WIND ENERGY IN KANSAS: TO BUILD…OR NOT TO BUILD?

by

RODERIC L. ELDER

B.Arch., Kansas State University, 1977
B.S., Kansas State University, 1978

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Major Professor
C. A. Keithley

Abstract

"To reach a port we must sail, sometimes with the wind,
and sometimes against it, but we must not drift or lie at anchor."
(Oliver Wendell Holmes, American Jurist, 1809 – 1894)

In these times of high energy costs, dwindling supplies of fossil fuels, and talk of "global warming," we must decide what we are going to do to with the abundance of wind energy available in Kansas. We can no longer afford to "drift," not caring about the sources of our electricity, or what we are doing to the planet. We must act now to ensure a bright future for our children.

Many wind turbines are being erected across Kansas, and this natural resource of wind energy is one that should be tapped, but only after careful planning. There are many factors to consider regarding wind farms; environmental concerns, economics, impacts on the health and well-being of individuals living near wind farms, and tax implications, to mention only a few. Studies are being completed on these issues, and due consideration must be given prior to construction. There are areas across the state that should be avoided when locating wind farms, and other areas in which wind turbines might be a natural "fit." It is the latter areas which should be the focus of attention for construction, but again, only after giving careful consideration to the overall effects. Wind energy has become a part of Kansas, but future site selections should be done only after careful planning.

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Dedication

To Jan,

who provided invaluable assistance and encouragement,

and to

Lance and Jordan,

my sons, who give me great joy.

CHAPTER 1 - Introduction

"When the wind changes direction, there are those who build walls,
and those who build windmills." (Ancient Chinese Proverb)

Today, more than ever, people the world over are searching for "renewable" sources of energy to use in lieu of "non-renewable" fossil fuels (coal, oil and natural gas). Fossil fuels "…currently provide more than 85% of all the energy consumed in the United States, nearly two-thirds of our electricity, and virtually all of our transportation fuels" (United States Department of Energy, 2008). While virtually impossible to predict, it is anticipated that the supply of fossil fuels will be exhausted sometime during the twenty-first century. This depletion would lead to an essential need for additional sources of power. Many people see wind energy as one of these sources, because wind "will continually be produced as long as the sun shines on the earth" (The Need Project, p. 48).

Figure 1.1: Smoky Hills Wind Project

Photo by Jan Bohn Rice

In Kansas, one cannot travel the highways without seeing the giant, skeleton-like blades of wind turbines being hauled to a wind farm construction site. Kansas is not alone in states where such farms are being constructed, however, as the use of wind energy is being actively pursued in several parts of the country. On the northwest edge of Palm Springs, California, a wind farm of more than 4,000 turbines has been capturing wind energy since the mid-1980s, and farms are also active in Iowa, Hawaii, and many other states, as well as sites around the world.

Studies have shown that the states in the central part of the country have the greatest potential for the development of wind farms, perhaps the greatest potential of anywhere in the world. Across Kansas, there are eight active wind farms, with production capacity ratings ranging from 1.5 megawatts (MW) to 250 MW of electrical energy. The locations of these farms is a moot point, but what other locations in Kansas would be best for future wind farms? What or who is driving the development of these wind farms? Where is this energy being used (who is benefitting from this capture of Kansas wind)? Who is standing in the way of future development, and what are their reasons? These are but a few of the questions that will be explored in this report, along with the controversy surrounding the construction of such farms.

The author will attempt to answer the above questions in a manner that will present an unbiased assessment of wind farms. The controversy concerning locations of wind farms will also be addressed (at the time of this writing, the Kansas Supreme Court has just heard an appeal of a court case (Zimmerman, et al. v. Board of Wabaunsee County Commissioners – a case in which landowners filed to overturn a county ban on all commercial energy production (Appellate Court Case No. 98487)).

Chapter 2 of this report presents a brief history of the use of wind energy and how it has evolved over the centuries.

Chapter 3 covers information on the technology of capturing wind energy. Everyone is familiar with the wind turbines being erected around the world, but how do these giant windmills really work? Is the electrical energy produced by wind turbines sufficient to justify the cost (erection of one turbine can “range upwards to $300,000…” (City of Palm Springs, California. 2008))? Information on other means and methods of capturing the wind will also be discussed.

In Chapter 4, data on Kansas wind levels and densities is discussed. Wind turbines require wind speeds of “at least 21 km/h (13 mph)…” (City of Palm Springs, California. 2008), and current wind maps show Kansas with maximum average wind speeds ranging between 15.7 and 16.8 mph at 154 feet above the ground. The wind chart included in the chapter illustrates that Kansas winds are of sufficient strength to operate turbines.

Chapter 5 is a presentation on available information regarding wind farms operating in Kansas at the time of this report, as well as the controversy surrounding proposed sites, especially sites in the Flint Hills area.

In Chapter 6, impacts and conclusions from the research are presented. It is hoped that a more in-depth, collective view of wind farms will be available to individuals who might be affected by the construction of a wind farm in their immediate locale. It appears that information is currently being presented in a random manner, providing only one side or the other of the issue, creating apprehension among some of the affected individuals.

Considering the subject matter and the surrounding controversies, it may not be possible to reach unquestionable conclusions regarding wind farms, particularly in the eyes of those adamantly opposed to their construction. Regardless, it is believed that unbiased, comprehensive information is provided.

CHAPTER 2 - A Brief History of Wind Energy Use

"The wind blows wherever it pleases. You hear its sound,
but you cannot tell where it comes from or where it is going."
(John 3: 8, The Holy Bible, New International Version)

Simply put, wind is the movement of air caused by the heating of the earth's surface. Regionally, air warmed by the sun rises and the higher cooler air descends to the earth, creating an unending cycle. Globally, warm equatorial air and cool polar air create a similar, but larger cycle, which results in the jet streams that circle the earth. The result is an energy source that man has used for thousands of years.

It is commonly believed and accepted that wind power was first harnessed and used by Egyptians nearly 7,000 years ago. Using sails of bundled reeds, they would navigate the Nile, eventually leaving the safety of the river behind and sailing into the Mediterranean (U.S. Department of Energy. 2005, September 12 and Vogel, 2005). People of other countries soon followed the lead of the Egyptians, and ships traveled the world using the wind's energy. Over time, it was found that wind could be used to grind grain, with the first such use believed to have been in Persia between 500 and 900 A.D., and "Arab geographers traveling in Afghanistan in 700 A.D. wrote descriptions of windmills," describing objects that resemble what we know as revolving doors (Vogel). These

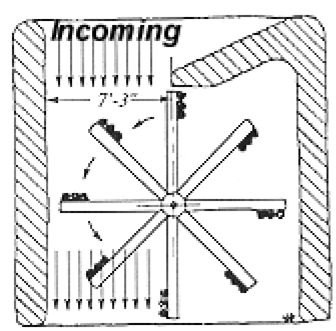


Figure 2.1: Persian Panemone

www.telosnet.com

were believed to have been panemones, which were capable of capturing the wind, but were found to be extremely inefficient.

As man traveled around Europe, the basic design for windmills was transferred from the people of one country to another, and design changes were made that improved the efficiency and ability to capture the energy produced by the wind. One result was the design of the now-famous Dutch windmills in Holland. These windmills had “propeller-type blades made of fabric sails” and were designed to “change direction so that [the windmill] could continually face the wind” (The Need Project, 2008). These windmills became the basis for what is used around the world today.

Figure 2.2: Dutch Windmill
www.pbase.com

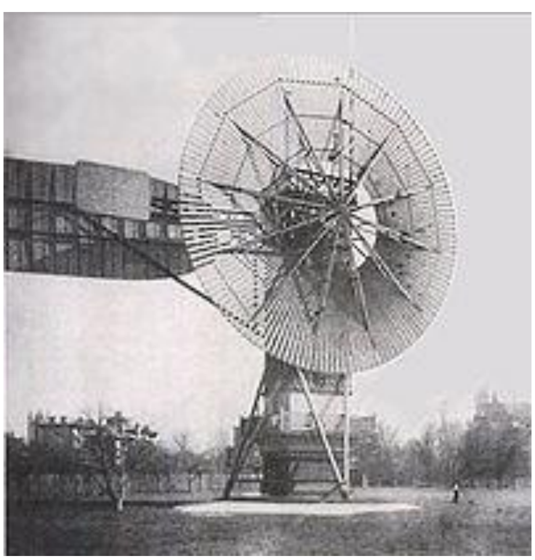


Figure 2.3: Brush Machine
www.windpower.org

In time, it was found that the energy from wind could be used for purposes other than filling sails, pumping water from the ground, and grinding grain. Advances in science eventually led to the conversion of wind energy into electricity. In Cleveland, Ohio, in 1887-1888, electrical inventor Charles F. Brush (1849 – 1929) invented his “Brush Machine,” “…believed to be the first automatically operating wind turbine for electricity generation" (www.windpower.org). The Brush Machine was huge by 19th century standards, with a rotor approximately 56 feet in diameter. The generator, however, was only rated at 12 KW. Interestingly, the company started by Charles Brush, Brush Electric Company, merged with companies that eventually formed General Electric, one of the largest wind turbine manufacturers in the United States.

As the U.S. population moved westward, the use of windmills also spread, and they became a fixture on rural farms and ranches, especially in the Midwest. Over the years, however, as electrical power was made available to the rural areas in the country, the need for windmills decreased to the point of being oddities, again used primarily for grinding grain and pumping water.

Figure 2.4: Steel-Bladed Windmill, Midwest United States

www.telosnet.com

CHAPTER 3 - Wind Energy Technology

"The answer my friend, is blowin' in the wind.…"
(Bob Dylan, American Songwriter, 1941 -)

The realization that fossil fuel supplies are dwindling has forced a more focused look at the development of alternative sources of energy, and wind appears to be the source most commonly considered around the world. There is increased research into the best methods of capturing the available wind energy, with much of the focus on the design of windmills, or turbines. Until last year, Germany had been leading the way in the development of wind farms, but the United States has now taken the lead. Other countries (India, Great Britain, Belgium, etc.), are also increasing their development, and in Denmark, the island of Samsø has developed and implemented a system that meets all its electricity needs with wind turbines (2008, December. *The Construction Specifier)*.

In the United States, wind energy currently provides about one percent of the electricity demand. According to the U. S. Department of Energy, however, "the installed wind energy capacity can reach 300 gigawatts [electricity is measured in watts: one kilowatt is one thousand watts, one megawatt is one million watts, and one gigawatt is one billion watts] to meet 20 percent of the U.S. electricity demand by the year 2030" (Davis, A., J. Rogers, & P. Frumhoff). In many parts of the country one cannot drive the interstate highways without seeing parts of wind turbines being hauled to a wind farm site, particularly in Kansas. We wonder at the sight, and ponder the inner-workings of turbines; how do they convert wind energy into electricity?

Basically, there are two types of wind turbines used around the world:

- Horizontal axis wind turbines (HAWTs), the type most commonly seen at wind farms, and
- Vertical axis wind turbines (VAWTs), some of which resemble large egg beaters.

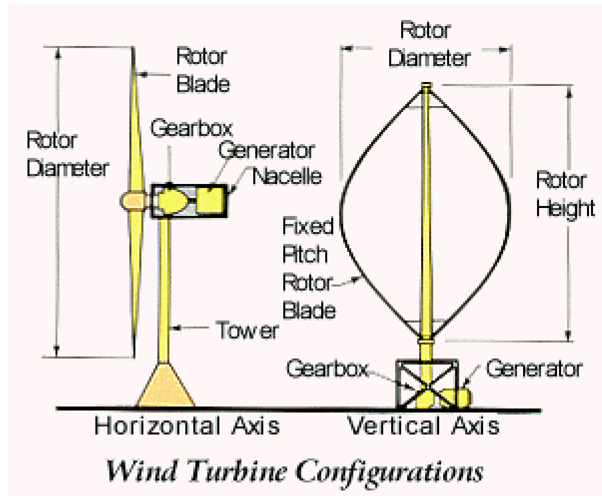


Figure 3.1: Wind Turbine Configurations

www.awea.org

VAWTs are not commonly used in the United States, and the future does not bode well for that design. According to Mick Sagrillo, owner of Sagrillo Power and Light, Forestville, WI, “Vertical technology is less efficient – the return on investment in terms of cost per kilowatt hour isn’t that good” (www.motherearthnews.com). Sagrillo goes on to say that, in his opinion, no VAWTs on the market today are comparable to HAWTs, and their inefficiency fights against them becoming a major player in the wind energy market.

The wind turbines that we see being erected across the country are all of a similar design, HAWTs, though they do vary in size. Commonly used turbines in the U.S. include:

- A 1.5 megawatt model manufactured by General Electric. It includes three blades, each 116 feet long, sitting on a 212 foot tower (total height: 328 feet when one blade is pointing up);
- A 1.8 megawatt model manufactured by Vestas, a company in Denmark, has 148 foot blades on a 262 foot tower (410 feet in height); and
- A 2.0 megawatt model manufactured by Gamesa, a Spanish company, has 143 foot blades mounted atop a 256 foot tower (399 feet height).

As impressive as those are, a 10 megawatt turbine is being manufactured by Clipper Windpower of Carpinteria, California, for installation in Great Britain. That tower will be a total of 574 feet in height, with the capability of powering 3,700 average homes (Woody, T. 2008, September 22). To put these towers in perspective, Figure 3.2 is an illustration of a typical tower, roughly 300 feet in height, compared with the outline of a Boeing 747 Jumbo Jet.

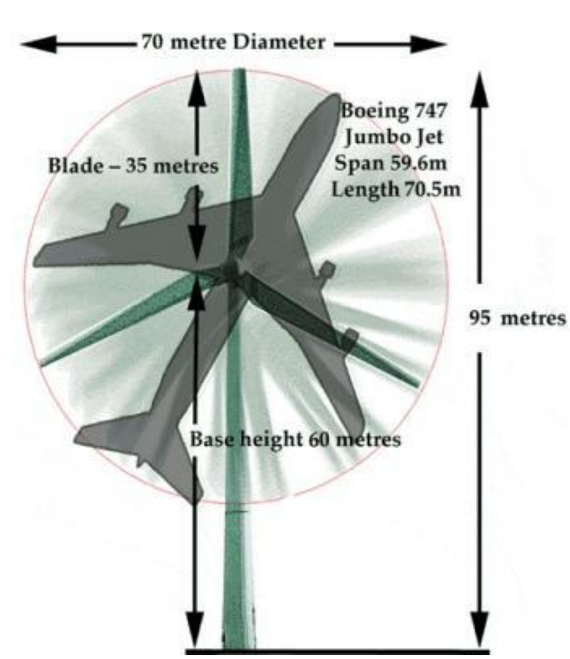
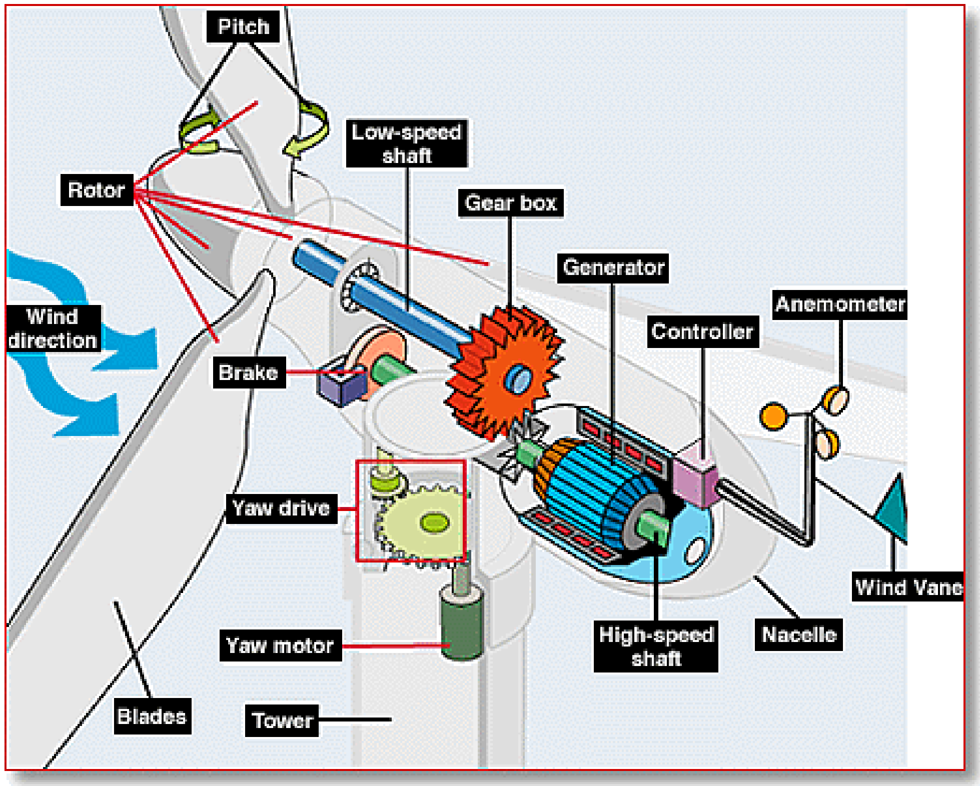


Figure 3.2: Turbine/747 Size Comparison
www.windaction.org

The height of these towers is not the only impressive factor to consider. On the 1.5 megawatt GE assembly, the "nacelle [turbine housing] alone weighs more than 56 tons, the blade assembly weighs more than 36 tons, and the tower itself weighs about 71 tons – a total weight of 164 tons" (www.windaction.org). As one might imagine, such huge assemblies require equally massive foundations. The foundation for a typical tower might measure 30 feet to 50 feet in length and width, with a depth of up to 30 feet (over 1,600 cubic yards of concrete and steel).

A typical wind turbine consists of three components: a rotor, the nacelle and the tower. The tower is used for three main purposes: to raise the rotor and nacelle to the height necessary to capture the greatest wind energy, to support the rotor and nacelle, and to conceal the equipment necessary to convey the electricity from the generator in the nacelle to the grid.

Inside the nacelle are the components that convert the kinetic energy of the wind into mechanical energy that generates electricity (refer to Fig. 3.3). When wind in the area of the turbine reaches the necessary speed, the wind striking the blades imparts thrust (force) that turns the rotor, converting the wind energy into rotational energy (Gipe, 2004). The rotor is connected to a low-speed shaft, which is connected to a gearbox. Inside the gearbox is a slow-moving gear which turns a smaller gear, which turns another shaft at a high speed. This high-speed shaft turns a generator, producing electricity. The electricity is transmitted down the tower to a transformer that converts the voltage before sending the electricity on to transmission lines.



Anemometer:

Measures the wind speed and transmits wind speed data to the controller.

Blades:

Most turbines have either two or three blades. Wind blowing over the blades causes the blades to “lift and rotate.

Brake:

A disc brake, which can be applied mechanically, electrically, or hydraulically to stop the rotor in emergencies.

Controller:

The controller starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 55 mph. Turbines do not operate at wind speeds above about 55 mph because they might be damaged by the high winds.

Gear box:

Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1000 to 1800 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring “direct-drive generators that operate at lower rotational speeds and don’t need gear boxes.

Generator:

Usually an off-the-shelf induction generator that produces 60-cycle AC electricity.

High-speed shaft:

Drives the generator.

Low-speed shaft:

The rotor turns the low-speed shaft at about 30 to 60 rotations per minute.

Nacelle:

The nacelle sits atop the tower and contains the gear box, low- and high-speed shafts, generator, controller, and brake. Some nacelles are large enough for a helicopter to land on.

Pitch:

Blades are turned, or pitched, out of the wind to control the rotor speed and keep the rotor from turning in winds that are too high or too low to produce electricity.

Rotor:

The blades and hub together are called the rotor.

Tower:

Towers are made from tubular steel (shown here), concrete, or steel lattice. Because speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

Wind direction:

This is an "upwind" turbine, so-called because it operates facing into the wind. Other turbines are designed to run "downwind," facing away from the wind.

Wind vane:

Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.

Yaw drive:

Upwind turbines face into the wind; the yaw drive is used to keep the rotor facing into the wind as the wind direction changes. Downwind turbines don't require a yaw drive, the wind blows the rotor downwind.

Yaw motor:

Powers the yaw drive.

Figure 3.3: Wind Turbine Mechanics

http://www1.eere.energy.gov/windandhydro/wind_how.html#inside

CHAPTER 4 - Wind Energy Levels

"The pessimist complains about the wind,
the optimist expects it to change, the realist adjusts the sails."
(William Arthur Ward, American Author, 1921 - 1994)

The United States Department of Energy, through the Wind and Hydropower Technologies Program, has been at the forefront in studying the use of wind energy across the country. In collaboration with the National Renewable Energy Laboratory (NREL) and other organizations, the Department of Energy has measured wind levels across the country. The readings obtained were classified according to density (watts per square meter) and speed (meters per second), and assigned a classification, 1 through 7 (Table 4.1). Classifications 1 and 2 included wind speeds too low to be considered capable of supporting wind turbines, and classifications 3 through 7 are considered acceptable.

To further illustrate the possibilities of wind energy, the wind power densities were used to develop maps (Figures 4.1 and 4.2) that show areas of the country where wind farms might be most viable. Exceptions were made for areas determined as "unlikely to be developed due to land use or environmental issues" (United States Department of Energy, 2005). These maps have been made available to "private industry and researchers with the intent of advancing current technology into a viable and attractive alternative to conventional fossil fuel energy generation" (Beecher, p. 12).

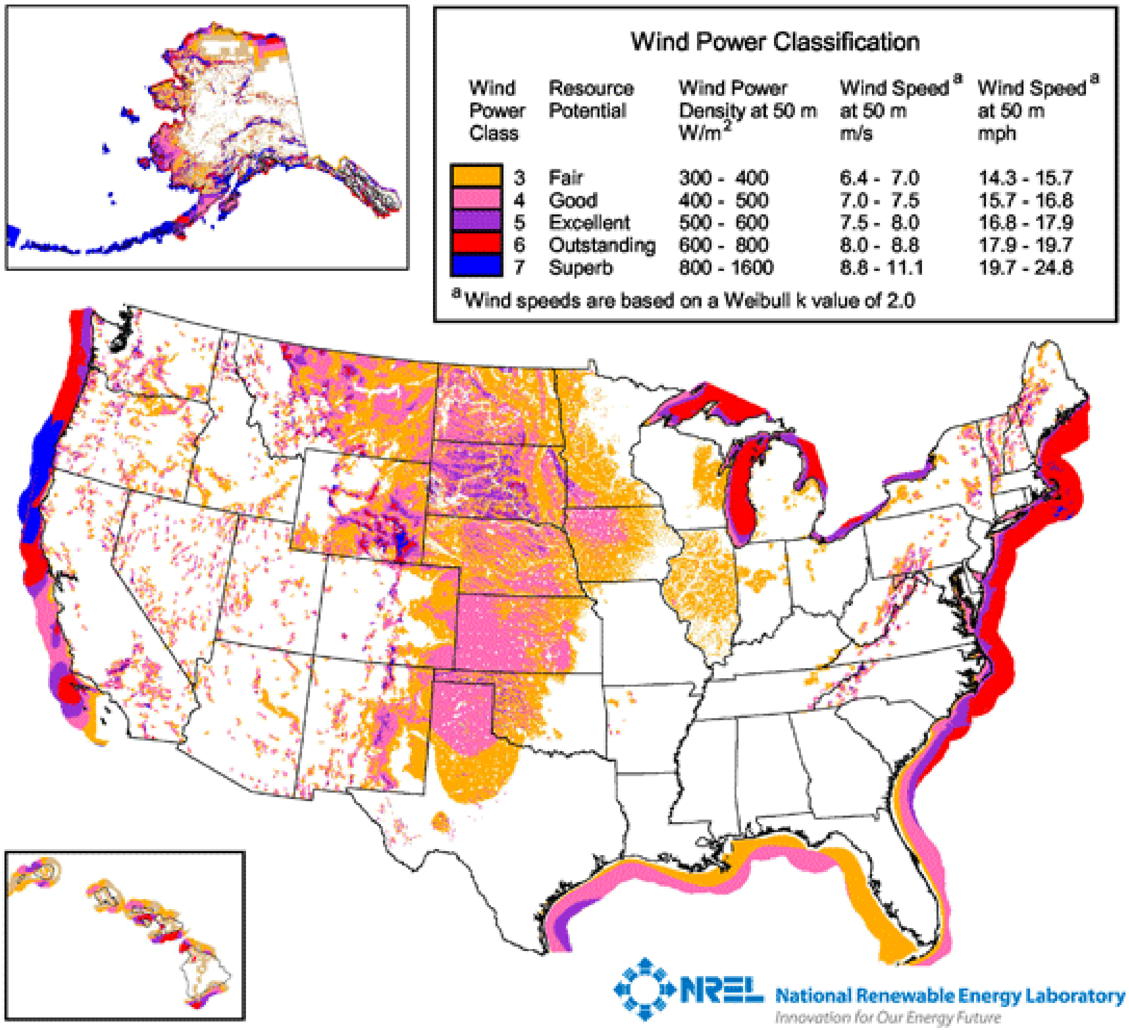


Figure 4.1: U.S. Wind Energy Resource Map

National Renewable Energy Laboratory

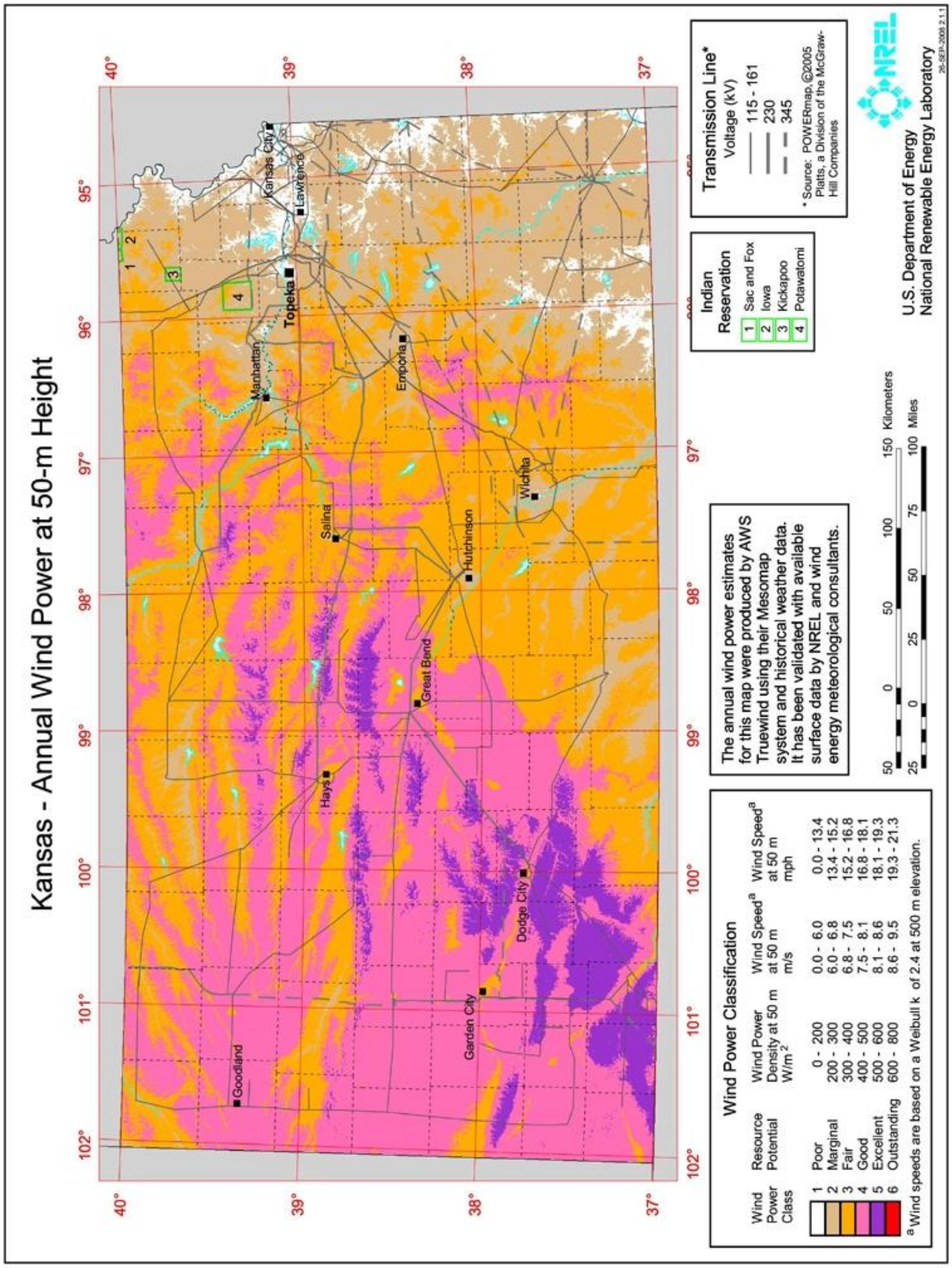


Figure 4.2: Kansas Wind Energy Resource Map

National Renewable Energy Laboratory

Table 1-1 Classes of wind power density at 10 m and 50 m(a)				
Wind Power Class*	10 m (33 ft)		50 m (164 ft)	
	Wind Power Density (W/m²)	Speed(b) m/s (mph)	Wind Power Density (W/m²)	Speed(b) m/s (mph)
	0	0	0	0
1				
	100	4.4 (9.8)	200	5.6 (12.5)
2				
	150	5.1 (11.5)	300	6.4 (14.3)
3				
	200	5.6 (12.5)	400	7.0 (15.7)
4				
	250	6.0 (13.4)	500	7.5 (16.8)
5				
	300	6.4 (14.3)	600	8.0 (17.9)
6				
	400	7.0 (15.7)	800	8.8 (19.7)
7				
	1000	9.4 (21.1)	2000	11.9 (26.6)

a. Vertical extrapolation of wind speed based on the 1/7 power law.

b. Mean wind speed is based on Rayleigh speed distribution of equivalent mean wind power density. Wind speed is for standard sea-level conditions. To maintain the same power density, speed increases 3%/1000 m (5%/5000 ft) elevation.

*NOTE: Each wind power class should span two power densities. For example, Wind Power Class = 3 represents the Wind Power Density range between 150 W/m² and 200 W/m². The offset cells in the first column attempt to illustrate this concept.

Table 4.1: Wind Power Density Classes

National Renewable Energy Laboratory

Further analysis of the wind power information that has been collected reveals that "Kansas has been ranked third in the nation for its potential wind resources" (Kansas Department of Wildlife and Parks. (January 11, 2007)). As is illustrated in Fig. 4.2, areas in Southwest Kansas present the greatest potential, with other areas having potential, but to a lesser degree. As a result, wind farms are being built across the state, but not without controversy.

CHAPTER 5 - Wind Energy in Kansas

"Ill blows the wind.…"
(King Henry VI. Part III, Act 2, Scene 5, Line 55,
William Shakespeare, 1564 - 1616)

Considering the investments being made on wind farms in Kansas, it appears that the capture of wind energy across the state is economically viable, and companies from around the world are taking advantage of this. These companies, principally from Spain and Italy, are building wind farms in Kansas, but at what costs? The answer to that question may not be known for years.

Why is there such a push for capturing wind energy in Kansas? Over the past few years, there has been growing concern over the quantities of "greenhouse" gases being released into the atmosphere by coal-fired electric plants (as well as other sources of pollution), resulting in what has become well-known as "global warming." The widely fluctuating costs of oil and natural gas are given as another reason for pursuing alternative sources of renewable energy, typically wind and solar. Wind is frequently cited as an inexpensive source of renewable energy, but is it really? According to the American Wind Energy Association, a major proponent of capturing wind energy, the electricity produced from the wind costs about one-and-one-half cent more per kilowatt hour than that produced by the use of fossil fuels, and the United States Department of Energy states, "Participating customers pay a premium on their electric bill to cover the extra cost of the renewable energy" (United States Department of Energy, 2005), so where is the savings? Perhaps the savings is not actually monetary, but more along the lines of preserving the earth. As has been noted, the use of fossil fuels, of which there is a dwindling supply, appears to be having an adverse effect on the earth's climate. Reducing the use of fossil fuels, and the gases released through their use, would do much to improve the environment.

Another impetus for increasing the quantity of wind energy captured in Kansas comes from the desire of the governor, Kathleen Sebelius, to do so. An ardent advocate of wind energy technology, she has repeatedly voiced her support for increasing the production of electricity through wind turbines, setting goals of producing "…10 percent of our state's electricity from wind power by 2010, and 20 percent by 2020" (State of the State address, January 10, 2007). In March, 2009, electrical power from wind energy surpassed the 1,000 megawatt level, ranking Kansas eighth among the states in the quantity of electricity produced from wind (Topeka Capital-Journal, 2009, March 20).

In addition to the Governor's goals, Westar Energy has announced support, and has taken action to meet the Governor's goals. On February 12, 2009, Westar requested bids for "…production of 500 megawatts of renewable energy," and advised that they will seek to bring "200 megawatts of the new production online by the end of 2010, bringing the company's total renewable portfolio up to 495 megawatts, or slightly more than 10 percent of the 4,750 megawatts in retail peak demand" (Carlson, James. Topeka Capitol-Journal. 2009, February 13). While not specifically stipulating the type of renewable energy to be produced, a Westar spokeswoman stated that it is believed that wind technology is the most viable form available at this time. Regardless, Westar has also announced that, “At some point in the future we will again need to build a base load plant” (Westar Energy press release dated October 1, 2007). A “base load plant” refers to a coal-fired plant.

Another advocate for wind energy is T. Boone Pickens, a man who made his wealth in the oil industry. According to Pickens, the United States now imports nearly 70 percent of its oil, and that amount continues to grow. We are, however, relying on “unfriendly and unstable foreign nations” (www.PickensPlan.com), and we are paying huge amounts of money for that oil ($475 billion in 2008). Pickens includes solar energy in his plan, but also focuses on two “pillars” of wind energy:

1. Generate up to 22 percent of our electricity from wind, and
2. Build a 21st century backbone electrical grid.

The existing electrical grid is not adequate for the introduction of the proposed amounts of electricity produced from wind, and constructing the necessary grid “will be the modern equivalent of building the Interstate Highway System in the 1950’s (sic)” (www.PickensPlan.com).

Not everyone agrees with the advocates, however, and some who dissent are making their voices heard. In a letter to the editor of the Topeka Capital-Journal on November 20, 2008, John Maier, Manhattan, stated, “There’s a lot of wind in Kansas, but I think most of it is coming from the Statehouse.” Mr. Maier continues his letter by reminding readers of problems that may be encountered, including the loss of land for farming and ranching, and the vulnerability of power lines to ice storms that frequent the state. Also voicing opposition to the Governor's plan are members of the state legislature, who favor the construction of a coal-fired power plant near Holcomb, Kansas. Such a plant was approved by the legislature in 2008, only to be vetoed by the Governor, an action that was upheld in a later vote of the legislature. A similar proposal was again before the 2009 legislature, and it, too, has been vetoed. The developer is now expressing doubts that the plant will ever be built.

At the time of this writing, the status of wind farms in Kansas was:

- Eight active wind farms with a capacity of slightly more than 1000 megawatts (capacity is the rating at which a wind farm is actually capable of producing electricity (e.g.: a wind farm rated at 250 MW is capable of producing 250 MW during peak winds; with production of lesser amounts when winds are light):

    Elk River Wind Farm, Butler County, 150 MW capacity,

    Flat Ridge Wind Farm, Barber County, 250 MW capacity,

    Gray County Wind Farm, 112 MW capacity,

    Kansas-Smith Farms, Meade County, 0.24 MW capacity,

    Meridian Way Wind Farm, Cloud County, 200 MW capacity,

    Smoky Hills Wind Project, Lincoln County, 250 MW capacity,

    Spearville Wind Farm, Ford County, 100 MW capacity, and

    Westar Wind, Pottawatomie County, 1.2 MW capacity.

- One wind farm under construction:

    Central Plains Wind Farm, Wichita County, 99 MW capacity.

- Thirty proposed wind farms, with a planned capacity of nearly 6,100 MW.

The locations of the wind farms noted above are indicated on Fig. 5.1 (the Flat Ridge Wind Farm in Barber County is shown as “under construction,” but the farm was dedicated and went active on March 05, 2009).

Opponents of wind farms do not appear to be against wind farms in general, but they are concerned with the sites selected for construction. One group, Protect the Flint Hills, states that their mission is to “protect the wide-open spaces of the KANSAS FLINT HILLS, the last significant expanse of tallgrass prairie on the continent” (www.protecttheflinthills.org). Protect the Flint Hills has produced a map, Fig. 5.2, on which 22 “special places” have been identified. The intent is to seek protection of those places from the construction of wind farms. They have not been entirely successful. Of the locations identified, wind farms have already been built in or near, or are proposed in or adjacent to seven of the 22 areas (refer to Fig. 5.1). Those sites include the Flint Hills Tallgrass Prairie Landscape, the Smoky Hills Landscape, and five lesser-known areas.

Anyone driving through Kansas on Interstate 70 (I-70) is aware of the Smoky Hills Wind Project, located on the north side of I-70 in Lincoln County, about 30 miles west of Salina. This wind farm, when complete, will consist of 155 turbines with a capacity of 250 MW, “enough to power 120,000 Kansas homes” (Breneman. Smoky Hills Wind Project Management Team Meeting. 2008, April 22). Though larger than most, this wind farm is typical of those being built in Kansas. The developer of the project is a local business, TradeWind Energy LLC, headquartered in Lenexa, Kansas, but the owner is a foreign company, Enel North America, Inc., a subsidiary of Enel SpA, headquartered in Rome, Italy.

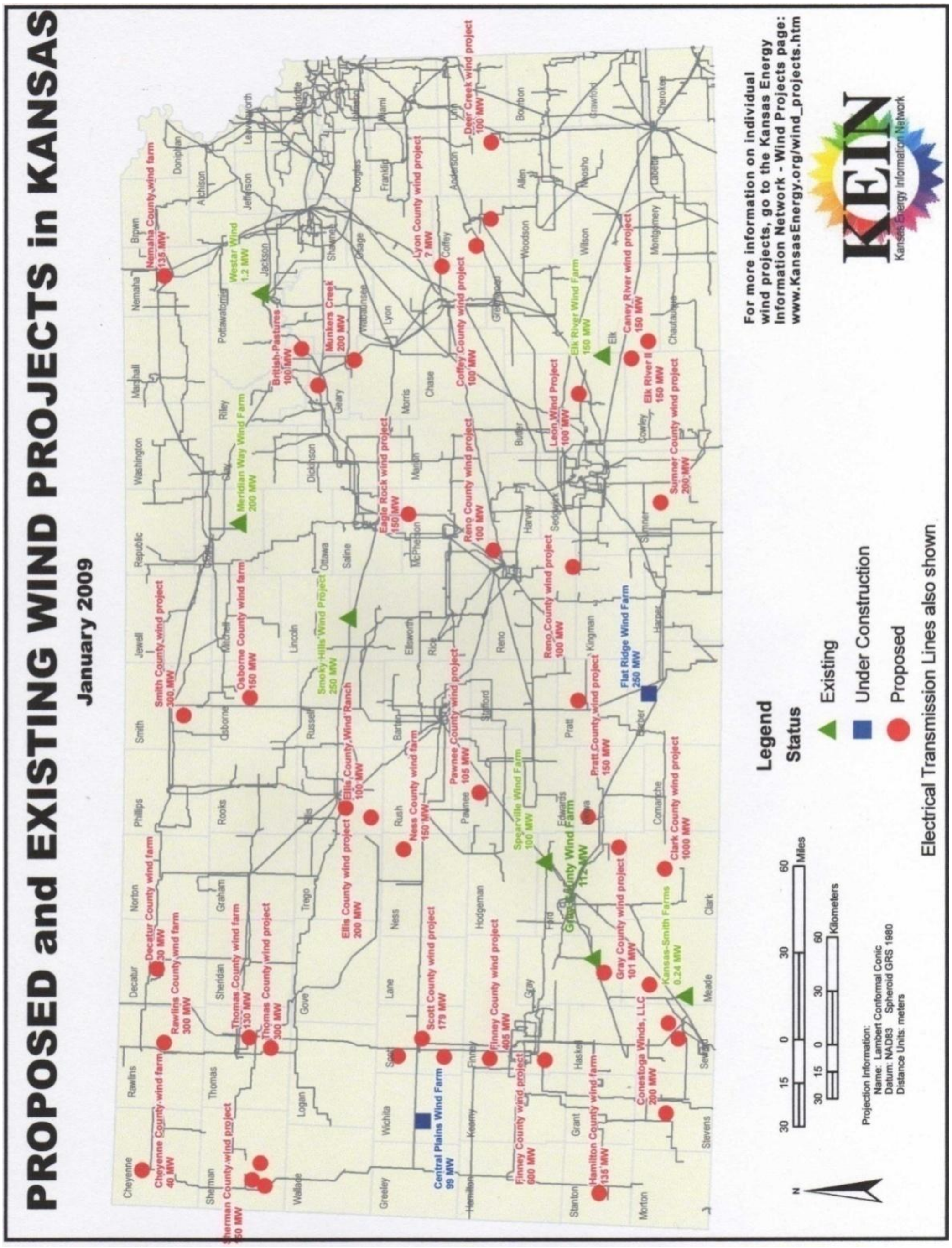


Figure 5.1: Kansas Wind Farm Locations

Kansas Energy Information Network

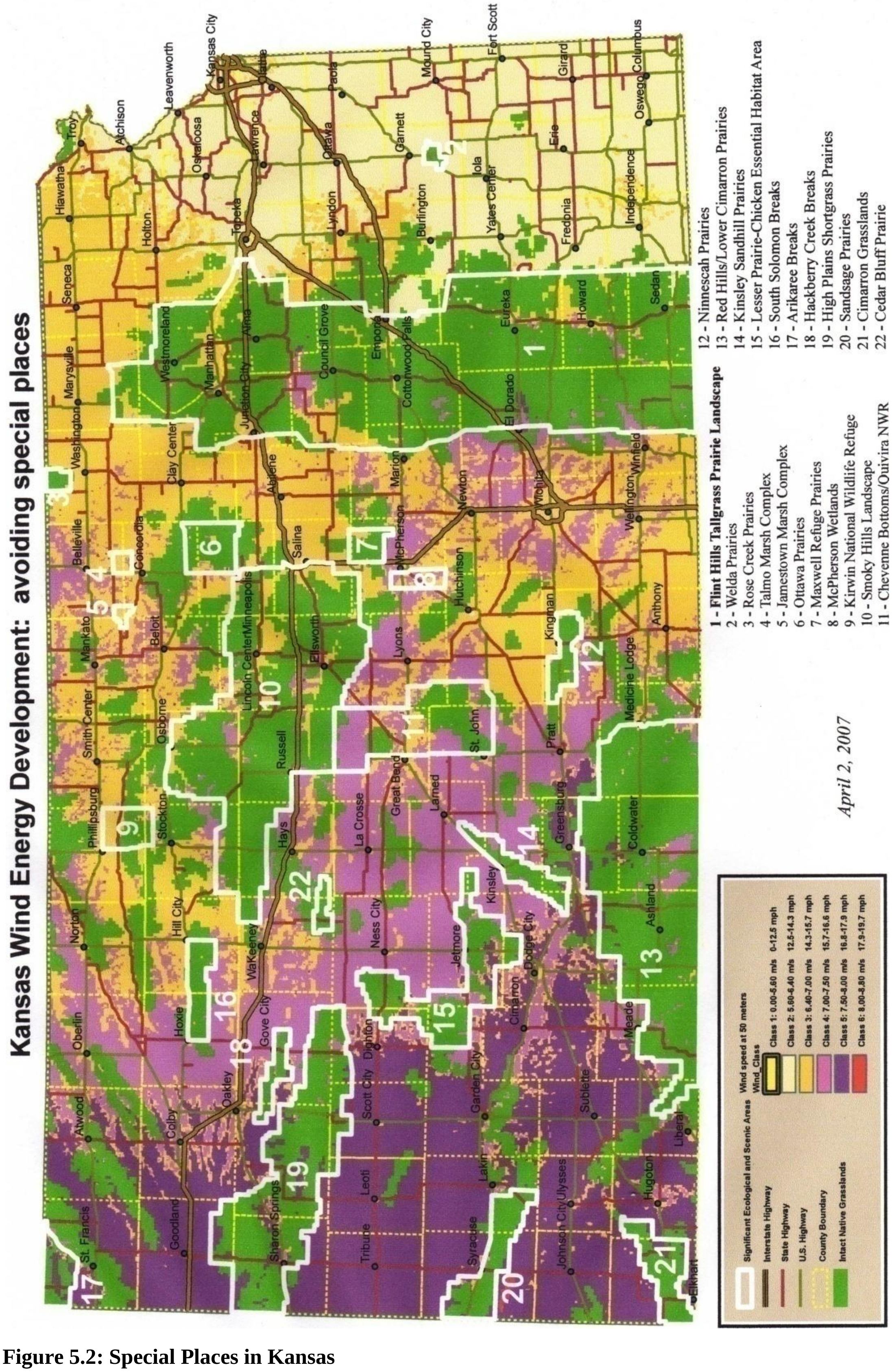


Figure 5.2: Special Places in Kansas

protecttheflinthills.org

The Smoky Hills Wind Project is being built in two phases (refer to Fig. 5.3). The first phase, shown in yellow, was completed in 2007, and consists of 56 wind turbines located on the property of 15 landowners. It has a rated capacity of 100 MW, enough to power 45,000 homes. The second phase, shown in magenta, consists of 99 wind turbines, and will bring the Smoky Hills to its full capacity, enough to power 120,000 homes.

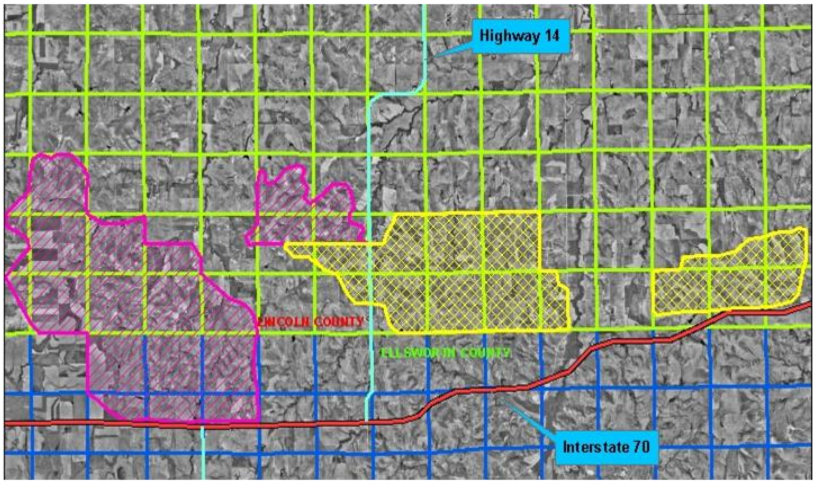


Figure 5.3: Smoky Hills Wind Project

U.S. Department of Agriculture

Figure 5.4: Smoky Hills Wind Project

Photo by Jan Bohn Rice

At Smoky Hills Wind Project, under development since 2003, most landowners in the area had primarily two concerns:

- What affects would the turbines have on the environment, and
- What affect would the wind farm have on the visual landscape?

These questions will be addressed in Chapter 6.

While the Smoky Hills Wind Project has been under construction, another company has been working towards erecting wind turbines in the area of the Flint Hills. They, however, have run into a great deal of opposition, with one conflict having been heard by the Kansas Supreme Court. The Flint Hills are known for their scenic beauty, and are considered by many to be "one of the most ecologically significant native grasslands in the world" (www.protecttheflinthills.org). Some residents see wind farms as an opportunity to supplement their income, with development companies paying the landowners $2,000 to $3,000 per year for each turbine, as royalties for the use of the land. With each wind turbine requiring two to three acres of land, plus acreage required for access roads, a large part of the Flint Hills, thus the tallgrass prairie, would be disturbed, or even destroyed, and that is the primary concern.

Figure 5.5: Flint Hills?

www.protecttheflinthills.org

In Wabaunsee County, the Board of County Commissioners banned the installation of the large wind turbines (the ban did not apply to the smaller, residential-sized turbines). In fact, Wabaunsee County has a ban on all commercial energy production, so the prohibition of wind turbines is not seen as discriminatory, but merely the application of current policy. Regardless, Wabaunsee County landowners who are interested in the erection of wind turbines filed suit against the county, a case that was heard by the Kansas Supreme Court (Appellate Case No. 98487) on October 14, 2008. At the time of this writing, the court is waiting on the filing of amended briefs, and it is unknown when a decision will be rendered.

In Kansas, as well as around the world, the emphasis on capturing wind energy has been on commercial wind farms. Almost escaping notice, however, are smaller turbines being erected at homes, schools, and other locations. Through the "Wind Turbines for Schools" initiative, small (1.8 kilowatt) turbines have been erected at schools in Concordia, Brookville, Fairfield, Girard, Sterling, and Walton. In Concordia, the turbine is mounted on a 60 foot tower located adjacent to the high school sports stadium.

Figure 5.6: Concordia, Kansas, School Turbine

Photo by Jan Bohn Rice

Power generated by the turbine is used for concession stand and press box operations. In Brookville, the turbine is not operational at present, but the plan is to use the generated electricity to power a greenhouse and to use the process as a teaching tool. A turbine similar in size to that erected at Concordia has been erected at a fire station in Manhattan, near the intersection of Kimball and Denison avenues. This turbine is operated by the Wind Applications Center at Kansas State University, and the electricity generated is used for powering the fire station and for experimental purposes.

Larger turbines have been erected or are planned at schools in Moscow, Pratt, Quinter, and Dodge City, with plans for using the electricity to a greater extent than at Concordia and Brookville. In Moscow, superintendent Larry Philippi stated that it is estimated that the turbine "will generate about 40 percent of the energy the school needs" and that the turbine "will pay for itself in 10 to 12 years -- less if rates increase and the school saves more per kilowatt hour" (Behlmann, 2008).

Figure 5.7: Moscow, Kansas, School Turbine

Garden City Telegram

Elsewhere in Kansas, wind turbines are being erected for various uses, and at varying scales, depending on the project.

- The town of Jetmore has installed two wind turbines from which they hope to obtain 12 percent of their energy. Jetmore, near Dodge City, is the first town in Kansas to own its wind energy system (CJOnline.com, 2009, January 12),

- The Kansas Department of Transportation has installed a small turbine at its shop in Osborne, and will install another at its shop in Lincoln. Each is to provide about 30 percent of the electricity needed by the shops, and
- The University of Kansas has announced plans to install a wind turbine to assist in powering Anschutz Library. This installation will be a part of a program approved by the student body to “reduce the campus’ dependence on unsustainable energy” (CJOnline.com, 2009, March 23).

CHAPTER 6 - Impacts and Conclusions

"Dust in the wind.…"

(Kerry Livgren, American Songwriter, 1949 -)

What is it that makes the construction of wind farms a controversial issue for some people, while other people welcome them as the way of the future? Factors to be considered include environmental issues, aesthetics, and economics. Each of these is dependent on an individual's point of view.

ENVIRONMENTAL IMPACTS

Many individuals have great concern for the environment, and believe that wind energy is the answer to their concerns. It seems their primary apprehension is the theory of global warming, and they are of the opinion that wind farms are one solution to that problem, since wind energy would reduce the quantities of carbon products released into the atmosphere. The wind farms, however, bring other environmental questions to the mind of landowners; what would be the affect on wildlife (particularly various bird species and bats), and what would be the affects of erosion on the landscape?

After the construction of the Altamont Pass Wind Resource Area, a large wind farm (more than 4,000 turbines) about one hour east of San Francisco, California, it was found that birds were being killed by the impact of flying into the turbine blades. As a result of these deaths, wind turbines became known as "bird cuisinarts," but are the numbers of deaths really that great, or has the problem been exaggerated? Opinions on this subject vary, depending on one's point of view. In the Altamont Pass area, studies of bird migration paths were not done, and the result was the deaths of many golden eagles, red-tailed hawks, and other raptors. Laurie Jodziewicz, communications and policy specialist for the American Wind Energy Association, stated during an interview that "Altamont Pass Wind Resource Area…was installed without understanding that there might be impacts to the raptor population in the area…subsequent projects did much better" (Rogers, 2009). Dr. Albert Manville, senior wildlife biologist with the United States Fish and Wildlife Service, was also interviewed for Mother Earth News, and his opinion is that more recent wind farm projects have not done much better. Manville stated that "the [wind] industry estimates mortality at around 58,000 per year; I estimate it to be closer to 440,000 per year" and "with rotor-swept areas approaching 4 acres in size, blade tips now exceeding 425 feet in height above ground level, and blade tips still spinning at 170 mph, the challenge only grows" (Rogers, 2009).

In Kansas, the avian concern is not as much for the mortality rate from impacts with turbine blades, as it is for the loss of nesting habitat for prairie chickens. Prairie chickens nest on the ground, typically in areas of tall grass where they are concealed from raptors and other predators. The construction of wind farms, which requires an average of two to three acres of land per turbine, destroys the tall grass, and without their natural nesting habitat the prairie chicken population is dwindling. In the 1990s, the United States Fish and Wildlife Service placed the lesser prairie chicken at 8 on a watch list of birds that are threatened or endangered (the scale ranges from 1 to 12, with 1 being the most endangered). In 2008, the lesser prairie chicken was moved up the scale to a 2, which means it is on the verge of being listed as threatened or endangered (Schrag, 2009).

The affects on the landscape might vary from one location to another, and be of greater concern to one group of people than to another. In Kansas, it seems the greatest concern is the effect of erosion due to roads required to access the turbines and the area around the base of each turbine. When roads are built across the landscape, the vegetation is stripped away, leaving bare earth exposed to the elements. Typically, these areas are covered with gravel, but they are still subject to the effects of erosion. Unless the vegetation is replaced, wind and rain can and will wreak havoc on the surface, possibly leaving the area unfit for use other than access to the turbines.

VISUAL IMPACTS

The visual effect of wind turbines and farms is one that varies from one individual to another. As has been stated, “beauty is in the eye of the beholder,” and that certainly applies to wind farms. When considering the visual aspect of wind farms, individuals usually focus on the turbines, with some people finding them to be visually pleasing, and other people seeing them as large, obtrusive, industrial machines, perhaps belonging in a science fiction movie. Neither position is necessarily right or wrong, they are simply opinions that each person holds, based on personal beliefs. Along with the visual impact of the turbines, however, one must also consider the electrical equipment required to move the electricity to and along the power grid. In urban areas, this equipment, because it is not considered visually appealing, is usually hidden behind screen walls. In rural areas, however, concealment is not possible, and the equipment is easily seen, sometimes from great distances. Is such equipment visually disturbing, or is it easily overlooked? As with the turbines, that is an issue each person must address individually.

Figure 6.1: Power Lines at Meridian Way Wind Farm, Concordia, Kansas

Photo by Jan Bohn Rice

PHYSICAL/PSYCHOLOGICAL IMPACTS

"'Listen,' John Yancy says, leaning against his truck…. The rhythmic whoosh, whoosh, whoosh of wind turbines echoes through the air…[Yancy] says they disrupt his sleep, invade his house, his consciousness. He can't stand the gigantic flickering shadows the blades cast…" (MSNBC, 2008).

In King City, Missouri, Charlie Porter has filed suit against a wind energy company, claiming the turbines near his home "have hurt his property values and made him ill….All we want is for the wind company to replace what they took from us – our peace and quiet and our property values” (CJOnline, 2009, February 4).

Not everyone sees wind turbines as a hazard to health and well-being, but not everyone lives near turbines, as do Mr. Yancy and Mr. Porter. Standing near a single turbine, one does hear the “whoosh, whoosh, whoosh” of the turbine blades cutting through the air, but when surrounded by several turbines the sound seems to be more of a constant, low, resonating roar, a sound resembling that of a far-off jet engine. As with the visual impact, though, sounds affect individuals in different ways; some finding such noises to be annoying, while others may find them soothing, or at least something that can be tolerated.

On a sunny day, the shadows of the blades are very noticeable, but are they a problem? Again, each person is affected differently by “shadow flicker.” The shadows created by the rotating blades must be considered when locating wind turbines, along with the latitude at which the turbines will be placed (sun angles) and the speed of the wind, which affects the speed at which the blades rotate.

ECONOMIC IMPACTS

Who gains from the construction of wind farms? The companies constructing the farms will typically negotiate contracts with the landowners, paying an average of about $3,000 annually for each turbine (AWEA, 2009). At what cost to the landowner are the turbines placed, though? Don Bangart of Chilton, Wisconsin, regretted his decision to sign a lease, and wrote an article he titled, "What have I done?" in which he rued the day he signed the contracts. Mr. Bangart describes the "scars" across his property that are the access roads to the turbines or trenches for the cables carrying electricity to substations; he tells of being escorted from a turbine on his property, because he "could not be there;" and he describes the tension created between landowners with turbines, and those without…all the while asking, "What have I done?"

It appears that landowners can reap monetary benefits by permitting wind turbines on their property, but what of the companies that own the wind farms? Government subsidies are readily available for those companies, and it seems that they are quite generous, especially when compared to the subsidies paid for other sources of energy. In an Executive Summary published in 2007, the Energy Information Administration, a branch of the United States Department of Energy, provided the following subsidy amounts:

Fuel Source	Subsidy (per megawatt hour)
Coal	$0.44
Natural gas and petroleum liquids	$0.25
Nuclear	$1.59
Solar	$24.34
Wind	$23.37

In addition to subsidies from the federal government, wind energy companies in Kansas are now eligible for a share of up to $5 million in bonds to assist in the establishment of their business (CJOnline, 2009, March 25).

Local governments are also involved financially, and not always in a positive manner. According to BEST (p. 169), "the wind-energy project may indirectly generate taxes for the local government, [but] a wind-energy facility also may entail public costs…such as improvements of local public roads [and] improved community services….Taken together, the costs to a small, rural government have the potential to be significant."

The construction of wind farms may be an economic boon to individuals seeking employment in the wind industry, as well as consumers of electricity. Currently, there are two bills before congress, one calling for a federal standard requiring that 25 percent of electricity come from renewable energy sources by 2025, another calls for 20 percent by 2021. If either bill passes and is signed into law, it

> "would create 297,000 new domestic jobs and save consumers $64.3 billion in lower electricity and natural gas bills…. The analysis also found that this renewable electricity standard would generate $13.5 billion in new income for farmers, ranchers and rural landowners, and reduce global warming pollution by 277 million metric tons a year by 2025, the equivalent of the annual output of 70 new, average-size, coal-fired power plants" (Union of Concerned Scientists, 2009).

The $64.3 billion in savings appears contradictory to the earlier statement that wind generated electricity costs more per kilowatt hour, but the UCS continues by stating, "Increasing utilities' reliance on renewable energy sources would diversify the electricity mix and increase competition in the energy market, reducing the demand for — and the cost of — fossil fuels. Under a 25 percent standard, electricity prices would be as much as 7.6 percent lower than business as usual between 2010 and 2030." If accurate, this bodes well for the American consumer.

CONCLUSIONS

All things considered, what is the best course of action in Kansas, to build…or not to build…wind farms?

Most people are aware that electricity is currently produced from the burning of fossil fuels, that fossil fuel supplies are finite, and that those fuels are being exhausted at an ever-increasing rate. We are also aware that the burning of those fuels may be having an adverse effect on our environment, and that alternative methods of producing electricity are highly desirable. Research has been, and is being, done on the conversion of wind, solar and biomass material energy into electricity. In Kansas we have an abundance of wind, a source of energy that will be available as long as the sun shines on the earth.

Figure 6.2: Uncle Sam

http://kansas.sierraclub.org/

Environmentally, the capture and conversion of wind energy into electricity appears to be a two-edged sword; wind energy reduces our need to use fossil fuels, thereby reducing the quantities of gases released into the atmosphere, which helps preserve the earth, but wind energy also has negative effects, primarily on wildlife and through erosion of wind farm sites due to loss of vegetation. Having considered the subject, the Kansas Chapter of the Sierra Club came out in favor of wind farms, to the point of stating that "it is critical that Kansas be a leader in Wind Power and take advantage of this economic opportunity" (Sierra Club, Kansas Chapter, 2009).

In addition to the environmental issues, one must also consider the destruction of the prairie and the visual impact of placing wind turbines in or near the "Special Places in Kansas." Those are the subjects of much discussion in the Flint Hills, and in the current Kansas Supreme Court case. Regardless of the outcome of that case, it is probable that the issue will be raised time and again, as more wind farms are proposed in the future.

The question remains: should wind farms be built in Kansas? Due to the abundance of wind energy across the state, the answer to that question is probably YES, but….

The state of the availability of fossil fuels demands that other sources of energy be explored. As has been noted, electricity from wind energy generally costs more than electricity produced from other sources, but the monetary cost alone cannot be the only consideration. We must also look out for the environment, or the money spent on the generation of electricity from wind energy will become a moot point.

Another question must also be answered: where should wind farms be built? Should companies be permitted to build on any land for which they can obtain the rights, or should greater care be exercised, and the "special places" avoided and preserved? It is the author's opinion that Kansas is a state of wide-open spaces, spaces that can and should be used for the capture of wind energy, but that the construction of wind farms should be restricted to areas that are not considered to be "state treasures" or "special places." To destroy the beauty that exists in the Flint Hills, Cheyenne Bottoms National Wildlife Refuge, the Red Hills Prairie in the southern part of the state, and similar areas, would be a tragedy, and those areas should be avoided. All it takes is proper planning.

Figure 6.3: Contrast

Photo by Jan Bohn Rice

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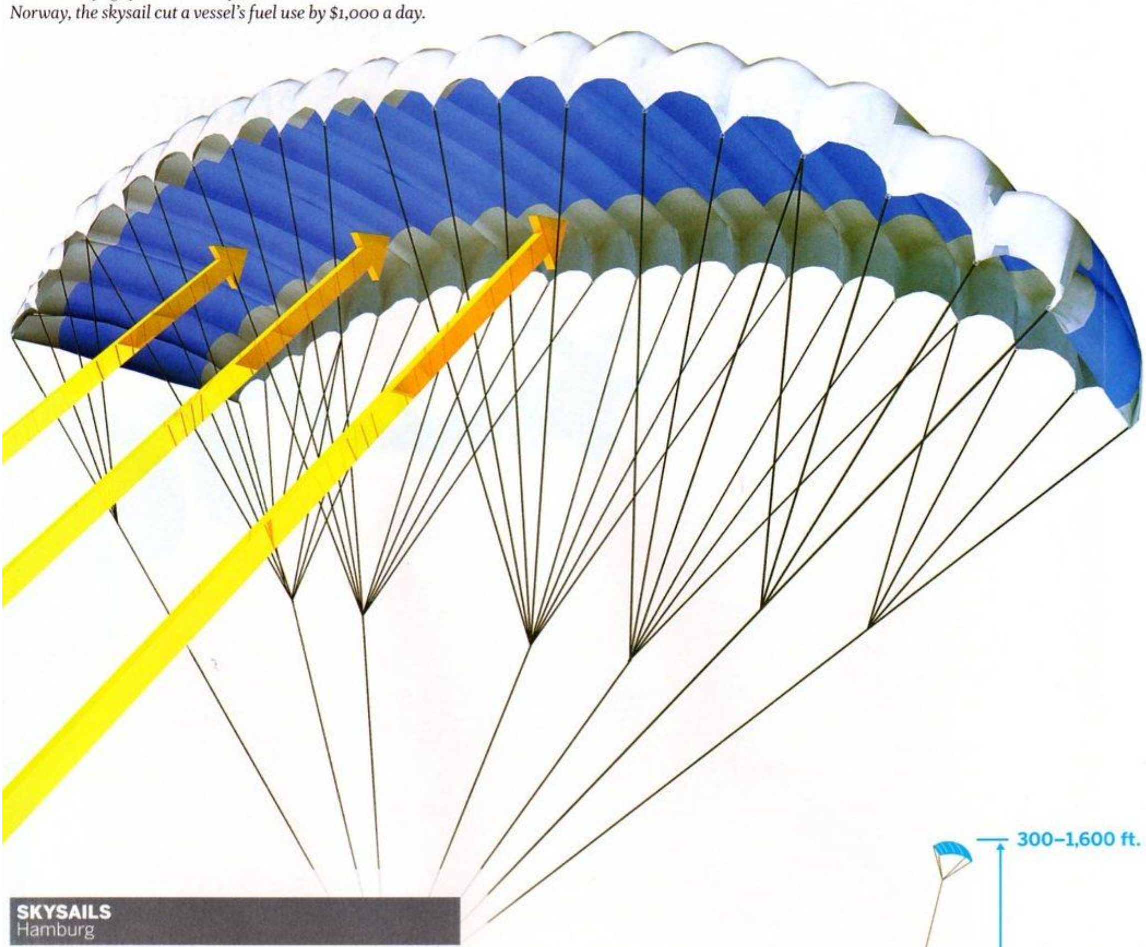
Appendix A - Other Uses of Wind Energy

The production of electricity through the capture of wind energy is but one facet of wind use that is being explored. The four figures on the following pages, all taken from Fortune magazine (Woody. 2008, October 27), are indicative of “cutting-edge” technologies that are being considered.

A Cargo Ship That Sails

Tow, tow, tow your boat is the idea behind attaching giant paraglider-shaped kites to cargo ships. The Hamburg startup SkySails has designed these giant textile sails large enough to cover the floor area of a ballroom. On a test voyage from Germany to Venezuela to America and then back to Norway, the skysail cut a vessel's fuel use by $1,000 a day.



SKYSAILS
Hamburg

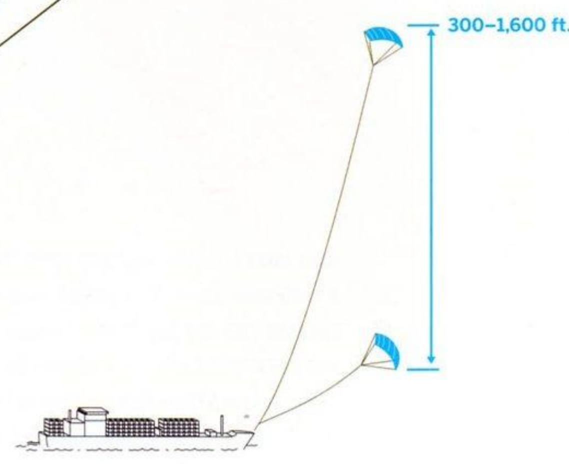
FOUNDED 2001

TECHNOLOGY The automated kite launches from a ship's bow and sails to a height of 300 to 1,600 feet to help propel the vessel. Ranging in size from 1,700 to 3,400 square feet, the double-walled kites can be deployed on a range of oceangoing ships, from shipping trawlers to mega-yachts.

ENERGY PRODUCTION/SAVINGS SkySails estimates that its kites can cut a ship's fuel consumption by 10% to 35% a year on average, with the cost of the system amortizing in three to five years. The kites also help cut greenhouse-gas emissions by reducing use of the ship's engines.

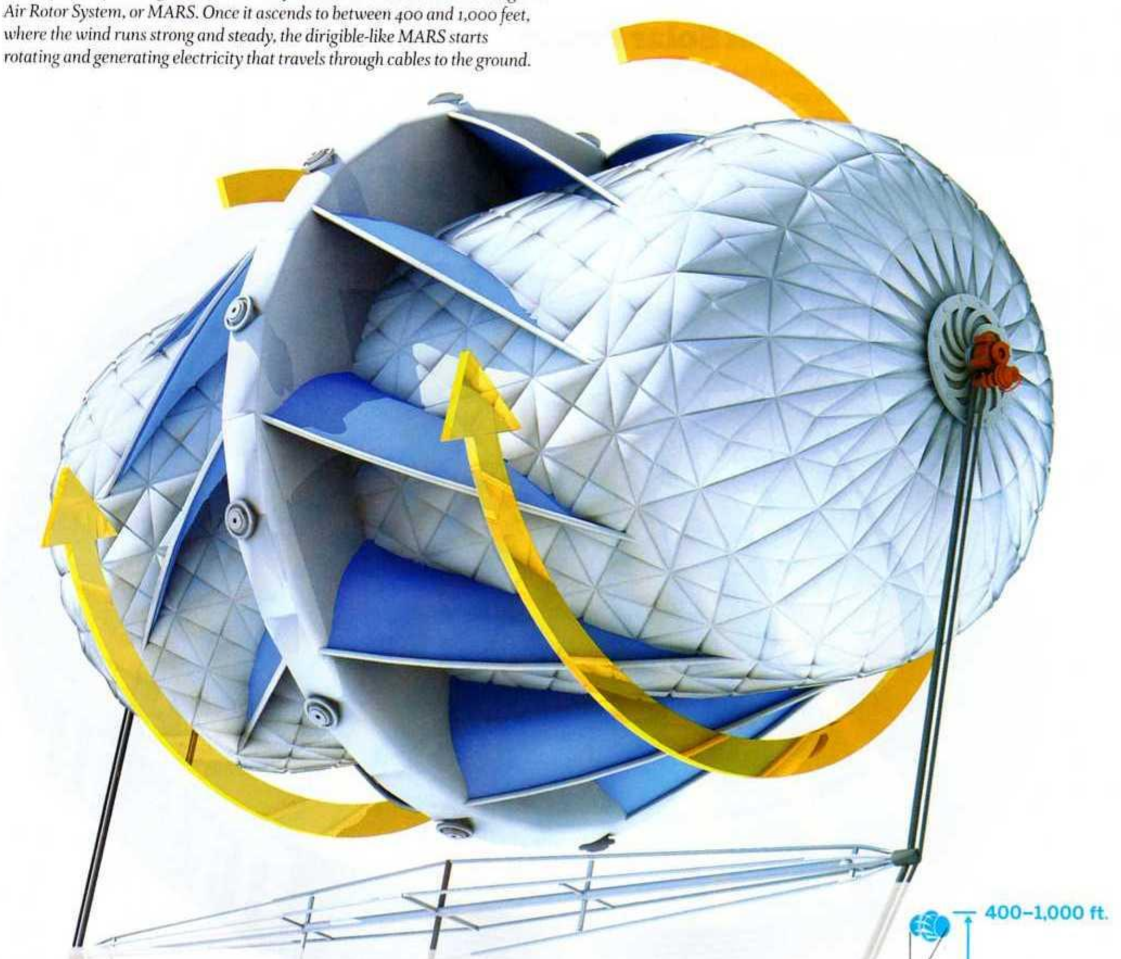
STAGE OF DEVELOPMENT The first pilot systems are in operation onboard a pair of cargo ships.

REALITY CHECK A slowing global economy could make sales to international shippers a challenge.



Floating Power Plants

What if a blimp could generate electricity? That's the idea behind the Magenn Air Rotor System, or MARS. Once it ascends to between 400 and 1,000 feet, where the wind runs strong and steady, the dirigible-like MARS starts rotating and generating electricity that travels through cables to the ground.



MAGENN
Kanata, Ontario

FOUNDED 1978

TECHNOLOGY The MARS is made of a Dacron-like proprietary material encased in a high-tension net and inflated with helium. As the blimp's rotor blades begin to spin, they activate generators that transmit power to the ground via a tether made of Vectran, a polymer stronger than steel. The MARS is mobile and can be deflated and redeployed in locations off the grid.

ENERGY PRODUCTION/SAVINGS A 30- by 57-foot prototype generated two kilowatts of electricity earlier this year, enough for one house.

STAGE OF DEVELOPMENT A ten- or 25-kilowatt version will be tested with Magenn's first customer in 2009.

REALITY CHECK More work must be done to determine how larger versions of the MARS will perform at higher altitudes.

A Little Wind

The elegantly sculptured Helix windmill turbine costs between $7,500 and $14,500, sits on a ten- to 25-foot pole, and is designed for residential backyards and commercial rooftops in low-wind-speed urban areas.

HELIX WIND
San Diego

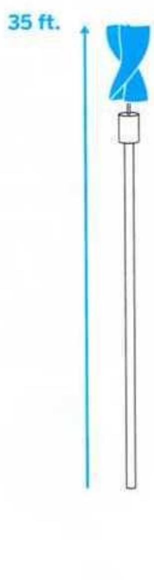
FOUNDED 2006

TECHNOLOGY The scoop-shaped aluminum-alloy blades are mounted vertically, allowing them to capture the wind from all directions while operating nearly silently, according to Helix. The compact seashell shape of the turbines—offered in two-kilowatt and four-kilowatt configurations—makes the turbine bird- and bat-friendly.

ENERGY PRODUCTION/SAVINGS One Helix turbine can power a typical home, and an owner should recoup the cost of the turbine in about ten years.

STAGE OF DEVELOPMENT The first production run of 50 turbines has been sold. A new tax break for small windmills in the recently passed bailout bill ought to help sales.

REALITY CHECK The turbine may face objections from local planning boards because of height or aesthetic restrictions.



Kiting in the Jet Stream

Researchers at Delft University are building what they call a Laddermill to tap the steady and stiff winds in the jet stream. The Laddermill consists of a stack of tethered kites that soar as high as five miles and then return toward earth in an endless loop to generate electricity.

LADDERMILL
Delft University of Technology
Delft, the Netherlands

TECHNOLOGY As the kites sail up to the jet stream and back, they pull with them tethers that turn an electrical generator located on the ground. The Delft researchers also are experimenting with a fleet of gliders that would soar in place of the kites.

ENERGY PRODUCTION/SAVINGS A Laddermill operating at 30,000 feet would generate an estimated 100 megawatts of electricity—enough to power 100,000 homes, according to Delft.

STAGE OF DEVELOPMENT The project is still in the R&D phase, although Delft has proved the concept by generating ten kilowatts of electricity by flying a 107-square-foot kite.

REALITY CHECK Commercial Laddermills are years away from operation and would have to operate in no-fly zones.