that should be in any primary school library wherever wind education is presented. The book provides a solid introduction to wind turbines and their advantages as renewable energy providers. The book is lavishly illustrated and includes experiments that help teach the wind's effects on temperature; measuring wind speed; grinding grain; and tracking one's own electrical use.

The School Library Journal says: Gr 4-8 This combination of science, history, and activities centers around the use of wind as a source of power. The historical information is excellent, and includes Persian windmills of 1000 years ago, Dutch windmills of the 17th century, and modern wind turbines. Amusing anecdotes and intriguing facts are woven into the text, keeping it lively. An American farmer brags about all of the tasks his windmill accomplishes, including sawing wood, running a washing machine, and powering a pipe organ. A fascinating section on a wind miller's daily life reveals how the expression "rule of thumb" came to be.

Black-and-white historical prints, photographs, and diagrams appear throughout. The mechanics of various windmills are briefly

# Recommendations (continued)

explained, but the emphasis is more on what the machines can do rather than on how they work. The well-balanced presentation offers worldwide coverage and objective information regarding the pros and cons of wind power compared to other sources. Each chapter ends with instructions for several projects. Some, like making a wind sock and wind vane, are directly related to wind power. . . . Appendixes include a list of windmills and turbine sites, energy associations, environmental groups, and related career opportunities. A worthwhile purchase. Steven Engelfried, West Linn Public Library, OR

Published in 1997, 144 pages, available from the American Wind Energy Association.

## **Renewables Are Ready By the Union of Concerned Scientists**

This is a guide to teaching renewable energy in junior and senior high school classrooms. It covers a wide range of renewable energy options, but has just one wind energy project: the building of a wind machine. If your curriculum were going to involve solar or biomass, too, then this would be \$5.00 well spent.

The 101-page book is available from UCS ([www.ucsusa.org](http://www.ucsusa.org)). It is also available from the AWEA.

## **Wind Energy in America - A History by Robert W. Righter**

This compelling saga is the history of the effort to capture the

power of the wind for electricity. Environmental historian Robert W. Righter begins his narrative with Biblical references to the wind, goes on to the Egyptians use of sailing craft on the Nile, and continues through to nineteenth-century electric experiments that empowered rural America. Finally, he presents the immense, acre-wide wind farms that feed the power grid in late-twentieth-century California and elsewhere.

Righter tells lively tales not only of eccentric inventors and technical innovations but also of the politics of the power industry, past and present. From his thorough research in a variety of archival sources, he describes how individuals and small businesses have contributed the most to wind-energy development, concluding that for rural America at least, an individual, decentralized power system is a reasonable alternative.

Unfortunately, the book was published in 1996, so it misses the most recent and most exciting developments in the proliferation of wind energy. The resourceful educator, however, would do well to consider this historical source and look to the Web for more current information.

This 359-page University of Oklahoma Press title is available from Barnes & Noble ([www.bn.com](http://www.bn.com)) and from the AWEA.

## **The World Wide Web**

The amount of information about wind energy on the Web is nothing short of overwhelming. Lots of it is geared toward those looking

# Recommendations (continued)

to build small-scale wind systems for backyard power generation. Other sites are targeted to the professional wind engineer. What follows is an analysis of what appear to be the best of what's out there as of the end of 2001 for general consumption and classroom use. The list is divided into three sections: Wind Energy Basics, Pennsylvania Specific Information, and Lesson Plans and Resources.

## Wind Power Basics

### American Wind Energy Association

[www.awea.org](http://www.awea.org)

Unlike some other sites, this one wasn't set up with the educator in mind. There's good information, but it's buried in the FAQs. They do have a bookstore with easy access to useful texts. You'll also find a link to state-specific information about the growing wind industry in Pennsylvania.

### Danish Wind Energy Association

[www.windpower.dk/core.htm](http://www.windpower.dk/core.htm)

There's no better site out there covering wind energy from the basics to the most advanced material than the Danish Wind Energy Association. Their animated interactive instructional program, Wind With Miller, presents the material in a highly entertaining form. Though it is probably targeted to younger students, even adults enjoy and learn from this dynamic site. They offer an online quiz and a "Guided Tour" which, once completed—and this is an extensive presentation—leaves you about as knowledgeable as the average wind energy engineer. There's also an online teacher's guide.

### European Wind Energy Association

[www.ewea.org](http://www.ewea.org)

While not as entertaining as the Danish site, the European site has a publications section which presents the case for the use of renewable wind energy as clearly as the case has ever been presented. There are several documents on the site including: Wind Energy - Clean Power for Generations, Wind Energy Technology, Wind Energy and the Environment, and Wind Energy Economics. While the site includes no catchy or illustrative graphics, it will provide the educator with a solid background in the basics.

### Franklin Institute

[sln.fi.edu/tfi/units/energy/wind.html](http://sln.fi.edu/tfi/units/energy/wind.html)

This is another of the best sites out there. The Franklin Institute has developed a program called "Blustery Beginnings." They also have a link called "Investigating Wind Energy." There's also an on-line renewable energy module (which includes a wind module) and all are as good as the Institute's reputation and include hands-on explorations into the magic of wind power.

### Future Energies

[www.FutureEnergies.com/](http://www.FutureEnergies.com/)

This site is a great news source which seems to be updated daily with the latest developments in energy. There is a lot of news about renewable energy developments worldwide and is a great resource for the student looking for a global perspective.

# Recommendations

(continued)

## **National Wind Technology Center**

[www.nrel.gov/wind/index.html](http://www.nrel.gov/wind/index.html)

This site has useful information of its own, plus it has links at the bottom of the page to two other useful sites, the National Renewable Energy Laboratory ([www.nrel.gov](http://www.nrel.gov)) and the U.S. Department of Energy's Wind Energy Program ([www.eren.doe.gov/wind/](http://www.eren.doe.gov/wind/)). DOE's site has a link called "Wind Energy Basics @ Favorite Links" which includes a useful diagram of wind turbine. Perhaps the most extensive link to wind education programs and resources on the web is NREL's Education Resources link ([www.nrel.gov/education/wind.html](http://www.nrel.gov/education/wind.html)).

## **Solar Dome**

[www.solardome.com](http://www.solardome.com)

Solar Dome presents information for those considering a wind turbine for home use (sitting, lifetime costs, schematics, etc.). They also have what might be the best glossary of wind energy terms on the web . . . and from California's "Energy Quest" there are online instructions for two in-class projects: "Making an Anemometer" and "Measuring Wind." They're both at [www.energy.ca.gov/education/projects/projects-html/projects.html](http://www.energy.ca.gov/education/projects/projects-html/projects.html).

## **Windustry**

[www.windustry.org/default.htm](http://www.windustry.org/default.htm)

Though this site was designed to acquaint farmers and local officials with the basics of wind power, it has lots of information presented in a coherent fashion for the average reader. It provides the basics of wind energy (history, economics, environmental benefits, etc.) in a manner useful to those making decisions about investments and

land use.

## **Pennsylvania Specific Sites**

### **Citizens for Pennsylvania's Future**

[www.pennfuture.org](http://www.pennfuture.org)

### **Clean Air Council**

[www.cleanair.org](http://www.cleanair.org)

This timely and highly informative energy guide is also available here. Numerous alternative and renewable energy options are discussed, including: wind energy, solar energy, hydropower, geothermal power, biomass, landfill gas and municipal solid waste and fuel cells.

### **Commonwealth of Pennsylvania**

[www.paenergy.state.pa.us](http://www.paenergy.state.pa.us)

### **Community Energy**

[www.newwindenergy.com](http://www.newwindenergy.com)

Read all about the Exelon-Community Energy wind plant in Mill Run, Pennsylvania, as well as find some basics about wind power and info on how you can make a difference by buying wind power.

### **Energy Education Resources: Kindergarten through 12th Grade**

[www.eia.doe.gov/kids](http://www.eia.doe.gov/kids)

Produced by the Energy Information Administration, this compendium lists over 163 private and public resources for energy educa-

# Recommendations (continued)

tion throughout the country. The Energy Information Administration also offers, "EIA Kid's Page".

**Pennsylvania Department of Environmental Protection**  
[www.dep.state.pa.us](http://www.dep.state.pa.us)

**Pennsylvania Joint Conservation Committee**  
[jcc.legis.state.pa.us](http://jcc.legis.state.pa.us)

**Pennsylvania Public Utility Commission**  
[www.puc.paonline.com](http://www.puc.paonline.com)

**Pennsylvania Wind Campaign**  
[www.pawindcampaign.org](http://www.pawindcampaign.org)

In addition to providing information on Pennsylvania's existing wind plants, the site provides a primer called "Wind Power 101" and a nice map showing wind resources statewide.

**Pennsylvania Wind Map**  
[www.pawindmap.org](http://www.pawindmap.org)

## **PENNSYLVANIA WIND FARMS SPRINGING UP**

Wind turbines are springing up across Pennsylvania, and the latest plans include these wind farms:

- Pocono Wind Farm in Waymart, Wayne County will generate 61.5 MW of electricity;
- Meyersdale Wind Project in Summit Twp., Somerset County will generate 30 MW;
- Mountain High Wind Project in Bear Creek Twp., Luzerne County will generate over 26 MW;
- Stony Creek Wind Project in Stony Creek Twp., Somerset County will create 54 MW;
- Forward Wind Project in Shade Twp., Somerset County will generate 36 MW;
- Bear Creek Wind Project in Bear Creek Twp., Luzerne County will make 46.5 MW;
- Keystone Wind Project in Somerset County will generate 30 MW;
- Brothers Valley in Garrett, Somerset County will create 15 MW.

TOTAL: 299+ MW

That's enough electricity for nearly 90,000 homes!

Source: **PennFuture's Green Power: Turn It On!**

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