

WIND ENERGY

**ARIZONA PUBLIC SERVICE
COMPANY**



WHAT IS WIND ENERGY?

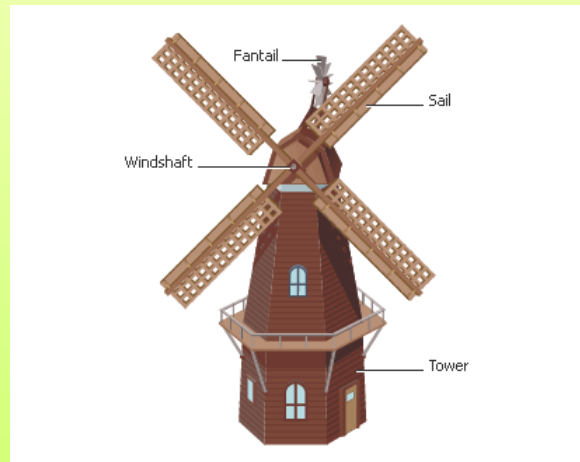
- ***Wind Energy is the energy contained in the force of the winds blowing across the earth's surface.***
- ***Wind is created when air that has been warmed over sun-heated land rises, leaving a vacuum in the space it once occupied.***
- ***Cooler surrounding air then rushes in to fill the vacuum. This movement of rushing air is what we know as wind.***



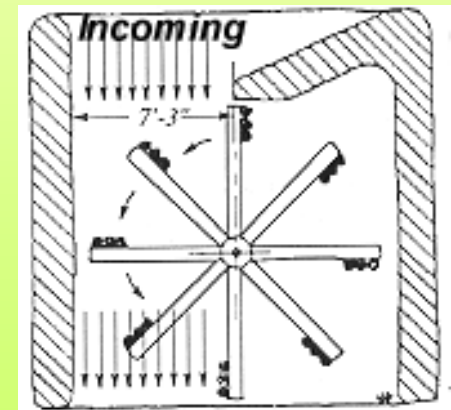
WIND IN ACTION

- **When wind strikes an object, it exerts a force in an attempt to move it out of the way. Some of the wind's energy is transferred to the object, in this case the windmill, causing it to move.**

- **Traditional European windmills have been used for centuries on the lowlands of northern Europe.**



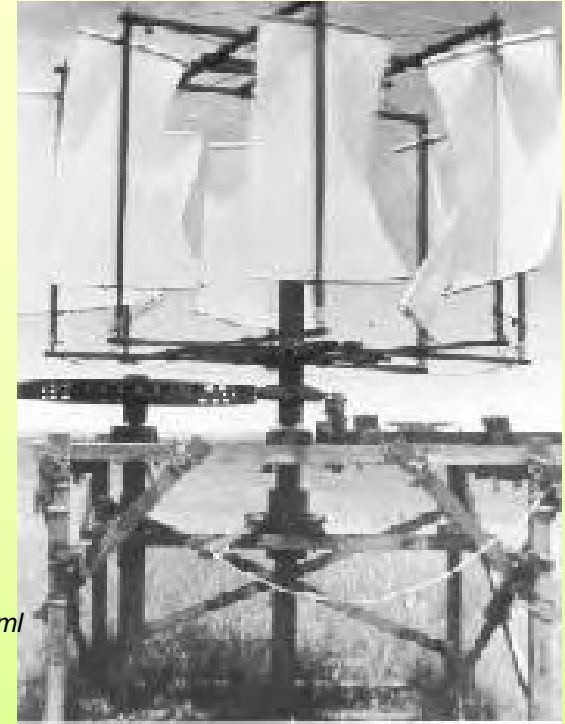
Modern wind turbines tower above one of their ancestors—an old windmill used for pumping water. Credit: Warren Gretz



Maximum efficiency of a “drag” device is obtained when the collector is pushed away from the wind, as is a simple, drag-type sail boat. In this Persian panemone design, the rotor can only harvest half of the wind striking the collection area. The panemone is one of the least efficient, but most commonly reinvented (and patented) wind turbine concepts.
<http://telosnet.com/wind/early.html>

HISTORY OF WIND USAGE

- **The wind is one of our earliest energy resources. Wind has been harnessed throughout recorded history, first to power boats and grind grain, later to pump water, press oil, saw lumber, and make paper.**
- **The first windmills were mentioned at the beginning of the Islamic civilization (7th Century).**
- **Windmills were developed in Persia about 500-900 AD and used paddles made of bundled reeds.**
- **Egyptians may have been the first to go up the Nile River around 4th Century B.C., powered by wind.**
- **Ancient Chinese used vertical axis windmills to grind grain and pump water**
- **Windmills were introduced to Europe by the Crusaders around 1300 A.D.**



A 19th-century American knock-off of the Persian panemone
<http://telosnet.com/wind/early.html>



Water Pumping on the Isle of Crete
<http://telosnet.com/wind/early.html>

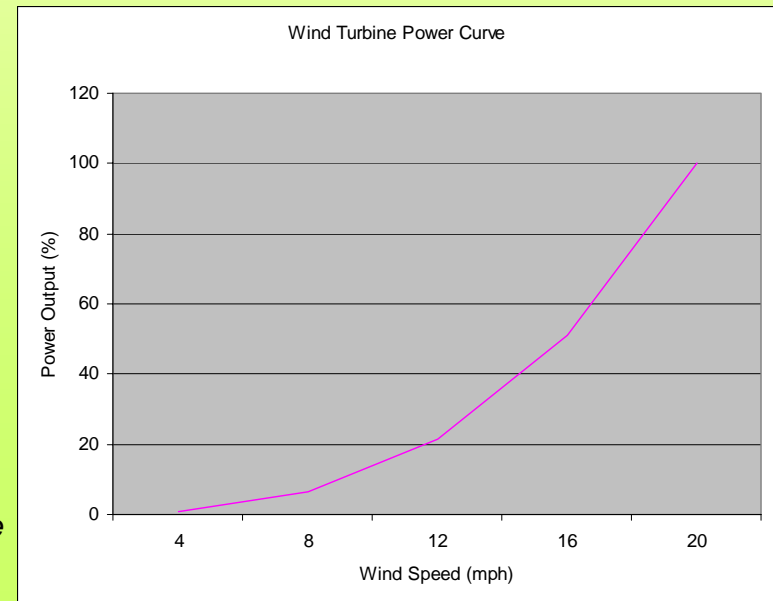
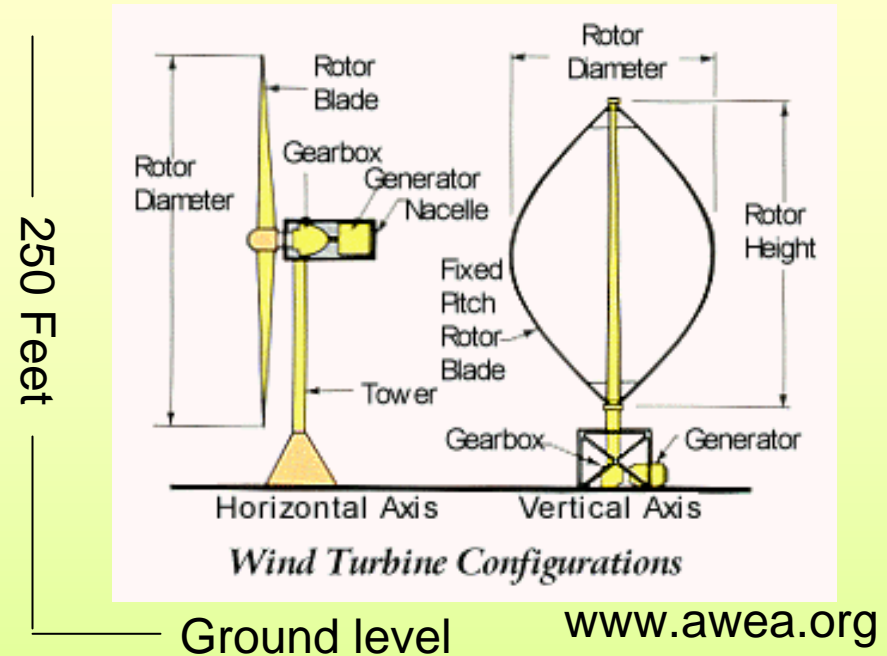
WIND TODAY

- *The American farm windmill, ideally suited for pumping water from deep underground, became an integral part of agricultural communities across the American West.*
- *The modern wind turbine is the result of design and material advances made during the 1980s and 1990s, which have enabled wind turbines to become increasingly efficient.*
- *Today, wind turbines the same size as the traditional European windmill can generate 250 to 300 kilowatts of power—a nearly tenfold increase in efficiency.*



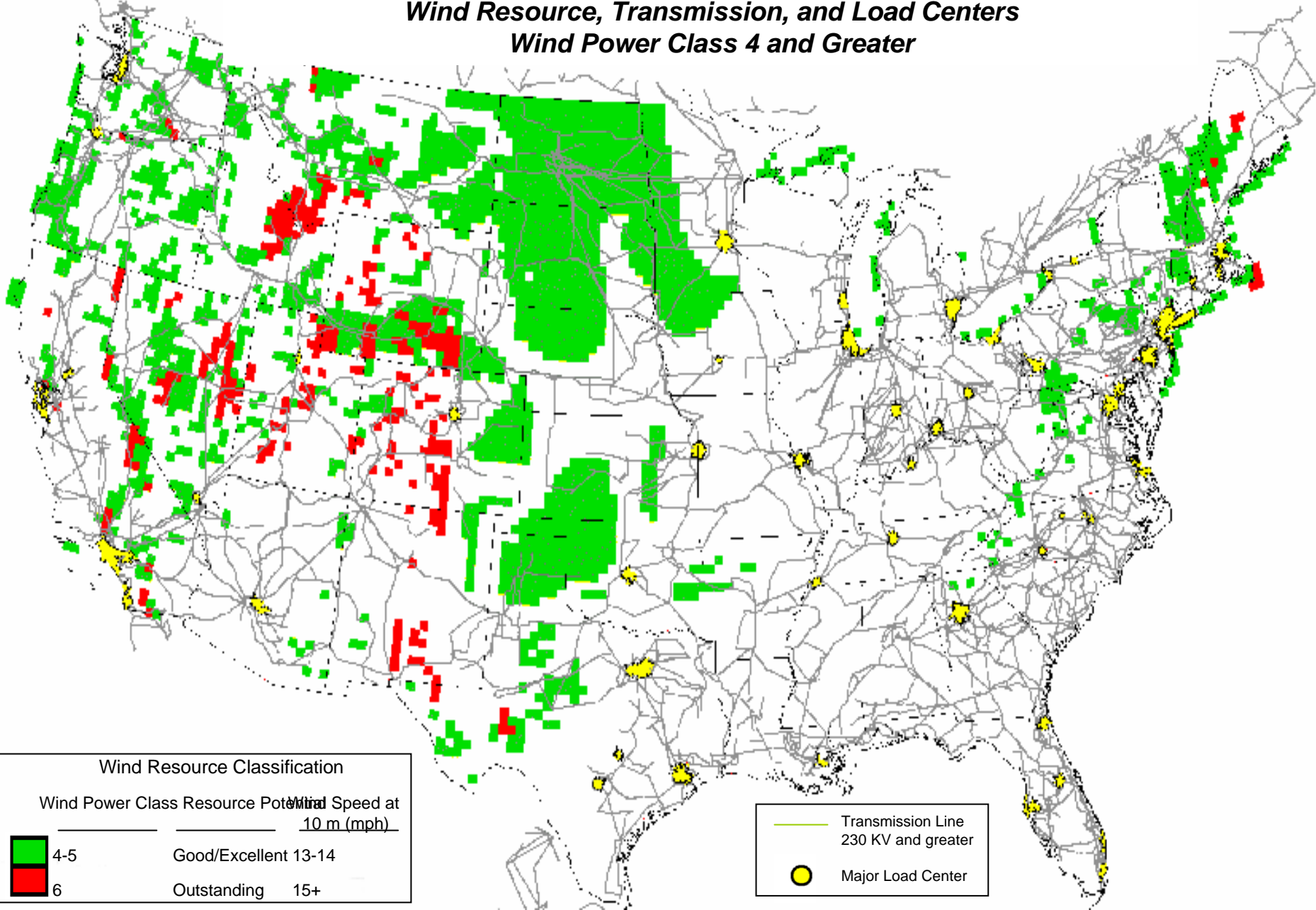
HOW DO YOU CONVERT WIND INTO ELECTRICITY?

- **Modern wind energy systems consist of three basic components:**
 - ❖ **Tower** on which the wind turbine is mounted
 - ❖ **Rotor** that is turned by the wind and the
 - ❖ **Nacelle**, which houses the equipment, including the generator, that converts the mechanical energy in the spinning rotor into electricity.
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- **Wind turbines are mounted on a tower to capture the most energy.**





Wind Resource, Transmission, and Load Centers

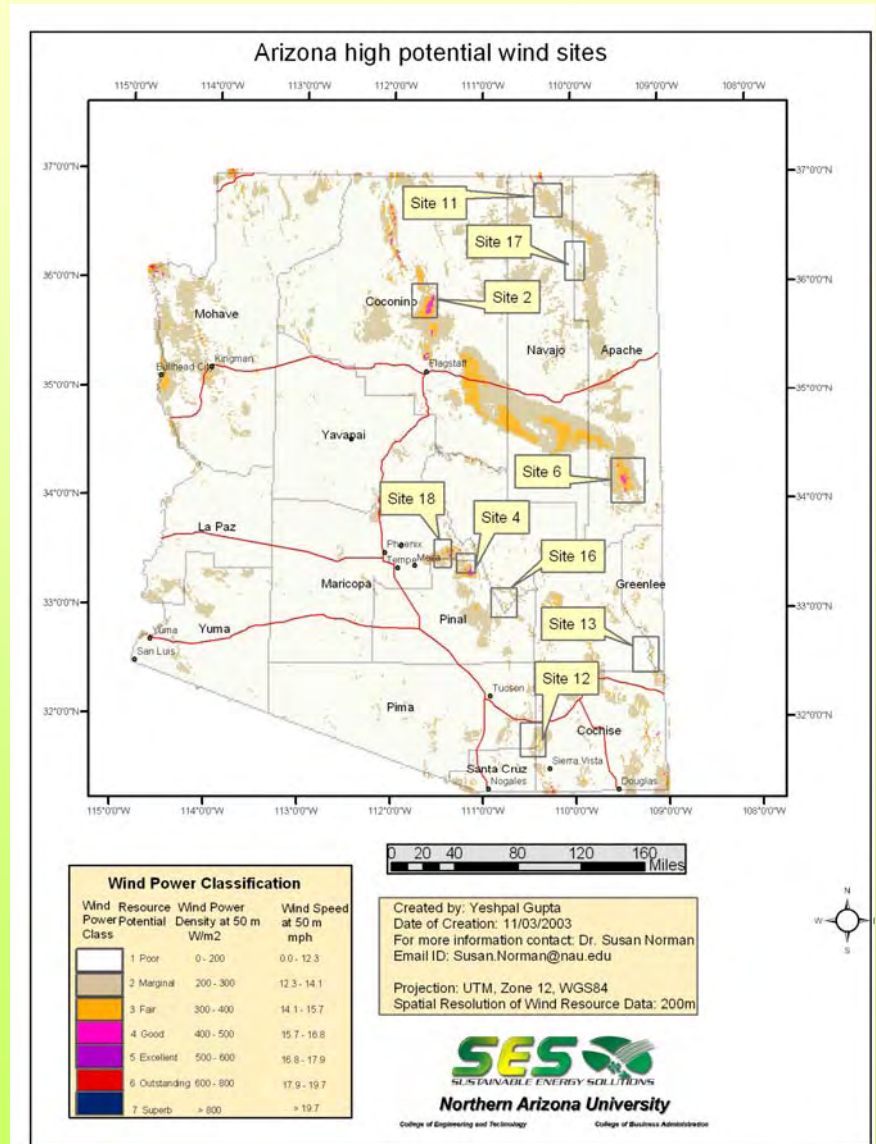
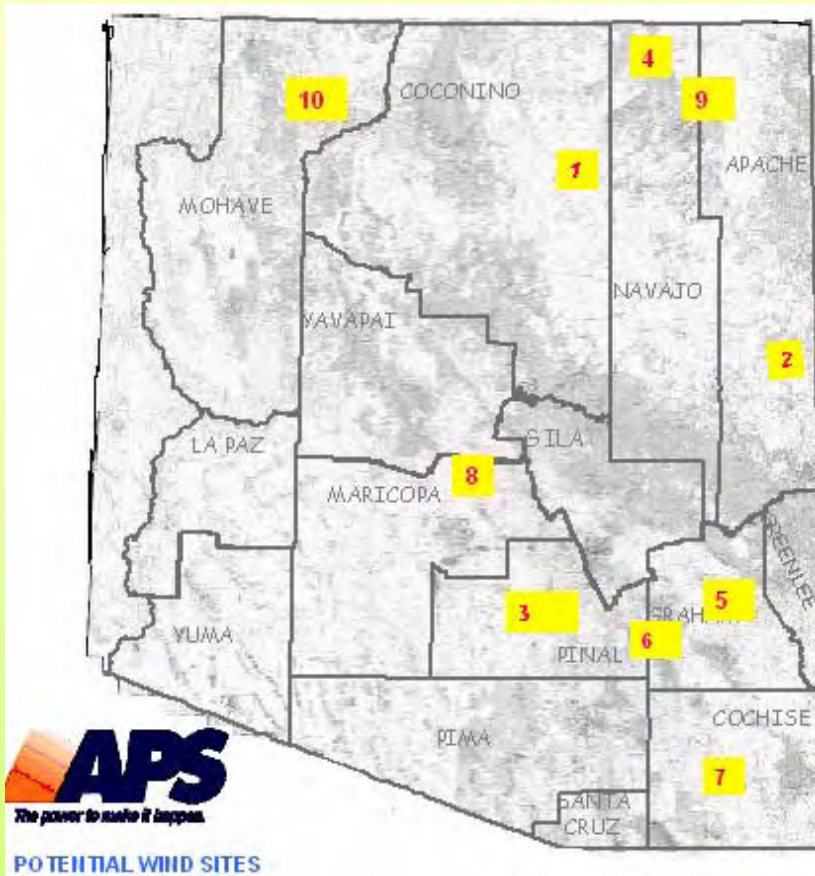
Wind Power Class 4 and Greater



Wind Resource Classification	
Wind Power Class	Resource Potential Annual Speed at 10 m (mph)
4-5	Good/Excellent 13-14
6	Outstanding 15+

	Transmission Line 230 KV and greater
	Major Load Center

POTENTIAL WIND SITES IN ARIZONA



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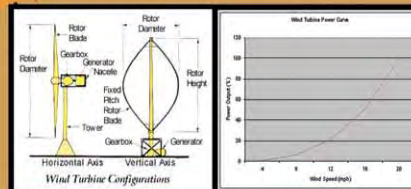
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The American farm windmill, ideally suited for pumping water from deep underground, became an integral part of agricultural communities across the American West.

Additional Sources of Information

http://encarta.msn.com/encyclopedia_761559991/Atmosphere.html

http://www.bergey.com/Wind_Energy_Primer/what_is_wind_energy.htm

<http://www.windmillworld.com/windmills/history.htm>

<http://www.building-history.pwp.blueyonder.co.uk/Buildings/Mills.htm>

<http://www.kidwind.org/materials/primer.html>

<http://is2.dal.ca/~malkhali/history.htm>

<http://telosnet.com/wind/early.html>

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