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# Harvest the Wind: A Wind Energy Handbook for Illinois

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2004



**Harvest the Wind**  
**A Wind Energy Handbook for Illinois**

by

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Prepared by  WINDUSTRY<sup>™</sup>  
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at Western Illinois University

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## Acknowledgements

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*First Edition Principal Contributors and Reviewers:* Rory Artig, Don Bain, Lisa Daniels, Skip DeLong, Paulo Dini, John Dunlop, Paul Gipe, Rick Halet, Brian Parsons, Michael Noble, Michael Tennis, and Tom Wind

## About Windustry

Windustry is a nonprofit organization that works hands-on with local and community-based wind projects, providing technical support to create an understanding of wind energy opportunities for rural economic benefit. This work helps lay the foundation to build markets for locally owned wind projects in the Midwest as well as to help rural landowners and communities benefit more from corporate owned wind projects. Windustry, through its work with Wind Powering America, a U.S. Department of Energy initiative, the National Wind Coordinating Committee (NWCC), and Windustry's new Wind Farmers Network, is working to create a wind energy knowledge base in rural communities around the Midwest. As part of this effort, Windustry organizes state, regional, and national wind energy forums aimed at moving the wind energy policy and project development dialogue forward, especially regarding community wind projects.

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## Foreword

Illinois, the Prairie State, has an abundance of natural resources: from the wind and waterways that carve and sculpt the state's rich fertile soils to the minerals that lie beneath the soils that provide fuel and raw materials for construction and manufacturing. Coal, in particular, has been a significant contributor to the nation's energy needs and the state's economy. The state may now have a new source of energy and revenue . . . the wind.

Wind has the potential to make a positive impact on our energy supply and economy due, in part, to improved technology and to the experience gained in development and production of wind generated electricity in several states. Wind energy can be converted to electricity for individual use or as part of a large-scale operation that distributes electricity to residential and business customers. The state's rural landscape should be explored to identify key sites to harvest the wind and, therefore, enhance incomes and create jobs.

The Illinois Institute for Rural Affairs (IIRA), through its Value-Added Rural Development Center, is working to raise awareness of the value of wind energy by providing

information and technical assistance to aid in the decisionmaking process in wind energy projects. As part of this effort, IIRA recognizes the need for an easily accessible publication that addresses wind energy experiences and provides necessary steps to harvest wind in Illinois.

Special thanks go to Windustry for preparing this document under contract. Thanks to Mary Holmes, David King, and Norman Walzer for assisting me with the editing of the initial draft and to Karen Poncin, IIRA, for preparing the material for publication. This handbook was made possible through funds from the Illinois Department of Agriculture, the Energy Community Foundation, and the Illinois Clean Energy Foundation. This document is also available on the IIRA website ([www.iira.org](http://www.iira.org)). Further information about this project can be obtained from Roger Brown, IIRA, 518 Stipes Hall, Western Illinois University, Macomb, IL 61455.

Roger Brown  
Project Director

## About the Illinois Institute for Rural Affairs

Located at Western Illinois University, IIRA is designed to improve the quality of life in rural areas by developing public-private partnerships with local agencies on community development projects in rural areas. IIRA works on projects such as rural economic and community development (including value-added agriculture), rural health care, rural education, rural public transportation, public management policies, housing, and technology.

The value-added agriculture project is administered through a unit of IIRA known as the Illinois Value-Added Rural Development Center. Through a variety of research and educational efforts, the center educates agriculture and economic development professionals regarding value-adding opportunities for their area. Outreach assistance is provided to these groups as they organize business ventures that will increase their income as well as expand employment opportunities in rural Illinois.



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## **Part I. The Fundamentals**

While humans have used wind energy for many years, only recently has the world begun to realize the wind's potential for generating large amounts of electricity. Although wind has emerged as an economic resource, the wind industry still faces many challenges. Wind turbines are still new to many parts of the country, including Illinois, leading some banks and investors to consider wind projects to be uncertain investments and leading some communities to struggle with how to permit and tax wind projects.

This section is designed to give an overview of the wind energy industry and the many benefits and challenges to wind development in the United States today. In *Harvest the Wind*, it is our goal to provide enough of the details for you to make thoughtful decisions on how or when or even if at all to participate in this exciting new industry.



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# Chapter 1. Getting Started: An Overview of the Fundamentals of Wind Energy, Wind Energy Opportunities, and the Energy Industry

## A Briefing on the Fundamentals of Wind Energy and the Wind Energy Industry

### What Is Wind Energy?

Wind rushes through golden aspen leaves, making them tremble in its presence. Wind whips dust into clouds that skip across dry vacant lots. Wind can sink ships and wear away mountains one speck of dirt at a time. But where does this phenomenon we know as wind come from?

As the sun strikes the earth, it heats the soil near the surface. In turn, the soil warms the air lying above it. Warm air is less dense than cool air and, like a hot-air balloon, rises. Cool air flows in to take its place and becomes heated. The rising warm air eventually cools and falls back to earth, completing the convection cycle. This cycle is repeated over and over again, rotating like the crankshaft in a car, as long as the solar engine driving it is in the sky.

The atmosphere is a huge, solar-fired engine that transfers heat from one part of the globe to another. The large-scale convection currents, set in motion by the sun's rays, carry heat from lower latitudes to northern climates. The rivers of air that rush across the surface of the earth in response to this global circulation are called wind. This wind resource is renewable and inexhaustible, as long as sunlight reaches the earth.

### A Brief History of Wind Energy

When the term “wind energy” comes to mind, people tend to think of the spinning windmill blades of 1930s-era farmsteads; however, wind has been used as a source of energy by sailors, farmers, and settlers for centuries. Since the earliest times, wind has been used to move

ships across seas, grind grains, and raise water from beneath the earth.

Windmills have been in existence since at least AD 644, when they were used to grind grains in Persia. From there, windmills spread to China and on to Europe, where they were common from the 12th to the 19th centuries. The introduction of steam energy caused a slow decline in the use of windmills.

Energy is the ability to do work. Power is the rate at which work is performed. Windmills on farms were also used to replace animal energy and, in the 1920s and 1930s, provided electricity in rural America. At this time, only 10 percent of the nation's farms were served by electricity; literally thousands of small wind turbines were in use, primarily on the Great Plains. These “home light plants” provided the only source of electricity to homesteaders in the days before the Rural Electrification Administration (REA) brought electricity to the countryside. Central station power was incompatible with the electricity produced by home light plants, and many REAs required customers to disconnect their home light plants before they would bring in their lines. Electric utilities now serve nearly all rural families in the United States.

Modern wind energy technology was pioneered in California in the 1970s and 1980s, sparked by soaring fossil fuel prices and a growing interest in more environmentally sound energy. The first “commercial-scale machines” emerged during this time (50-300 kW at that time). Over 17,000 wind turbines of varying models and sizes were installed in California between 1981 and 1990, and the

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state continued to dominate the U.S. wind power market into the mid-1990s. Attractive state and federal incentives combined with technical innovations to drive the wind industry in California in the early 1980s. Not surprisingly, the U.S. wind industry suffered when some of these incentives ended in the mid-1980s, allowing European turbines (mostly Danish designs) to take over the market. As the U.S. industry lagged in the late 1980s and early 1990s, the European market grew steadily as a result of stable, supportive public policy, technology innovation, and the excellent wind regimes of northern Europe. Much of the development in Europe came in the form of cooperatively owned single turbines or small clusters of turbines, a model that did not gain much attention in the U.S. until very recently.

The U.S. wind market began to rebound in the mid-1990s, with new renewable energy policies and green power initiatives across the country. The first major wind installations outside California were installed in Minnesota, Iowa, and Texas in 1994 and 1995, followed by even larger installations in several states in the late 1990s. In 2003, 30 states have or will soon have significant wind energy



Buffalo Ridge in southwest Minnesota, one of the first large wind farms outside of California.

Photo courtesy of Tom Wind

projects. Meanwhile, the European market continues to thrive, especially with the advent of offshore wind applications that help the densely populated region conserve land. Wind development has also been significant in India in recent years, and is emerging in places such as China, Japan, and Australia.

### **Overview: State of Wind Around the Globe**

Wind energy is the world's fastest growing energy source, with more than 34,155 MW of capacity installed by October 2003, enough to power the equivalent of more than eight million average American households. The amount of electricity produced by wind turbines is growing rapidly in Europe, Asia, and the United States for both environmental and economic reasons. The total installed capacity of wind energy in the world has quadrupled since 1997. Wind has been the fastest growing energy source in the world since 1990, with an average annual growth rate of 25 percent. Germany leads all nations with 13,184 MW of installed capacity in October 2003, followed by Spain with 5,198 MW, the United States with 5,072 MW, and Denmark with 2,927 MW. Around the world, wind development is heavily concentrated in Europe, the United States, and India with growing markets in China, Japan, and Australia. The U.S. and Europe account for 90 percent of the world's wind power capacity (75% in Europe; 15% in U.S.).

In some locales, wind energy provides a significant proportion of the local energy supply. Several states in Germany derive more than 10 percent of their energy from wind. In Schleswig-Holstein, wind turbines supply 25 percent of the electricity, and the state has a goal of increasing to 50 percent by 2010. Denmark is the leader in national

**Table 1. Top 10 States for Wind Energy Potential\***

Rank	State	Installed Wind Capacity (Nov. 2003)
1.	North Dakota	66.29 MW
2.	Texas	1,293.0 MW**
3.	Kansas	113.7 MW
4.	South Dakota	44.3 MW
5.	Montana	0.1 MW
6.	Nebraska	14.0 MW
7.	Wyoming	285 MW**
8.	Oklahoma	102 MW
9.	Minnesota	560.6 MW**
10.	Iowa	467.61 MW**
16.	Illinois	50.4 MW**

\* This list is based on the Pacific Northwest Laboratory's 1991 study. Ongoing efforts to assess wind energy potential will alter these rankings somewhat, but this list still currently provides us with the best tool for comparing potential among states.

\*\* Note that projects currently under construction and scheduled to be completed by the end of 2003 have been included in these totals.

Sources: *Wind Power Monthly* and the American Wind Energy Association

percentage of electricity from wind with over 15 percent.

### **Overview: State of Wind in the United States and Illinois**

In the United States, wind energy development was almost entirely centered in California until the mid-1990s. California still hosts nearly 40 percent of U.S. wind energy capacity (1,782 MW in July 2003), but many other states now also have significant wind developments. Texas rapidly installed over a thousand MW in recent years to become the second leading state, while steady development keeps Iowa and Minnesota competing for third and fourth place. Wind energy projects are not necessarily concentrated in the windiest parts of the country. For example, North Dakota is considered to have the greatest potential for wind energy potential in the country, often called the "Saudi Arabia of wind," but is only getting its first major wind installations in late 2003. California, in contrast, ranks only 17th among states for wind energy potential according to *An Assessment of the Available Windy Land Area and Wind Energy Potential*

*in the Contiguous United States*, published by Pacific Northwest Laboratory (PNL) in 1991. (This ranking system places Illinois in 16th place among U.S. states for wind energy potential.) Factors such as public policy support, growing demand for electricity, public interest in renewable energy, and availability of transmission lines in windy areas all play a significant part in determining where wind energy emerges.

Currently, wind generation represents about 0.3 percent of the U.S electricity supply with 5,325 MW installed as of October 2003. The American Wind Energy Association projects that the U.S. could top 6,000 MW by the end of 2003, which is enough electricity to serve nearly two million average American homes.

Strong public policy support and financial incentives in Illinois along with the identification of several good wind resource areas has brought much attention to the state from the wind industry. As of October 2003, many large and small wind energy projects are in various stages of planning and development. At least one large project (50.4 MW) in Lee County is under construction and is expected to be completed by the end of 2003. There are also a number of small wind turbines in operation around the state, some new and some that have been producing power for years. This handbook is designed to help readers understand the potential for wind energy projects in Illinois and presents ways to personally develop or participate in projects.

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## Understanding the Opportunities

### The Potential of Wind Energy

In a study for the U.S. Department of Energy, PNL estimated that wind energy rated at Class 5 (on a scale of 1-7, seven being the strongest wind resource) and could meet more than one-fourth of the nation's electricity consumption, excluding the use of any environmentally sensitive areas. With expected advancements in technology, PNL estimates that wind turbines could theoretically generate twice the total consumption of electricity in the United States. With only 0.3 percent of the nation's electricity supply coming from wind turbines in 2003, we have barely begun to tap this vast potential. The U.S. Department of Energy has set a goal of obtaining five percent of the U.S. electricity supply from wind by 2020, while the American Wind Energy Association has set a slightly more ambitious, but still modest goal of six percent by 2020. A number of states have policies requiring much more aggressive development of renewable energy. California utilities, for example, are obliged to provide 20 percent renewable energy by 2017. As wind has proven to be the least costly renewable resource, many of these state renewable energy standards will result in large amounts of wind development.

### The Wind Energy Industry and Its Players

Like the turbines themselves, the firms dealing with wind energy run the gamut from small retail shops or mail-order catalogs selling micro turbines to wind energy developers who count their annual revenues in millions of dollars. The major groups involved in the wind industry include small and large wind turbine manufacturers, small wind turbine dealers, wind project developers, consultants and contractors, electric utilities, clean energy advocates, rural economic development

groups, government representatives, and rural landowners and communities.

There are fewer than 20 large wind turbine manufacturers around the world, and even fewer small wind turbine manufacturers. A list of manufacturers that sell turbines in the U.S. is included in the appendices. Many of the large turbine manufacturers are based in Europe, especially in Denmark and Germany.

Small wind turbines are often sold directly by the manufacturer, through mail-order catalogs, or by local renewable energy dealers. Small wind turbines will typically be sold and serviced by small businesses, which are sometimes locally owned. There are few dealers of large-sized wind turbines in North America. These wind turbines are either sold directly by the manufacturer or by the manufacturer's regional representative. Some large-sized wind turbines are available only for use in multiturbine wind power plants.

Wind developers or wind energy companies buy or lease windy land, finance the installation of wind turbines, and operate and maintain the turbines for an extended period. After a project is constructed, the role wind developers play varies. Sometimes they will own and operate the wind farm, or sometimes they will just operate the project for a different owner.

Private consultants and contractors serve the needs of any party in wind turbine transactions that is willing to pay their fees. They provide specialized skills or knowledge not generally available. A consulting meteorologist can independently evaluate the wind resources at a site. Engineering consultants can offer technical comparisons among competing wind turbines or provide "due diligence" reports to banks considering loans for proposed wind projects. Contractors are often needed

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for the construction phase of wind projects for tasks such as pouring concrete and erecting the turbines. There are also many trade associations worldwide that provide information about wind energy consultants and contractors. The American Wind Energy Association (AWEA) is the major wind energy association in the U.S. and can be a good resource. AWEA's membership directory is available online at <[www.awea.org/directory](http://www.awea.org/directory)>.

Electric utilities are also key players. Their cooperation is required to interconnect any wind turbine with the power grid, even when the interconnection is on the customer's side of the utility's kilowatt-hour meter. Selling electricity to a utility involves negotiations between the non-utility generator (NUG), a farmer for example, and the electric utility. These negotiations generally result in a contract binding both parties to an agreement for a fixed amount of time. Electric utilities also represent the main market for wind-generated electricity, whether they are interested in wind power for their own purposes or are under political, regulatory, or legal pressure or obligation to invest in wind energy.

Clean energy advocates work to educate the public about the benefits of renewable energy and influence public policy to favor clean energy technologies like wind. The fact that wind energy projects often mean large investments in rural communities has captured the attention of groups interested in rural economic development such as local elected officials, farm groups, and other rural advocacy organizations.

The government plays a role in wind energy development at the local, state, regional, and national levels. Local government units are responsible for zoning and permitting wind turbines and often in determining how they are taxed. The state and federal governments control many of the incentives available to

wind projects and generally play a regulatory role in the energy industry.

Finally, residents and landowners in rural communities also have a major role in the wind industry. As the suppliers of windy land, these groups can have substantial influence over how wind energy develops. As the industry has grown, landowners and communities are gaining an understanding of the tremendous value of their wind resource and are finding ways to keep more of the benefits in the local community. These methods range from farmers negotiating better land leases with developers to actual local and community investments in wind projects. Case studies of these kinds of projects are included in Part IV of this handbook.

### **Measuring the Energy in Wind**

There is no linear correlation between wind speed and wind energy. Doubling wind speed, from 10 mph to 20 mph for example, does not simply double the energy in the wind. Rather, the energy increases eight times. A site with an average 15 mph wind speed is much more valuable than a site with an average wind speed of 13 mph. Although there is only a small difference in wind speed, the windier site contains nearly 60 percent more energy.

Wind speed varies from year to year, season to season, and with the time of day. Wind speed also varies with height above the ground. Typically, the term used most often to describe the wind resource is the "annual average wind speed." In general, an annual average wind speed of at least 14.3-15.7 mph at 50 meters is desirable. More wind is nearly always better. (Chapter 2 of this handbook takes an in-depth look at how wind resources are assessed.)

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## How Wind Energy Is Transformed into Electricity

Wind turbines or wind generators are machines that capture the kinetic energy in the wind and convert it to mechanical or electrical energy that can then be applied to some use. When hot or cool breezes blow, a wind turbine produces electricity. The major parts of most modern wind turbines include the rotor, nacelle, tower, and foundation. The rotor is the spinning part of the turbine. It turns the electric generator located in the nacelle. Wind turbines are installed on towers typically more than 100 feet in height so they can intercept stronger and less turbulent wind than if they were near the ground. Most large-scale machines installed today have towers that are more than 200 feet high.

Although machines vary, most wind turbines begin spinning at wind speeds of about 6-9 mph (3-4 m/s) and begin generating electricity at 9-11 mph (4-5 m/s). They produce increasing power with increasing wind speeds until wind speeds reach about 25-30 mph (11-14 m/s), at which speed most wind turbines reach their “rated” output. Most wind turbines do not operate in wind speeds above 55-65 mph (25-30 m/s). Designers typically concentrate their efforts on optimizing the performance of wind turbines for a wind speed range of 9-65 mph (4-30 m/s).

### *Types of Wind Turbines*

Wind power technology worth \$7.3 billion was installed around the world in 2002, according to the AWEA. This technology included small turbines in remote corners of the world, farm-sized turbines to power agriculture operations, farmer-owned commercial wind ventures, and large \$100 million or more corporate wind farms.

There are two major classes of modern wind turbines: (1) vertical axis wind turbines

(VAWTs), those with rotors spinning about a vertical axis; and (2) conventional horizontal axis wind turbines (HAWTs), those with rotors that spin about a horizontal axis. VAWTs have not performed well in commercial markets due to various problems such as blade fatigue, difficulty mounting them on high towers to capture the best wind, and other design issues. Most wind turbines in use today are HAWTs. These have conventional rotors with two, or more commonly three, slender blades. On most modern wind turbines, the rotor spins upwind of the tower.

Wind turbines come in many different sizes for different applications. When classifying wind turbines, it's typical to use what is called the nameplate capacity rating, which refers to its peak energy output at a certain wind speed. Turbines in use today range from tiny, less than 1 kW machines to enormous machines with 2 MW or more of nameplate capacity. Many wind turbine manufacturers are rapidly developing even larger machines, especially for offshore applications.

For the purposes of this handbook, we will divide wind turbines into two categories: (1) small wind turbines and (2) large wind turbines. Small wind turbines are generally used for remote or stand-alone power systems for households beyond the reach of utility lines or in households, farm operations, or small businesses supplementing their utility supply with wind energy. Large wind turbines are referred to as utility or commercial-scale and are used alone, in small clusters, or in large wind farm applications to provide electricity to a power grid.

It should be noted that there are differences among professionals on how exactly to divide and categorize wind turbines; however, we believe that for this handbook's purposes it will be most useful to make these distinctions based on how wind turbines can be used in the state of Illinois. Turbines under 40 kW

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installed in Commonwealth Edison's (ComEd) territory are eligible for the company's net metering program (see Chapter 5). Larger turbines do not have access to this special rate structure anywhere in Illinois. Thus, for Illinois and for this handbook's purposes, it will be most practical to consider any turbine under 40 kW to be a small wind turbine and any machine greater than 40 kW to be a large or commercial-scale turbine. In other states, which have different net metering programs and incentives, it might make sense to draw the line elsewhere.

### *Types of Generators*

Nearly all small wind turbines use alternators. Very few small wind turbines today use direct current generators. Alternators produce an alternating current, the voltage and frequency of which varies with wind speed.

Many small wind turbines use alternators to generate variable-frequency alternating current that is rectified to direct current for charging batteries at off-the-grid sites. Small wind turbines are designed to provide a variety of voltages for various battery charging applications: 12, 24, 48, and 120 volts. In some applications, such as remote water pumping, variable-frequency alternating current is used to directly drive a motor at variable speed.

Some small wind turbines use electronic inverters in conjunction with alternators for producing constant-frequency, utility-compatible alternating current. These wind turbines deliver 120 or 240 volt, single- or three-phase alternating current at 60 hertz for residential or small commercial applications.

There are a few small wind turbines that use induction generators. These wind turbines generate 240 volts, single- or three-phase alternating current at 60 hertz directly. They have no need for electronic inverters. These

wind turbines are designed for residential and small commercial applications, though some have been used in larger wind farms.

Most large wind turbines use induction generators and produce utility-compatible electricity directly. These wind turbines produce 480 volt, three-phase alternating current at a steady 60 hertz (in North America), which is suitable for supplying a utility with electricity or for meeting the electrical loads at homes, farms, and businesses. Some medium-sized wind turbines use specially designed large-diameter ring generators. Induction generators are similar to the induction motors found in many large appliances such as blowers, pumps, and washing machines. These alternators require the use of large electronic inverters to produce electricity compatible with that from the electric utility. Like their counterparts with induction generators, these wind turbines deliver 480-690 volt, alternating current at 60 hertz.

There are two types of small and large wind turbines suitable for producing utility-compatible energy: (1) those that use induction generators and (2) those that use alternators in conjunction with inverters. Regardless of which is used, the interconnection with the utility is the same. Cable from the wind turbine's control box connects it to the service entrance side of the utility's transformer. In effect, the wind turbine becomes a part of a home or business electrical circuit not unlike that of an electric stove.

### **Wind as a Commodity**

Landowners can use wind energy in several different ways. They can install a wind turbine to offset their domestic or commercial electrical consumption, sell electricity to the utility company, or both. Landowners can also lease land to a wind developer for a royalty payment. The best form of participation

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depends on a number of factors, including the degree of risk the landowner is willing to assume and the resources he or she wishes to invest.

### *Domestic and Commercial Consumption*

Normally, electric utilities will build a power line almost anywhere if someone will pay for it; however, those more than one mile from an existing utility service may find it cheaper to install an independent energy system for their domestic or commercial use. Whether installing an independent energy system is more economic than utility power depends upon the size of the electrical load, the utility's policy toward new service connections, and the distance from existing lines.

For some parts of the country, heating comprises most of a home's energy demand. In many areas, there is a strong correlation between the availability of wind energy and the demand for heat. It is not surprising that there have been numerous attempts to use wind machines solely for heating. Experience has shown that it is more cost-effective to produce a high-grade form of electricity that can be used for all purposes, including home heating if desired, than to build a wind turbine that can be used only for one function.

Wind machines continue to be important for pumping water in the United States and in developing countries. The American farm windmill, which dependably pumps low volumes of water from shallow wells, is still extensively used for watering remote stock tanks in the western United States. There are probably more than a million of these wind pumps still in use around the world today.

### *Selling Electricity*

Electricity generated by a wind turbine is most often sold to a utility. Unless a landowner is installing a stand-alone turbine for a remote

location, the machine will be connected with the local utility. This interconnection gives the landowner a chance to sell electricity to the utility; interconnection cannot occur, however, until some technical and financial issues are resolved with the utility. Landowners should discuss any special switches, transformer, insurance, or metering requirements well in advance with the utility.

In one form of interconnection, the wind turbine is wired to the consumer's residential electrical service. When the wind is blowing, the wind turbine produces electricity that flows to the service panel. From there it seeks out those circuits where electricity is being consumed. When the wind machine can't deliver as much energy as needed, the utility makes up the difference. If electricity is not being used when the wind machine is operating (or is being used at a rate less than the amount it is generating), the excess flows from a service panel through the electric meter out to the utility's lines. Sometimes the utility will install a second kilowatt-hour meter to measure the amount of electricity fed back into the utility system. This is only one of several different ways of interconnecting wind turbines with the electrical network and is most applicable for small wind turbines.

The rates paid by a local utility for buyback of electricity generated by a wind machine differ, but generally are in the range of \$0.02 or \$0.03/kWh. Tax credits or some of the other financial incentives available in Illinois may apply, however, increasing the return. (Read more about incentives in Chapter 5.) Under the right conditions, a utility will pay a fair price for electricity sold back to it. If so, it might be profitable to install a large wind turbine or multiple large wind turbines and sell as much energy to the utility as possible. This is farming the wind for profit.

There are several key factors in determining the cost-effectiveness of a wind turbine. One

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of the most important factors is the cost to buy, install, and operate the wind turbine. Another is the amount of energy the wind turbine will produce at a particular site. The third critical factor is the value of the energy that the wind turbine will produce. If the value is high, then more can be paid for the wind turbine or a slightly less windy site can be used. If the price paid for wind-generated electricity is low, as is the current situation in much of Illinois, then the cost of the wind turbine must be low, the turbine installed must be at an especially windy site, or you must make good use of grants and/or other financial incentives available for wind energy.

### **Options for Landowners**

There are three major ways to invest in wind energy: (1) individual ownership, (2) joint investment, and (3) leasing land and wind rights. Each type of investment has different associated financial risks. Individual ownership is the most risky, while leasing land and wind rights offer the lowest financial risks to the landowner.

#### *Individual Ownership*

All too often, landowners look only at a wind turbine's initial cost. They contrast this with what they are accustomed to paying for their utility and throw up their hands in despair. "The wind may be free," they might be overheard saying, "but it sure costs a lot to catch it." They're right. The revenue a turbine earns from utility sales, however, or the money it saves can make the investment worthwhile. For an individual landowner, a small turbine might be a less daunting investment; however, individual ownership of large turbines is not necessarily out of reach.

#### *Joint Investment*

Cooperatives or investor pools offer the landowner the opportunity to participate

as an equity investor while sharing the risk with others. The landowner may provide the land at fair market value or the land and/or a cash payment as the equity contribution to a multiparty venture such as a cooperative or a limited liability corporation. This model is becoming popular in the Midwest, especially in Minnesota. (See Case Study #6 in Part IV of this handbook.)

Joint investment offers landowners a means for improving the economics of wind energy in two ways: (1) through selling jointly and (2) through buying cooperatively. First, it enables the landowner to buy the most cost-effective wind turbine regardless of the size the landowner alone can afford. Today, the most cost-effective wind turbines may cost one million dollars or more, a sum many may not be able to invest on their own. Second, joint purchases enable several landowners, with or without additional participants, to pool their buying power when negotiating with wind turbine manufacturers.

#### *Leased Land*

Perhaps the least risky option is to lease the land to a wind developer. The wind company then assumes most of the risk. Under lease arrangements, landowners usually receive either a percentage (usually 1-4%) of gross revenues from the sale of electricity or an annual fixed payment (usually \$3,000-\$4,000 per MW installed, depending on the type of turbine and the amount of land used). The royalty may be a fixed amount or on a sliding scale with a lower amount in the early years and a higher amount after the project's debt has been repaid.

Lease terms vary widely. Some wind projects lease land "in perpetuity." Forever is a long time and leases "in perpetuity" can diminish the value of land. Most leases are granted for a period of 20-30 years.

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Leasing is not without its share of risk—principally, that the wind company will deliver on its promises to build the project when they say they will, with the number of turbines they say they will use, and that they will produce the amount of electricity they plan.

### **Distributed vs. Wind Power Plant**

The dispersed, or distributed, model of wind energy development represents a decentralized alternative to the utility-scale wind plant model. Instead of concentrating large arrays of turbines at one location, single turbines or smaller clusters are used to serve a local electricity load.

The distributed wind model may offer other advantages and disadvantages. Electricity from smaller, dispersed projects potentially can be easily assimilated by the existing transmission system. Existing lines could handle the incremental power contributed by the dispersed turbines. Additionally, there may be rural economic advantages to dispersed wind models since there is potential for keeping energy dollars in local communities, providing local jobs, and encouraging ownership by local landowners.

Among the possible disadvantages are a higher proportion of total costs spent for operation and maintenance (interconnection and safety equipment requirements are the same whether the projects are large or small), greater difficulty in finding parts, and lack of access to volume discounts.

### **The Challenges of Harnessing Wind for Energy**

Like any other crop, wind energy is profitable only when the revenues from its sale exceed the costs for planting, tilling, and harvesting. The cost of wind-generated electricity has been declining steadily since the early 1980s. By the mid-1990s, costs had declined nearly

tenfold, from about 50¢/kWh in 1980 to about 5-6¢/kWh. Today, costs are estimated to be 3-5¢/kWh or even lower at the best wind sites. These costs are competitive with or cheaper than any other form of new electricity generation; however, many utilities in Illinois will pay only in the range of 2¢/kWh for wind-generated electricity. The reasons why they pay so little for such a valuable commodity are complex and will be discussed throughout this handbook.

Large-scale development of wind energy is also dependent on the availability of power lines to transport the electricity to load centers if it cannot be used locally. This presents a challenge for wind energy because most of the country's best wind resource areas are in rural regions that have little need for large amounts of new electricity generation. The current transmission infrastructure is not really built to accommodate moving large amounts of electricity from rural windy areas. Upgrading the transmission system can be a slow, expensive, and contentious process, and alternative technologies for storing or transporting wind power (such as hydrogen or compressed air storage) might be years away from commercial viability. The need to develop new technologies and modernize the transmission system is widely recognized, however, and there are many efforts underway to improve the situation.

### *The Electric Utility Industry*

In the mid- and late-1990s, the electric utility industry was in the throes of its greatest upheaval since the 1920s with so-called restructuring and deregulation being done. In most cases, this has meant the introduction of some level of competition and customer choice as well as the loosening of various rules for utility operations. As of 2003, 17 states, including Illinois, have restructured their electricity markets. Six other states have passed restructuring legislation, but have delayed or

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suspended implementation for various reasons, including competition not establishing itself and concern over events in California in 2000 and 2001. The California deregulation legislation, in combination with other factors during that time, proved nothing short of a disaster with power shortages and skyrocketing electricity rates. The California energy crisis cooled the fervor for electricity market deregulation in many states, but the impact of changes already implemented continues to have far-reaching repercussions for the energy sector. Some of these changes prove beneficial to those who want to harvest the wind and sell it to electric utilities.

Some argue that in markets with consumer choice opportunities, utilities will be driven to compete on value and not solely on price. Proponents of this view suggest that utilities may want to add wind energy to their generating mix as a means of selling “green” electricity to their customers. A small portion of green electricity (e.g., from wind energy) could aid these utilities in distinguishing themselves in a crowded and highly contested market from their competitors who might be selling “brown” electricity from only conventional sources. For example, in 2001, ComEd won a bid for 50 MW of renewable energy from the City of Chicago. ComEd will begin buying electricity from the 50.4 MW Mendota Hills Wind Farm by the end of 2003.

By wrapping themselves in a green mantle, these utilities could either charge more for their electricity than their competitors or perhaps profit by the perception that their electricity is more valuable. In turn, the green utilities could pass along some of this increased value to the independent energy producers from whom they buy their electricity. In other words, under this scenario, utilities could be willing to pay more for wind-generated electricity than they do today, making wind development a profitable pursuit.

This approach has been used by utilities in some states and, in the absence of stronger policy incentives for renewable energy, green pricing does seem to be an effective tool for spurring some renewable energy development. Today, there are only two green power marketing programs in operation in Illinois: (1) EcoPower from the Environmental Resources Trust/ComEd and (2) the St. Charles Green Power Program. EcoPower is a wholesale renewable energy certificate program for retail electric suppliers, utilities, and other marketers. These groups can purchase certificates that represent the environmental benefits of electricity produced from renewable resources and the sales will, in part, go toward new renewable energy installations in Illinois. Currently, the EcoPower portfolio only includes landfill gas-generated electricity, but ComEd has said that they plan to include other renewable resources, such as wind, in the future. The St. Charles program, launched in September 2003, is a partnership of the City of St. Charles municipal utility, ComEd, and wind marketer Community Energy Inc. to offer commercial and residential customers the option of supporting renewable energy development. Currently this program is also based on landfill gas energy, but will incorporate wind as it becomes available.

Renewable energy advocates also are proposing that a portion of all electricity generation be set aside for renewable sources such as wind energy. Thirteen states have some version of a renewable portfolio standard (RPS), and the evidence suggests that a well-constructed RPS triggers far more renewable energy development than green pricing programs.

#### *Land Use Compatibility*

Wind turbines are compatible with most land uses, with the exception of wilderness reserves. Wind turbines are compatible with residential, commercial, and agricultural land uses. It is not necessary to install wind turbines in the

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immediate vicinity of the load (e.g., a home, business, or farm building). To best capture the wind, it is preferable to site turbines some distance from buildings and trees. This also facilitates building and maintenance. Because tall structures may shed ice in the winter, it is best not to install wind turbines in the midst of parking lots or playgrounds. Placing the turbine near pedestrians is acceptable if common sense precautions are taken. It is not uncommon for public footpaths to pass within yards of wind turbines in Europe.

**Environmental Considerations.** No form of energy, including wind energy, can be generated without some environmental concerns. The environmental issues associated with wind energy are quite small when compared to conventional generation technologies, such as coal, oil, or nuclear power, but still can be problematic. In general, careful attention to the siting of turbines will greatly minimize environmental problems. Some potential environmental issues to consider when installing a wind turbine are the noise the machine makes, the appearance of the wind turbine on the landscape, and the impact the wind turbine may have on birds and other wildlife. As might be expected, these issues are more serious when attempting to site turbines in environmentally sensitive, scenic, or heavily populated areas. (All the topics outlined below and more are covered in more depth in Chapter 3).

**Aesthetics.** Turbines are placed on high points that are exposed to the wind, often where they are readily visible. People have a wide range of reactions to wind systems. It depends on their distance and perspective, turbine design, color, motion, personal attitude, and how they fit into the landscape. If the project is visible to others, aesthetics is likely to be a concern that needs to be evaluated. That said, most rural midwestern communities have welcomed wind turbines as part of their working landscape. More aesthetic objections have been raised to

projects planned for mountain ridgelines or offshore from resort communities.

**Noise.** Most sound generated by modern wind turbines will be masked by the background noise of the wind. Wind systems can generate sound in several ways: air passing over the blades and blade tips, turbulence from air passing the tower before hitting the blades, yaw motors and hydraulic pumps running, gears turning, brakes activating, and cooling fans running. Aerodynamic sound (the “swooshing” sound of blades cutting through the air) is the most commonly heard noise from wind turbines, while modern designs have minimized mechanical and electronic noise. At very low wind speeds, noise is not an issue because the turbine will be stationary or turning slowly (but, not generating power). At high wind speeds, the turbine sounds will be almost completely lost in the background noise. Turbine noise will be most apparent at medium wind speeds, when the turbine is generating power and the background wind noise is only moderate. Even under these conditions, turbines will only be audible to people in the immediate vicinity.

**Flora and Fauna Impacts.** Wind turbines have little or no impact on most plants and animals, but there have been some high-profile problems at a handful of project sites. Most notable have been the bird kills in the Altamont Pass in California and near the straits of Gibraltar in Spain. No single environmental issue has caused more alarm among wind energy advocates and environmentalists alike than the existing or potential effect wind turbines have on birds. It is the kind of “hot button” issue that elicits strong emotional responses. That some wind turbines hurt birds some of the time should come as no surprise. Most tall structures impact birds to some degree, as do most power plants. This issue, like all others, must be considered in context. There have been extensive studies of wildlife and avian

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impacts conducted by the National Wind Coordinating Committee that have resulted in changes in standards and practices in wind siting (available at [www.nationalwind.org](http://www.nationalwind.org)). These new practices have greatly reduced the risk wind turbines pose to birds. (See Chapter 3 for more information on this topic.)

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## The Energy Industry

### Electricity and the Electric Grid

Electricity generated by wind turbines will run clocks, stereos, refrigerators, or lights. It will run farm mills or feeders. In short, wind-generated electricity can be used wherever utility power is presently used. All large wind turbines and some small wind turbines generate electricity identical to that supplied by the electric utility: constant-voltage, constant-frequency alternating current. With passage of the Public Utility Regulatory Policies Act (PURPA) in 1978, homeowners and businesses in the United States have been permitted to connect these wind turbines with the utility network.

Most small turbines are connected to the residence and the utility grid through the distribution system. Any electricity produced and not used by the residence is surplus and is sold to the utility. In many states, the value of this surplus generation is banked by the utility in an arrangement called net metering or sometimes net billing. The utility balances the customer's account monthly or annually by offsetting purchases with deliveries of surplus generation. Customers benefit from this arrangement because they receive higher value for more of the electricity they generate. Net metering programs vary in how net excess generation (NEG) is treated. (If a customer generated 500 kWh in a month, but only used 450 kWh, the NEG would be 50 kWh.) Most net metering programs require utilities to purchase NEG at their avoided cost rate (which is typically low), but Minnesota and Wisconsin require utilities to pay customers retail rates for their NEG. In Illinois, net metering is only available in ComEd's service territory and its use of net is limited to wind turbines of less than 40 kW. Elsewhere in Illinois, and in other states without net metering rules, customers are entitled to sell their excess electricity to utilities at the

avoided cost rate but cannot "bank" that energy to offset their own consumption. In places without net metering rules, small wind turbines will probably only be economical in a situation where the customer's energy use very closely matches the turbine's energy output.

Small clusters or single large wind turbines may be interconnected with the utility's low-voltage distribution system, depending upon the number of turbines and their size. Often, this requires installation of transformers and special metering by the utility. Unfortunately, most large wind turbines produce a three-phase alternating current and most distribution systems in rural areas are only single-phase. This presents special problems that may require construction of a three-phase distribution line. The best sites for wind projects are located near existing three-phase distribution lines.

Large arrays or wind energy plants require interconnection with the local utility's high-voltage transmission system. Wind plants require the installation of transformers among the wind turbines, a high-voltage substation, a separate switch-yard, and special metering.

Small wind turbines are well-suited for remote applications where utility power does not exist or in areas where it is limited or extremely expensive. In such locales, the value of the service provided by the small wind turbine is high, justifying the turbine's initial cost and the cost of maintenance. Where wind-generated electricity must compete with low-cost, utility-supplied electricity in applications interconnected with the utility grid, small wind turbines often do not provide a good return on investment.

The economic competitiveness of wind turbines with conventional forms of generation tends to increase with larger turbines and

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larger wind farms. For uses where the wind turbine is interconnected with the utility network and must compete with utility-supplied electricity, large wind turbines are more cost effective than small wind turbines, despite requiring much larger upfront investments.

### **Characteristics of Electricity**

We all use electricity, but it has qualities with which we may not be familiar, qualities that are important when siting a wind turbine or a wind power plant.

Electricity travels at the speed of light. When considering a regional transmission system, it can, for practical purposes, be considered to flow instantaneously. Electricity flows with a specified “force” or potential, measured in volts, forcing a quantity of electrons to flow, creating a current measured in amps. Electricity must be generated at the same time that it is used. To meet the instantaneous load on the system, utilities must increase or decrease the output of their power plants throughout the day as the load changes. Since power plants cannot be started instantaneously, utilities maintain what they call “spinning reserve” generators, turning but not generating electricity that can be brought on-line quickly to match the increasing load.

The power output of a wind generator changes with the speed of the wind, which varies throughout the day. Therefore, a wind generator connected to the distribution system affects the utility in much the same way as variations in the load. A change in the output from a wind generator requires the power plant to inversely change its power output. The utility sees only the instantaneous net total of the system load and the dispersed generation. It does not distinguish the variation in a wind generator’s output from changes in the load on the system.

Since the utility system is designed to follow changing loads, it can similarly accommodate changing power output from an intermittent technology like wind. If a large portion of the power is generated by wind energy, however, the variations in the power generated may overshadow the utility’s ability to follow net demand, and the quality of power may suffer.

The maximum acceptable contribution from wind energy in a utility’s generation mix depends on many factors: type of base load generation, type of peaking plants, type of spinning reserve, location of the wind generation on the distribution system, etc.; however, most utility planners expect that utility systems can accommodate from 10-20 percent or more of their electricity from wind energy before other strategies to handle the power fluctuations will need to be implemented. Electricity demand constantly fluctuates, meaning a number of generating plants must move on- and off-line throughout the day to meet the shifting demand. At any given time only about 15 percent of generation is consciously being dispatched to meet changes in load. In that scenario, the variability of wind at low penetration levels (where wind is providing less than 10-20% of total generating capacity) would be lost in the greater variability of the system. Illinois would need thousands of megawatts of wind energy capacity in order for wind to represent 10 percent of the state’s total generation capacity. With only 50.4 MW of wind planned to be installed in Illinois by the end of 2003, it will likely be some time before the variability of wind has any impact on the state’s electricity system.

Utilities must plan to supply all the power demand on their system during peak load conditions. For a winter-peaking utility, that might be in the evening during a cold snap. A summer-peaking utility will probably reach its peak demand during a hot afternoon when the air conditioning load is at a maximum. While

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the utilities supply electricity throughout the year, their cost of electricity is at a maximum during their peak periods. The “value” of wind energy to the utility is closely related to the utility’s peak demand profile. A wind turbine may be quite valuable to a utility whose peak load occurs on a cold, blustery night. In contrast, the turbine may contribute very little to meet a peak demand during a sultry, calm summer afternoon. In reality, a wind turbine in Illinois can be counted on to produce at least some electricity about 80 percent of the time. Given these conditions, a utility might choose to build these factors into a negotiated power purchase contract. In that case, it will pay a flat rate for electricity produced by the wind system, regardless of whether it was produced during the utility’s peak

### **For Further Reference . . .**

#### *Technology*

For a tutorial on how wind turbines work, visit the National Wind Technology Center’s website: <[www.nrel.gov/wind](http://www.nrel.gov/wind)>.

Take a guided tour or read the Danish Wind Energy Association’s *Wind Energy Manual* at <[www.windpower.org](http://www.windpower.org)>.

Wind industry standards and technical information from the American Wind Energy Association can be found at <[www.awea.org/standards/index.html](http://www.awea.org/standards/index.html)>.

#### *Wind Power Research and Development*

Proposed Compressed Air Storage Facility in Iowa: [www.idea.iastate.edu/isep/index.asp](http://www.idea.iastate.edu/isep/index.asp)

National Renewable Energy Laboratory:  
[www.nrel.gov](http://www.nrel.gov)

#### *Transmission*

Information on transmission for wind power in the upper Midwest is available in *Wind on the Wires*: <[www.windonthewires.org](http://www.windonthewires.org)>.

National Wind Coordinating  
Committee’s transmission publications:  
[www.nationalwind.org/pubs/default.htm](http://www.nationalwind.org/pubs/default.htm)

#### *Wind Energy Development Status*

American Wind Energy Association’s Wind  
Project Database: [www.awea.org/projects/  
index.html](http://www.awea.org/projects/index.html)

- World Wind Energy Association:  
[www.wwindea.org](http://www.wwindea.org)
- European Wind Energy Association:  
[www.ewea.org](http://www.ewea.org)
- Windustry Wind Turbine Sites Database  
(best for locating small turbines):  
[www.windustry.org/sites/](http://www.windustry.org/sites/)
- *Wind Power Monthly’s* Windicator:  
[www.windpower-monthly.com/windicator](http://www.windpower-monthly.com/windicator)

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## **Part II. The Value of Wind**

Wind energy can be a lucrative investment for landowners, communities, businesses, or utilities. The keys to a successful wind project are choosing a good site to place the wind turbines and financing the project in a favorable way. The chapters in Part II. The Value of Wind outline (1) factors that determine what makes a good wind site such as wind resource, access to power lines, zoning ordinances, environmental concerns, etc., and (2) factors that determine whether a project is financially feasible such as costs, financial incentives, markets for wind-generated electricity, and possible business structure options.



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## Chapter 2. Know Your Wind: A Guide to Assessing Wind Resources for Landowners and Prospective Wind Project Developers

This chapter is intended to guide prospective wind farm developers through the process of site assessment. It provides practical information on how to develop reliable estimates of the wind resource and electricity production at a given site. This includes information on how to measure wind speeds and direction; how to qualify your land's potential for wind projects; how certain variables affect wind production costs and return on investment; what information is typically needed by banks and investors to finance a project; and where to look for additional information

### Acknowledgments

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### Overview of Wind Resource

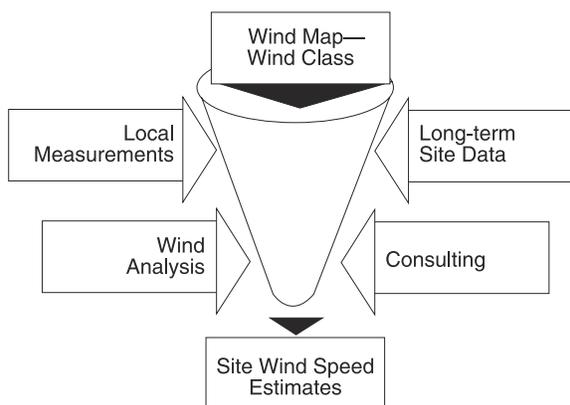
#### *Wind Resource Information Funnel*

Primary questions that anyone considering a wind project must answer are “How strong are the winds at my site?” and “How much energy will my prospective wind turbine produce in these winds?” In this report, we will guide potential developers through the steps necessary to estimate the wind resources at their sites. These refinements are produced by examining data from local, short-term measurement sites and regional, long-term records; analyzing factors relevant to wind resources like site exposure and wind roses (also known as speed and direction distributions); and getting consulting support. The wind resource data generated can be used during the funneling process.

The rough estimates at the beginning of the process are used to conduct a preliminary

assessment of the feasibility of a wind project in order to determine whether further consideration of wind energy is warranted. The

**Figure 1. Wind Resources**



You might think of the wind assessment process as a funnel where rough estimates of wind power class from wind maps go in one end and more refined and precise estimates of site-specific wind speed come out the other end.

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more refined estimates in the middle of the process can support your calculations of the cost and income potential from a wind project. The best estimates of site-specific wind speed can support a cash flow analysis of a wind energy investment, an investment prospectus for potential partners, and a loan application to a lender.

The wind resource powering a wind project is as fundamental to the project's success as rainfall is to alfalfa production. The objective of this chapter is to provide a concise body of wind resource data and information that will support the needs of wind trainers and potential wind project developers. Furthermore, we provide suggestions for how would-be project developers can use the data presented to perform a variety of critical assessments of their wind energy investment opportunities and how they might go about acquiring additional information that will increase the reliability of their assessments or increase their understanding of the specific wind resources available at their sites of interest. The material is presented in a logical manner designed to allow you to quickly make the determination of whether or not wind projects are worth your detailed consideration.

The wind speed data for a site is critical to both the investor and the lender for a project. The investor must evaluate the long-term energy production and economic performance of the project to be assured that it generates an acceptable rate of return. The lender needs assurance that the revenues generated by the project month-to-month and year-to-year will be sufficient to cover the payment on any loan that is made. The project performance on the average is important to the investor, while project performance during poor wind months or years are important to the lender.

\* If your estimate of wind speed is 110 percent of actual, then your estimate of wind energy production is 133 percent higher than actual; therefore, your actual energy production will be approximately 67 percent of your estimates.

### *Impacts on a Wind Project*

The power in the wind is the fundamental determinant of wind project success. Wind energy production from a particular wind turbine changes in proportion to approximately the cube of the wind speed. For this reason, if you overestimate the wind speed at your site by 10 percent, you are overestimating wind energy production from your project by 33 percent.\* In more concrete terms, if you expect and need \$10,000 of revenue per year to pay off your loan and earn some profit, you would only earn \$6,700. At the very least, there goes your profit; at worst . . . .

Fortunately, by developing a thorough understanding of the factors that influence the wind resource at a particular site-exposure, obstacles, height above the ground, etc.-you can include the inevitable uncertainties in your decisionmaking process and take action to get the most cost-effective performance from any project that you choose to develop.

### **Assessing Your Wind Resource**

#### *Wind Speed and Project Value: The Critical Unknown*

Just as good land is fundamental to successful farming, a good wind resource is essential to successful wind project development. Different locations across a state, county, or section are likely to "possess" different wind resources. As a prospective wind project developer, one of your first priorities needs to be developing reliable estimates of the wind resources on the land that you control. Although wind data is not as readily available or as well understood as soil data, there is a reasonable and growing

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compilation of data that you can draw on to make this important determination.

In many states, public entities, usually state governments, have been collecting measurements of wind speed and direction, air temperature, and pressure data at prominent locations for a number of years. The U.S. Department of Energy's Wind Program and the National Renewable Energy Laboratory (NREL) in Golden, Colorado, have also been involved in this effort, including the production of a wind resource map for Illinois. The number and sophistication of these measurements, as well as their usefulness in meeting the needs of a wind project developer, vary from county to county and from state to state.

The odds are that the existing measurement sites are not on or even near your property, so you will need to do some research to develop estimates of your wind resource that will satisfy yourself and your banker. The following sections will help you develop these estimates and give you suggestions on how to improve the reliability of the estimates, thus increasing your confidence in the rest of the analysis of a wind development opportunity.

The ideal wind project assessment data set would be a decade long set of measurements of wind speed and direction along with air temperature and pressure taken above, below, and at the exact height above the ground as the hub of the chosen wind turbine. Such a data set would allow you to estimate the energy production of a wind turbine at that site and to describe the variability in energy production, and, ultimately, revenue production, that you could expect from month-to-month and year-to-year and to do so with high reliability. The wind resource assessment process described in this chapter is designed to allow you to take the less than ideal data that you are likely to have and develop reasonable and clearly explained

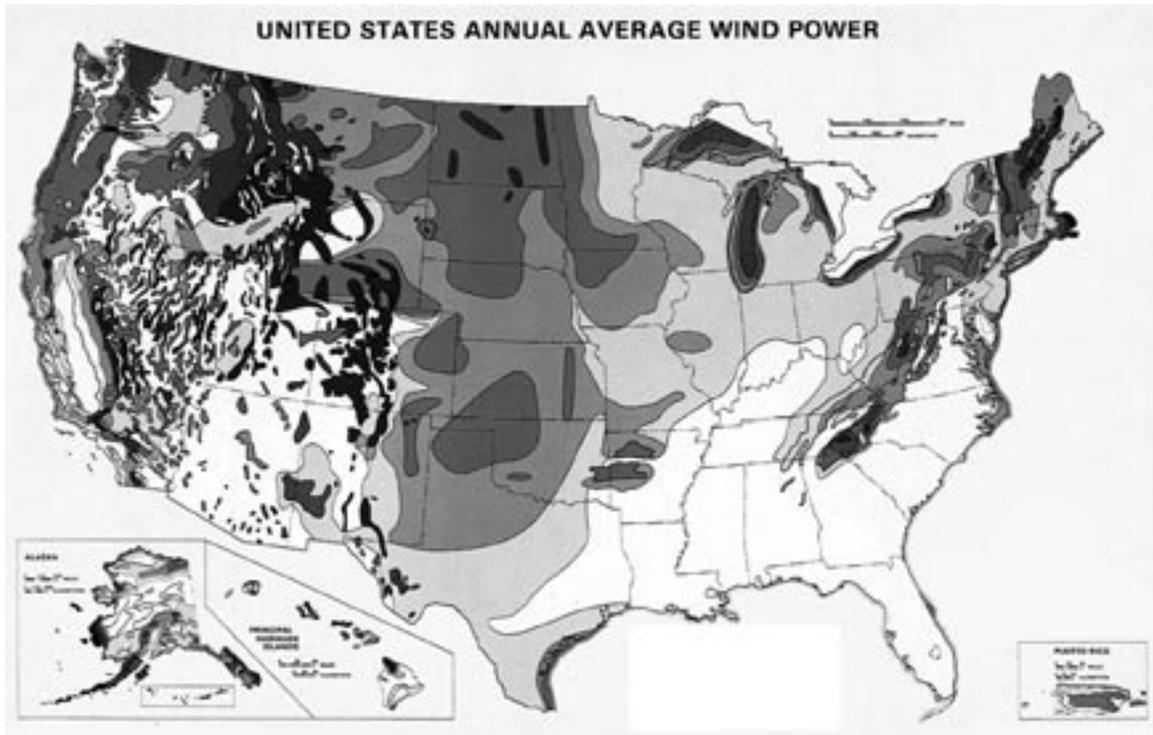
estimates of all the wind parameters of interest. For example, if you have data for one or two years from a nearby measurement site, you need to determine what the long-term average wind year and "poor" wind years might look like. Alternatively, if you have long-term measurements taken 10 feet above the ground, you need to estimate how much faster the wind blows at 200 feet (wind turbine hub height) above the ground. Reliable and proven techniques are readily available to make the kinds of estimates that might be required, so don't despair.

*Is the Wind Resource in My Area Sufficient to Warrant Serious Consideration of a Wind Project?*

**Using Existing Wind Maps to Estimate Wind Resource.** Research performed and measurements taken over the last 30 years have shown that wind resources vary considerably throughout the Midwest and that some areas are just not appropriate for wind development at the current time. This information has been condensed into a number of wind resource maps or atlases, which can give you a quick but general sense of the wind resource in your area. The oldest of these wind maps was produced by Battelle Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy in the early 1980s (see Figure 2). For some parts of the country, this assessment remains the best indicator of wind resource potential. As you can see from the map, wind resources appear to be highest (Wind Class 4) in the northwest and western parts of the Midwest, declining to Class 3 in the central part of the region and ultimately to Class 2 in the eastern part of the Midwest. Wind power class is defined as a range of wind power densities (in watts per square meter of swept rotor area, or area perpendicular to wind flow), at a given height above the ground.

The zones of transition between the most promising wind areas and those with less

**Figure 2. United State Annual Average Wind Power**



Wind Power Class	Density at 10m (33 ft) W/m <sup>2</sup>	Speed at 10m (33 ft)		Density at 50m (164 ft) W/m <sup>2</sup>	Speed at 50m (164 ft)	
		m/s	mph		m/s	mph
1	0-100	0-4.4	0-9.8	0-200	0-5.6	0-12.5
2	100-150	4.4-5.1	9.8-11.5	200-300	5.6-6.4	12.5-14.3
3	150-200	5.1-5.6	11.5-12.5	300-400	6.4-7.0	14.3-15.7
4	200-250	5.6-6.0	12.5-13.4	400-500	7.0-7.5	15.7-16.8
5-7	250-1,000	6.0-9.4	13.4-21.1	500-2,000	7.5-11.9	16.8-26.6

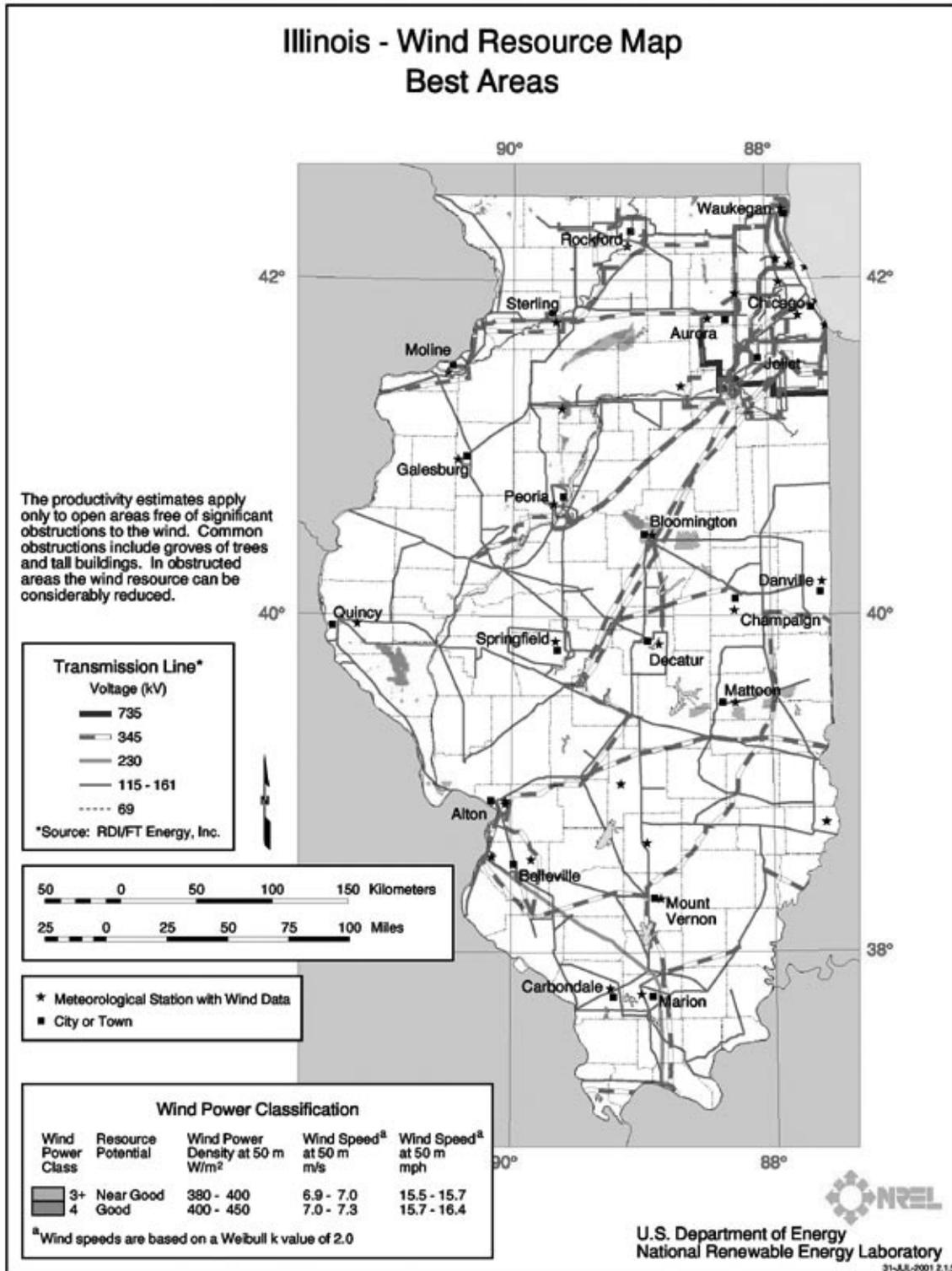
Source: Pacific Northwest Laboratory (1997)

promise occur quite abruptly in parts of the Midwest, making the task for a project developer in this region quite challenging. Fortunately, there are newer and more refined estimates of wind resources available in many states, which can give developers additional guidance regarding the wind resources in this area. In 2002, the Department of Energy’s Wind Program and NREL produced new wind resource maps for Illinois (Figures 3 and 4). The new map shows that Illinois has at least 3,000 MW more in potential wind capacity from “good” wind resource areas than was earlier estimated in the national study. There are scattered areas of good wind resource (Class 4, or 15.7-16.8 mph at 50 m) in central

and northern Illinois with at least five prime wind zones identified: (1) SE of Quincy, (2) the Bloomington area, (3) north of Peoria, (4) the Mattoon area, and (5) between Sterling and Aurora, as well as other potential sites, especially in northern Illinois.

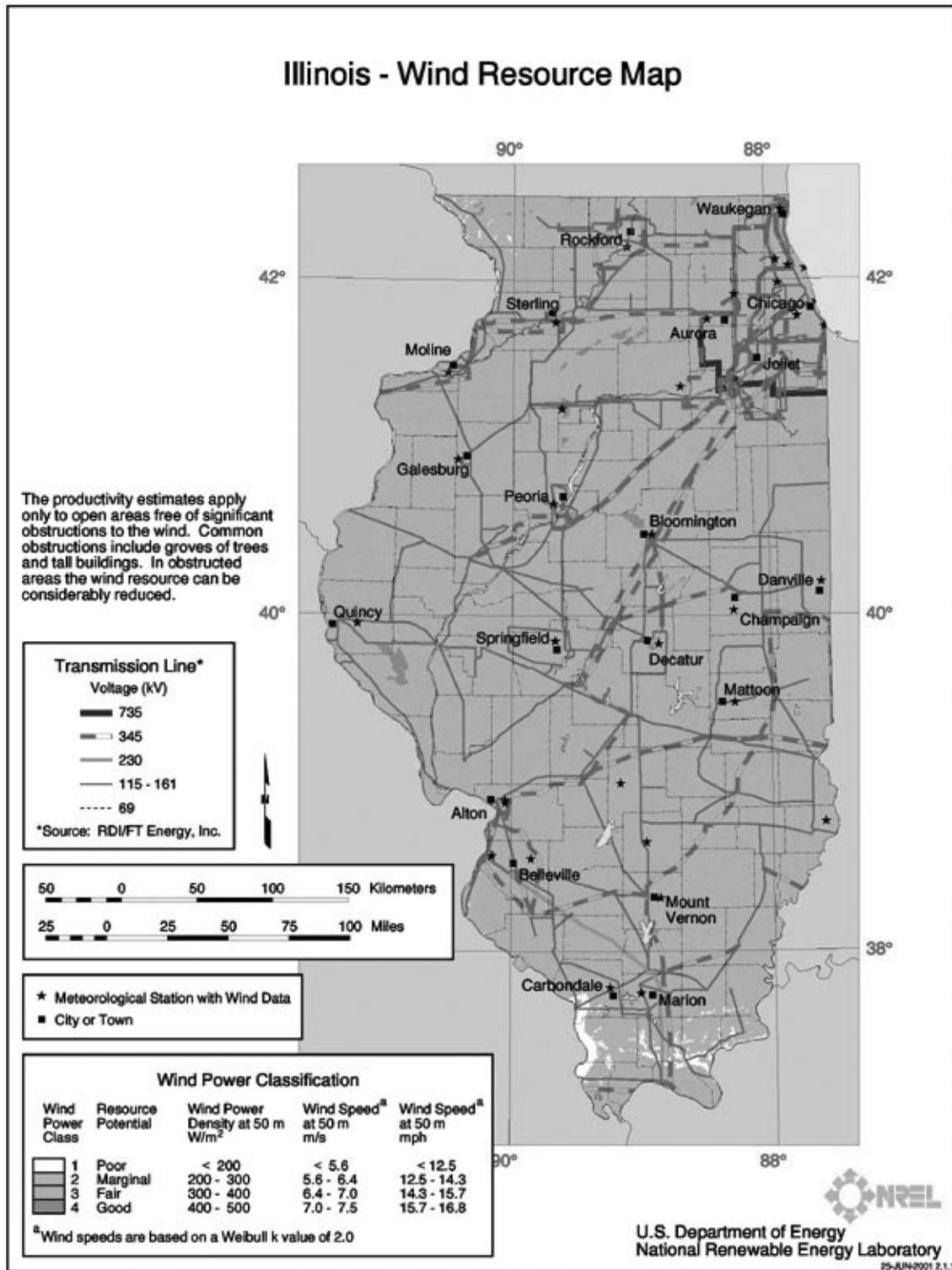
The maps are presented in two formats. Both formats show the wind resource, using NREL’s standard wind power classification system, in relation to transmission lines and major cities. Figure 3 shows the wind resource at all levels throughout the state, and Figure 4 highlights the best areas suitable for utility-scale wind energy development. The potential in these windy lands is about 3,000 MW of installed

Figure 3. Illinois – Wind Resource Map, Best Areas



Sources: U.S. Department of Energy and the National Renewable Energy Laboratory

Figure 4. Illinois – Wind Resource Map



Sources: U.S. Department of Energy and the National Renewable Energy Laboratory

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wind generation capacity. In a Class 4 wind regime, the annual average output of a wind power plant is typically about 25 percent of the installed capacity. The Class 4 areas represent about 0.4 percent of Illinois' land and are largely rural agricultural areas.

Due to likely advances in technology and the significant incentives available in Illinois, a number of additional areas with only slightly lower wind resource (Class 3+, or 14.3-15.7 mph at 50 m) may also be suitable for wind development. These Class 3+ areas highlighted on the map of best areas represent an additional 6,000 MW of wind potential. The closer your site is to these measurement locations, the more reliable your estimate of local wind resources will be. The total amount of Class 4 and Class 3+ lands combined is about 694 square miles or 444,554 acres (1,800 square kilometers; 1.2% of Illinois' land area), and the wind potential from these areas is about 9,000 MW. Each square mile may support about 10 MW of installed wind capacity. All urban and environmentally sensitive lands (e.g., state parks, wildlife refuges, etc.) have been excluded in estimating the wind potential.

You should locate your particular wind development site on this wind power map to obtain a rough estimate of the wind class for your project. If your land is Wind Class 4 or better on the map and your property is clear of trees and buildings in all directions and higher than its surroundings (i.e., one to two miles), then you are well-justified in looking further into wind project development. Conversely, if your area shows up as Wind Class 2 or less and your property is in a valley, surrounded by hills or tree covered, it is unlikely that a wind development on your site will be economical. If your area shows up as Class 3 on the map and is well exposed to the winds, you might have a viable wind project opportunity; however, you will need to invest extra resources in estimating the wind speeds at your site

(recommended for any project 10 kW and larger).

NREL produced these maps using an analytical and empirical computer mapping system and a variety of climate data sets. According to the previous information for Illinois (the 1987 *Wind Energy Resource Atlas of the United States* and the 1991 report, *An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States*), Illinois had essentially zero potential in Class 4 and above wind areas. The new information shows that Illinois has at least 3,000 MW more in potential wind capacity from good wind resource areas than earlier estimated.

**Qualifying Your Land's Potential for Wind Projects.** It is important to remember that the wind resource at a particular spot is strongly influenced by local terrain, vegetation cover, and manmade structures. Once you have a sense for the Wind Class in your local area, you should assess the exposure of your land to winds. Terrain features like valleys, bluffs, and nearby hills can block or disturb wind flow, reducing the winds that reach your property. Tree cover or buildings on or near your property are also likely to reduce wind flow (more on this later). Since you will ultimately have to connect your wind project to the utility distribution or transmission system or, for a small project, to your home or farm, you should also consider the proximity of existing utility lines to your property. The wind maps discussed earlier present wind resources in terms of wind power class. In order to develop estimates of the energy production and, ultimately, the economic benefits and costs of a wind investment, you need to translate your wind power class into a range of possible wind speeds. This wind speed range can then be used to calculate estimates for a wind turbine's production at a given location.

**Table 2. Conversions from Wind Power Class to Annual Average Wind Speed (NREL system)**

Wind Class	At 98 ft (30 m) Height		At 164 ft (50 m) Height	
	Power* (W/m <sup>2</sup> )	Speed (mph)	Power* (W/m <sup>2</sup> )	Speed (mph)
1	0-160	0-11.4	0-200	0-12.5
2	160-240	11.4-13.2	200-300	12.5-14.3
3	240-320	13.2-14.6	300-400	14.3-15.7
4	320-400	14.6-15.7	400-500	15.7-16.8
5	400-480	15.7-16.6	500-600	16.8-17.9
6	480-640	16.6-18.4	600-800	17.9-19.7
7	>640	>18.4	>800	>19.7

\* Wind power density is expressed in watts per square meter (W/m<sup>2</sup>) of swept area perpendicular to wind flow.

Table 2 shows the wind speed ranges at heights of 98 feet (30 meters) and 164 feet (50 meters) above the ground for each wind power class. Your wind investment should make economic sense when you assume wind speeds at the low end of the wind power class range. For example, if your site appears to be in Class 5, then the attendant annual average wind speeds at a height above the ground of 98 feet on your well-exposed site could range from as low as 15.7 mph to as high as 16.6 mph. In order to obtain a conservative, preliminary determination of the viability of a wind investment at your site, you should evaluate project economics at an average annual wind speed of 15.7 mph. It would be prudent to evaluate economics at a wind speed 10 percent or 1.6 mph lower (14.1 mph) just to understand what the impact of overestimating wind speeds can be. Evaluate project economics using wind speeds of 16.0 to 16.6, the upper half of the wind power class, only to get a sense for the potential upside of this investment. We are not doing you or wind energy development any favors by overestimating the available wind resource.

The power shown in Table 2 is in watts per square meter of rotor swept area. This means a turbine with a blade diameter of 23 feet

(10 kW Bergey, for example) has a swept area equal to the area of the circle it rotates within, 415 ft<sup>2</sup> or 38.6 meters<sup>2</sup> (area =  $\pi * dia^2 / 4$ ). Thus, in a Class 3 area, with turbine mounted at 98 feet above the ground, you calculate the available power of the wind as 240 W/m<sup>2</sup> \* 38.6 m<sup>2</sup> = 9273 Watts. That theoretical power in the wind can usually be captured into electricity by a turbine (with 5-35 ft rotors) at approximately 20 percent efficiency. (Larger turbines operate at 25-28% efficiency.) If the turbine ran all year (8,760 hours), you would produce 17,520 kilowatt-hours of electricity. The Bergey spreadsheet calculator, available online at <www.bergey.com>, estimates a similar 17,337 kilowatt-hours per year for this turbine, which helps validate the use of the above table to get a rough estimate of expected power from a site.

**Collecting Wind Resource Information from Nearby Sites.** Wind class information from wind maps is most useful in making a preliminary determination of the viability of your wind project. Once you convince yourself—based on wind map estimates—that you might go forward, you should then scour your area for good quality wind measurement information. One of the simplest and least costly ways to begin improving your estimate

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of the wind resources at your location is to collect information from nearby sites where wind resource measurements have been taken. If you choose to have a consultant conduct this work for you, the following sections should assist you in defining the consultant's scope of work and evaluating the quality and reliability of the results. Table 3 provides a checklist of the data that you should try to acquire.

Once you have found wind measurement data from a nearby area, you need to determine if the data sets are valid and reliable and whether they are at least somewhat representative of your site. In general, if the measurement system accurately collected wind data 80 percent or more of the time and if the site is located on well-exposed terrain, well-removed from hills, valleys, bluffs, or trees, the data set is appropriate to help you make an informed decision. If the measurement location is near significant obstructions to wind flow or the monitoring equipment captured less than 50 percent of the data, it is not appropriate to use in the assessment of your own site.

At this point in your evaluation, you might wish to solicit the services of an expert in wind resource assessment to develop estimates of

**Table 3. Desirable Data from Nearby Wind Measurement Sites**

- 
- Site elevation
  - Monthly average wind speed
  - Wind rose (wind speed and direction frequency data, showing directions from which the wind is strongest and weakest)
  - Site exposure (local terrain—hills, valleys, etc.—vegetation cover, and manmade structures)
  - Height(s) above ground
  - Data recovery (number of hours of valid data vs. total possible hours)
  - Site location with respect to your property (wind speeds generally increase to north and west)
- 

the wind resource at your site. Independent consulting meteorologists are available to conduct this work. Alternatively, and with some caution, you might call on wind turbine marketers to assist you in this task.

Once you have validated the data, you can use it to estimate the wind resource at your site. This task is critical to your overall evaluation of the wind investment and should receive considerable attention. The larger the project or investment under consideration, the larger and more expensive is the effort that is warranted. There are a number of factors that influence the complexity of this task and the ultimate reliability of the result. The complexity or roughness of the terrain at your site and at the site where your measurements were taken is very important. In California, where wind projects are constructed along the ridge tops of some very rugged terrain, developers of large projects have reported installing one wind measurement system (anemometer) for every two or three turbines to acquire wind resource data reliable enough to satisfy lenders and investors. In the Buffalo Ridge area in southwestern Minnesota, you might have seen five or six wind measurement systems operating across the area that was ultimately occupied by the 73 turbines of the first development in 1994. For installations of single, small machines, site specific measurements are often foregone, and decisions are made based on measurements taken at other sites and the judgment of the developer and a local wind turbine salesperson.

In the Midwest, particularly away from river valleys or prominent geological features, we anticipate that reliable wind estimates can be developed using relatively simple averaging or extrapolation techniques. One promising technique has been developed and used extensively in Europe to assist local landowners in evaluating the feasibility of clusters of community-owned wind turbines. This computer-based assessment basically takes site

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data like that listed in the table on the previous page for both the wind project site of interest and wind measurements of nearby sites and generates wind resource estimates at the target site based on the principles developed in the *European Wind Atlas*. In Europe, where the wind community has been using this approach for some time, prospective owners, wind turbine salespersons, and lenders have come to trust and rely on this technique. In the early stages of wind development in the Midwest, this and other techniques will need to be tested and proven so that buyers and lenders can achieve the same level of confidence as their European counterparts. There are now companies in the United States that offer computer-based wind site assessment.

#### **Computer-Based Wind Site Assessment.**

Computer-based wind site assessment is an emerging alternative resource in wind resource assessment. The following are two leading companies in the field:

SSESCO, Inc.  
1217 Bandana Boulevard North  
St. Paul, MN, 55108  
(651) 842-4260  
Fax: (651) 842-4256  
www.windlogics.com

TrueWind Solutions, LLC  
255 Fuller Road, Suite 274  
Albany, NY 12203  
(518) 437-8661  
Fax: (518) 437-8659  
www.truewind.com

#### **Measuring the Energy in Wind**

Site-specific measurements give the most reliable estimates of the wind resources for a project; however, they can be quite costly and require, at a minimum, six months to several years to complete. As a result, deciding whether or not to undertake a measurement program hinges on an assessment of the costs

and benefits of such an effort. Discussions with wind resource assessment experts suggest that you might be able to contract for four to six months of measurements from a tower of approximately 100 feet (30 meters), along with some consulting to evaluate this short measurement record with respect to long-term data for a cost of \$1,500 to \$3,000. For individuals considering single wind turbines of a size to generate the power used at the house or farm (10-20 kW), the entire project might cost \$20,000 to \$35,000 and generate \$600 to \$1,680 per year in revenue. Investing in wind measurements could amount to 5-15 percent of your total wind investment, which could be burdensome. On the other hand, for larger wind turbines and clusters of wind turbines where investments would be at least several hundred thousand dollars and annual revenues would be at least tens of thousands of dollars, an added expense of \$1,500 to \$3,000 is more justified. A systematic assessment of the monetary benefit of conducting on-site measurement programs is difficult to conduct. Indeed, many of the benefits might be difficult to value in monetary terms (e.g., getting faster approval and a more favorable interest rate on a bank loan).

#### *Measurement Programs*

**Large Wind Projects: Multimillion Dollar Investment.** The measurement program that you undertake should carry a cost that is consistent with the overall size of your potential investment and with the uncertainty of the resource in your area. If you are contemplating a multimillion dollar wind project in an area where no wind measurements have been taken, it would be wise for you to take at least two years of measurements with a multilevel meteorological tower in order to confirm your wind resource. If the terrain surrounding your site is rugged, it may be appropriate to install several anemometers across the site at wind turbine hub height to assure yourself that you have

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a reliable estimate of the variation of wind speed across your site. In fact, it is quite common for the lenders to large wind projects to require rigorous wind resource assessment efforts before approving loans. Many lenders to large wind projects even hire independent meteorologists to validate the developer's estimates of the available wind resources.

**Medium Wind Projects: \$2-\$4 Million Investments.** For projects of this scale (a small cluster of turbines), you should seriously consider a short-term measurement program, which includes anemometers at several heights and a measurement period lasting at least a year, combined with a careful wind data interpolation effort. Such an effort would eliminate a great deal of uncertainty in your estimate of wind resources and give you and your banker data that can confidently be used to evaluate an investment of this magnitude. The closer, more representative, and more reliable the nearby measurements are, the more confidence you can have in your assessment of wind resources.

**Small Wind Projects: Less than \$1 Million.** For small utility-scale projects (a single utility-scale turbine), large investments in on-site measurements are more difficult to justify. Even so, the revenue generated by projects this size could range from \$25,000 to \$100,000 per year or more based on capital investments of \$200,000 to \$800,000; investments of a few thousand dollars in wind resource assessment and validation are, therefore, certainly warranted. For less than \$10,000, you should be able to have a contractor install an anemometer on a tilt-up tower at or near hub height, collect up to six months of wind data, and carry out a careful interpolation with existing wind measurements from other representative sites.

**Home- or Farm-Sized Wind Projects: \$5,000-\$40,000.** If your intent is to install a small wind turbine sized to supply a portion

of the energy needs of your home or farm, on-site wind measurements are not required but certainly worth considering. A simple anemometer that logs average wind speeds costs under \$100 if you provide the pole, or up to \$2,500 installed with a tip-up 100-foot (30 meter) tower. An existing tall structure on the property can be used in lieu of a dedicated pole, but its shape and location will impact the data collected. It has also been suggested to install a small turbine (1,000 watts or less) and collect data from this machine for a year or more and, thus, get the experience in operating a turbine along with your data. There is a list of vendors who provide this equipment later in this chapter.

If you are unable to get site wind data, you must rely on extrapolation or projections of the wind speed at your site. You should consider investing \$500 or more for a consultation with a wind assessment consultant with experience in your area. These practitioners are not certified yet, so you should be advised to carefully review their credentials and references before hiring them. An outline of what to expect from a site evaluation contractor is included in Figure 5.

### *Measuring Your Wind*

To qualify for some Illinois state grant programs (described in Chapter 5), you must provide wind resource information to justify the economics for your project. According to the fiscal year 2004 guidelines, projects 201 kW and larger are required to submit a full year of "professional" wind data. In this section, we have outlined some cost-effective ways to collect information about your wind resource. As outlined above, investing more to collect sound wind data is a good idea for larger turbines and probably necessary for the Illinois state grant program.

The office handling state grant applications would like to see weekly average wind speeds

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## Figure 5. Minimum Requirements – Site and Wind Resource Evaluation Report

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At a minimum, you should expect the following from a site evaluation contractor:

1. Site description, including property description and site elevation above sea level
  2. Site map, including property lines; topographic contours; locations of existing electricity distribution, transmission lines, and roads; and obstacles to wind flow—trees, terrain, buildings, etc.
  3. Wind statistics from nearby representative wind monitoring stations, including . . .
    - Measurement site description, including location relative to proposed site, elevation above sea level, and exposure
    - Annual average wind speed for as many years as possible up to twenty
    - Monthly annual winds based on as long a record as possible
    - Wind speed and wind power roses showing frequency of winds over range of wind speeds or power levels from different directions
    - Wind shear coefficient or annual average wind speeds at all anemometer levels
  4. Projected annual wind speed at the site, along with an explanation of how the projection was determined
  5. Annual average wind speed that will be exceeded 70%, 80%, and 90% of the time, along with a description of the method for determining the distribution of wind speeds
- 

recorded, but would settle for monthly average wind speeds from your anemometer. The least expensive way to accomplish this is to purchase an anemometer connected to a small meter that records average wind speed; you will have to go out weekly to verify the instrument is operating correctly. You will then need to go out monthly to record the average wind speed and then reset it. These instruments can be purchased for under \$100 from <[www.inspeed.com](http://www.inspeed.com)>. There are other wind anemometers listed in this book that will work (see below for a list). Be sure to buy enough wire to connect the anemometer to a protected place for a computer. This might be a good option for the smaller wind projects (under 20 kW).

For 20-200 kW turbines, you will probably want to invest in a more expensive data logging wind instrument. This instrument will log and store wind speed averages in smaller increments such as every ten minutes or every hour. This ten-minute or hourly data provides a much more accurate estimate of your future turbine's electrical production. This is not as important for annual revenues of \$500, but certainly important if you are generating \$5,000 or more a year worth of electricity. Call the Illinois Department of Commerce at (217) 557-1925 for more details on the wind resource information you will need to submit.

The tower needed to get the anemometer high in the air, where the wind quality is better, will be much more expensive than the instrument

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itself. Towers over 10 meters (33 feet tall) should be installed by professionals. A 30-meter (100-foot) tower costs approximately \$2,000, and another \$500-\$1,000 for installation, depending on the contractor and his or her proximity to your site. Taller towers are even more expensive. A 50-meter tower will cost about \$7,000 installed, and a 70-meter tower will cost over \$10,000 installed. For projects under 200 kW, you might be able to collect adequate data by placing an anemometer on another tall structure, such as a cellular tower, a grain elevator, or an old water pumping windmill tower. Approximate costs for using a cell tower are \$1,000-\$1,500 for the installation of the equipment and \$1,000 or more for a one-year sublease from the cell tower operations company. For smaller projects, you can be creative in how you collect your data, keeping safety in mind, of course.

### **Anemometer Suppliers (Short List of Inexpensive Equipment)**

- **INSPEED – Pole Mount Anemometer**

A new manufacturer of inexpensive anemometer and modified bicycle computer to measure wind speed; cost is under \$100.

Inspeed  
10 Hudson Road  
Sudbury, MA 01776  
(978) 397-6813  
www.Inspeed.com

- **ONSET – HOBO Micro Station Data Logger**

A miniature, all weather data logger that can accept up to four inputs and stores up to 512,000 records. It does have an averaging feature, so you can take data every minute and have that be a one-minute average of 100 samples of the wind speed throughout that minute. This data logger could store more than a year's worth of data from one wind anemometer (you

could have several anemometers and/or a wind direction or temperature indicator if desired). Cost of data logger, \$195; software required to download to laptop, \$95; and anemometer, \$195. That means you can have all you need for one anemometer for \$485.

Onset  
470 MacArthur Boulevard  
Bourne, MA 02532  
(800) LOGGERS, (800) 564-4377,  
(508) 759-9500  
Fax: (508) 759-9100  
www.onsetcomp.com

- **NRG – Wind Explorer**

A long-standing data logger in the wind industry, which costs \$590 for just the logger and anemometer, weathertight logger, and 9V operation, allows remote installations. It stores several months to a year of data, depending on your selection of time interval. This instrument can accept two channels of input, and uses a memory card to store and transfer data. These cards cost \$60 and require a card reader and software, which costs \$125, to be useful. The entire package costs \$775 for the minimum required. NRG makes everything you would need to monitor wind, including tip-up towers from 30 feet to 165 feet tall. A 20-meter (66 foot) tall tower costs \$800. You can get the Explorer data logger, anemometer, data plug, and 20-meter tower as a package for \$1,530.

NRG Systems  
110 Commerce Street  
Hinesburg, VT 05461  
(802) 482-2255  
www.Nrgsystems.com

- **DAVIS – Vantage Pro Weather Station**  
Here's a user-friendly device that has the option of wireless data transfer between the base station and the instruments. This

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unit includes sensors for temperature, wind speed, rainfall, and humidity. (Farmer's take note: This might be useful for your records during the growing season.) \$684 price includes Weatherlink software, which allows computer retrieval of stored data.

Davis Instruments Corporation  
3465 Diablo Avenue  
Hayward, CA 94545  
(510) 732-9229  
Fax: (510) 670-0589  
www.davisnet.com

- **Second Wind – Nomad Datalogger**

This company is focused on larger wind projects and offers a datalogger with instruments for several thousand dollars. It is mentioned here because they also offer long-term monitoring services for the installed wind project (useful if you need to bill the utility for lost production due to curtailment, or to verify that turbine manufacturer's power curve is correct). Contact them if you are doing a utility-scale turbine project and need some of their additional Wind Park services.

Second Wind Inc.  
366 Summer Street  
Somerville, MA 02144  
(617) 776-8520  
www.secondwind.com

## **What Information Do My Banker and I Need?**

### *Average Annual Versus Year-to-Year Variations*

Wind turbines are like crops; they have good production years and bad production years. Your banker will want a realistic assessment of the energy and revenue production of your project during a poor wind year in order to be sure that you can cover any loan payment that you have. Different bankers are likely to have different perspectives on this issue; however,

all evaluations need to rest on an assessment of the year-to-year variations in wind availability over the long term.

Because we do not yet have 20 to 30 years of wind measurements in most good wind energy locations, we must take an indirect approach to determining how much the winds at our wind site vary year to year. This approach relies on a comparison of short-term wind records at promising sites with those at reference sites where wind measurements have been taken for many years, often airports or National Weather Service installations. Ideally, the year-to-year changes seen at wind sites will be mirrored by changes at the reference sites. The annual average wind speed in any year might vary from the long-term average.

### *Wind Speed and Tower Cost Increase with Height. How High Should My Tower Be?*

**The Benefits/Costs of Increasing the Height of Your Wind Turbine Tower.** One of the first things that wind researchers learned when they began measuring wind speed for wind projects was that wind speed generally increases as you get higher above the ground (Figure 6). Basically, the wind is slowed down by friction where it comes in contact with the ground or ground cover. As a result, wind speeds increase at increased heights above the ground at wind sites. This phenomenon, known in the wind industry as wind shear, presents wind developers with an opportunity to improve the overall economics of their investment by putting their wind turbines on taller towers. As a developer, your task is to determine if the extra cost associated with a taller tower will pay off in increased wind energy production and revenue. In this section, we will describe wind shear, its effect on wind energy investments, and the uncertainties surrounding estimating wind shear. For years, wind developers used the rule-of-thumb that wind speed increased over a site according to the  $\frac{1}{7}$ th power law. The

**Figure 6. Wind Shear Determines How Much Winds Change with Heights Above the Ground**

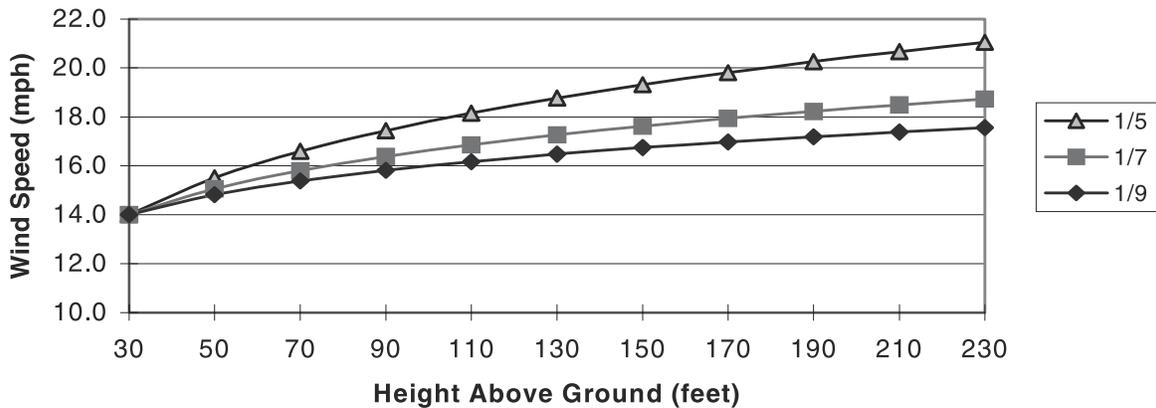


Figure 6 shows a graph of wind speed as a function of height above the ground, assuming the wind speed at 30 feet is 14 mph and different power law coefficients. The coefficient of a power law expression is the exponent of the equation,  $V_2 / V_1 = (H_2 / H_1)^{\text{coefficient}}$ .

mathematical equation for this rule-of-thumb is

$$V_{\text{hub ht.}} = v_{\text{anem. ht.}} \times (\text{hub ht.} / \text{anem. ht.})^{1/7(\text{power coef.})}$$

The power coefficient varies by terrain; typical values are  $\frac{1}{5}$  (0.111),  $\frac{1}{7}$  (0.143), and  $\frac{1}{9}$  (0.200). For reference, the impact of increasing the height of your wind turbine tower from 100 feet (approximately 30 meters) to 130 feet (approximately 40 meters) on average wind speed would be 4.2 percent under the  $\frac{1}{7}$ th power law. If wind shear is greater than typical,  $\frac{1}{5}$ th power, average annual wind speeds increase by 5.9 percent. If on the other hand, wind shear is lower than typical,  $\frac{1}{9}$ th power, the wind speed increase would only be 3.3 percent. Remember that wind turbine energy production increases by approximately the wind speed increase cubed, meaning that wind energy increases associated with the tower height increase from 100 feet to 130 feet would be 6.6 percent, 8.6 percent, and 12.2 percent, respectively. If the cost of increasing the wind turbine tower height from 100 feet to 130 feet increases the total project cost by less than eight percent, then the extra investment in the tower is justified by the increase in wind energy production if wind shear follows the  $\frac{1}{7}$ th

power law or higher. (This information should be used in specifying the wind turbines for a project and in estimating their annual energy production.)

*How Does Wind Speed Change with Height (Wind Shear) at My Site?*

During the last few years, researchers have been making measurements of wind shear at promising wind energy locations using meteorological towers with several levels of wind measuring equipment. We can get estimates of the wind shear coefficient in the area near the meteorological tower by comparing the wind speed measurements hourly and monthly or by comparing annual averages at different heights above the ground (Table 4).

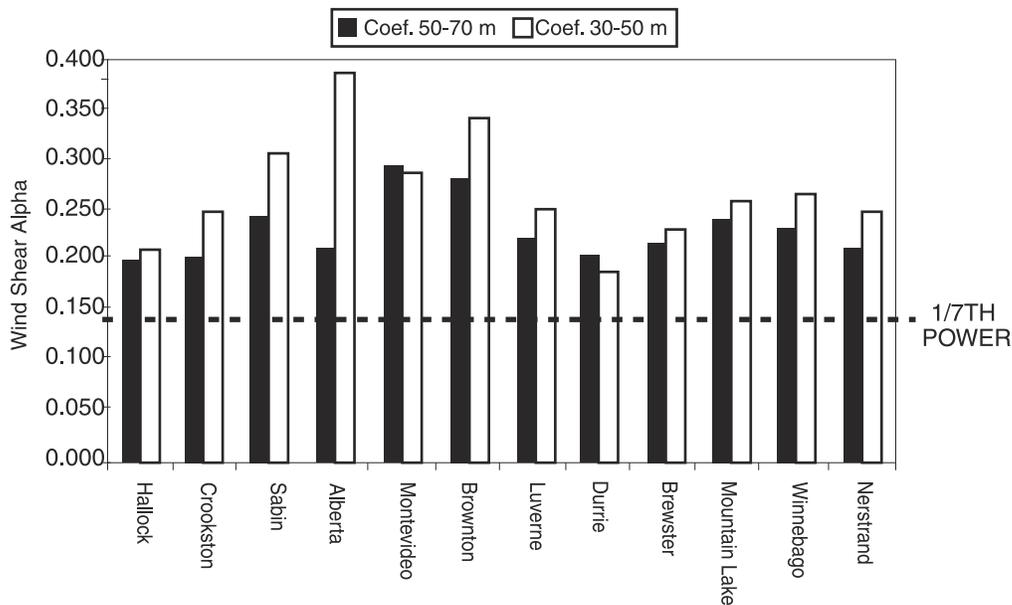
Figure 7 shows the calculated wind shear (alpha) coefficient for 12 Minnesota Wind Resource Assessment program sites that have been in operation since 1995 or earlier. This figure shows that instead of the  $\frac{1}{7}$  coefficient so often referred to for determining the wind shear in an area, it might be more appropriate to use a  $\frac{1}{5}$  or  $\frac{1}{4}$  coefficient for wind shear calculations in Minnesota. This figure also

**Table 4. Wind Shear Exponent (Alpha)**

Year	Height	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
1995	30m-50m						0.17	0.19	0.22	0.21	0.21	0.17	-0.22	0.14
	50m-70m						0.20	0.25	0.24	0.26	0.24	0.22	0.15	0.22
1996	30m-50m	0.11	0.17	0.18	0.18	0.16	0.17	0.21	0.22	0.29	0.23	0.15	*	0.18
	50m-70m	0.02	0.22	0.18	0.20	0.19	0.16	0.21	0.23	0.27	0.24	0.19	*	0.18
1997	30m-50m	0.10	0.13	0.16	0.16	0.15	0.18	0.19	0.22	0.21	0.16	0.10	0.11	0.16
	50m-70m	0.16	0.13	0.11	0.18	0.16	0.16	0.21	0.23	0.22	0.26	0.22	0.16	0.18
1998	30m-50m	0.04	0.12	0.14	0.15	0.15	0.18	0.22	0.26	0.24	0.24	0.20	0.17	0.16
	50m-70m	0.02	0.13	0.09	0.13	0.12	0.14	0.16	0.21	0.21	0.18	0.18	0.18	0.13
1999	30m-50m	0.18	0.16	0.17	0.19	0.14	0.15	0.21	0.24	0.25	0.24	0.22	0.20	0.20
	50m-70m	0.30	0.21	0.21	0.17	0.18	0.19	0.23	0.24	0.26	0.24	0.23	0.22	0.22
2000	30m-50m	0.20	0.20	0.20	0.17	*	*	*	*					0.19
	50m-70m	0.23	0.22	0.22	0.22	0.45	0.35	0.25	0.27					0.28
Average	30m-50m	0.13	0.16	0.17	0.17	0.15	0.17	0.20	0.23	0.24	0.22	0.17	0.07	0.17
	50m-70m	0.15	0.18	0.16	0.18	0.22	0.20	0.22	0.24	0.24	0.23	0.21	0.18	0.19

\* Equipment was damaged during this period.

**Figure 7. Wind Shear Coefficients Measured at Promising Sites in Minnesota**



New WRAP Sites 11-5-96 —Data to be validated

indicates considerable variation in wind shear from location to location and at different heights above the ground. In general, the more open and flat the area surrounding a potential turbine site is, the less wind shear there will be. Sites with significant nearby obstructions will show greater wind shear values at heights just above these obstructions.

Wind turbine vendors most often offer towers that place turbine hub height in the range of

80-120 feet (25-37 meters) for home- and farm-sized turbines and 164-230 feet (50-70 meters) for utility-scale wind turbines. Towers as high as 100 meters are being developed. Under those circumstances, you might need both coefficients to estimate the increase in wind speed produced by increasing wind turbine tower height. If there are meteorological towers nearby (on land) that are comparable to your site, you should use the average of the wind shear coefficients

from these sites in your calculations of average annual energy production and in assessing whether increasing wind turbine tower height increases the pay-off for the investment. If the terrain or ground cover around your site is less favorable than that around the meteorological towers, you should use a conservative value for the power law co-efficient  $\frac{1}{2}$  or smaller unless a wind resource specialist can argue persuasively for a higher, less-conservative value.

For the purposes of obtaining a bank loan, you might be justified in using one of the lower wind shear coefficients measured at representative sites. In the absence of comparable measurements, you should use the  $\frac{1}{7}$ th power law expression because it is widely accepted.

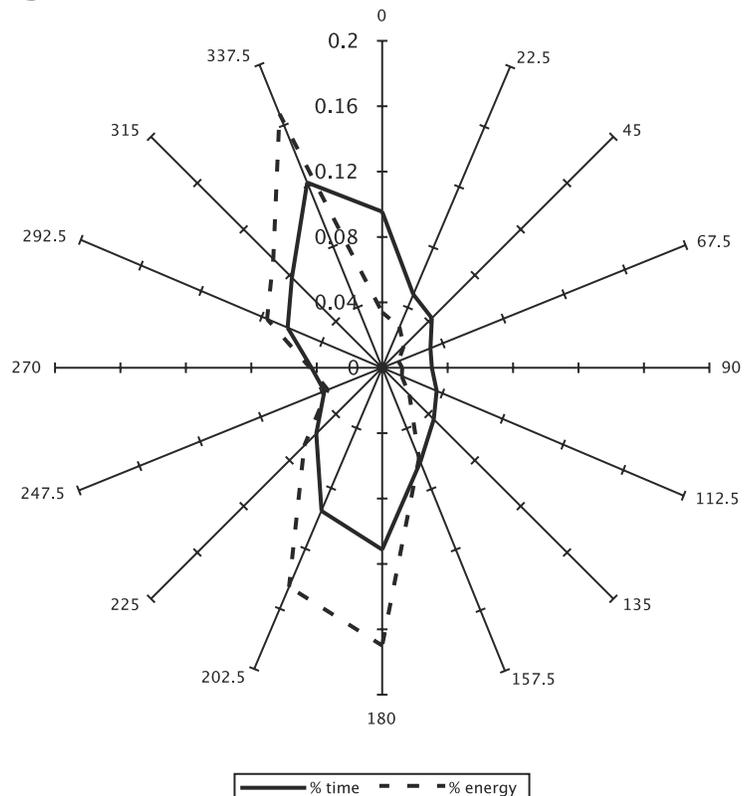
**The Currie 50-Meter Wind Rose.** The wind rose is important if you plan on placing multiple turbines at a site, or if you can move the turbine around your site to get maximum output (Figure 8). The wind rose shows from which directions that the wind will generate the largest percentage of the energy blows. Typically, this is from the northwest and south in the Midwest, but there are plenty of sites that have significant winds from other directions. (Zero degrees is north.) If the winds are predominantly from two directions, you should be sure to not have obstacles to the wind upstream from your turbine in those directions. You could place turbines five to seven turbine rotor diameters from objects at right angles to the predominant wind direction. If the wind seems to blow from all directions throughout the year with equal intensity, then you must try and place your turbine in an open area and eight to ten rotor diameters from any object that might interfere with the wind.

### *How Do I Choose the Specific Spot for My Wind Project?*

Choosing the actual spot on your property for your wind project may be a tradeoff between the most windy and well-exposed location and the distance that location is from either the utility distribution lines or your home or farm electrical service. In this section, we will give you a number of pointers to help ensure that you can identify pluses and minuses of any specific location and avoid selecting sites where wind flow to your project is severely compromised.

**Obstacles and Wind Roses.** In an ideal world, your project site would be the most prominent piece of property for miles and would have no obstructions to wind flow (such as hills, valleys, trees, or buildings) within 2,000 feet. As a practical matter, your site might not be perfect, so you need guidelines to avoid bad sites and to take advantage of your best

**Figure 8. Currie 50-Meter Wind Rose**



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options. Essential data to support this process comes from a wind speed rose or wind power rose, a chart that conveniently shows where the strong and weak winds come from over the course of a year.

**Wind Turbine Wake Effects of Siting More than One Machine.** If you are considering a project with several wind turbines, you should use the wind roses to assess how much space to leave between wind turbines. Since wind turbines are themselves obstacles to wind flow, they leave “wakes” in downwind directions where wind energy is depleted for considerable distances. Rules of thumb suggest that wind turbines in the dominant wind power directions should be at least eight to ten wind turbine diameters apart. In the directions where winds are weak, spacing of three to five diameters can be acceptable. This means that wind turbines with rotors that are 82 feet (25 meters) in diameter should be placed 650-820 feet apart in the dominant wind directions. (Researchers have shown that the size of the downwind disturbance to wind flow created by a wind turbine is proportional to the wind turbine’s rotor diameter. For this reason, wind turbine spacing to avoid unacceptable losses in the performance of downwind machines is defined in “rotor diameter” terms rather than simply in feet or meters.)

Again referring to the wind rose for the Ruthton/Holland site (see Figure 8), it would clearly be critical to multiple wind turbines spaced at least eight rotor diameters apart in the south-southwest/north-northeast direction. Based on the important secondary wind directions shown on the wind rose, turbines should also be spaced eight or more rotor diameters apart in the northwest/southeast direction. This wind rose, with strong winds from essentially perpendicular directions, does not leave much opportunity for wind developers to reduce the spacing between machines, in any direction, below eight to ten rotor diameters.

*Setbacks – Protecting Your Wind Access.* Since obstacles at considerable distances can obstruct the flow of wind to a wind turbine, it is important to control the property surrounding your site so that unobstructed wind flow is ensured over the life of the project. In the terminology of county and state planners, this is described as using setbacks from property lines to ensure unobstructed wind flow. The turbine wake effects described above and the turbine siting guidelines described in the “Know Your Land” chapter provide valuable guidance in this regard. In general, your wind project should be set back sufficient distance from property lines to ensure that developments or buildings on adjacent property do not reduce the wind flow and, thus, reduce the economic performance of your wind project.

Some local planning boards may have setbacks for wind turbines documented in their codes; however, these requirements may reflect safety and noise rather than wind access considerations. As a result, you should always do your own evaluation to determine the setbacks that protect your access to the wind.

If your property is not large enough to provide the necessary distances, you might consider purchasing wind easements from your neighbors to ensure the same protection as setbacks. The participants in large-scale wind projects often acquire easements from neighbors for this purpose. The location and size of these easements should be determined considering the dominant wind power directions at your site and your expectations as to the potential scale of obstacle. If your primary concern is the construction of wind projects in upwind directions, then setbacks and easements that provide you with a buffer of around 1,600 feet should be sufficient.

*Conclusion.* Wind energy is a new “crop” for rural America and, as a result, wind project developers need to work hard to assure

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themselves and their bankers that wind investments make sense. This work is especially necessary in assessing the wind speeds at a promising site for development. As with other crops, wind farmers should understand what the cash flow implications of good and bad wind years might be and resist the temptation to pin their investment analysis to a single site wind speed value. With this in mind, this chapter was designed to define a range of wind speeds upon which decisions can be based.

We have attempted to provide numerous approaches for wind farmers to improve the reliability of the wind resource estimates on which they base their decisions by conducting on-site wind measurements or obtaining consultation and analysis of their situation from qualified outsiders. In time, we expect more of this support to come from the institutions that farmers already rely on such as university agricultural programs and county or state government.

For today, however, wind farmers must do their homework and seek out the consultation and other support they need on their own. We hope the information provided here will help support these pioneering efforts.

### **Who Can Help Me?**

In Illinois, there are few turbines installed and few consultants in the state to provide assistance. The authors do not endorse particular consultants or businesses, but, to help you find consultants and expertise, we have included a sampling of consultants in Illinois and other states below:

- FPC Services, Inc.  
Bruce and Joyce Papeich  
1771 Sublette Road  
Sublette, IL 61367  
(815) 849-5135
- Illinois Wind and Solar  
Attn: David A. Serafini  
226 Highwood Avenue  
Highwood, IL 60040  
(847) 432-1092  
daserafini@illinoiswindandsolar.com  
www.illinoiswindandsolar.com
- Lake Michigan Wind and Sun  
1015 County U  
Sturgeon Bay, WI 54235-8353  
(920) 743-0456  
Fax: (920) 743-0466  
www.windandsun.com  
info@windandsun.com
- Midstate Renewable Energy Services  
Attn: Bill Fabian  
4501 Goldfinch Road  
Champaign, IL 61822-9541  
(217) 398-6385  
bill@midstatepower.com  
www.midstatepower.com
- Seventh Generation Energy Systems  
Attn: David Blecker  
7295 E. Cate Road  
Belleville, WI 53508  
(608) 424-1870  
www.seventhenergy.org  
info@seventhEnergy.org
- Bergey Windpower  
Bergey Windpower is a large supplier of small wind turbines. It lists 14 certified dealers in Illinois and many more in surrounding states. The full list is available at <www.bergey.com>.
- Energy Maintenance Service, Inc.  
129 Main Street, P.O. Box 158  
Gary, SD 57237  
(605) 272-5398, (888) 449-5732  
www.energym.com  
info@energym.com  
(Good source for used equipment and other services)



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## **Chapter 3. Know Your Land: A Guide to Siting Wind Turbines for Landowners and Potential Wind Project Developers**

A wide range of issues needs to be considered when siting a wind project. Placing turbines to take advantage of the best wind resources must be balanced with minimizing their impact on their surroundings and the environment. Ecological and geological aspects of proposed sites must also be taken into consideration. A windy site over a wetland or a downtown area is not likely to be “developable,” and projects on native prairie or other delicate ecosystems may raise special concerns. It is also important to make sure that the soil and underlying rock can support a wind turbine. Permitting, environmental studies/mitigation, and construction costs are all site-specific and can have a significant impact on the overall economics of a project. These and other siting issues must be examined in the early stages of planning a wind project.

Wind projects are subject to many siting considerations and permit requirements, depending on their size and location. A single small residential turbine on a farm may be subject to minimal environmental/neighbor concerns, zoning requirements, and permits. If the same small turbine were on a large lot in a developed residential neighborhood, many additional “good neighbor” issues would need to be considered even if there were no additional formal requirements. Specific rules for both small and large turbines vary widely from state to state, county to county, and even neighborhood to neighborhood.

When permits are required, they become part of the “critical path” or timeline toward completing the project. If there are surprises, then significant delays and extra costs are likely. In the worst-case scenario, a planned project might have to be cancelled if needed permits are denied or siting-related costs become too high. Good project planning means knowing early on what the local requirements are and designing the project to be consistent with those requirements. This same point applies to prudent actions that are not required by permits. If it is unclear whether a local government will require a permit or what its standards are, it will be difficult to make commitments or design a project that will pass muster. Potential environmental or neighbor concerns should be identified upfront.

Government policy often favors wind projects because the technology does not require mining, refining, or transportation of fuels; has zero emissions; does not consume, heat, or contaminate water; does not involve toxic chemicals; is quiet and safe to operate; and produces no waste. Most of these advantages also mean wind systems can be relatively easy to site compared to most other kinds of power plants. Unfortunately, careless project design, installation, or operation can offset these advantages. Achieving all the benefits of wind energy depends not only on how much energy the turbines produce but also on how well the project’s impact is minimized.

Usually, negative impacts of wind projects can be avoided, reduced, or mitigated by conventional means, especially if the project is sensibly located and all the issues are considered during the planning stages. This chapter will focus on siting issues surrounding wind projects, Chapter 4 will discuss the permitting and taxation of wind projects.

## The Land

A good look at your land will tell you whether your property can support a wind turbine. Your land should be able to support the weight of the turbine itself as well as the weight of the construction equipment required for larger turbines. A construction company or a geologist who does soil borings can help you determine this.

Turbines require lots of open space to harness the power of the wind; the land surrounding turbines can be used for farming and ranching. The turbine platform itself occupies only a few square yards, or even less for small turbines. You may also need room for an access road.

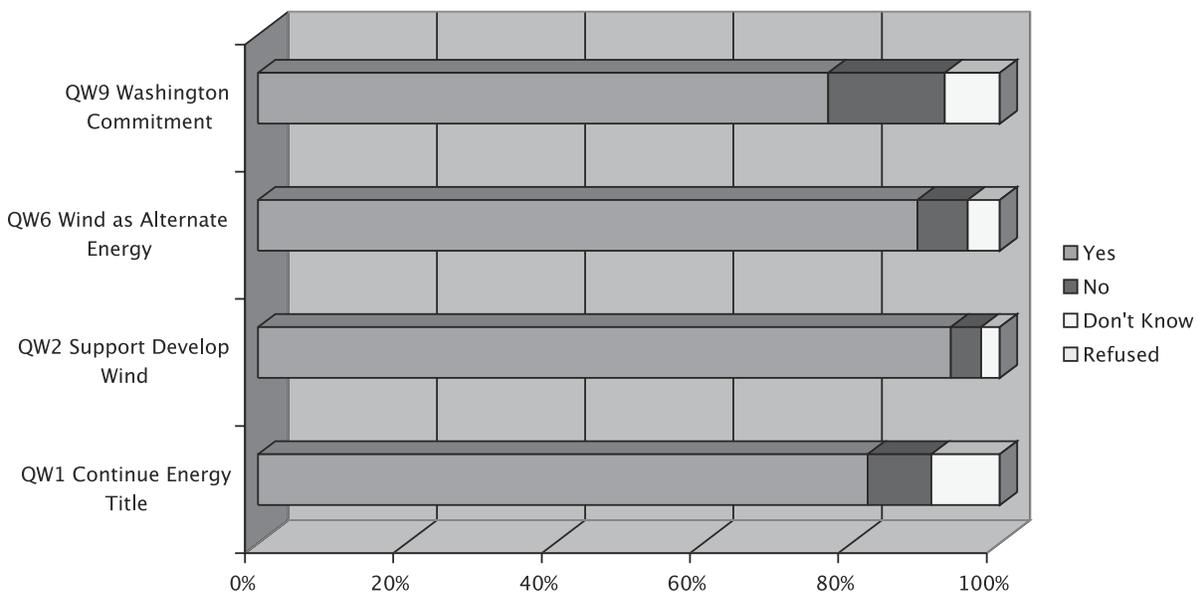
You'll want to place your project away from buildings and trees. The site must be large enough to accommodate setbacks from a neighbor's property or buildings, which may be required by local zoning laws. It is a good idea to place your turbine back from property

lines in case your neighbor later builds an obstruction that affects the flow of wind.

## Aesthetics

People have widely varied reactions to seeing wind turbines on the landscape. Some people see graceful symbols of economic development and environmental progress or sleek icons of modern technology. Others might see industrial encroachment on natural or rural landscapes. Surveys have found that the "visual quality" of wind turbines garners less support than any other aspect of wind energy, even though respondents still preferred wind energy to other technologies. Public opinion surveys on both sides of the Atlantic have consistently shown strong support for the development of wind energy. Typically, two-thirds or more of those polled support wind development, including in areas with existing wind turbines. For example, in the spring of 2003, a national survey by the American Corn Growers Association of corn producers revealed 93

**Figure 9. Support for Wind Energy**



National AGCA survey results show overwhelming support among corn producers for the Federal Farm Bill renewable energy title, the development of wind energy as an alternative to traditional energy, and for a national commitment to wind energy. Courtesy of the American Corn Growers Association.

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percent support for wind energy development among corn producers. (The complete survey is available on the ACGA website at <[www.acga.org/news/2003/042103.htm](http://www.acga.org/news/2003/042103.htm)>.)

To prevent controversy and division in communities about wind energy, developers must do everything possible to ensure that wind turbines and wind power plants are seen as good neighbors. One means for maximizing acceptance is to incorporate aesthetic guidelines into the design of wind turbines and wind power plants. There may be no way to eliminate all objections to the appearance of wind turbines on the landscape, but there is some consensus on how to minimize these objections. The guidelines can be as simple as “build an aesthetically attractive project and keep the turbines turning.” Or it could be as simple as the guidelines used by a district council in Denmark: All turbines should look alike and they should all rotate the same way.

The most significant means for improving public acceptance is by providing visual uniformity. Even when large numbers of turbines are concentrated in a single array, or there are several large arrays in one locale, visual uniformity can create harmony in an otherwise discordant vista. Visual uniformity is simply another way of saying that the rotor, nacelle, and tower of each machine should look similar. They need not be identical; they just need to appear similar.

When wind turbines are seen spinning, they are perceived as being useful and therefore beneficial. Observers are quicker to forgive the visual intrusion if the wind turbines serve a purpose. Turbines that are often stationary too often can give the impression that the technology is unreliable. In other words, if the wind turbine breaks, it should be fixed as soon as possible to convey a good image to the public.

California surveys have shown that developers should bury all power lines and integrate extraneous equipment, such as transformers, into the turbines themselves or remove them from the site. The latter is now possible with the advent of larger turbines. When used with tubular towers, the transformers and control panels can be installed inside the towers, as is done on offshore and harbor breakwater installations.

Signs near a wind turbine or at a wind plant should serve to inform the public about the wind turbines and their place on the landscape. Operators should avoid using wind turbines as a means for elevating advertising billboards to new heights. Billboards, like any other extraneous structure, add visual clutter to the landscape.

Large wind turbines are often well over 200 feet tall and cannot help but be visible. This is compounded by the fact that the best wind sites are usually high areas, unobstructed by trees, buildings, or anything else that could block the turbine from view. No amount of camouflage will make wind turbines invisible. In general, the color of wind turbines should avoid sharp contrasts with the surrounding landscape. White is by far the most common choice.

Aircraft obstruction marking, by intent, seeks to increase contrast with the landscape. Designers must limit the height of wind turbines and should avoid sites near airports to minimize the need for obstruction marking. That said, all Federal Aviation Administration regulations should be strictly adhered to for legal and safety reasons. Manmade objects taller than 200 feet are required to file for an FAA permit. Typically, permits require red and white lights to be installed on the nacelle.

Operators should douse security lighting at their wind plants and substations to decrease the contrast between the wind plant and the

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nighttime landscape of rural areas where wind turbines are typically installed. Nighttime security lights are non-essential and can be activated as needed by motion detectors.

### *Shadow Flicker*

Shadow flicker is a notable but minor issue. It occurs when the blades of the rotor cast shadows that move rapidly across the ground and nearby structures. This can create a disturbance when the shadow falls across occupied buildings, especially when windows open onto a turbine turning in front of the sun.

Shadow flicker may be more of a problem in northern Europe, Canada, and the upper Midwest than elsewhere because of the northerly latitude and the low angle of the sun in the winter sky. There are few recorded occurrences of such concern in the United States and, because of the greater distances between wind turbines and homes in the upper Midwest than in Europe, shadow flicker may not pose a problem. Research has shown that shadow flicker, under worst-case conditions, would affect neighboring residents a total of 100 minutes per year. Under normal circumstances, the turbine studied would produce a shadow flickering shadow only 20 minutes per year.

### **Property Values**

According to a first of its kind national study published in 2003 by the Renewable Energy Policy Project (REPP), commercial-scale wind turbines do not harm “viewshed” property values. The Effect of Wind Development on Local Property Values systematically analyzed property values data, including over 25,000 transactions of properties in sight of wind projects over 10 MW installed from 1998 to 2001. REPP found no evidence that property values are harmed by wind installations. In fact, for the great majority of wind projects,

property values in the viewshed actually rose faster than in the comparable community with the pace increasing after the turbines came online. (The full study is available at <[www.repp.org](http://www.repp.org)>.)

### **Noise**

Next to aesthetics, no aspect of wind energy creates more consternation or more debate than noise. Whether wind turbines are “noisy” is as much a subjective determination as whether wind machines appear “beautiful” or “ugly” on the landscape. Where wind turbines have been seen as an intrusion on an otherwise rural setting, some nearby residents have objected to them on the grounds of their noise impact. If wind turbines are unwanted for other reasons, such as their impact on the landscape, noise serves as the lightning rod for disaffection.

Noise, however, unlike aesthetics, is measurable. Wind turbines are not silent. They are audible. The sounds they produce—the swish of blades through the air, the whir of gears inside the transmission, and the hum of the generator—are typically foreign to the rural settings where wind turbines are most often used. As wind turbine technology has improved, the amount of noise produced has fallen considerably over the years. In many cases, the sound of the wind rushing overhead is enough to mask the sounds generated by the machinery. Noise levels have been reduced by placing rotors on the “upwind” side of the tower, eliminating the low-frequency “whop-whop” of blades passing through the tower’s shadow. Tubular towers and nacelles are streamlined to produce less noise with the passage of wind. The nacelles also are better soundproofed to contain noise from the equipment inside. Most sound emanating from modern wind turbines is aerodynamic noise, or the sound of the blades “cutting” through the air. At higher wind speeds, most of this sound will be drowned out by

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the sound of the wind itself. It will be most noticeable at lower wind speeds, just above the threshold for the turbine to start generating power (3-4 m/s). The sounds of wind turbines do not interfere with normal activities, such as quietly talking to one's neighbor, any more than the sounds common in any suburban or rural setting.

An "Acoustic Noise Impact Assessment" study was commissioned by Illinois Wind Energy, LLC, and Tomen Power Corporation for the planned 51 MW Crescent Ridge Wind Farm in Bureau County, Illinois. The study analyzed the project design and the surrounding landscape to determine how sound would impact residents in the area. The study concluded that even using conservative estimates, the project as planned would be compliant with the numerical noise limitations imposed by the Illinois Pollution Control Board. The full Crescent Ridge Wind Farm noise study is available on the project's website: <[www.crescentridgewind.com/noisereport.pdf](http://www.crescentridgewind.com/noisereport.pdf)>.

You might have to perform a similar study for your project to comply with noise regulations. Consult Title 35: Environmental Protection Subtitle H: Noise Chapter I: Pollution Control Board, Part 901–Sound Emission Standards and Limitations for Property Line-Noise-Sources to learn more. Full text is available online at <[www.ipcb.state.il.us/Archive/dscgi/ds.py/Get/File-12260](http://www.ipcb.state.il.us/Archive/dscgi/ds.py/Get/File-12260)>.

The National Wind Coordinating Committee's *Permitting of Wind Energy Facilities Handbook* also addresses noise issues and can help you determine if unwanted sound will be an issue at your site. It is available at <[www.nationalwind.org](http://www.nationalwind.org)>.

Quite simply: Wind turbines emit some sound; whether you consider it noise will depend on your perception of wind energy and how close you are. The sounds of

wind turbines do not interfere with normal activities. It will usually be "no big deal."

### **Public Safety**

Safety is important around tall towers, moving parts, and high voltages. If an unauthorized person falls off a turbine or wind instrument tower, that tower may be viewed as an "attractive nuisance" for which the owner may be held liable. Other safety concerns arise from falling ice, guy wires, turbine breakage, and accessibility to electrical equipment and interiors of tubular towers. Standard safeguards are locking the turbine tower doors, placing information kiosks a good distance away from the turbines, and building fences around the base of the towers. FAA lighting requirements for aircraft safety will be site specific.

### **Loss Prevention**

From the outset of project planning, it is essential to maintain a focus on liability prevention. That concept must remain throughout the decisionmaking process, regarding project location, design, installation, operation, and decommissioning. Failure to do so will diminish options later. Dependence on insurance as a substitute for solid planning is a poor practice and could be costly in a number of ways. The key is diligence throughout the planning and implementation of your project.

Because wind turbines may be considered "attractive nuisances" in some jurisdictions, as the tower is being erected, prominently post warning signs at eye level on the tower. These signs should warn DANGER: HIGH VOLTAGE or DANGER: AUTHORIZED PERSONNEL ONLY.

With the possibility that the tower will become an "attractive nuisance" and be scaled by thrill seekers, children, or vandals, install anti-climb guards. These can be purchased from the tower supplier or you can improvise. (This is mainly

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relevant for turbines on lattice towers, which are rarely used for large turbines anymore.)

For small turbine towers making use of guy wires, avoid placing guy anchors in pathways. Slip fluorescent guy guards over the guy cables to make them more visible. Fence out horses and cattle from access to the guys where they are anchored if you have exposed guy cables or an exposed control panel. Don't give them the chance to damage any components near the base of the tower.

### **Biological Resource Impacts**

As with any construction project or large structure, wind energy can impact plants and animals, depending on the sensitivity of the area. Among the concerns associated with wind energy development are direct fatalities from collisions or electrocutions and loss of wildlife habitat and natural vegetation.

#### *Birds*

There has been considerable concern over the impact of wind turbines on populations of birds. It is inevitable that most large structures (e.g., cellular towers, smokestacks, lighthouses, transmission lines, monuments, and so on) kill birds to some extent. In early environmental reports, the U.S. Department of Energy cites studies finding that 2,700 birds were killed annually over 11 years at a television tower in Florida, 800-1,400 birds per season were killed over a five-year period at a radio tower in North Dakota, and 50,000 birds were killed one night at an airport in Georgia.

Bird collisions with aerial structures and electrocutions on power lines serving wind turbines have gained wide attention because significant numbers of legally protected raptors were injured or killed at Altamont Pass, California. Birds may collide with spinning or stationary turbine blades, towers, or guy wires. They may be electrocuted when perching or

roosting on new power lines, riser poles, or substations. A great deal of attention is being focused on bird behavior, perceptions, and how to assess potential and actual impact.

Indications are that there have not been similar occurrences elsewhere in the United States. Much has been learned from the problems experienced in California, and wind farms subsequently have been better designed and sited to minimize their impacts on birds. Northern States Power (now Xcel Energy) commissioned an avian impact study of its large wind projects near Lake Benton, Minnesota. Over a four-year period, 55 bird fatalities related to the wind installations were recorded. While these deaths are regrettable, it is not a number that will have any significant impact on bird populations in this area. The landscape of rural Illinois and the style of wind turbines most likely to be erected there have much more in common with southwest Minnesota than the mountain passes of California. Full results from *Avian Monitoring Studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a 4-Year Study* are available at <[www.eqb.state.mn.us/EnergyFacilities/wind.html](http://www.eqb.state.mn.us/EnergyFacilities/wind.html)>.

#### *Mitigating Avian Impact*

A number of steps are commonly required of new wind projects. How intensively they are performed depends on the scale of the project and its location. They include a preconstruction review of whether and what kinds of species use the site and immediate area. For larger projects, this may include an expensive yearlong field study. Many smaller projects don't need anything beyond a review of existing information with state wildlife officials. If a single turbine project would be located "in harm's way," a greater degree of concern and scrutiny would be expected. The likely impact on birds is estimated, and decisions are made about what to do: Go ahead as planned, proceed with modifications

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to the plan, or not build. If there are avian concerns, permits usually include an ongoing impact monitoring requirement and a periodic review of actual results.

An “Avian Risk Assessment” was performed for the Crescent Ridge Wind Power Project in Bureau County, Illinois, in 2002 using information about known bird risks from North America and Europe and observations of the proposed wind farm’s site. It was concluded that installing wind turbines at that location would have no significant adverse impact on bird populations. The project site is spread over five to six sections of actively cultivated farmland, is host to nearly a dozen houses and outbuildings, and is transversed by several asphalt and gravel county roads. The risk for birds in this area was determined to be low because there is little habitat for endangered species, threatened species, or raptors. Also, the site is not in a migratory pathway, and avian use of the area for nesting and foraging appears to be low. The design of the project will also mitigate bird impacts by widely spacing the turbines and using tubular towers, which do not attract perching raptors as lattice towers do. This study demonstrates some of the bird risk factors that should be considered when planning a project in Illinois. The complete study is available on the Crescent Ridge Wind Farm’s website: <[www.crescentridgewind.com/avianstudy.pdf](http://www.crescentridgewind.com/avianstudy.pdf)>.

The death of any animal is unfortunate and should be avoided whenever possible. Biologists remind us that rather than focusing on the number of individual birds killed, it is important to place the issue in the context of the total population. The deaths, regrettable as they are, may not have any biological significance.

For a more complete discussion of wind energy’s impact on birds, see the National Wind Coordinating Committee’s Avian/Wind

publications at <[www.nationalwind.org/pubs/default.htm](http://www.nationalwind.org/pubs/default.htm)>.

### *Wildlife and Habitat Loss*

Wind project developers must also be sensitive to other kinds of wildlife and wildlife habitat when choosing sites for wind turbines. Although wind farms in agricultural areas are unlikely to have significant impacts on wildlife or habitat, it is still necessary to study the issue. The U.S. Fish and Wildlife Service recently released a set of voluntary guidelines for wind developers to follow for the purpose of minimizing impacts on wildlife (July 2003). The guidelines address three key areas: proper evaluation and selection of potential sites for wind energy facilities; proper location and design of turbines and associated structures within the site areas; and research and monitoring to assess impacts of the project on wildlife. The guidelines are available online at <[www.fws.gov/r9dhcbfa/windenergy.htm](http://www.fws.gov/r9dhcbfa/windenergy.htm)> or by contacting the USFWS at (800) 344-WILD.

### **Construction**

Wind systems can involve the transportation of large and heavy equipment. For example, cement mixing trucks and large cranes need access to the tower foundation. These vehicles can compact soils and damage roadways not built to handle their weights. Unpaved public roads are likely to have weight restrictions during rainy seasons and spring thaws, but frozen roads are good for carrying high loads. Turbine components need to be placed close enough to the tower for a crane to reach while the project is being built, when major rebuilding or large component replacements occur, and when the turbine is being dismantled. This can cause a large, temporarily disturbed area near the turbines. Soil excavated for foundations and construction waste must also be stored, recycled, or disposed of properly.

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Erosion is another potential environmental problem that can stem from construction projects. In addition to increased siltation of streambeds, alteration of stream courses, and increased flooding that can accompany it, erosion can leave deep scars on the land. Wind companies can reduce the risk of serious erosion by minimizing the amount of earth disturbed during construction, principally by eliminating unnecessary roads, avoiding construction on steep slopes, allowing buffers of undisturbed soil near drainages and at the edge of plateaus, ensuring revegetation of disturbed soils, and designing erosion-control structures adequate to the task.

The single most reliable technique for limiting erosion is to avoid grading roads in the first place. The Bureau of Land Management's Ridgecrest, California, office suggests that driving overland, rather than grading roads, to install and service turbines will significantly lessen erosion damage. Instead of using wide roads graded to bare earth, British, German, and Danish wind plant operators use farm tracks to service their wind turbines. This "tread lightly" practice minimizes erosion and the scarring it creates.

### **Land Use**

While wind systems require large open spaces for wind access, they actually use very little land, roughly a quarter acre for one

large turbine. The need to maintain wind access means the intervening lands cannot be improved by anything that obstructs the wind. The impact of a wind system is directly related to the size of the footprint on the land. Turbine pads, construction areas, guy wires and tilting towers, corridors for power lines, access roads, and foundations for electrical equipment all take up space. Sometimes the surrounding land is in a productive economic use that requires specific access for farming equipment. The footprint area might also encroach on a wildlife habitat or a fragile ecosystem.

Wind developers should consider how the land is used when siting facilities. Although the turbines themselves do not take up much room, their placement and the placement of access roads and other related structures affect the landscape. In natural areas, this means working to minimize impacts on wildlife and habitat (as previously discussed above). On farmland, this means placing wind energy facilities with the farmer's needs in mind. For example, roads should be placed along fence lines or other natural barriers whenever possible to avoid carving up fields. Landowners planning to lease land to a wind developer should stay involved with the siting process to make sure turbines and roads will not interfere with farm operations or other activities on the land.

### **Dismantling and Restoration**

At the end of a project's life, nobody wants an eyesore to develop in the form of a derelict turbine. This is an aesthetic and safety issue that must be dealt with upfront. Once a turbine is removed, restoring the project site to a usable condition is important. A common issue is determining how much of the foundation will be removed in the end. Developers often commit to removing foundations to several feet below the ground. The cost of these



Wind turbine on a farm in Iowa

Photo by Lisa Daniels

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activities and how to pay for them needs to be considered.

### **Addressing Siting Issues**

There are many ways to address the issues cited above; they all become part of project planning. Many of the responses below are used by permitting agencies but, even if not, they can be effective ways to ensure that any project is successful from all perspectives.

#### *Setbacks*

Maintaining distances from various features is an effective tool with several uses. Turbines can be located away from residences to reduce noise impact, and away from public rights-of-way and locations frequented by people for safety reasons. Maintaining a distance from environmentally sensitive areas is common. Space is required between turbines and other wind obstructions. Lastly, turbines may need to be located away from aesthetic vistas, cultural or historic sites, and landmarks. Setbacks might be dictated in local zoning ordinances; it is important to check if your community has setback regulations in the early stages of designing your project. See Chapter 4 for more information on who to call to investigate setbacks in your community.

#### *Project Design*

There are many aspects of project design that affect land use, environmental issues, and permit issues. Turbines are usually painted a neutral or subdued color and are free of advertising. Projects typically have minimal signage but post appropriate warnings and emergency contacts. Turbines can be selected for low noise output. Tubular towers have become common due to aesthetics, easy winter maintenance access, and diminished opportunities for birds to perch. Fluids can be used in turbines in electrical equipment that will not be hazardous when spilled on

the ground. Appropriate fencing, gates, locks, warning signs, equipment enclosures, anti-climb provisions, and guy wire markings are common features contributing to safety. Use of proper erosion and drainage controls is common as well. Project footprint can be minimized by using preexisting roadways and rights-of-way, putting turbine foundations next to roads, placing electric lines underground, using existing rights-of-way for electrical wiring, using towers that don't tilt or require guy wires, and mounting accessory electric equipment on turbine foundations.

Projects should be designed to minimize impact on other uses of the land. Roads should be placed along property or fence lines to avoid isolating small portions of land. Landowners should stay involved with project design, keeping in mind how wind energy equipment will affect farm or ranching operations.

#### *Project Plans*

Various plans are used by developers and permitting authorities to organize activities and ensure that they are done properly. Depending on the scale and type of project, a plan can range from involving basic discussions and coordination with another person or agency to preparing detailed documents that must be formally approved and monitored for compliance. They include plans for transportation routing, roadway maintenance, and repair; temporary construction area definition, timing of use, and restoration; how and when to do bird impact surveys during operations; erosion control; handling fluid spills; routine maintenance procedures, including what to do with used lubricants and bad parts; restoration of vegetation and prevention of noxious weeds; how to deal with historical or archaeological artifacts which may be found; and project dismantling and site restoration procedures.

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*In Summary*

Just because a site is windy does not necessarily mean it is suitable for wind turbines. Once you have considered the full range of factors involved in siting a wind project—and received input from appropriate experts—you can decide whether your land is right for a turbine. Then you, too, may be able to harness the wind.

For additional information about siting and permitting of wind turbines, we recommend the National Wind Coordinating Committee's *Permitting of Wind Energy Facilities Handbook* (2002). The publication is available online at <[www.nationalwind.org/pubs/permit/permitting2002.pdf](http://www.nationalwind.org/pubs/permit/permitting2002.pdf)> or by contacting . . .

National Wind Coordinating Committee  
c/o RESOLVE  
1255 23<sup>rd</sup> Street, Suite 275  
Washington, DC 20037  
(888) 764-WIND  
[www.nationalwind.org](http://www.nationalwind.org)

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## Chapter 4. Know What Fits Your Community: A Guide to Permitting and Taxation of Wind Turbines in Illinois

If you have good wind resource and land that is well-suited for wind turbines, you still must consider how your community views and regulates wind power. Neighbors might have questions about how turbines will look on the landscape or how they affect property values. Communities around the country are working to find the best ways to permit and tax wind generation facilities. These issues are vital to windy areas because they determine the impacts and benefits of wind energy projects for the broader community. Some states, like Minnesota, have developed statewide policies, while other places, like Illinois, have left permitting and zoning decisions to counties. This chapter will summarize wind energy ordinances and taxation policies in place in Illinois counties through 2003, but we expect many more regulations to be established as wind energy continues to emerge in Illinois and in the United States. You must also consider the availability of transmission lines and transmission line capacity.

### Neighbors

Often, neighbors are concerned about wind project aesthetics, noise, and whether having a wind farm nearby will reduce the value of their property (see discussion in Chapter 3). Turbines do make some sound and tend to be very visible on the landscape; therefore, they can have an impact on humans. Be sensitive to your neighbors. Talk to them ahead of time and find out their concerns. If possible, place your turbines where neighbors will not see or hear them as much. Talk to other wind turbine owners to find out what concerns their neighbors had and how they addressed them.

### Zoning and Permitting

Any wind turbine is subject to local zoning laws. You can learn more about these laws by consulting your local county officials or a lawyer familiar with your jurisdiction. If the zoning in your area does not allow high towers, you will need to obtain a special permit from your local planning commission. Investigating zoning laws early on in the development of your wind project can help avoid unnecessary delays. When wind energy expands into a new region, many cities, counties, and even states formulate new

zoning and permitting laws specifically to address the siting of wind turbines. These laws can significantly influence the pace and practicality of wind energy development as well as how the broader community will benefit from wind energy investment. Overly restrictive zoning and permitting laws can discourage development even in areas with good wind resources while a law intended to encourage wind energy development can backfire if its effect is to reduce tax revenue for the community or diminish protections for neighbors of wind projects. Some states also have requirements based on the size of electric generating facilities. For example, 5 MW or larger projects in Minnesota must receive a permit from the Minnesota Environmental Quality Board (EQB), which requires an environmental impact statement (EIS). State permits usually supersede local zoning laws.

As wind energy grows in Illinois, the permitting of wind turbines has become a somewhat controversial issue in some areas. At the state level, Illinois has implemented a number of strong incentives for renewable energy that have fueled much of the recent interest in developing wind energy in the state. As new wind projects are proposed, many of the affected counties are establishing



Wind turbines have become part of the landscape in Iowa.

Photo by Lisa Daniels

their own zoning and permitting laws. Below we have outlined the permitting activities of counties where there has been interest in developing large wind projects. We have also included contact information for officials in each county who are knowledgeable about the permitting process.

The National Wind Coordinating Committee's *Permitting of Wind*

*Energy Facilities Handbook*, referred to in the previous chapter, provides more information on this topic as well as permitting case studies from around the country. Part IV of this handbook includes a case study of the permitting process for a large wind farm in Bureau County, Illinois.

### **Permitting in Illinois**

The permitting process is the stage of a wind project most likely to receive public scrutiny. As wind energy grows in Illinois, permitting of wind turbines has become a highly controversial and emotionally charged issue in some areas. At the state level, Illinois has implemented a number of strong incentives for renewable energy (see Chapter 5 for more information) that have fueled much of the recent interest in developing wind energy in the state. As new wind projects are proposed, many of the affected counties are establishing their own zoning and permitting laws. The following is a summary of permitting regulations in place in Illinois. Prospective

wind developers in other Illinois counties can look to these regulations as precedents, but should understand that rules will likely continue to vary from place to place unless a statewide law is adopted. Under this system, rules for wind turbines and other tall structures (such as cell towers) could be similar or completely different on a county-by-county basis.

#### *State Level*

An important item to note for permitting wind turbines is the Illinois state law exempting "Agricultural Use" additions from zoning. A person interested in installing a turbine on his or her property would need to demonstrate that the turbine will be used for farm operations. This would be the best course of action for most farmers interested in placing a smaller turbine (under 100 kW) on their farm.

#### *Counties*

The following is a list of counties in Illinois that have wind projects in the planning stages or under construction. A number of them have adopted new ordinances pertaining to wind energy facilities. In many cases, these counties have zoned wind turbines and meteorological data collection towers (met towers) as Special Use in areas zoned for agriculture. You should consult your county planning office to determine what kind of zoning applies to the property you are interested in using for your wind turbine or meteorological data collection tower and if there are any other relevant ordinances.

- Boone County

Troy Krup  
Director of Planning  
601 N. Main Street  
Belvidere, IL 61008  
(815) 544 5271

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*Overview:* Ordinance language was added in 2002 to allow wind turbines and met towers as Special Use in the county. As of the summer of 2003, there are no wind turbines permitted, although there are several met towers permitted in the northern part of the county for a wind development company called enXco.

*Met Tower Permits:* Special Use in A-1 districts. After receiving your Special Use permit, the project will require a building permit. A professional engineer from the State of Illinois must sign the drawings/load calculations as meeting Illinois code for wind loading for that area of the state (80 mph).

*Wind Turbine Permits:* Special Use in A-1 districts

- Bureau County

Planning and Zoning Department  
700 S. Main Street, Room B-5  
Court House  
Princeton, IL 61356

*Overview:* See Case Study #3 in Part IV of this handbook for more information about permitting in Bureau County.

- DeKalb County

Paul Miller, Director of Planning  
110 E. Sycamore Street  
Sycamore, IL 60178  
Hours: 8:30 A.M. - 4:30 P.M.  
(815) 895-7188  
Fax: (815) 895-1669

*Overview:* No language was added to the ordinances for wind turbines, rather they are considered as possible Essential Public Services in Section 4.02 of the Ordinances, Item K. It is up to the person applying for the Special Use zoning to

demonstrate that it fits this category. Special Use applications all follow Article 9 procedures, again contained in DeKalb County's zoning ordinances (available at [www.dekalbcounty.org](http://www.dekalbcounty.org)). It will be a three-month process to obtain a permit with fees in the \$500-\$600 range for a smaller project and the \$1,000-\$1,500 range for a larger project. Conditions can be applied as the planning board sees fit.

In 2003, wind project development company FPL Energy received a permit for a large wind project of 30 turbines near the Lee County border. There are several permitted met towers in the county that have been placed by various developers over the past few years. The planning office is aware of one smaller turbine operating in the county; it was not required to have a permit because it was demonstrated to fall under the state zoning exemption for items strictly used for agriculture.

*Met Tower Permits:* Special Use in A-1 districts

*Wind Turbine Permits:* Special Use in A-1 districts

- Jo Daviess County

Linda Delvaux  
Jo Daviess County Zoning  
791 US Route 20 West  
Elizabeth, IL 61028  
(815) 858-3810

*Overview:* No permits have been issued for wind turbines as of July 2003. Some developers have expressed interest in a few of the windy ridge tops.

*Met Tower Permits:* Require a building permit.

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*Wind Turbine Permits:* Special Use in A-1 zoned areas; falls under public service or radio tower category of Special Use

- Lee County

Chris Henckel  
Lee County Zoning  
112 E. 2nd Street  
Dixon, IL 61021  
(815) 288-3643

*Overview:* Lee County was one of the first places in Illinois to catch the attention of wind developers due to a large ridge system in the north and central parts of the county, divided by Interstate 39. Several developers already have projects in the planning stages. Navitas Energy was awarded a grant from the Illinois Clean Energy Foundation in 2002 to develop a 50 MW project, and as of October 2003, 63 Gamesa 800 kW turbines on 212 feet towers were under construction. (See Case Study #7 in Part IV of this handbook for details about this project.) FPL Energy has a permit for 34 1.5 MW turbines for a project near the eastern border of Lee County, close to DeKalb County. Forever Power of Sublette, Illinois, is planning a 25 MW project near its hometown and has a permit for 27 turbines (size is not known). There are met towers at each of these project sites.

*Met Tower Permits:* Need a building permit. Walk into the county office (address above) and submit a site plan and met tower information along with the permit fee.

*Wind Turbine Permits:* Special Use permits are required for turbines placed in Ag-1 zoned areas. The fee for a permit is \$25 per foot of tower height to the hub. This is per tower, so it would be quite expensive to obtain a permit for a large project. Also note that the setback from residences is set for these permits at 1,400 feet, with a 600

feet setback exception if the landowner signed a document giving such permission. Road setbacks are 500 feet, and adjoining property setbacks are height of tower and rotor plus 10 percent (unless the adjoining landowner wishes to wave this exemption).

- McLean County

Phil Dick, Director of Planning and Zoning  
Mike Behary, County Planner  
104 W. Front Street  
Bloomington, IL 61702  
(309) 888-5160

*Overview:* There is a large glacial moraine that creates a ridge on either side of Bloomington-Normal. Several wind developers have focused on the east side of the moraine. There are three developers with met towers installed, enXco, Invenergy LLC, and Zilkha Renewable Energy. None of the developers have applied for a Special Use permit as of July 2003. The county has added language to their ordinances on wind turbines. They are classified as Utility Major, and page 133 of the ordinances addresses the restrictions.

*Met Tower Permits:* Requires a building permit. A professional engineer must sign the drawings/load calculations as meeting Illinois code.

*Wind Turbine Permits:* Special Use permits are required for turbines placed in Ag-1 zoned areas. Additional requirements stated in the Utility Major category on page 133 of the zoning ordinances include the following:

- Setbacks of 2,000 feet from R-1 or R-2 zoned properties
- Height of tower and blades not to exceed 450 feet except if within 1.5 miles of the corporate limits of a municipality of

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25,000 or more; it then shall not exceed 200 feet— This means that you cannot put up a utility-scale turbine within 1.5 miles of the Bloomington-Normal boundaries, given the heights of towers used for large turbines.

Additional provisions are stated, but apply to most all turbine projects put up in the Midwest. For example, FAA lighting as required, PE certification of the tower foundation design, etc., are typical for nearly all turbine installations.

- Pike County

Marvin Paxton, Zoning Administrator  
100 E. Washington Street  
Pittsfield, IL 62363  
(217) 285-1363

*Overview:* A large project in Pike and Adams Counties was announced in 2002 by Chicago-based developer Invenergy and St. Louis-based Innoventor; it could be delayed, however, due to difficulty in finding a buyer for the electricity willing to pay the desired price.

*Met Tower Permits:* Require a building permit.

*Wind Turbine Permits:* Special Use permit required in A-1 zoned areas.

- Stephenson County

Terry Groves, Planning Director  
295 W. Lamm Road  
Freeport, IL 61032

*Overview:* In the past year, several developers have approached the county with a variety of sites they are studying for wind projects. Navitas Energy has three sites throughout the county, and Zilkha Renewable Energy has a site on the north

edge of the county that borders with Wisconsin. Both have met towers collecting wind data, but neither has applied for a Special Use permit. The county now has a wind turbine siting ordinance under consideration by its zoning board. (All this is as of July 2003.)

*Met Tower Permits:* Require a building permit.

*Wind Turbine Permits:* Special Use permits are required for turbines placed in Ag-1 zoned areas. The siting ordinance is in process; it could include language requiring a 700 feet setback from homes.

## **Taxation**

For large privately owned wind projects, property taxes are the main way the larger community benefits from investment in wind power. A 50 MW project roughly represents a \$50 million investment; however, if the project is owned and operated by a company based outside the local community, a large percentage of that money will not stay in the local economy. Of course, some of the money will go to landowners hosting the turbines and local people who work on the construction or operations of the project. Even so, the broadest benefit of large wind energy projects for most communities will be through taxes.

Illinois law makes counties responsible for determining how to tax wind energy facilities. Among the decision each county must make is how to define the split between real estate taxes and personal property taxes that an assessor would use to assess a wind turbine. A law passed in 1979 compels counties to base assessments on precedents. That is, counties must tax wind turbines in the same way and at the same rate similar structures were taxed in the past. As modern wind turbines are quite different in size and function than anything that has come before, this law leaves quite a

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bit of room for interpretation by individual counties. In Illinois, counties could find a wind turbine to be anywhere from zero to 100 percent real estate, and, thus, the tax could be anywhere from nothing to an amount so high that it could make a wind project uneconomical!

There are several counties in Illinois that have actively investigated how to tax wind turbines, but most have not yet reached that point. The Lee County assessor has hired a lawyer and done historical research to determine how much of a wind turbine is real estate. They determined the taxable items are the foundation and the tower, and, thus, the taxable amount of a wind turbine is in the range of 28-30 percent of construction costs. Construction costs are the costs to purchase and install the wind turbine and electrical equipment, estimated in the range of \$1,000-\$3,000 per kilowatt of capacity. The larger the project, the lower the cost per kilowatt will be. Large wind farms cost approximately \$1,000 per kilowatt. Thus, a \$1 million project would have about \$300,000 of its value assessed as real estate. A little less than one-third of that amount, or \$90,000, is taxable. The current tax rate in Lee County is \$7 per \$100 of taxable property; therefore, the tax would be \$6,300 per year for that hypothetical \$1 million dollar wind project. These amounts will likely change over time because the county assessor can boost the assessed value or the tax rate can be increased to pay for a new school or other infrastructure. Bureau County has plans to follow the lead of Lee County in determining a tax structure for wind turbines.

You should call the local county assessor and find out what the tax amount will be for a project in your county. They may require several months to research this, or they may follow the lead of other counties (but possibly have a lawsuit in the future that still require a change).

Some states have avoided the uncertainty of allowing each county to establish its own wind energy facility tax structure by adopting statewide rules. Some states, such as Wisconsin, have chosen to make wind energy facilities exempt altogether from property taxes in order to encourage more development in the state. In states where wind turbines are exempt from property taxes, wind project developers often offer to pay counties a stipend as a gesture of good will. Minnesota originally taxed wind installations through property taxes, but faced difficulties with annual assessments of personal property. As a result, the counties hosting wind projects, the wind industry, and state agencies worked out the current system of taxing wind energy production at rates based on the size of the project. This allows counties to receive more consistent annual revenues and relieves the complicated assessment problems. Counties also have the advantage of a steady cash flow for the entire life of the project rather than declining revenue from the depreciating value of the property.

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## Chapter 5. Wind Energy Economics: An Overview of Wind Energy Economics, Financial Incentives, and Tools for Analysis

In years past, momentum for wind energy was largely based on its identity as a clean, emissions-free energy technology that could help us have cleaner air and water while conserving our natural resources. Today, wind energy is seen as a growing industry with a host of new economic opportunities for rural landowners and communities, while the environmental benefits are nearly taken for granted. As wind energy grows to be a significant electricity source, economics are becoming the bottom line for landowners and communities deciding whether or how to become involved.

### Risks and Rewards

There are many ways to take advantage of the economic benefits of wind energy. Individuals can save money on their energy bills or even make money by generating electricity with a small wind turbine. Landowners can earn money from the wind in many ways—from leasing out land to a wind development company to building their own commercial-scale wind turbine. Communities can diversify their economies and enjoy greater reliance on local resources when their members invest in wind. Of course, a wind project will provide these advantages only if the economics have been thought through in advance. Wind power can be lucrative, but markets can also be competitive and the margins can be tight. Like any investment, wind energy projects require some research and a basic understanding of the risks, costs, and benefits involved.

#### Risks

Every financial investment carries with it a certain amount of risk, and wind energy is no different (Figure 10). There are basically three ways of investing in wind projects, each of which entails a different level of risk:

**Leasing Your Land.** The least risky way to harvest the wind is to let someone

else put up the capital and operate the wind project. You receive payments for the use of your property, while another party constructs and maintains the project. That party owns the turbine; you simply retain the rights to the use of your land.

**Investing with Others.** You can share the risks of a wind energy project by investing with others. The advantage to this approach is that you can share responsibilities and costs as well as profits and control.

**Investing on Your Own.** The most risky method is to install and maintain your own turbine or turbines. You assume all the costs and responsibilities, but you also reap all the profits and have full control over the project.

**Figure 10. Wind Development: Risk and Reward**



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## *Costs*

There are several components in the cost of a wind project. They include the cost of the turbine itself, construction costs, interconnection fees, metering equipment, maintenance and repair, and any consulting services you use. How much your wind project costs will depend on your financing arrangements, the size of your project, and taxes. In general, larger turbines and larger projects benefit significantly from economies of scale. That is, a 1,000 kW turbine will cost less to install per kW of capacity than a 10 kW turbine. And installing several, dozens, or hundreds of turbines will usually cost less per kW of capacity than installing a single turbine.

As you go about planning your wind project, you must estimate these costs. Some will be straightforward: You can contact a turbine manufacturer and find out how much a particular turbine and tower costs. (Consult the resources section at the end of this handbook for information on how to contact turbine manufacturers.) Others will be less definite: You can't accurately know ahead of time exactly how much maintenance and repair your turbine will require, though you can talk to other owners of a similar turbine. There are some general guidelines to help you estimate costs in Chapter 9.

Over the last 25 years, policymakers have increasingly recognized the environmental and economic benefits of wind energy and, as a result, they have developed many incentives for wind energy investors at the state and federal levels. In Arizona, Iowa, Massachusetts, Minnesota, Nevada, New Jersey, North Dakota (systems larger than 100 kW), Ohio, Rhode Island, Vermont, Washington, and Wyoming, you will not pay state sales tax for your wind energy system. Small projects are often exempted from state permitting procedures. Some states also provide low-interest loans for wind projects, exemption

from property taxes, and accelerated rates of depreciation for renewable energy equipment. These and other incentives may help to reduce your wind project costs. Because wind turbines are business investments, they can often bring substantial tax savings to their owners. For example, the federal government currently offers a 1.8¢/kWh tax credit for energy generated by wind turbines, available for projects installed by December 2003 for the first ten years of operation. (It is widely hoped and expected that this tax credit will be extended as it has been several times in the past.) The tax credit is adjusted for inflation, so it will rise over time. This and other incentives and funding opportunities in Illinois are detailed later in this chapter.

## *Benefits*

The economic rewards of owning or leasing land for a wind turbine operation fall into four categories: (1) the electricity you do not have to pay for (because you are producing it yourself), (2) revenue you receive for selling energy you produce, (3) tax savings and state and federal incentives, and (4) land lease payments.

You may not necessarily enjoy all of these rewards. For example, with a small turbine you might produce enough electricity to substantially reduce your own needs, thus lowering your electric bill considerably, but you might not have excess to sell. Offsetting your electric use can still be an economic gain, however, even if you are not receiving a check for your turbine production.

With a small- or middle-sized turbine, you might sell excess energy to your electric company. Your turbine will first supply your own power needs on site and then any excess generation can be fed into the grid. Under a system called net billing or net metering, when your excess power reaches the grid, your meter will run backwards. If at the end of the billing

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period you have generated more electricity than you have used, your electric company will pay you for the difference. Thirty-six states across the U.S. currently have some type of net billing provision for wind turbines. Illinois is counted among these states, though net metering is only available on an experimental basis to ComEd customers. Eligibility requirements for net billing programs vary widely from state to state; most have size limitations (projects under 40 kW in Illinois).

The retail rate is simply the price residential customers pay to buy electricity. The avoided cost is the estimated cost the utility would incur to produce an incremental amount of extra generation. The retail rate is higher than avoided cost. Federal laws have historically required utilities to buy electricity from large wind systems only at their avoided cost, although restructuring of the electric industry is opening some additional purchasing options. Avoided cost rates can be quite low—under 2¢/kWh in some areas.

If you own or are a part owner of a commercial-scale wind project, a major benefit will be revenue from selling electricity. In the planning stages of a wind project, a crucial step is securing a power purchase agreement (PPA), usually with an electric utility. A PPA obligates the agreeing entity to buy your electricity at a certain price for a certain number of years.

Various state and federal tax incentives are available for all kinds of projects; however, to take advantage of these benefits, it is necessary to thoroughly understand the eligibility requirements and to set up your project accordingly.

For landowners who lease land for wind turbines, economic benefits come in the form of payments that range from one-time lump sums, to regular annual payments, to royalties based on project revenue percentages.

## **Economic Incentives and Financial Assistance Programs**

The cost of wind energy has fallen dramatically since the modern era of wind energy technology began in the early 1980s. Although specific costs vary from project to project and from region to region due to differences in markets, wind resources, and economies of scale, the American Wind Energy Association estimates that the average cost of wind power has decreased by 90 percent over the past 20 years. At this point, a well-sited wind farm can be cheaper than any other new source of energy generation. As technology continues to improve and the market for wind energy grows, this downward trend in costs is likely to continue for some time.

As with all energy technologies, wind power greatly benefits from supportive public policy. Incentive programs help broaden and develop markets for wind-generated electricity. There are a number of federal programs outlined here that benefit wind energy.

### *Federal Incentives*

**Wind Energy Production Tax Credit.** The Wind Energy Production Tax Credit (PTC) is a per kilowatt-hour tax credit for wind-generated electricity sold. Available during the first ten years of operation, it provides 1.5¢ per kWh credit adjusted annually for inflation. The adjusted credit amount for 2002 is 1.8¢ per kWh. Note that the PTC is only available for electricity sold to another party; thus, a turbine generating electricity for use on the owner's farm does not qualify. Enacted as part of the Energy Policy Act of 1992, the credit, which had expired at the end of 2001, was extended in March 2002. The credit is set to expire again December 31, 2003. Although there is broad support for another extension of the PTC, efforts have been unsuccessful so far. (Current as of October 2003.) A long-term extension of the PTC would provide much

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needed stability to the wind industry because it would allow for long-term planning.

The tax credit applies to all wind power facilities owned by a tax-paying entity. For non-tax-paying entities, such as municipal electric utilities, a separate provision, the Renewable Energy Production Incentive (REPI), provides a direct payment based on annual energy production. Although designed to be comparable with the PTC, the exact level of the REPI is contingent on annual appropriations from Congress, and it is considered a less certain subsidy than the PTC.

The value of the PTC is reduced if the facility owner also receives certain types of local or state financial incentives such as initial-cost buydowns or investment tax credits. Wind and biomass facilities, as well as other renewable energy facilities, also benefit from an accelerated capital cost depreciation schedule of five years.

The rules associated with this credit limit the type of tax liability that can be offset. You will need a tax attorney to help ensure that your project will be able to use the credit.

For more information and updates on the status of the PTC, visit <[www.windustry.org/resources/legislation.htm](http://www.windustry.org/resources/legislation.htm)>.

**Federal Renewable Energy Production Incentive.** The REPI provides financial incentive payments for electricity produced and sold by new, qualifying renewable energy (including wind) generation facilities. Eligible electricity production facilities are those owned by local and state government entities, such as municipal utilities, and not-for-profit electric cooperatives. Qualifying facilities are eligible for annual incentive payments of 1.5¢ per kilowatt-hour for the first ten-year period of their operation. This incentive is not considered bankable since it must be appropriated each year by Congress. It is set to

expire in the fall of 2003 if Congress does not take action to renew the program.

**U.S. Department of Agriculture Renewable Energy Systems and Energy Efficiency Improvements Program.** The 2002 Farm Bill's Energy Title provides \$23 million per year from 2003-2007 in the form of grants, loans, and loan guarantees for renewable energy (including wind) projects. Only the grant program was implemented in 2003. According to 2003 guidelines, applicants for the program must be agricultural producers or rural small businesses, U.S. citizens or legal residents, and have demonstrated financial need. Rural Development grant funds may be used to pay up to 25 percent of the eligible project costs. Eligible projects include those that derive energy from a wind, solar, biomass, or geothermal source, or hydrogen derived from biomass or water using wind, solar, or geothermal energy sources. Awards will be made on a competitive basis for the purchase of renewable energy systems and to make energy improvements. New guidelines and rules will be implemented for the next round of applications in 2004 and subsequent years.

In August 2003, the USDA announced winners from the first round of grant applications. Over \$21 million was awarded for projects in 24 states. Minnesota led all states with \$4,678,632, followed by New York (\$2,878,027), Illinois (\$2,186,596), and Ohio (\$2,043,612). Many grants will support wind projects, including small residential-scale turbines, farmer-owned utility-scale turbines, and rural electric cooperative wind projects.

For a complete list of 2003 award winners, see <[www.rurdev.usda.gov/rd/newsroom/2003/renew\\_en.html](http://www.rurdev.usda.gov/rd/newsroom/2003/renew_en.html)>.

USDA press release:  
[www.rurdev.usda.gov/rd/newsroom/2003/9006awardees.html](http://www.rurdev.usda.gov/rd/newsroom/2003/9006awardees.html)

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For more general information, visit [www.windustry.org/resources/farbill.htm](http://www.windustry.org/resources/farbill.htm) or contact . . .

USDA Rural Development State Office – IL  
Illinois Plaza, Suite 103  
1817 S. Neil Street  
Champaign, IL 61820  
(217) 398-5235  
Fax: (217) 398-5337

**Depreciation.** The federal aligned accelerated cost recovery system helps businesses recover investment in renewable energy. Wind has a five-year depreciation schedule under this program. (I.R.C. Subtitle A, Ch. 1, Subch. B, Part VI, Sec. 168 [1994]).

**Public Utilities Regulatory Policy Act of 1978 (PURPA).** PURPA was enacted as part of the National Energy Act of 1978, during a time of unprecedented energy supply instability in the United States. The law requires utilities to purchase energy from non-utility generators or small renewable energy producers that can produce electricity for less than what it would have cost for the utility to generate the power, or the “avoided cost.” Although once considered a key incentive for renewable energy, PURPA is less helpful for renewable energy today due to lower baseload fossil energy prices.

#### *Opportunities in Illinois*

Illinois ranks 16th among the contiguous states in wind energy development potential (Pacific Northwest Laboratory 1991), and as discussed in Chapter 2, there are several areas of the state with good wind resources, specifically a total of 6,790 km<sup>2</sup> with 6,980 MW of potential wind energy. This, coupled with a number of strong incentives and programs available in Illinois, make the state an attractive place for wind development.

Many factors have helped Illinois establish several solid incentive programs for renewable energy, including state policies, utility initiatives, and consumer demand.

#### **State Tax Incentives**

*Special Assessment for Renewable Energy Systems.* Illinois has a property tax provision that provides for a special assessment of renewable energy systems. Renewable energy equipment is valued at no more than conventional energy system equipment. The special assessment provision applies to passive solar space heat, solar water heat, active solar space heat, photovoltaics, wind, and geothermal electric equipment in industrial, commercial, and residential sectors.

#### **Other Financial Incentives and Funding Programs**

*Net Metering.* Illinois does not have a statewide net metering law, but the state’s largest utility, ComEd, an investor-owned utility serving the city of Chicago and surrounding areas, implemented a limited net metering program in 2000. The program allows for net metering of wind and solar electric systems of 40 kW or less and is available to all customer classes. Enrollment is limited to installed capacity of 0.1 percent ComEd’s peak annual demand. The utility will purchase net excess generation at avoided cost on a monthly basis. Then, to make up the difference between the avoided cost rate and the retail rate, ComEd will make an annual payment to participants calculated by multiplying the difference in price by the number of kilowatt-hours provided by the customer to the utility. This payment system requires the use of dual meters, thus ComEd has agreed to pay the cost of reading and installing the additional metering equipment needed. A small wind turbine owner who is taking advantage of this program is profiled in Part IV of this handbook.

*Renewable Energy Resources Trust Fund.*  
This \$250 million public benefits fund for

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renewable and energy efficiency was created in 1999 as part of a settlement between the State of Illinois and ComEd that allowed ComEd to merge with PECO Energy of Pennsylvania. The fund was established with a one-time payment from ComEd and is administered by the Illinois Clean Energy Community Foundation (described below). Funds are to be used only on projects within Illinois that demonstrate a benefit to the state's environment or economy. Most of the fund (\$200-\$225 million) is slated for renewable and energy efficiency programs, but at least \$25 million must be used on clean coal programs.

*Illinois Clean Energy Community Foundation.* ICECF is an independent, nonprofit, grant making foundation created with authorization from the Illinois legislature. The foundation supports efforts and projects that protect and improve the environment in Illinois. ComEd, the state's largest electric utility, provided ICECF's \$225 million endowment. The foundation's three main goals are (1) to increase energy efficiency, (2) to expand the use of renewable energy resources, and (3) to preserve and enhance natural areas and wildlife habitats throughout Illinois. Financial support for programs focused on these goals is distributed through a competitive grant making process. Nonprofit organizations, local and state government agencies, and educational institutions are eligible for grants as are some businesses planning charitable projects. Individuals are not eligible. Grants relating to renewable energy range from market development and policymaking projects to demonstration projects and installation of small wind turbines. For details on eligibility, current funding priorities, and how to apply, contact . . .

ICECF  
2 N. LaSalle Street, Suite 950  
Chicago, IL 60602  
(312) 372-5191  
Fax: (312) 372-5190  
[www.illinoiscleanenergy.org](http://www.illinoiscleanenergy.org)

*Renewable Energy Resources Program.* RERP was established to promote investment in, development, and use of renewable energy within the State of Illinois. The program focuses on fostering increased utilization of renewable energy technologies, including wind, solar thermal energy, photovoltaic systems, dedicated crops grown for energy production, organic waste biomass, hydropower that does not involve new construction or significant expansion of hydropower dams, and biogas stationary fuel cells. As the most market-ready and cost-competitive renewable energy technology available, wind energy could benefit greatly from this program. Funding for RERP comes from the Renewable Energy Resources Trust Fund described above and the program is administered by the Illinois Department of Commerce and Economic Opportunity. Funds are available in two categories: (1) the Renewable Energy Resources Grant Program for a wide range of renewable energy technologies and (2) the Renewable Energy Resources Rebate Program, which is aimed more specifically at nonprofit entities, government, and individuals installing solar energy systems.

*Renewable Energy Resources Grant Program –* Specific guidelines for this program change from year to year, so it is important to carefully review the latest information available. According to guidelines released for fiscal year 2004, the grant program is available for wind systems with 5 kW-2,000 kW of nameplate capacity under the following guidelines: (1) wind projects from 5 kW to 200 kW can receive up to 50 percent or up to a maximum of \$2.00 per watt with a maximum grant

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of \$50,000; and (2) wind projects between 201 kW and 2,000 kW can receive up to 30 percent of the project costs with a maximum grant of \$500,000. In previous years, even larger wind projects were eligible. Grant funds are only available for equipment and installation expenses, and projects must be located within the State of Illinois. This means grants will not cover project development expenses such as legal fees and feasibility studies. To be eligible, applicants must be customers of an electric or gas utility that imposes the Renewable Energy Resources and Coal Technology Development Assistance Charge. A list of participating utilities is included in the program's "Guidelines and Application," which are included as Appendix II in this handbook.

The Illinois Department of Commerce and Economic Opportunity will evaluate applications based on the cost-effectiveness and economics of proposed projects, feasibility, economic development potential, and public education benefits. Only one grant may be issued for each applicant, entity, or project, and applicants for wind projects 201 kW or greater must provide one year of "professional meteorological data collected at appropriate altitudes." Projects up to 200 kW must also provide some wind resource justification or site-specific data. (Please see Chapter 2 for ideas on how to obtain wind resource information.)

As of July 2003, the Illinois Commerce Department reported that there have not been large numbers of applications for these grants yet. Under previous grant guidelines, there were fewer than five applicants for projects over 10 MW, no applicants for projects between 1 and 10 MW, and less than ten applicants for projects under 1 MW. Two wind projects (one small and one large) that benefited from this program are profiled in Part IV of this handbook.

For questions about the application or eligibility requirements, contact . . .

Rex Buhrmester, Project Manager  
Illinois Department of Commerce and  
Economic Opportunity  
Bureau of Energy and Recycling  
Alternative Energy Development Section  
620 E. Adams Street  
Springfield, IL 62701-1615  
(217) 557-1925 or (800) 785-6055

*State Green Power Purchasing.* In 2002, former Illinois Governor George Ryan issued an executive order giving the state a goal to purchase green power for at least 5 percent of the electricity used by buildings owned or operated by agencies under the Governor's control by 2010. The amount of renewable energy purchased will grow to at least 15 percent by 2020. The executive order defines green power as electricity generated from renewable sources such as wind, solar, organic wastes, and hydropower. It excludes the burning of municipal solid waste, wood waste, or tires.

*City of Chicago Green Power Purchasing.* Two years before the state government committed to buying green power, the City of Chicago joined with 47 other local government bodies in a green municipal aggregation effort. Together, the group uses about 400 MW of electric power and plans to have 20 percent (about 80 MW) of it come from green power by 2005. In 2001, the group chose ComEd to provide the green power. The government agencies involved in this purchase are taking advantage of 1997 legislation that established a competitive electricity market in the state.

*Renewables Portfolio Goal.* Illinois passed legislation in 2001 creating a statewide goal of having 5 percent of the state's energy production and use be derived from renewable sources by 2010 and 15 percent by 2020; however, no enforcement or

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implementation provisions were included (e.g., an implementation schedule, a method of compliance verification, or a credit trading system). In 2003, the Illinois legislature is debating whether to make this goal a standard. Other states with firm commitments to renewable energy lead the U.S. in installed capacity and have established thriving markets for renewables.

### *Other Useful Policies and Incentives in Other States*

#### **Minnesota Small Wind Production**

**Incentive.** In Minnesota, wind projects under 2 MW are eligible for a payment of 1.5¢/kWh for the first ten years of production. This incentive is designed to encourage dispersed and locally owned wind projects. Minnesota is the only state in the country with this kind of incentive and, as a result, is the only state in the country to host truly farmer-owned utility-scale wind projects. One such project is profiled in the Case Studies of Part IV of this handbook.

**Minnesota Small Wind Tariff.** The Minnesota Public Utilities Commission has established a standard tariff for small wind projects (under 2 MW) in Minnesota selling power to Xcel Energy. Small wind projects in Xcel territory can expect to receive 3.3¢/kWh for their electricity.

**Iowa Renewables Portfolio Standard.** Laws enacted in 1983 and 1991 require Iowa utilities to have 2 percent of their energy from renewable sources. The state achieved this goal with 240 MW of wind installed in 1999 and has continued to be a national leader by adding new projects every year.

**Renewable Energy/Portfolio Standards.** Thirteen states have enacted some form of RES/RPS legislation around the country. Among them are Arizona, California, Connecticut, Iowa, Maine, Massachusetts,

Minnesota, Nevada, New Jersey, New Mexico, Pennsylvania, Texas, and Wisconsin. The individual laws vary widely, but all those designed to benefit wind energy (such as the Minnesota and Texas policies) have spurred large amounts of wind development.

The U.S. Senate passed a national renewable energy standard requiring 10 percent of the nation's energy to come from renewables by 2020 two years in a row (2002 and 2003); however, it is not likely that the provision will appear in any final national energy legislation this year.

#### **Tools for Economic Analysis**

Part III of this handbook, "The Opportunities," will describe many of the practical issues you will need to consider when planning your project. Much of the information presented will be useful for doing economic analysis. In particular, you will find lists of wind project cost estimates and information about financing in Chapter 9. Here we will describe some of the tools you can use to perform economic analysis as you read the next chapters of this handbook. Online tools for wind project economic analysis are available from Windustry and the National Renewable Energy Laboratory.

- **Windustry Wind Project Calculator**  
The Wind Project Calculator is a spreadsheet that was developed to assist farm owners and operators in evaluating the economics of installing a wind turbine on their farms to provide electricity for the farm and home. To use the program, you must download the spreadsheet to your computer. Then you must enter specific information about the type of turbine you are considering, the estimated annual average wind speed, information about electricity use and electric rates, and information about financing and income taxes. The program will estimate the cash

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flows for investing in a wind turbine and the rate of return on the cash investments. The Wind Project Calculator was used to produce the results presented in Scenario #1 in Part IV of this handbook.

**Note:** This is a *Microsoft Excel* spreadsheet that uses Macros. The Windustry Wind Project Calculator is available online at <[www.windustry.org/calculator/default.htm](http://www.windustry.org/calculator/default.htm)>.

- National Renewable Energy Laboratory's Wind Project Financial Calculator  
This is a Web-based levelized cost of energy calculator for wind energy projects. It is a more general tool suited for larger wind projects. Please note that this tool is free to use, but you must create a username and password in order to use the application and save your work. NREL's Calculator is available online at <<http://analysis.nrel.gov/windfinance/login.asp>>.
- Wind Powering Irrigation Analysis Calculator  
This is a version of the Windustry spreadsheet adapted specifically for irrigation applications of wind energy by Northwest SEED, based in Washington. It is available online at <[www.nwseed.org/resources.asp#calculator](http://www.nwseed.org/resources.asp#calculator)>.



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## **Part III. The Opportunities**

Now that you have learned about the factors contributing to the value of your wind, Part III will explore how you can make the most of your wind resource. Chapters in this section will address opportunities for different kinds of projects, possible business structures for wind projects, and markets for wind energy. They will also provide practical advice for planning your project. Chapter 6 will focus on small wind systems, while Chapters 7-9 will focus on large wind systems.



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## Chapter 6. Small Wind Turbines: Special Issues and Resources for Small Wind Systems

Large or small, wind energy projects essentially need the same things in order to be successful: good wind resource, a good site, an accepting community, and circumstances that cause the economics of the project make sense. There are some unique aspects of small wind systems that need to be addressed; however, this chapter describes how you can determine whether a small wind energy system is right for you. Chapters 7-9 will focus, for the most part, on large wind turbines, but the discussions will still be relevant to people interested in a small wind turbine.

### Small Wind Turbine Feasibility

When considering installing a small wind energy system, you first need determine if a small wind turbine is practical for you and your property. You need to have access to a good wind resource, your property must be suitable for a wind turbine, and local zoning codes must allow the installation of wind turbines.

### Applications

Small wind turbines are used in a wide variety of applications, from off-grid water pumping to supplementing grid power for homes, farms, or small businesses. Your goals for your wind turbine will determine what makes sense for you.

#### *Off-Grid*

Off-grid systems are most practical in areas that are far away from utility power lines. This could mean a pumping station in the middle of a large field, a remote mountain village, or a cabin in the wilderness. Power lines are quite expensive to build, and, in some cases, running new utility lines is more costly than installing a stand-alone energy system. Under these conditions, a small wind system is an economical choice. Off-grid wind turbines usually use batteries to store excess power from windy times to be used during calmer periods. Many off-grid wind turbines are also used in

hybrid systems with other technologies such as solar power or biofuel generators.

#### *Grid-Connected*

Grid-connected systems are usually installed by people looking to reduce their electricity bills or the environmental impact of their energy consumption. Grid-connected systems make the most sense in places where utility interconnection procedures and fees are not overly cumbersome and where other financial incentives are available.

### Wind Resource

To perform well, a wind turbine of any size needs to have access to decent winds; however, small wind turbines can work in some places that might not have enough wind to make a large turbine economical. For a thorough explanation of how to assess your wind resource, see Chapter 2. In general, long-term wind resource studies are not cost-effective for small machines. Your best options are to use publicly available wind data and the other low-cost options mentioned in Chapter 2 to estimate your wind resource. For small wind turbines, an average annual wind speed of at least 10 mph (4.5 m/s) is desirable.

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## Is Your Property Suitable?

### *Siting*

Beyond having good wind resource, you need to determine whether your property is a suitable place for a wind turbine. Chapter 3 included a detailed discussion about wind energy siting, but there are also a few specific things to keep in mind when considering a small wind turbine. Generally, even small turbines are best suited to areas that are not densely populated such as farms. It helps to have at least an acre of land so as not to encroach upon neighbors. The wind will vary even on your property, so you need to choose a spot that is clear of buildings, trees, and other obstructions. Since a wind turbine is a long-term investment, you also need to consider where new buildings might be constructed in the future and where new trees might be planted. It is best to choose a site for your wind turbine where it will be at least 30 feet above anything within 300 feet. You must also consider the length of the wire that will be needed to connect the turbine because a substantial amount of energy can be lost over long distances (due to wire resistance) (U.S. Department of Energy 2002).

### *Zoning*

An important step when considering a small wind energy system is investigating whether your community's zoning ordinances allow for the installation of a wind turbine. For example, many communities have ordinances restricting how high structures can be. You might need to obtain a building permit and possibly a conditional use permit or a variance if you find that your community has zoning regulations that restrict your ability to install a wind turbine. A variance refers to permission to build a structure that would otherwise be prohibited by zoning ordinances, and a conditional use permit allows you to proceed with your project if you meet certain terms.

Rural areas and agricultural zones tend to have far fewer restrictions. If you can demonstrate that the turbine will be for agricultural use, it will likely be exempt from zoning restrictions under Illinois state law.

If your community is considering passing a new ordinance pertaining to wind energy, the American Wind Energy Association has developed a model ordinance that can be used to “promote the safe, effective and efficient use of small wind energy systems.” The text is available online at [www.awea.org/smallwind/documents/modelzo.html](http://www.awea.org/smallwind/documents/modelzo.html) or it can be obtained by contacting the AWEA (see the resource section at the end of this chapter). An ordinance like this can significantly expedite the permitting process for small wind turbines.

Objections to small wind turbines raised at local zoning board hearings are similar to those raised for large wind farms. It is important that you help your neighbors understand the difference between your small wind turbine and a utility-scale wind farm. Those machines might be as much as 100 times bigger and two or three times taller than the turbine you are proposing. People in your community might wonder if the turbine will be noisy or unsightly or if it could harm birds. Chapter 3 of this handbook should also help you respond to these kinds of objections.

To learn what restrictions your community might have for wind turbines, contact your local planning office, building inspector, town clerk, or zoning board. Contact information for some county permitting offices in Illinois can be found in Chapter 4.

## **Economics**

### *Size*

The average home in the United States uses about 9,400 kilowatt-hours of electricity every year. Depending on the wind speeds

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in your area, you would need a 5-15 kW turbine to make a significant contribution to an electricity load this size (U.S. Department of Energy 2002). You can determine what size generator you need by studying your electricity bills, your wind resource, and considering what kinds of energy-efficiency improvements you can make. Wind turbine manufacturers can provide you with expected annual energy outputs of their machines at various annual average wind speeds. The turbine size you choose will also be somewhat determined by the turbine models available because there are only a few manufacturers selling small turbines in the U.S.

#### *Cost*

AWEA estimates that a 10 kW home wind energy system costs approximately \$32,000. A general rule of thumb for small wind turbines is that they will cost between \$3 and \$5 per watt to install. Larger wind turbines cost more upfront, but will cost less per watt. Taller towers also cost more, but your turbine will produce more power at the higher wind speeds, reducing the payback period. Most small turbine manufacturers provide detailed cost estimates and power production projections on their websites (listed at the end of this chapter).

#### *Will It Be Economical?*

A small wind turbine will be most economical if you have large electricity bills to offset. This will be particularly true if utility-supplied electricity is expensive in your area (10¢-15¢ per kilowatt-hour). Small wind turbines have the best chance of providing a return on the investment in states that have good incentives for the sale of excess electricity or for the purchase of the wind turbines themselves.

**Net Metering.** Nationally, most utilities are required to buy excess electricity from small wind systems at their avoided cost; however,

in many states, net metering programs compel utilities to buy back excess electricity at the retail rate. Essentially, this allows customers who generate their own power to turn their electric meters backward when they have more energy than they can use. Net metering programs vary in their rules and availability by state and by utility. In Illinois, net metering is only available through ComEd's Wind and Photovoltaic Generation Pricing Experiment program. The program is available to all ComEd customers, but is limited to generators that are 40 kW or smaller. ComEd purchases net excess generation at avoided costs plus an annual incentive payment. This program is running on an experimental and voluntary basis. Although utilities are free to set up similar voluntary programs, new legislation would be needed to require net metering programs for all Illinois utilities.

For more information on this, contact . . .  
Denise A. Bechen  
ComEd Energy Delivery Operations Center  
ESO Technical Services  
2nd Floor (02-NE-025)  
Three Lincoln Centre  
Oakbrook Terrace, IL 60181-4260  
(630) 576-6783  
Fax: (630) 576-6353  
E-mail: Denise.Bechen@exeloncorp.com

#### *Net Metering Programs in Other States.*

Thirty-seven states have some kind of net metering program: Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, and Wyoming. Some of the more innovative programs include those in Minnesota and Wisconsin where customers are paid the retail rate for net excess generation,

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and in Iowa where there is no size limit on generators that can enter net metering arrangements.

*Renewable Energy Resources Grant Program.*

The Illinois state grant program described in Chapter 5 has the potential to be particularly lucrative for small wind systems. Wind projects from 5 kW to 200 kW can receive up to 50 percent or up to a maximum of \$2.00 per watt. (Full grant guidelines are included in the Appendices.)

Under current conditions, small wind turbine projects in Illinois have the best chance of being economical if they can take advantage of the two programs listed above. Therefore, an Illinois resident living in ComEd's service territory can install a 10-40 kW turbine and have the opportunity to apply for a grant to cover up to half the cost of the turbine and sell electricity to ComEd for avoided cost rates plus an extra incentive payment. Illinois residents living outside ComEd's territory can anticipate only receiving avoided cost rates for their excess power, though if you live in another investor-owned utility's territory, you could be eligible for the state grant program. Illinois residents that live in municipal utility or rural electric cooperative service area might find it difficult to design a small wind system that provides a return on investment. This could change if Illinois follows the lead of many other states and establishes a statewide net metering program.

*Interconnection*

If you want to use your wind turbine to reduce your consumption of utility-supplied electricity, your best option is to connect your system to the electricity grid. In this arrangement, the utility supplies electricity when your turbine is unable to meet your needs, and it will also buy any extra electricity generated from your turbine. Under the Public Utility Regulatory Policies Act of 1978 (or

PURPA, discussed in detail in Chapter 7), most utilities are required to connect and purchase power from small wind systems. You cannot assume the process will be easy, however, because the utility might have extensive safety or power quality requirements that are prohibitively expensive or time consuming.

Small wind systems can connect easily to the grid, but the process of obtaining permission to interconnect may be anything but easy. You must contact your electric provider and inform them of your interest. (This may require talking to a number of different employees at the company.) They will have an estimator tell you the cost to interconnect, and they will also stipulate the safety equipment and electronics required. If you are not an electrical whiz, leave the details to a qualified electrician. In your initial exploration you can have the turbine provider help interpret what is required and how much it will cost. The main interconnection issues are safety requirements and power quality. The connection must meet electrical codes; the power must match the utility's voltage, frequency, and quality; and you must automatically stop supplying power to the grid in the event of a power outage for the safety of utility workers.

A grid-connected system does not need battery storage because, in effect, the utility power grid becomes your storage system. When you have excess electricity, it is sent to the grid; when you need extra power, you take it from the grid. A regulated utility will be required to allow you to interconnect and to buy your excess electricity at the published avoided cost. There are some rural electric cooperatives and municipal utilities that are "nonregulated" and are not required to purchase your energy. You will have to ask and find out what rules apply to your electricity provider.

At minimum, you will require the following devices to connect a wind turbine to the grid:

- *Lockable Disconnect* – This device provides a safe way to ensure a utility worker can lock out your turbine while working on the lines nearby.
- *Electronic Power Inverter* – This device makes the power quality acceptable to the utility in terms of proper phase, voltage, and protection for their system and yours. Most turbines now offer an inverter for a grid-tie package in their pricing.

It is likely that the utility will require you to enter a formal interconnection agreement. In states with competitive electricity markets (such as Illinois), you might have to sign separate agreements with the company that operates the local power grid and your electricity provider.

#### *Choosing a Small-Scale Wind Generator*

Once you have made the decision to install a small wind energy system, you still have to decide exactly what kind of turbine to buy and how much of the installation work you want to do yourself. When selecting which turbine to buy, you should consider how much electricity you want to generate and what size turbine makes sense economically. You should also compare prices and product reviews to choose which turbine is right for you. For reviews and more detailed advice on choosing a turbine, see Mick Sagrillo's 2002 article in *Home Power Magazine*, "Apples and Oranges." It is available online at <[www.homepower.com/magazine/downloads\\_wind\\_power.cfm](http://www.homepower.com/magazine/downloads_wind_power.cfm)>.

#### **Resources**

##### *Small Wind Turbine Manufacturers*

- Abundant Renewable Energy  
(African Wind Power generator distributor)  
22700 NE Mountain Top Road  
Newberg, OR 97132

(503) 538-8292  
[www.abundantre.com](http://www.abundantre.com)

- Aeromax Corporation  
9234 E. Valley Road, Suite E  
Prescott Valley, AZ 86314  
(888) 407-WIND  
[www.aeromaxenergy.com](http://www.aeromaxenergy.com)
- Bergey Windpower Company  
2001 Priestley Avenue  
Norman, OK 73069  
(405) 364-4212  
Fax: (405) 364-2078  
[sales@bergey.com](mailto:sales@bergey.com)  
[www.bergey.com](http://www.bergey.com)
- Solar Wind Works  
(distributor for Proven Wind Turbines)  
16713 Greenlee Road  
Truckee, CA 96161  
(530) 582-4503  
Fax: (530) 582-4603  
[chris@solarwindworks.com](mailto:chris@solarwindworks.com)  
[www.solarwindworks.com](http://www.solarwindworks.com)
- Southwest Windpower  
P.O. Box 2190  
2131 N. First Street  
Flagstaff, AZ 86003-2190  
(520) 779-9463  
Fax: (520) 779-1485  
[andy@windenergy.com](mailto:andy@windenergy.com)  
[www.windenergy.com](http://www.windenergy.com)
- WindTech International, LLC  
125 Maple Avenue  
Katonah, NY 10536  
(914) 232-2354  
Fax: (914) 232-2356  
[info@windmillpower.com](mailto:info@windmillpower.com)  
[www.windmillpower.com](http://www.windmillpower.com)

- Wind Turbine Industries Corporation  
16801 Industrial Circle, SE  
Prior Lake, MN 55372  
(952) 447-6064  
Fax: (952) 447-6050  
wtic@windturbine.net  
www.windturbine.net

*For Further Information*

This chapter should give you a taste of what generating your own power with a small wind turbine is all about; however, it is likely that you will want to educate yourself further. Below are some publications and organizations that will be helpful as you continue your research.

- U.S. Department of Energy's Wind Energy Program  
*Small Wind Electric Systems: An Illinois Consumer's Guide*, 2001. Available online at [www.eere.energy.gov/windpoweringamerica/pdfs/small\\_wind\\_small\\_wind\\_illinois.pdf](http://www.eere.energy.gov/windpoweringamerica/pdfs/small_wind_small_wind_illinois.pdf) or by contacting the DOE's Wind Powering America Program:

William Hui  
U.S. Department of Energy  
Chicago Regional Office  
One South Wacker Drive, Suite 2380  
Chicago, IL 60606-4616  
(312) 886-8586  
William.hui@ee.doe.gov

Other resources available from DOE for small wind turbines are as follows:

- *Small Wind Turbine Resources* – [www.eere.energy.gov/windpoweringamerica/small\\_wind.html](http://www.eere.energy.gov/windpoweringamerica/small_wind.html)
- *Evaluating Your Technology Options: Small Wind Turbines* is an online guide to designing your small wind electric

system: [www.eere.energy.gov/power/consumer/eval\\_wind\\_turb.html](http://www.eere.energy.gov/power/consumer/eval_wind_turb.html).

- American Wind Energy Association's *Small Wind Systems Slide Show* – a detailed visual presentation on small wind turbine applications, economics, siting, and interconnection. The slide show is available to download at [www.awea.org/pubs/documents/swslides/toc.htm](http://www.awea.org/pubs/documents/swslides/toc.htm).

*"Advice from and Expert"* – a series of columns from AWEA's *Windletter* by Wisconsin-based small wind system expert Mick Sagrillo. Topic areas include technology, zoning, insurance, and success stories. The columns are available online at [www.awea.org/faq/sagrillo/index.html](http://www.awea.org/faq/sagrillo/index.html).

Contact Information:

AWEA  
122 C Street, NW, Suite 380  
Washington, DC 20001  
(202) 383-2500  
Fax: (202) 383-2505  
windmail@awea.org  
www.awea.org

- Midwest Renewable Energy Association MREA is a nonprofit network for sharing ideas, resources, and information about renewable energy and energy efficiency. They organize a large energy fair every summer in Wisconsin and host a variety of practical renewable energy workshops, including "how to" courses for small wind systems. For more information on workshops, the energy fair, or membership, visit the MREA website or contact them . . .

Midwest Renewable Energy Association  
7558 Deer Road  
Custer, WI 54423  
(715)-592-6595  
Fax: (715)-592-6596  
info@the-mrea.org  
www.the-mrea.org

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- Other Books and Publications
    - *Home Power Magazine* is “The Hands-On Journal of Home-Made Power,” published every other month. It is available on newsstands in the U.S., Canada, and internationally. It features articles on home power systems, including small wind turbines.

*Home Power Magazine*  
P.O. Box 520  
Ashland, OR 97520 USA  
(800) 707-6585  
[www.homepower.com](http://www.homepower.com)

- *Wind Power for Home & Business: Renewable Energy for the 1990s and Beyond*, Paul Gipe, Chelsea Green Publishing, Paperback, 1993.
- *Wind Energy Basics: A Guide to Small and Micro Wind Systems*, Karen Perez and Paul Gipe (Preface), Chelsea Green Publishing, 1999.



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## Chapter 7. The Market for Wind Energy in Illinois

Determining the market or use for a wind project's generation is one of the most fundamental and crucial tasks for the would-be wind farmer. Every project needs a marketing plan, even if it is not written. Larger projects will not obtain capital without one. Effort put into a marketing plan is an investment in success.

### Early Markets for Wind

Wind got its start with water pumping windmills and small, low-voltage home wind electric plants in rural areas that were not electrified. Millions of these units were installed, and some water-pumping windmills continue to work today. With rural electrification, the small residential electric wind systems were abandoned; their technology was not compatible with utility power, which was cheap and relatively reliable.

Certain nongrid applications for wind continue to this day. Remote sites where there are no utility lines still can be attractive locations for turbines. With utilities charging upwards of several thousand dollars for significant line extensions to reach consumer loads, alternative electric supplies can be economical. People without utility service nearby sometimes use wind with battery banks and photovoltaic systems to supply household electricity. Water for stock and wildlife watering still can be delivered with water-pumping windmills. Lastly, remote sites for various communications, instrumentation, and public service uses are also good candidates for small wind systems.

The markets for wind changed significantly in the early 1970s. People became more environmentally conscious and interested in self-reliance with regard to natural energy sources. The oil shortages and high prices of the 1970s increased concerns about domestic energy sources. Wind was widely available, clean, and held much promise. Technical,

political, and tax initiatives eventually were put in place to facilitate greater use of wind as an energy source. These initiatives created a favorable environment that produced today's wind industry. The biggest boosts for wind came in the form of market creation, financial incentives, and partial deregulation of the utility industry.

### Public Utility Regulatory Policies Act (PURPA)

PURPA was one of five bills in the National Energy Act of 1978. One of the primary objectives of PURPA was to “back out foreign oil” and to stimulate use of domestic renewables—opportunities that were blocked by regulation and monopolistic practices. PURPA has become popularly known for its small-power production program because, with its move toward deregulation, it launched a major change in electric markets for new power plants.

Today's wind industry was galvanized in 1980 by California's adoption of PURPA rules, along with state incentives, from single experimental, small, remote-use, and residential turbines to multi-megawatt wind farms using dozens of much larger, commercial turbines that sold wholesale energy to utilities. In the process, turbines improved greatly, a new industry was born, and various incentives were combined to make wind much more competitive today than it was when the first large wind farm was constructed in 1981. Were it not for the market provided by

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PURPA, the wind industry would not be what it is today.

PURPA was the first major piece of legislation in the trend toward deregulation of the utility industry. It enabled non-utility power producers to supply themselves without discriminatory treatment, ensured access to the grid, and required utilities to buy their output. A mandatory utility purchase requirement was based on the utility's "avoided cost" and was not well-received within the utility industry, primarily because there was no way for them to earn money on power purchases and new power plants might not be needed. Thus, the avoided cost portion of PURPA has received the most attention; however, other portions of the small power production program were crucial to market success.

In 1980 and 1981, the Federal Energy Regulatory Commission (FERC) adopted rules that launched the small power production and cogeneration program. The rules established many rights and obligations for utilities, states, and power producers. States were required to implement their own consistent rules for utilities that were state-regulated. Federal power marketing agencies and utilities not regulated by the state were made accountable directly to FERC for enforcement of federal rules. States initially held hearings to determine how they would interpret the FERC rules. Subsequently, utilities would be required to file their avoided costs for approval at least biennially.

### *Qualifying Facilities*

A new class of non-utility power producers—"qualifying facilities" or QFs—was created by PURPA. Only QFs are eligible for the benefits of PURPA. Qualifying "small power producers" consist of generators run by wind, solar, biomass, hydropower, and waste resources. Utility ownership of QFs is limited to 50 percent. Projects can become QFs by

a simple declaration or they can ask FERC for certification. The latter is costly and is common when significant capital must be raised.

### *Regulatory Exemptions*

PURPA exempts QFs from utility-type regulation. This is necessary because persons would be deterred from building QFs if they were regulated like a traditional electric utility; the administrative costs would be too high. QFs are not retail suppliers, and there are no service territory issues. Also, QFs are exempt from financial, rate, and organizational regulation at the state and federal levels. The exemptions, however, do not include environmental, site permitting, building, electrical, zoning, or any licensing laws at any level of government.

### *Avoided Costs*

The benchmark price for sales of QF output to utilities is based on the concept of the purchasing utility's "avoided costs." The avoided cost is the cost that the utility would otherwise have incurred to obtain an equivalent amount of energy or capacity. With avoided cost, the utility's ratepayers would be unaffected, and the QF would have the opportunity to receive payments based on monies the utility would have spent anyway. For example, if a utility was planning a new 200 MW power plant that would generate power at 7¢/kWh, the first 200 MW of QFs willing to contract for the life of the utility's planned plant would get 7¢/kWh. Conversely, if a utility has surplus power, the only costs avoided would be the costs of fuel and variable operations and maintenance costs. In the former case, offsetting retail purchases (self-supply) is likely to provide the highest value to a wind turbine owner.

Avoided costs are subject to adjustment to account for many factors:

- Costs or savings due to line losses
- Time commitment—whether the commitment to energy deliveries is for a specific period of time or intermittent as available sales occur
- Interconnection costs of new utility capacity
- Length of time the QF agrees to supply generation to the utility
- Determination of whether the QF’s facility can be throttled by the utility
- Expected or demonstrated reliability of the QF’s facility
- Coordination of maintenance outages with the utility
- Aggregate energy or capacity of a diversified group of QFs

Needless to say, the calculation of avoided costs can be complicated. Since the rules require avoided costs to be periodically filed with the state or FERC, there are opportunities to review how they were determined. Clearly, the wholesale electric power markets affect how much a utility is willing to pay for QF generation. In recent years, some states and utilities have used the competitive bidding process to establish their avoided costs. Competition has lowered the costs of potential supplies, and QFs now often compete with each other for utility markets.

#### *Power Sales Contracts Under PURPA*

PURPA envisions several possible arrangements for QFs to enter into energy or capacity sales agreements with utilities. QFs up to one MW have the right to get a standardized agreement, reducing costly negotiations. QFs can choose between selling

all of their output, using it all themselves, or engaging in the simultaneous purchase and sale of electricity. When selling to the utility, the QF can sell “non-firm” energy, which is intermittent and without delivery commitment, or can sell stated quantities of energy or capacity for fixed periods of time (i.e. “firm” power). Since firm resources allow more certain future planning, it is more valuable and typically fetches a higher price. When selling firm output under contract, a QF has the options of receiving a predetermined price based on the approved forecast of avoided costs or a price that floats with actual future avoided costs. If both agree, the QF and utility may strike an agreement that does not follow the PURPA rules. All of these options should be reviewed by the QF as part of its strategic and financial planning; they can strongly affect the economic value of a wind project to both buyer and seller.

#### *QF’s Rights and Responsibilities and the Utility’s Rights and Responsibilities*

QFs have many rights that are fundamental in enabling them to be efficiently developed, financed, and operated. The specific terms of many of them have been subject to considerable interpretation by the states in implementing FERC’s rules. Among those rights, QFs are entitled to the following:

- To receive back-up, maintenance, supplementary, and interruptible power from their serving utility at nondiscriminatory rates.
- To connect their generator to the utility’s lines if it can be done safely and reliably.
- To enter into a legally enforceable power sales contract.
- To request or refuse wheeling of output to a nonlocal utility.

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QFs also have responsibilities. They must meet and maintain the criteria for QF status, pay wheeling and marginal interconnection costs, abide by the requirements of power sales agreements, conform to reliability and safety standards, and provide power during emergencies upon request.

To properly manage a QF purchase program, utilities also have various rights provided under PURPA. They are important in maintaining the integrity of the power system, and they offer some flexibility in the utility's management of its dealings with QFs. Utilities have the following rights:

- To refuse purchases from QFs during system emergencies or at rates exceeding avoided costs.
- To be paid for QF interconnection costs.
- To recalculate and propose new avoided costs as conditions change.
- To use their supplying utility's avoided costs if they get their electricity from another utility instead of from their own power plants.

Utilities have many responsibilities under the PURPA program as well. They include the requirement to purchase all QF output at avoided costs, to purchase output from QFs over 500 kW within 90 days, and to notify QFs in advance of nonpurchase periods.

#### *Government Agency Roles and Responsibilities*

PURPA requires both FERC and the states to adopt certain roles in order to implement and manage the program. FERC issues rules for states, federal power marketers, and nonstate-regulated utilities to follow. Utilities that are not regulated by the state have as much latitude to interpret and implement the federal PURPA rules as states do. FERC processes

and adjudicates requests for and about QF certification. Enforcement of PURPA rules may be performed by FERC or left to the courts.

The states have a broader role. In addition to implementing the federal rules for state-regulated utilities, state utility regulators also must approve nondiscriminatory rates for sales to QFs and utility expenditures for purchases from QFs. They also review and approve utility avoided cost filings, set standard rates for smaller QFs, oversee interconnection issues, and periodically report to FERC. The state's rules for PURPA implementation are basic knowledge for QFs dealing with state-regulated utilities. Some states have their own laws about renewables, purchase of generators, and/or incentive programs that may involve action by utility regulators or other agencies. These laws often complement or go further than required by PURPA. This is permitted as long as there is no conflict. Illinois' Renewable Energy Resources Grant Program fits into this category.

Rules related to the purchase and sale of electricity from small power production facilities can be found in the Illinois Legislature's Joint Committee on Administrative Rules Administrative Code: Title 83: Public Utilities, Chapter I: Illinois Commerce Commission, Part 430 Purchase and Sale of Electric Energy from Cogeneration and Small, Power Production Facilities (General Order 214). This is available online at <[www.legis.state.il.us/commission/jcar/admincode/083/08300430sections.html](http://www.legis.state.il.us/commission/jcar/admincode/083/08300430sections.html)>.

#### *Wind Project Strategies Under PURPA*

A clear understanding of the PURPA program will help a potential wind project sponsor develop realistic expectations under today's laws and regulations. PURPA has greatly expanded the opportunities to use a project's generation and get the most value from it. It is

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important to know a QF's rights for planning a project, negotiating with potential buyers, and sizing a project. The basic marketing strategies enabled by PURPA include the following.

**Self-Supply.** PURPA's rules permit simultaneous purchase, sale, and self-supply with the generator's output. Self-supply is common where a small to medium on-site electric load is fed by a small on-site or nearby wind turbine. The turbine is connected with the utility line, and the turbine generation offsets retail purchases from the utility and sells excess generation at the avoided cost rate. This scenario has the potential to be more lucrative for the QF where net metering is in place.

**Wholesale Power Sales.** Where there are no on-site loads or the wholesale market is lucrative, a project can sell all of its output, usually with a power sales contract (often called a power purchase agreement). In this scenario, economies of scale can be advantageous in reducing the cost of wind energy production. These projects can be costly; outside financing usually is needed. If there are few other assets to back the loan, financial institutions typically require firm, long-term power sales contracts to provide some assurance of a revenue stream to pay the project's costs. PURPA provides for long-term fixed price contracts.

PURPA allows the utility that serves the project site, if the QF agrees, to transmit the QF's output to another utility. In this instance, the receiving utility inherits PURPA's purchase obligation at its avoided cost and the QF must pay transmission ("wheeling") charges to the local utility. In this fashion and with the local utility's help, a QF can expand its market opportunities. Lastly, no regulation prevents a QF from building its own transmission line to reach another buyer.

QFs can sell to multiple buyers. For example, in summer, they can sell to one utility and in

winter to another. Or perhaps one utility will pay more for firm energy while another utility may pay more for excess nonfirm energy. The distribution and pricing of nonfirm production is always an issue because of interseasonal and interannual variations in production. The point is to be creative and flexible in finding maximum value for every kilowatt-hour produced.

**Collective Power Sales.** While a smaller QF may be entitled to a simple standard agreement when selling output on an individual basis, more value may be had by consolidating output and sale with other individual generators. Long-term contracts and agreements with alternative terms may not be available to individual small QFs. A collective or cooperative organization could take advantage of economies of scale in purchasing, administration, financing, power sales contracting, and maintenance. PURPA does not require each owner/investor/operator to engage in autonomous agreements with utilities or give to utilities the right to require it. PURPA enables a group of dispersed wind QFs to obtain a higher avoided cost-based payment due to the aggregate value of the production, which would be more reliable than one turbine equaling the size of the group. Also, widely dispersed turbine locations could add value by increasing the probability of generating any fraction of the total capacity.

PURPA enables many project strategies. They can be used alone or in combination (e.g., self-supply during summer when retail offset is most valuable and wholesale sale in winter when avoided costs may be higher). Since the power markets are in flux, regulations and institutions are changing. Demand for electricity and fuel prices change. A good strategy today may not be a good strategy tomorrow. Planning for flexibility may be crucial for some projects' success. For others, planning and strategy will be determined by

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financing requirements during the early years and by new opportunities later.

### **Emerging Markets for Wind**

While PURPA provides the foundation for today's wind markets, the markets themselves are changing with deregulation of the utility industry, new mandates for renewable energy in many states, increased public interest in renewable energy, and the cost competitiveness of wind power. We have identified some of the emerging markets for wind power here.

#### *Local Utility Projects*

Some local utilities are experimenting with small quantities of wind, often by installing one or several turbines. Many of these utilities are consumer-owned within the community. Participation in these types of projects may be a way to use wind power on a local basis. There are now a number of successful wind projects owned by local utilities. Part IV of this handbook includes a case study of one such project in Waverly, Iowa.

#### *Sales to Power Brokers*

Brokers who operate at the wholesale level may become buyers for wind power. They may buy electricity from many different sources and have many different customers who want what they have to sell. In concept, this is little different than many other kinds of brokerage businesses. Brokers typically add value because they have access to many potential markets that sellers do not.

#### *Sales to Aggregators*

As a result of deregulation, there may be an emergence of aggregators who would assemble specific or customized combinations of electricity from different sources. The aggregators could add value by packaging the power supply according to the buyer's

needs. For instance, one buyer may want to buy electricity that has moderate exposure to fuel price risk, no risk of greenhouse gas tax, a fixed price for the next 15 years, is based entirely in the United States, and is highly reliable. Another customer may want a different combination of characteristics. It is the aggregator's job to assemble such packages or "products." Aggregators may operate at the wholesale or retail level (i.e., they may sell their products to local distribution companies or directly to large retail users).

Aggregators could add value to wind by buying output from dispersed turbines and selling their combined output as a single product with less variable delivery characteristics. This may be an easier, new form of PURPA's avoided cost adjustment for aggregate capacity, which was technically and economically correct but difficult to administer.

One type of market that aggregators and others may address is the "green power" market (i.e., sales of renewable energy as a distinct product). There is strong evidence that there are wholesale and retail markets for "green power." For example, in 2001, the City of Chicago, along with 47 other local government partners, announced plans to buy green power equivalent to 20 percent of the group's electricity consumption by 2006 from ComEd and the Environmental Resources Trust. This green municipal aggregation effort will eventually lead to the purchase of about 80 MW of renewable energy. The government agencies are taking advantage of Illinois' newly competitive electricity market by choosing "green power."

#### *Wholesale Markets*

There is no reason the electric utilities that remain in the retail distribution business will not continue to be potential customers for wind energy. Many will also want to continue to sell electricity to consumers and

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will need various products. They may obtain their resources from their own power plants, brokers, and aggregators or directly from independent generators. In windy locations where the customer base demands “green power,” these entities may be good buyers of wind generation due to their closeness to customers and suppliers. Some may buy wind energy because it is “green” and others because it immunizes them from fuel price or global warming risks.

### *Green Power Programs*

The success of green power programs around the country have demonstrated that some people are willing to pay higher rates to receive “green energy.” In regulated markets, these programs take the form of utility green pricing initiatives through which customers can voluntarily opt to pay extra each month to support the utility’s investment in renewable (usually wind) energy development. More than 300 utilities around the country offer green pricing programs. In competitive electricity markets, like Illinois, green power marketing is an entrepreneurial activity where marketers compete for business from consumers interested in supporting renewable energy. There are also about a dozen organizations that market green energy certificates (also known as green tags, renewable energy certificates, or tradable renewable certificates) around the country. Green certificates represent the environmental attributes of the power produced from renewable energy projects and are sold separately from commodity electricity. Customers can buy green certificates without having access to a utility green pricing program of a competitive green power marketer.

In 2000, ComEd and the Environmental Resources Trust (ERT), a nonprofit certifier and broker of green power, teamed up to offer a wholesale renewable power product in Illinois. ComEd is selling the product, called EcoPower, through the APX Midwest

Market. Electricity suppliers purchasing “green tickets” through the APX Market can use the EcoPower label in their retail marketing. At present, Ecopower consists entirely of power generated from landfill gas facilities; however, ComEd plans to add other renewable resources, such as small hydro, wind, and solar, to the Ecopower portfolio in the future. Profits from the sale of the EcoPower product will be used to finance the development of new renewable resources in Illinois through a fund to be administered by ERT. In 2002, ERT partnered with AES NewEnergy to offer a renewable energy option to nonresidential customers in Illinois. This program also only includes landfill methane generation in its renewable portfolio.

The St. Charles Green Power Program, launched in September 2003, is the first such program available to Illinois residents and businesses. ComEd will supply the City of St. Charles (located just west of Chicago in Kane County) electric utility, with renewable energy certificates representing the environmental benefits of renewable energy. Initially, the program will be based on landfill gas generated electricity, but it will eventually support wind power when it becomes available. Community Energy, Inc., a renewable energy marketing company, will assist the City of St. Charles in marketing the program. This program is one model Illinois communities can use to support wind energy in Illinois.

### *Public Policy Driven Sales*

The market for wind energy is also being driven by public policy commitments to renewable energy. The long list of renewable energy incentive programs detailed in Chapter 5 demonstrates some of the policy factors driving the market for wind energy. Public policy also can play a more direct role in establishing wind energy markets through

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renewable energy standards, goals, and buying commitments.

Among the most effective ways to create a stable and robust market for wind energy is to establish a Renewable Energy Standard (RES) or a Renewable Portfolio Standard (RPS)—that is, to require a certain percentage of energy to come from renewable sources by a specific date. Many states that have implemented such laws have seen enormous amounts of wind energy growth. The Texas RPS is often cited as the most successful of these laws. Enacted in 1999, the Texas law required utilities in that state to incrementally work toward having 2,000 MW of renewable energy by 2009. The first deadline required 400 MW of renewable energy by 2003, but Texas utilities found wind energy to be so cost-effective that 915 MW of wind power capacity were installed in 2001 alone. Other states, including Arizona, California, Connecticut, Iowa, Maine, Massachusetts, Minnesota, Nevada, New Jersey, New Mexico, New York, Pennsylvania, and Wisconsin, also have versions of an RPS.

An RES for Illinois has been seriously under consideration in 2003. The proposed law would build on a statewide renewable energy goal enacted in 2001. The goal states that at least 5 percent of the state's energy should be derived from renewable sources by 2010, and at least 15 percent should be from renewable sources by 2020. As it is a goal rather than a standard, the law does not include an implementation schedule, credit trading provisions, or any means of ensuring compliance. A firm RES in Illinois would establish the largest market yet for potential wind farmers in the state.

The Illinois state government has made a large commitment to buying green power. In 2002, former Illinois Governor George Ryan issued an executive order committing the state to purchase green power for at least

5 percent of the electricity used by buildings owned or operated by agencies under the governor's control by 2010. The amount of renewable energy purchased will grow to at least 15 percent by 2020. The executive order defines green power as electricity generated from renewable sources such as wind, solar, organic wastes, and hydropower. It excludes the burning of municipal solid waste, wood waste, or tires. The state is currently fulfilling its commitment to green power with landfill methane gas generated electricity supplied by AES NewEnergy.

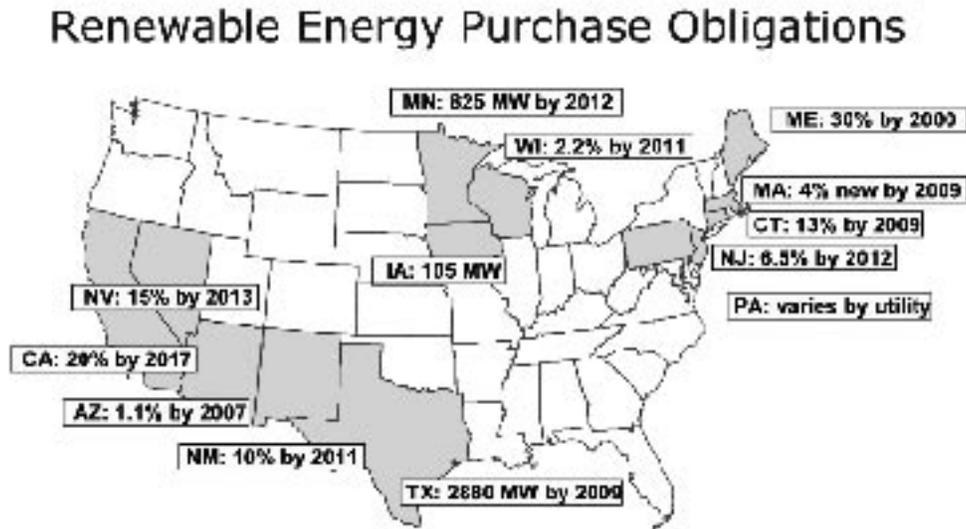
## **Illinois Market Overview and Opportunities**

### *Deregulation in Illinois*

As of May 2002, the Illinois electricity market became completely deregulated, meaning residential, commercial, and industrial customers can all choose their own power provider. The Electric Service Customer Choice and Rate Relief Act of 1997 triggered the restructuring of the Illinois electricity market and set a schedule for deregulation over the next four years. In 1999, a third of residential customers gained access to competitive power suppliers. The market opened further in 2001 for all commercial and industrial customers, and the deregulation process was completed in 2002 when remaining residential customers were added to the competitive market. A 1999 amendment to the restructuring law, among other things, slightly adjusted the deregulation schedule and required ComEd to allocate \$250 million to a special environmental initiatives and energy-efficiency fund. This money later became the endowment of the Illinois Clean Energy Community Foundation (discussed in Chapter 5).

The Illinois Commerce Commission (ICC) has offered periodic assessments of Illinois' electric industry restructuring. Although all Illinois customers have full access to a

**Figure 11. Renewable Energy Purchase Obligations**



Thirteen states have some form of a renewable energy standard.

*Sources:* Lawrence Berkeley National Laboratory and National Renewable Energy Laboratory

competitive electric market, most customers have little or no access to actual competition. In the most recent report issued in August 2002, the ICC stated that there is “absolutely no competition (or choice) for residential electric customers, and it is unlikely that competition (or choice) will be available for these customers for the next several years.” The situation for commercial and industrial customers appears to be less extreme. ICC concluded in August 2002 that these customers have some access to competition within ComEd’s service territory, but little access outside of it. According to another ICC report released in April 2003, customers representing 14 percent of Illinois electricity load had switched to retail suppliers in 2001. Most came from AmerenCIPS, ComEd, and Illinois Power.

To read the full report of the ICC Summer 2002 Roundtable Discussion, *Implementation of the Electric Service Customer Choice and Rate Relief Law of 1997*, visit <[www.icc.state.il.us/iccl/inside/cc/ops/020826cmrndtbl.pdf](http://www.icc.state.il.us/iccl/inside/cc/ops/020826cmrndtbl.pdf)>. To

read the full *Assessment of Retail and Wholesale Market Competition in the Illinois Electric Industry in 2001*, visit <[www.icc.state.il.us/iccl/ec/docs/020421genrep.pdf](http://www.icc.state.il.us/iccl/ec/docs/020421genrep.pdf)>.

For more information about electricity deregulation and competitive power markets, visit the U.S. Department of Energy’s Energy Information Administration Status of State Electric Industry Restructuring Activity website: <[www.eia.doe.gov/cneaf/electricity/chg\\_str/regmap.html](http://www.eia.doe.gov/cneaf/electricity/chg_str/regmap.html)>.

#### *Selling Wind-Generated Electricity in Illinois*

Figure 11 illustrates current renewable energy standards enacted in the U.S. Barring the passage of a renewable energy standard, PURPA rules requiring utilities to buy electricity from wind projects meeting the QF criteria is the most accessible market for wind-generated electricity in Illinois. In this scenario, the utility will pay their published avoided cost rate. We have collected rates from a number of Illinois’ larger utilities and

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include them in the Appendices. In most cases, these rates are going to be too low to cover the costs of installing a wind turbine. This will be especially true for smaller projects or projects in less than excellent wind resource areas. Making maximum use of available financial incentives will be critical to the success of many projects in Illinois. Obtaining additional revenue from a state or federal grant (as described in Chapter 5) or another source is probably the best option for making small utility-scale wind projects in Illinois economically feasible.

Avoided costs for various utilities are included in the Appendices.

#### *Additional References and Resources*

To obtain a copy of an Illinois utility service territory and electric facility map, send a letter to . . .

Chief Clerks Office  
Illinois Commerce Commission  
527 E. Capitol Avenue  
Springfield, IL 62701

You must state who you are and that you will not disclose the map to the general public. The cost is \$10.

**PURPA Handbook.** More than any other single federal law, the Public Utility Regulatory Policies Act of 1978 (PURPA) made possible the renewable energy development of the 1980s. AWEA developed this summary as a quick reference to PURPA's legislative provisions. This publication was produced by AWEA in cooperation with the National Renewable Energy Laboratory (Soft cover, 14 pages, 1992).

**Green Power Network.** The Green Power Network provides news on green power markets and utility green pricing programs. See <[www.eere.energy.gov/greenpower](http://www.eere.energy.gov/greenpower)>.

**Plug In Illinois.** This website is designed to help Illinois residential and business customers understand the electric restructuring process. Visit the ICC's website: <[www.icc.state.il.us/pluginillinois](http://www.icc.state.il.us/pluginillinois)>.

**Investor-Owned Utilities in Illinois.**  
Information obtained from ICC's Plug In Illinois: Power of Choice Website

**Ameren Energy Marketing**  
*Service Area/Customer Mix:* All of Illinois; all nonresidential customers with annual electrical usage in excess of 15,000 kWh

*Type of Services:* Power and energy

*Customer Contact Information:*  
Andrew M. Serri  
Ameren Energy Marketing Company  
400 S. Fourth Street  
St. Louis, MO 63102-1826  
(314) 613-9125  
Fax: (314) 613-9073  
[www.amerenenergy.com](http://www.amerenenergy.com)

**Blackhawk Energy Services, LLC**  
*Service Area/Customer Mix:* ComEd and Illinois Power service territories; all nonresidential retail customers with annual electrical usage in excess of 15,000 kWh

*Type of Services:* Power and energy

*Customer Contact Information:*  
John Oroni, Vice President  
Sales and Marketing  
100 N. Lincolnway, Suite B  
North Aurora, IL 60542  
(630) 264-6600  
Fax: (630) 264-6611  
[joroni@blackhawkenergy.com](mailto:joroni@blackhawkenergy.com)  
[www.blackhawkenergy.com](http://www.blackhawkenergy.com)

**Central Illinois Light Company (CILCO)**  
*Service Area/Customer Mix:* All of Illinois; all nonresidential customers

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*Type of Services:* Power and energy

*Customer Contact Information:*

Tina M. Grebner  
300 Liberty Street  
Peoria, IL 61602  
(888) 451-3911  
tgrebner@cilco.com  
www.cilco.com

**Constellation NewEnergy**

*Service Area/Customer Mix:* ComEd, Illinois Power, Ameren CILCO, AmerenCIPS, Ameren UE service territories; all nonresidential customers with annual electrical usage in excess of 15,000 kWh

*Type of Services:* Power and energy.

*Customer Contact Information:*

Jim Belden, Director  
Sales & Marketing  
550 W. Washington Boulevard, Suite 300  
Chicago, IL 60661  
(312) 704-8527  
Fax: (312) 704-8530  
jim.belden@constellation.com  
www.newenergy.com/

**Dynegy Energy Services, Inc.**

*Service Area/Customer Mix:* Mid to large commercial and industrial

*Type of Services:* Power and energy.

*Customer Contact Information:*

James Nordloh, Director  
Commercial and Industrial Sales  
1211 W. 22nd, Suite 804  
Oak Brook, IL 60521  
(630) 472-9239  
Fax: (630) 472-9279  
james.nordloh@dynegy.com  
www.Dynegy.com

**EnerStar Power Corporation**

*Service Area Requested/Customer Mix:* AmerenCIPS, ComEd, Illinois Power, and Central Illinois Light Company service territories; all nonresidential customers

*Type of Services:* All services that may be provided by an Alternative Retail Electric Supplier (ARES)

*Customer Contact Information:*

Angela Bruce Griffin  
Customer Account Executive  
EnerStar Power Corporation  
P.O. Box 190  
Paris, IL 61944  
(217) 463-4145, ext. 603  
Fax: (217) 466-7669  
agriffin@enerstar.com  
www.EnerStar.com

**Exelon Energy Company**

*Customer Contact Information:*  
Exelon Corporation  
10 S. Dearborn Street, 37th Floor,  
P.O. Box A-3005  
Chicago, IL 60690-3005  
(312) 394-7398

**ComEd**

*Service Area/Customer Mix:* ComEd's service territory

Customer Care Center  
P.O. Box 805379  
Chicago, IL 60680-5379  
(800) Edison-1 (1-800-334-7661)  
www.comedtransmission.com.

**Illinois Power Energy, Inc.**

*Service Area/Customer Mix:* Mid to large commercial and industrial

*Type of Services:* Power and energy

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*Customer Contact Information:*  
Chip Martin, Director  
Commercial and Industrial Sales  
Illinois Power Energy, Inc  
2828 N. Monroe Street  
Decatur, IL 62521-2200  
(217) 876-3902  
Fax: (217) 876-7475  
chip.martin@dynergy.com

**MidAmerican Energy**

*Service Area/Customer Mix:* All of Illinois; all nonresidential customers

*Type of Services:* Power and energy

*Customer Contact Information:*  
MidAmerican Energy Company  
2811-5th Avenue  
Rock Island, IL 61201  
(877) 227-5632  
www.midamericanchoice.com

**Peoples Energy Services Corporation**

*Service Area/Customer Mix:* All of Illinois; all nonresidential customers

*Type of Services:* Power and energy

*Customer Contact Information:*  
Bobbi Welch, Director  
Retail Power Marketing  
205 N. Michigan Avenue, Suite 4206  
Chicago, IL 60601  
(888) 698-1728  
Fax: (888) 698-1730

**Sempra Energy Solutions**

*Service Area/Customer Mix:* ComEd's service territory; all nonresidential customers with annual electrical usage excess of 2 MW

*Type of Services:* Power and energy

*Customer Contact Information:*  
Mark Ludwig, Vice President  
Sales/Midwest Commodity  
1901 Butterfield Road, Suite 1000  
Downers Grove, IL 60515  
(630) 390-2700  
Fax: (630) 390-2717

**Sempra Energy Trading Corporation**

*Service Area/Customer Mix:* ComEd, Illinois Power, Central Illinois Public Service Company, and Central Illinois Light Company service territories; all nonresidential customers with annual electrical usage in excess of 15,000 kWh

*Type of Services:* Power and energy

*Customer Contact Information:*  
Peter Doering, Vice President  
Sempra Energy Trading Corporation  
58 Commerce Road  
Stamford, CT 06902  
pdoering@sempratradng.com

**South Beloit Water Gas & Electric Co.**

*Service Area/Customer Mix:* All of Illinois; all nonresidential customers.

*Type of Services:* All services that may be provided by an ARES.

*Customer Contact Information:*  
Gregory A. Genin  
Director of Energy Management Services  
222 W. Washington Avenue  
P.O. Box 192  
Madison, WI 53701-0192  
(800) 521-1725, ext. 3994  
greggenin@alliant-energy.com

**WPS Energy Services, Inc.**

*Service Area/Customer Mix:* ComEd, Illinois Power, AmerenCIPS, and CILCO; all nonresidential customers with demand of 1 MW or more

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*Type of Services:* Power and energy.

*Customer Contact Information:*

WPS Energy Services, Inc.

3 Westbrook Corporate Center, Suite 550

Westchester, IL 60154

(708) 449-4100

(877) 449-4100 (toll free)

Fax: (708) 449-4122

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



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## Chapter 8. Choosing a Business Structure

Wind energy development in the United States has followed a very different model from that in Europe. For the most part, developments here have been large wind farms costing \$25-\$100 million each that are owned and financed by large corporations with little or no local presence. With this development model, the local benefits mostly have been restricted to the economic stimulation during the construction phase, tax revenue to communities, jobs for a small crew of windsmiths, and modest payments to landowners. Although there are similar wind farms in Europe, a large part of the market for wind energy comes from distributed developments with local ownership. Much of that development is done through farmers or rural community cooperatives and, as a result, local members of the community take full responsibility for and earn all the benefits of the investments. In Europe, these types of wind projects are very lucrative because they earn value as power resources and as carbon emission-free generation, and they also benefit from incentives developed by the local governments.

Today, the idea of local and community wind is catching on in the U.S., while Europe is moving more toward large, corporate, offshore wind developments. Models of locally and community owned wind projects are springing up in many states, especially in the Midwest. Leasing land to a large wind development company is still the most common way for farmers to be involved with wind power and that might continue to be true for quite a while. It is important that landowners and communities know that they have options when it comes to taking advantage of their wind resource, however. Every individual will have to weigh the pros and cons of these options.

Generally, these competing arrangements can be evaluated based on their ability to deliver low-cost wind energy and local benefits, not to mention profitability. In general terms, these business arrangements are best when they accomplish the following:

- Facilitate local investment.
- Make optimal use of state and federal incentives (tax credits, payments, and grants).
- Attract lenders offering low-interest rates and long financing periods.
- Provide an acceptable rate of return for investors.

It is recommended that if you are setting up a wind energy business you should consult with an accountant and an attorney willing to take the time to understand your particular wind energy project and apply the most favorable business structure.

With these ideas in mind, let's assume you have established that you have a good wind resource on your property, and you have decided to undertake a wind energy project. How will you do it? As with any business venture, there is more than one way to structure your involvement. Do you want to own a wind turbine by yourself, or join forces with a partner? Or do you want to lease your land to someone else? The structure you choose for your wind energy business will depend on the following three main factors:

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1. *Time and Effort* – You need to determine how much of your own time and effort you are willing to put into this venture. Some business structures will require more participation from you than others. For example, if you decide to own your own turbine, you will be responsible for repairs and maintenance; therefore, you must either contract for maintenance or find yourself climbing your turbine tower now and again with a toolbox in your hand. An individual farmer planning to put up one or two large projects should expect to spend an average of five to ten hours per week for two years developing the project.
  2. *Risk and Return* – In most business ventures, this rule holds true: The greater the risk, the greater the return. How much risk are you willing to undertake, and how great a return are you looking for? You should consider the amount of risk you can take with your wind project in light of your other financial commitments.
  3. *Legal Feasibility* – Depending on the laws of your county or state at the time, some forms of ownership may be difficult to pursue. Others will be more advantageous. Sound legal advice is imperative before you choose a business structure. For example, in most states, an LLC will be better able to use tax incentives than a cooperative.

### **Business Structure Options**

As discussed in the previous chapter, the utility avoided cost rates available to most wind projects under PURPA are not high enough to support a wind project on their own. Thus, it is critical that your business is structured to take advantage of as many state and federal incentives as possible. In essence, the state and/or federal government can be an important financial partner in every wind project that is installed. The laws defining these incentives have specific requirements, and it is imperative that your business structure meet these specifications.

There are three basic ways to harvest wind energy:

1. You can contract with a wind developer or other owner.
2. You can form a joint venture with others.
3. You can own the turbine or turbines yourself.

### *Contracting with Developers*

Contracting with a wind developer involves the least time, least effort, least risk, and, of course, the least reward and lowest amount of control over a project. Usually developers approach property owners with specific projects in mind. Once you sign a contract to allow wind turbines on your land, you are not obligated to do any more work. This business structure is currently the most common form of large-scale wind ownership, mainly because turbines are so capital intensive.

A wind developer is an individual or company that constructs, owns, operates, and manages wind energy systems. Developers essentially act as “middlemen” between landowners who have good wind resources and power suppliers or power marketers who buy electricity. Sometimes electric companies own the wind generation and contract directly with landowners to host the turbines.

Under this model, landowners can enjoy a fairly hands-off or involvement-free method of harvesting wind energy, as the developer assumes all financial obligations and liabilities.

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Developers usually sign contracts with landowners for either fixed yearly payments or a percentage of the annual revenue.

Developers think in terms of “projects.” A project might consist of one turbine or hundreds of them, based on the amount of electricity the developer expects to sell. Contracts between developers and electric companies are called Power Purchase Agreements (PPAs). The price of wind-generated electricity has declined rapidly, which has helped build the market for wind energy.

Most of the wind energy produced by developers in the U.S. has been a direct result of state mandates requiring utilities to invest in wind energy. A few projects have been implemented because of “green marketing” programs, in which utilities produce clean energy and sell it at premium prices. The outlook for wind energy throughout the U.S. is good, so developers are continuing to look for landowners who are willing to lease rights to their wind resource. As you will see later in this chapter, however, this is only one of many options for landowners.

Primarily, landowners and developers make the following three types of arrangements regarding wind energy: (1) leasing land, (2) wind easements, and (3) selling land.

**Leasing Land.** A developer may lease or rent your land for the life of the turbines, which is usually 25-30 years. You might be compensated with a lump sum, annually through a royalty payment of a fixed amount each year, or with a percentage of the electricity sales revenue. Basing the lease on a share of revenues can help capture future increases in the value of wind power but also can mean that your payments will fluctuate. In this arrangement, you retain ownership of your land. Landowner payments are typically about \$3,000 to \$4,000 MW per year per

MW, depending on location, wind resource, value of the electricity, type of turbine, and other factors. For example, farmers in Bureau County who are leasing land for the planned 51 MW Crescent Ridge Wind Farm will likely receive the greater of either a flat rate of \$5,000/turbine/year or a payment based on the energy production. With that area’s wind resource, the 1.5 MW turbines planned for that project could yield farmers about \$6,200/turbine/year. This wind farm will have 34 turbines spread across 2,200 acres, which translates to about \$96 per acre for local landowners. According to the USDA, Illinois farms yield about \$60/acre with corn or soybeans. (*Source:* Hans Detweiler, formerly of the Environmental Law and Policy Center, now with the Illinois Department of Commerce [WindEnergy LLC 2003]).

**Wind Easements.** A wind easement is a deed or will executed by the owner of a particular plot of land or air space to ensure a wind energy developer adequate exposure to the wind. Easements run in perpetuity unless the deed provides for termination. Developers usually compensate for easements with a payment upfront.

Wind easements must be in writing and must be filed, recorded, and indexed by your county recorder’s office. They must include (1) a description of the real properties benefited and burdened by the easement, (2) the vertical and horizontal angles and distances from the turbines in which an obstruction to the wind is affected, (3) all terms and conditions for granting or terminating the easement, (4) the responsibilities of the benefited party and the burdened party, and (5) any other provisions.

Wind easements can affect your tax picture. Any properties benefited by a wind easement cannot be appreciated by the value of the easement, but any properties burdened by a wind easement must be depreciated by any value lost to the easement. These are a few

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factors among many that you should consider when arranging a wind easement.

A wind energy easement agreement, like any easement agreement, is a legally binding agreement that needs to be carefully reviewed and understood before executing it. A wind energy easement agreement will have a long-term effect on you and your land. It will affect not only you but also future generations. It is important that you not agree to or execute any easement agreement or easement option agreement until you have discussed it with your attorney and he or she has had an opportunity to review it. It is strongly advised that upon receiving a wind energy agreement or option agreement that you take it to your attorney along with the outline attached in Appendix III. Note that a land lease and wind easement agreement will likely be offered by a developer in the same contract. When a developer approaches you with a wind energy agreement or when just considering the prospects of such an agreement, the following are some of the questions that you should ask yourself and/or the developer:

- How much of my land will be tied up and for how long?
- How much will I be paid and how will I receive payments?
- Are the proposed payments adequate now and will they be adequate in the future based on what I am giving away?
- If a lump sum payment is being offered for long-term rights, am I really being adequately compensated?
- Does the proposed method of payment or the easement itself present any adverse tax consequences to me?
- Are there firm plans to develop my land, or is the developer just trying to tie it up?
- Is the developer willing to guarantee that a specific number of wind energy turbines will be built on my land by a certain date or at least willing to guarantee me certain minimum payments?
- If payments are to be based on revenues generated by the wind energy turbines, how much information is the developer willing to disclose concerning how the owner's revenue will be determined?
- What easement rights is the developer able to later sell or transfer without my consent, and how might such transfer or sale affect me? Will the original developer still be liable to me if the new developer or owner of the easement rights does not pay me or otherwise defaults?
- What are the developer's termination rights? Can the developer simply terminate the easement at any time, and if so, how does that affect future payments?
- What are my termination rights and are they easily exercised?
- If the easement is terminated either voluntarily or involuntarily, what happens to the wind energy structures and related facilities located on my land? Is the developer required to remove everything, including underground cables and foundations, and if so, how soon and at whose cost?

You should always consult an attorney before signing away wind rights. A document prepared for Windustry outlining legal issues surrounding wind easements is included in the Appendices. It will give you a general idea of what types of provisions might be contained in proposed easement agreements or easement option agreements that wind energy developers may present to you in an effort to obtain wind

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energy easements over all or a portion of your land.

**Purchasing Land.** Developers will sometimes purchase your land outright to develop a wind farm. You reap a one-time profit. Once you have sold the land, however, you have no access to that wind resource.

### *Investing with Others*

Developers make their money by selling wind-generated electricity to power suppliers or power marketers. In order to make a profit, they must produce that electricity at the lowest cost possible. If you can sell your wind energy yourself—perhaps with other partners but without a developer as a middleman—you will likely earn greater revenue than via a fixed lease payment. You will also assume greater risk and responsibility, however.

If you decide to build a partnership or pursue a joint venture to retain equity in wind turbines on your land, you can choose from one of the following options.

**Cooperative.** In this form of business organization, the business is owned and controlled by those who use its services. Returns are based on patronage, not investment. Your cooperative can be either tax-exempt or non-tax-exempt. Cooperatives have a long tradition in the rural U.S., including farm-based energy enterprises such as ethanol cooperatives. Even so, the development of wind cooperatives has been hampered by their inability to take advantage of the federal production tax credit. In 2003, Minnesota passed a new law which offers a new way to form cooperatives with investor members. This new structure might prove to be more beneficial for using wind energy incentives and raising capital. If successful, it can serve as a model for other states interested in providing more opportunities for wind power cooperatives. (A summary

of the new Minnesota law is available from the Minnesota Association of Cooperatives: <[www.wfcmac.coop/coops/mac/billsf679/Ch308Bsummary.pdf](http://www.wfcmac.coop/coops/mac/billsf679/Ch308Bsummary.pdf)>.)

**Pass-Through Entities.** A pass-through entity business structure allows tax credits and operating gains and losses to be allocated to the members of the entities rather than remaining with the entity itself. Some examples of pass-through entities that would qualify for the federal production tax credit include limited liability companies, partnerships, sub-chapter “S” Corporations, and limited liability partnerships.

### *Limited Liability Company (LLC)*

The characteristic factor of an LLC is that owners are not liable for things that go wrong that are not the owners’ responsibility. This offers owners some legal protection in case of accidents and disasters. In this type of structure, gains and losses are allocated to the owners, who pay taxes on them.

The LLC appears to have some general advantages over the other pass-through entities. If an LLC makes or loses money, the income or loss is allocated to all its owners (members), and they pay taxes, if they are in a taxable bracket, on a personal income basis. The members would also get their share of the tax credits. This meets the goal of getting a production tax credit (an additional source of revenue), which passes through to the members, and the LLC as an entity does not pay taxes.

An LLC is treated as a partnership, both for state and federal tax purposes. The entity is a pass-through entity. Unlike a corporation, it pays no taxes at all. An LLC can qualify for the federal production tax credit (PTC). For locally based wind projects, this typically means finding a large equity partner with enough tax liability to fully use the PTC.

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With an LCC, at the end of the year, a form K-1 is issued to each member. Based upon the member's investment in the LLC, this would indicate how much income or loss there has been for the year; this must be reported on the individual income tax returns. There is no money exchanged other than the members' federal taxes are affected by the profits and losses of the LLC.

LLCs have become the structure of choice for farmer-owned wind projects. Part IV of this handbook includes a case study of Minwind I & II, two farmer-owned LLC wind projects in Luverne, Minnesota.

Cooperative Development Services of Wisconsin recently published a paper on the LLC model for wind projects. The paper, *Wisconsin Community Based Windpower Business Plan*, is available through the following source:

Mary E. Myers  
Cooperative Development Services  
131 W. Wilson Street, Suite 400  
Madison, WI 53703  
(608) 244-0118  
memyers@merr.com

### *Partnership*

In most partnerships, liability for the project's debts and liability for personal debt are joint-and-several. This means that if only one partner has money, he or she is going to pay if anything goes wrong. Partnerships are a little more risky.

### *Partnership vs. Limited Liability Company*

While as a member of a partnership the level of investment does not matter when it comes to paying debts, this is not true for an LLC. Owners are limited to the extent of their investment with an LLC. The only time that an owner could be held responsible for any

loss is when the loss is related to something with which he was involved. If there were an accident with a blade that involved negligence, the liability would only involve those who had something to do with the problem. A member of an LLC is only exposed to the amount of his investment.

### *"S" Corporation*

An "S" Corporation may be advisable in certain specified situations; however, for this discussion, we should assume that there are too many rules and regulations that may prevent application here. For example, you can only have a limited number of members in an "S" Corporation, and you have only one class of stock.

### *Limited Liability Partnership*

Another business structure is a limited liability partnership. A limited liability partnership has limits to the number of partners it can have; if you have over a certain number, you would have to file with the Securities and Exchange Commission (SEC) and follow procedures that could be costly. Also, if anyone dies or leaves the partnership, then you have to re-form it every time.

### *Individual Ownership*

If you choose to own a turbine yourself, you assume all responsibility for the work and all the risks. You also receive all the profits. You may decide to purchase a small turbine to offset your own energy use, or to secure financing for a large turbine with the intention of selling power to a utility.

Wind turbines vary greatly in size, and the installed price is in direct proportion to that size. A large-scale turbine is a big investment, but smaller turbines cost more per kWh produced. A quick rule of thumb for the installed cost of large wind turbines is \$1,000

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per kW of capacity installed, which assumes some economies of scale for multiple turbines installed concurrently. Total installation costs for an individual large turbine may be 50 percent higher. The price for small farm-sized turbines may be double or triple the cost of large-scale development, so the value of the electricity generated is an important consideration.

The investment required for a large wind turbine is quite substantial, especially for an individual. With the exception of very wealthy individuals, most people will need to enlist an equity player in order to invest in a large wind turbine. Obtaining a sizable grant through the USDA or the State of Illinois could also help make investing in a large wind turbine more feasible for the average farmer.

### *Community Ownership*

Another emerging model of wind power development is community ownership. If private interests can benefit from wind, why can't public groups do the same? A community-based project is perhaps the best way for the broadest group of people to participate in harvesting the wind. The most common example of this kind of project to date has been municipal utility-owned wind turbines. There are a number of examples in Iowa, Minnesota, and around the country where community interest in wind power has driven the local utility to build small wind projects. One such project is profiled in Part IV of this handbook. School projects are another model for community-based ownership that are gaining in popularity. These projects are especially prevalent in Iowa where several school districts have discovered that wind energy can bring a new revenue stream for the school while providing an innovative tool for class projects and hands-on learning. A case study of a school-based project in Eldora, Iowa, is included in Part IV of this handbook.

### *Which Business Structure Is Best?*

This question will have to be addressed for each and every wind energy project. There are no "cookie-cutter" models to follow yet for locally owned wind projects, so you will need to do your own investigation. From the outset, you will want to carefully consider many factors when creating the structure of your business to maximize the wind energy incentives for which you may qualify. Some of the factors include the following:

- The availability of strategically located sites
- Your confidence level in the wind resource assessment
- Your financial goals, costs and availability of capital, and their influence on the size and structure of the project
- Your overall return on investment and the expected cash flow in good wind years as well as bad wind years

### *In Summary*

As you can see, there are many ownership structures from which to choose. Which structure you choose will depend on your current financial situation, your goals, and possibly the enthusiasm or availability of others. Talking with other turbine owners about their business structures can be enormously helpful.

It will take careful and creative thought to get this new "crop" off the ground; however, the same background and skills used for marketing and risk assessment of corn as a commodity can be used for marketing this new renewable energy commodity. This chapter is not intended to present the best or only business structure for a wind energy project. What works in one situation may not in another. The success of any wind energy endeavor

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in Illinois will depend on the ability of the owners to maximize the benefits from wind energy incentives. Once again, it is best to consult an attorney, CPA, or both in order to determine the best business structure.

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## Chapter 9. Planning Your Project: A Guide to Some of the Practical Aspects of Buying and Installing Large Wind Turbines.

Large-scale wind energy projects can be immensely complex, requiring large investments in time, effort, and money. This chapter is designed to offer some practical advice for planning your wind project. In particular, we will address several issues that offer the greatest challenges for wind energy projects such as interconnection, transmission, and financing. The information here focuses on large wind turbine projects; go to Chapter 6 for more practical information on small wind turbines.

### How to Choose the Best Wind Site

If you are interested in harvesting your wind energy resource, you should know the value of your wind resource before you enter negotiations with developers, other investors, or financiers. More details on wind resource and choosing a good site are available in Chapters 2 and 3.

#### *What to Look for in a Good Wind Site for Large Wind Turbines*

- The site must have a strong wind resource (minimum annual average of 11-13 mph at 30 feet above the ground).
- The site must be close to high-voltage three-phase power lines so the turbines can be connected to the electric grid. (Single-phase power is acceptable for small wind turbines.)
- The site should be in a rural location that will not raise objections from neighbors.
- The site should be elevated above surrounding terrain and be free of obstacles that could diminish its wind resource.

Developers often look for a site where they can contract for adjacent land in order to protect their wind access from future buildings or trees that might obstruct the wind resource. It is a

good idea for you to know as much as you can about your land and the value of your wind resource before you begin negotiating with developers, other investors, or landowners, or pursue your own financing. The more you know, the more value your land has. Also, remember that even if your land is not ideal for wind turbines, you could still invest in another wind project in your community.

#### *Siting and Permitting Tasks*

There are many tasks a prospective turbine owner or developer needs to perform related to siting and permitting for the overall project plan and strategy. The most important is initially adopting a goal of impact minimization by avoidance, design, location, and mitigation. This goal is met through permitting, design, installation, and operations. Take all concerns about impact issues seriously. If they are not addressed, siting related issues can become costly problems in the future (e.g., denial of permits, large unanticipated extra costs, inability to meet previously committed deadlines, complaints, lawsuits, etc.). Depending on the scale, type, and location of the prospective project, there are basic steps to follow. More specific information about siting and permitting is available in Chapters 2 and 3.

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These first steps apply during the initial idea stages and while wind measurements are being taken:

1. Learn what typical construction activities are needed, their sequence, and what equipment would be used. This will be refined when the project is designed. Some of this is outlined later in this chapter and turbine vendors, wind project developers, and other turbine owners can supply more detailed information.
2. Talk to turbine owners in the area. What was their experience with permitting, impact issues, agencies and neighbors? There are several places to find out where other wind turbines are installed in Illinois:
  - Windustry Wind Sites  
[www.windustry.org/sites/default.htm](http://www.windustry.org/sites/default.htm)  
(Good source for finding small wind turbines and small commercial projects)
  - American Wind Energy Association Wind Project Database/Illinois  
[www.awea.org/projects/illinois.html](http://www.awea.org/projects/illinois.html)  
(Best for large projects.)
  - U.S. Department of Energy/National Renewable Energy Laboratory—renewable energy project database  
[www.eere.energy.gov/state\\_energy/mystate.cfm?state=IL](http://www.eere.energy.gov/state_energy/mystate.cfm?state=IL)
3. Find out what the interconnection equipment requirements and sizes are from the local utility. Discuss preferred and alternative locations for connecting to their lines as well as the locations of their rights-of-way. (There will be more on this later in the chapter.)
4. Consult with neighbors and others who will see or be affected by the

project. This includes agencies that are dealing with public lands if such lands are adjacent to the project site. It also includes any special interest groups whose concerns may be involved. If the project is likely to be large, asking for input may be appropriate via public meetings, press releases, and targeted briefings. People generally react better to being included in the planning process early. It will also help you identify potential problems and hurdles.

Follow the next steps if the wind measurements show significant winds that appear adequate to support a wind project:

5. Consult with a local civil engineer or geologist to learn what the requirements are for any roadways on hillsides and turbine foundations. Obtain recommendations for erosion control. This information will be needed to engineer the turbine foundation; it affects construction, access, and design.
  6. Review existing information about any sensitive wildlife species and habitats that exist in the area. If the project affects federal lands, power lines, or facilities, formal consultation with the U.S. Fish and Wildlife Service is required (contact their closest regional field office) and an environmental impact study may be necessary. In 2003, the USFWS issued interim guidelines for siting wind turbines to have the least impact on wildlife and habitats. They are available online at [www.fws.gov/r9dhcbfa/windenergy.htm](http://www.fws.gov/r9dhcbfa/windenergy.htm).
- To prepare for obtaining permits other than basic electrical and mechanical, the following steps are useful:
7. Consult with various agencies to learn what their requirements and concerns

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are. Get copies of all relevant rules and forms. These local agencies include the highway department; holders of any rights-of-way that would be affected; city or county planning, permitting, or zoning offices; and the fire and public safety departments. Contact information for several Illinois county planning and zoning offices is included in Chapter 4.

8. If the project is in or near sensitive bird habitats or if species of concern inhabit the site, consult the National Wind Coordinating Committee's avian/wind publications. The information will facilitate informed discussions of how and what to do. These documents are available from NWCC online at [www.nationalwind.org/pubs/default.htm](http://www.nationalwind.org/pubs/default.htm) or by contacting NWCC in Washington, DC at (888) 764-WIND. Questions about birds are very likely to come up.
9. Make a list of potential issues that need to be addressed in the project design and plan. Identify whose involvement is needed to address each issue. Consult with these parties about the range of options and techniques. (See also the *NWCC Permitting Handbook*, which has been previously referenced.)
10. Review what standards and permit requirements are likely to be imposed on your project. This includes mechanical and electrical permits. Previous permits may give an indication of what to expect.
11. Formulate plans to deal with the various issues and requirements. Before your plan(s) are finished, get comments from any concerned or involved people.

Subsequently tie the above activities into the entire project planning:

12. Assess the costs and time needed for all the above activities and requirements, and factor this into the rest of the project's planning.
13. Design the project, get the costs, do your economic analysis, and put together a timeline for completion of the various tasks. Information in this handbook and our suggestions for economic analysis tools should get you started.

The above outline of activities will get most small wind project developers started in the right direction by identifying and dealing with any issues in a logical order during project planning. If the project is sizable or entails controversial issues, a consultant may be very helpful. While all the above activities are likely to be done by a small commercial project developer, many of the same issues will apply to residential and single turbine installations on a less formal level. Each issue should be considered and not quickly dismissed without the facts. At this point, you should be ready to apply for any needed permits with confidence that the project will comply and that there will be few surprises. (See Chapter 4 for information about permitting procedures in Illinois.)

### **Technology**

Chapter 6 discussed how to go about choosing a small wind turbine, but how do you choose a large wind turbine? If you are investing hundreds of thousands or even millions of dollars in a wind turbine, you need to make an informed choice.

#### *Size*

You will want to choose a turbine that meets the size needs of your project. When you reach the point of choosing a wind turbine, you will have decided at least roughly how big you want your project to be—whether its multiple

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large turbines or just one. Some financial incentives are limited to certain project size ranges, so keep that in mind as you select your turbine. For example, the Illinois state Renewable Energy Resource grant program offers different levels of grants for different sized projects. It might be to your benefit to choose a turbine in the upper ranges of one of the established categories.

#### *Wind Resource and Climate*

Some turbines are specifically designed to work in lower wind resource areas such as much of Illinois. Other turbines are designed to work in arctic conditions, which might be valuable during Illinois winters. A wind turbine model with a track record in areas with similar wind resources and climates to your site might be a good choice.

#### *Availability*

You might find the perfect turbine to fit your needs, but it needs to be available in your timeframe. Many large wind turbine manufacturers are based in Europe, making transportation and timing important considerations. Also, not every manufacturer is interested in supplying orders for small numbers or single turbines. They find it more cost effective to focus on large projects.

#### *Proximity of Operations and Maintenance Teams*

Your operations and maintenance costs will be significantly reduced if your turbine supplier has active O&M teams in your area. This reduces the cost of travel and response times for unexpected maintenance problems.

#### *Local Resources*

One major wind turbine manufacturer, NEG Micon of Denmark, has a Midwest office and service facility in Champaign, Illinois, and maintains its U.S. operations headquarters

in Rolling Meadows, Illinois. NEG Micon turbines are common in the Midwest, including several projects in Minnesota and Iowa. Some of these projects are small, locally owned projects that consist of single turbines or small clusters of turbines. The “Case Studies” section of this handbook includes several projects that use NEG Micon turbines.

### **Interconnection and Transmission**

#### *Connecting to the Grid (Large Wind Turbines)*

If you plan to connect your turbine to the existing power grid, you must make sure that your turbine is near a three-phase power line. Also, some utilities restrict how close a turbine can be to power lines, so make sure you know that ahead of time. The power lines you connect to must have the capacity to handle the added electricity from your turbine. You should start talking to a local electric distribution company in the early stages of planning your project. For large wind farms, the proximity to existing transmission lines is critical to minimizing infrastructure requirements and keeping costs down. High voltage lines can cost \$50,000 per mile, so sites with good wind with access to transmission capacity can be very valuable. Single turbines and small clusters will have an easier time finding available transmission lines, but there are no guarantees until you check.

In order to sell your electricity, you must connect your project to the electricity grid. Finding a location to establish this interconnection will play almost as important a role in choosing your site as wind resource. A very windy location without access to the electricity grid will not be suitable for most wind projects (the exception being off-grid systems). Interconnection can be in the form of connecting to a power line or attaching to a substation. For large turbines, the power line or substation must have three-phase power and the appropriate voltage (typically

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12 kV, 24 kV, or 34.5 kV for one or two large turbines) to handle your electricity. If you do not know the voltage of power lines near your site or if you do not know who owns them, start talking with the local utility company; they should be able to help learn more.

**Interconnect Study.** The owner of the power line or substation you wish to connect to can determine whether the facility is appropriate for your project and whether it has available capacity for your power. This determination is made through an interconnect study, which sometimes can be quite expensive (see the section on wind project costs later in this chapter) and take several months (or more) to complete. ComEd publishes a “*Blue Book*”: *Guidelines for Interconnection of Generation to the ComEd System*, available from them for \$50. Some ComEd interconnection procedure information also is available online: <[www.comedtransmission.com/trsfiles/attachment-k.doc](http://www.comedtransmission.com/trsfiles/attachment-k.doc)>. For other utilities, ask if they offer a similar publication to guide you through the process. The resulting study will tell you whether you will be allowed to interconnect, and if so, what kinds of electrical equipment need to be installed (at your expense).

**Interconnection Agreement.** When the interconnect study is complete, you will need to negotiate an interconnection agreement with the utility. This agreement will include a detailed design of the interconnection; specific costs; any limitations on operation of your turbine such as times when your generator can and cannot run; and what power quality, metering, and safety measures must be taken. You need to carefully analyze and add up the costs associated with the interconnection agreement.

**Transmission Service.** Transmission service is necessary to move your electricity on the utility grid. If the buyer of your electricity is not the same as the owner of the transmission

lines, there will be additional charges (wheeling charges). These charges can be significant and need to be factored into the economics of your project. You also need to consider that “line losses” can reduce the amount of electricity you can sell by up to 10 percent.

## Project Costs and Financing

### *Wind Project Costs*

Here we will address perhaps the biggest question of all: How much does all of this really cost? Wind project costs were outlined in Chapter 5, but the following lists should provide a good sampling of actual costs. You can use these numbers as examples when doing initial financial projections and calculations, but plan to obtain estimates that are more specific to your project as soon as possible.

**Turbine and Tower Costs.** The largest expense in any wind energy project is going to be the wind turbine hardware itself. We have surveyed prices of wind turbine models that are in wide use. There are many other turbines to choose from; these are merely examples. You can find out more about available turbines and prices by contacting manufacturers and consulting their websites. For a list of small wind turbine manufacturers, see Chapter 6. For a list of large wind turbine manufacturers, see the AWEA’s online membership directory: <[www.awea.org/directory](http://www.awea.org/directory)>. Also, please note that these prices are accurate as of July 2003, but will almost certainly change over time.

**Sample Turbine Pricing** (Prices are from July 2003; these will change. Do not expect to get these exact prices.)

- Bergy 10 kW with 23 foot rotor – \$30,700. Includes guyed lattice tower and electronics to connect to grid, but not installation.

- Jacobs 20 kW with 29 foot rotor and 100 foot lattice freestanding tower – \$30,500. Includes electronics to tie to grid, but installation costs are separate.
- Remanufactured E-15, 39 kW (15 meter rotor diameter) and 80 foot lattice tower – \$68,000 installed with everything needed to operate as a grid-connected machine.
- NEG Micon 900 kW with 52 meter rotor – \$925,000 (at current exchange rate with Danish Kroner). Includes 72 meter tower and installation costs.

### **Interconnection Costs**

*Small Wind Turbine.* The costs to interconnect are very hard to typify. The turbines that can interconnect at the farm using a larger transformer provided by the utility might cost a few hundred dollars to a few thousand dollars to interconnect. This work would be quoted and done by your Residential Energy Supplier, the company that sends you your electric bill.

*Large Wind Turbine Project.* For larger projects that require interconnecting a distribution or transmission level power line nearby, the costs can vary widely. It is imperative to research the interconnection process early in the planning phases because the costs can be prohibitive for a project. Three phase lines are required for large generators, but you cannot assume that any three-phase line can carry the power from your turbines. You may incur significant unanticipated costs if the power line near your site does not have the capacity to handle more electricity. In other words, you need to check whether nearby power lines are “full.” Transmission lines are notoriously expensive to build and difficult to site. If the electricity from your wind turbine(s) needs to be transported on wires to reach an appropriate power line, the cost will be \$40,000-\$60,000 per mile for the feeder line. This feeder line is at a higher voltage than what the generator

creates—often the voltage of the distribution line (12 kV, 24 kV, and 34.5 kV are typical figures). This requires a step-up transformer at the base of the wind turbine. The transformer costs in the \$10,000-\$15,000 range for a 1 MW size turbine. At the point the electricity is transferred from your ownership to the utilities (the interconnect point), you will be responsible for paying for all the equipment needed to make that a safe and stable interconnect. This equipment might include one or all of the following:

- Switches that can disconnect your project
- Breakers to protect the power system should you have a fault
- Metering to tell the utility how much you have generated and added to their system
- Various other electrical structures/devices.

The utility will tell you all the equipment that is required when they study the interconnection of your system. (ComEd publishes a “*Blue Book*”: *Guidelines for Interconnection of Generation to the ComEd System*, which is available from them for \$50.) This interconnection equipment cost could range from tens of thousands of dollars to hundreds of thousands of dollars. The only sure way to determine the cost is to request an interconnection with the utility and have them tell you, via an interconnection study. Interconnection studies themselves cost money, often \$5,000-\$10,000 for projects in the 1 MW range. For example, the utility might advise you to put in a “dual line feed” to avoid them curtailing your turbine for those few days a year they need to do line maintenance. The dual line is a second, redundant line that allows your project to generate power even if the first is taken out of service. Evaluating the cost effectiveness of a dual line feed will be part of your economic analysis.

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*Installation Costs.* Installation costs are all the expenses required to get your turbine up and running once it arrives. Often you will hire a company experienced in erecting and connecting wind turbines to the grid. This company can provide you a cost estimate for your project. The contractor will give one price for all the installation, roads, electrical, insurance, etc. This figure ranges from \$300,000 to \$500,000 for a 1 MW size turbine.

The following are the main items they will quote:

- *Access road* – If required, it is typically a 15 feet wide gravel road at grade. Budget \$25 per foot, plus additional money for road turnouts, culverts, and a crane pad. These costs could add up to \$10,000 or more.
- *Foundation* – This cost depends on the height of your tower and weight of the generator assembly and rotor, plus the soil conditions at your site. A 1 MW turbine foundation is very large; it will need eight to ten truckloads of concrete, with costs ranging from \$40,000 to \$120,000. As previously mentioned, a contractor often will give an inclusive price for all the installation, roads, electrical, insurance etc. (\$300,000 to \$500,000 for a 1 MW turbine.)
- *Wiring to Turbine Base* – This includes installation of a pad mount transformer at the turbine base if required, underground wiring on the property, electric poles to carry the power to the utility line if required, and installation of all these components. The cost range is \$20,000 to more than \$200,000 should you require several miles of feeder line
- *Turbine Erection* – The major cost for erection is the rental of the crane. A 300-foot crane with the necessary 200-plus

ton capacity can cost \$80,000 or more for a simple one day erection. Should you have weather delays or other difficulties, the rental charge of the crane might add 10 percent per day to the costs. Note that turbine erection would be included inclusive installation costs (\$300,000-\$500,000 for a 1 MW turbine).

Turbine commissioning costs are usually included in the price the turbine manufacturer or dealer will charge when ordering the machine. They will send one or more people to oversee the “commissioning,” which is the process of final wiring, setting parameters, and verifying that the turbine is operating safely and generating power as shown in the manufacturer’s literature.

## **Operating Costs**

### *Operations and Maintenance (O&M)*

You can choose to provide most of the O&M yourself once you are trained by the company technicians that do the turbine commissioning. Third party and turbine manufacturers also do turbine O&M for \$6,000 to \$10,000 per year for a 1 MW size turbine. Each different type of turbine has its own O&M costs; some are considered higher maintenance and cost more yearly for maintenance. This O&M includes monitoring the turbine 24 hours a day/seven days a week. You need someone on call at all times to solve the many small turbine controller issues that arise (and to shut down or start up your machine). These modern large machines are often warranted to run at 95-97 percent availability. This is achieved partly by the quality of the machine and partly by the quick response of the O&M team. Down time is lost money. You’ll make most of your money on the 30-60 days per year that the wind blows over 30 mph at hub height and the turbine generates at close to peak output all day. You want to operate those days or face losing

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significant income. If you are selling electricity to ComEd in the summer for 6¢/kWh during peak summer hours (ComEd's quoted avoided cost) and your 1 MW turbine misses a windy day, you will have lost over a thousand dollars in income for that 24-hour period. That's more than 1 percent of your annual income.

### *Insurance*

Insurance costs range from \$8,000-\$15,000 per year for a 1 MW size turbine. There are several California based insurers with significant experience insuring wind machines; they can provide valuable input on your project costs by outlining the various scenarios you need to protect yourself against. WindPro Insurance is the largest provider; contact them at [info@windpro-insurance.com](mailto:info@windpro-insurance.com) or at (760) 836-0417. You can also visit their website at [www.windpro-insurance.com](http://www.windpro-insurance.com).

### *Administrative and Legal*

At minimum, you will have to hire an accountant to prepare your taxes, but you will likely need other professional services to deal with contract issues, billing, insurance settlements, and whatever service issues arise. A developer typically budgets \$6,000-\$7,000 per year per turbine for administrative and legal costs. Do not assume that you can put up this big machine and just sit on the porch enjoying the income. There will be plenty to do. You need to budget yourself or another person five hours or more every week to deal with issues relating to the turbine.

### *Contingency*

This term refers to an amount of money you will set aside should an unforeseen problem arise and require immediate attention. For example, if lightning strikes the machine, you will want to get it repaired quickly. The repair could require you to use contingency money rather than wait for the insurance claim to be

processed. Often, a set amount will be paid into a contingency fund each year.

### **Financing Wind Projects**

Chapter 5 discussed the economics of wind energy in general terms and provided a list of the various tax incentives, grants, and other financial assistance programs. This section is designed to help you plan the financial aspects of your project. The information presented here, in conjunction with the economic analysis tools suggested at the end of Chapter 5, should help you with your plans.

Previous chapters have discussed different types of wind projects and the possible business models that can be used to develop them. Once a basic style of project has been identified, there are several questions that should be answered when beginning to do the financial analysis:

1. What rate structure will apply to the project? Will net metering apply?
  - Remember that in Illinois, only projects less than 40 kW in ComEd territory will be eligible for net metering.
  - If you are a Qualifying Facility under PURPA (see Chapter 7), you will be eligible to receive avoided cost rates.
  - The value of wind-generated electricity increases if it can be sold as "green electricity."
2. How much, if any, of the energy produced will be used on site?
3. What production or tax incentives apply to the project?

- Read the list of incentives in Chapter 5 carefully to see which programs are applicable for your project.
- Remember that wise use of incentives could be necessary to make your project economically viable. Adjusting your plan to make maximum use of the incentives is probably worthwhile. This will almost certainly be true for projects in Illinois, given the amount of wind available.

4. What is the cost of buying and installing the turbine or turbines?

- The previous section on costs should help you make good estimates. More specific information is available from turbine manufacturers.

5. What is the interest rate and principle of the loan; the amount of nonborrowed capital in a project and the forgone interest rate on the capital; and the applicable tax rates for income earned from the project?

- *The Interest Rate and Principle of the Loan* – One of the biggest costs of a wind project can be arranging financing. Once the installed cost per turbine is determined, the amount of capital that must be borrowed can be estimated. It is important to be realistic about the amount of equity that a bank will require for the project. In addition, the interest rate on the loan is important and can make the difference between a project that makes a profit and one that simply breaks even.
- *Equity Investment and the Foregone Interest Rate* – The equity investment in a project is the amount of capital that is not borrowed. This may come from private savings or

direct investment by members of a cooperative or LLC, for example. It is important to know what rate of return (interest rate) is foregone by investing the money in the turbine project. This is crucial in determining changes in tax payments.

- *Taxes* – Depending on how the project is set up, it will be subject to different tax rates. For example, members of a cooperative will pay personal income taxes on the profits they receive from the project. It is important to understand which tax rates will apply to your business structure. For more information, see Chapter 8 on ownership structures, and then consult a CPA.

*What Will the Bank Want to Know?*

With the exception of the smallest wind turbines, most wind energy projects require some kind of outside financing. In many cases, this means going to the bank for a loan, just as though you were buying any other large piece of equipment. A few banks and financial institutions in the Midwest are starting to become comfortable with financing wind projects. They have gained enough experience to know that wind energy can be a sound investment, so they have a good idea about what kinds of projects have the best chances for success. If wind energy is new to your area, however, local banks might be wary or have a lot of questions about wind energy. This section outlines some of the information you should have available before approaching a bank for a loan.

A lender will want an overview of your project, including detailed cost estimates (for equipment, interconnection, installation, operation, etc.) and a legal description of the proposed project site, possibly including aerial photos and Platt drawings. You also

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will need detailed budgets of project expenses and income (probably monthly for at least 24 months, and annually for three more years). Other requirements could include the following:

- Existing and pro-forma financial statements
- How and to what level will the project be capitalized
- Your plans for using state and federal incentives
- Legal ownership structure
- Background of majority owners
- Personal financial statements (based on capitalization)
- List of all required contracts, permits, and easements and your progress toward obtaining them
- Copy of proposed power contract
- Risk mitigation plans
- Construction management plans
- Ongoing management and extended warranties plans
- Insurance coverage, including property/casualty liability and business interruption

**Credit Guidelines.** Many lenders might require a minimum equity of 30 percent of the project costs. The term note will likely be amortized over ten years with quarterly or yearly payments.

**Evaluation.** The lender will evaluate your loan application based on the thoroughness and accuracy of your business plan; the validity and strength of your cash flow and financial

statements; your securing of adequate capital for the project; and a legal review of contracts, permits, and easements. Some of the concerns a lender might have about financing wind projects include the availability of equity capital; the stability of power purchase contracts; the stability and availability of state and national incentives; the stability of the market for wind energy; and the availability of proven expertise in wind project design.

*Sources:* AgStar Financial Services (Mankato, Minnesota) and Fishback Financial Corporation/First National Bank of Pipestone (Minnesota)

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## **Part IV. Case Studies**

### **Case Studies**

Case Study #1: Small Wind Turbines in Illinois  
Case Study from Kendall County, Illinois

Case Study #2: Mendota Hills Wind Farm, Lee County  
The First Utility-Scale Wind Project in Illinois

Case Study #3: Illinois Wind Energy, LLC's Crescent Ridge Wind Project  
A Permitting Saga from Bureau County, Illinois

Case Study #4: Community Ownership: Midwest Municipal Utility—A Wind Power Pioneer  
Waverly Light & Power (Waverly, Iowa)

Case Study #5: School Ownership: Eldora, Iowa  
Reading, Writing, Wind Energy, and Arithmetic

Case Study #6: A Pioneering Model for Farmer-Owned Wind Projects  
Minwind I and Minwind II (Luverne, Minnesota)

### **Scenarios**

Scenario #1: Can Illinois Farmers Own Their Own Utility-Scale Wind Turbines?

Scenario #2: Can Generating Your Own Power with a Small Wind Turbine Be Economical?



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**Case Study #1**  
**Small Wind Turbines in Illinois**  
**A Case Study from Kendall County**

**Turbine:** 10 kW Bergey turbine

**Location:** Near Newark, Illinois in Kendall County, about 50 miles southwest of Chicago

**Owner:** Gary Kizior

Gary Kizior installed a 10 kW Bergey turbine in December 2002, replacing his old Whisper 3 kW machine. It sits on the same 80-foot tip-up tower that the Whisper machine used. This project was half funded by the Illinois Renewable Energy Resources Grant Program and was among the first small turbines in the state to receive a grant through this program.

### **Turbine**

Gary chose a Bergey Excel 10 kW generator with a 23-foot diameter rotor because it had a reputation for quality and being low maintenance. There are no regular lubrications required, and he anticipates very low costs for upkeep and repair in the future. The turbine cost approximately \$20,000.

### **Funding**

Gary applied to the Illinois Department of Commerce for funding in July of 2002. Two months later he learned that his application had been approved. After submitting some additional paperwork, he received his check in a few weeks. Wind turbines from 5 kW to 200 kW are currently eligible for grants for up to 50 percent of the hardware and installation costs through this state program. More information about these grants is available in Chapter 5, and the full guidelines for 2004 are included in the Appendices.

### **Permitting**

This project took advantage of the exemption from zoning restrictions for agricultural projects in agriculturally zoned areas of the State of Illinois. This is a low-hassle route for farmers interested in small wind turbines.

### **Economics**

#### *Production*

Gary has a wind anemometer mounted 65 feet off the ground on the 80-foot tower. Data collected last year showed the annual average wind speed at this height to be 9.5 miles per hour; however, according to Gary, 2002 was a lower than average wind year, especially during the winter. The Bergey WindPower website has a calculator designed to model cash flow and payback periods for Bergey products. The calculator shows that an average annual wind speed of 9.5 mph will yield a yearly production



10 kW Bergey wind turbine

Photo courtesy of  
the National Renewable Energy Lab

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of 7,923 kWh, or an average monthly output of 660 kWh. This figure is based on an open site for the turbine free of obstacles to the wind. Gary's site and electrical configuration produces a little bit less than this estimate. He uses a transformer and existing inverter to charge batteries at the same time. These both consume power and reduce the amount he can sell to ComEd through the company's net metering program.

cost rate for their excess electricity. Receiving roughly 2¢/kWh rather than closer to 9¢/kWh would significantly lengthen the payback period for the turbine.

### *Net Metering*

Gary reports that he is saving approximately \$500-\$600 per year in electricity costs. ComEd reduces his monthly bill by the avoided cost rate (approximately 2¢/kWh) for the energy that he generates. Then at the end of the year, ComEd calculates the total amount of electricity he used and the amount of electricity he generated at the summer and winter peak and off peak rates, resulting in ComEd sending a check for the additional amount. In the end, he will average closer to 9¢/kWh for the electricity he offsets by generating his own power. Simple payback on such a system is 15-20 years after the grant award. This payback is for the turbine only; Gary used an existing tower and electronics, and the cost of those is not included in this analysis. Bergey advertises their turbine and inverter as \$22,900 and an 80-foot tower that tips up is \$8,400. Labor would cost extra if you were not able to do all the work yourself.

This project demonstrates one of the best scenarios available for landowners interested in buying a small turbine in Illinois. Gary was able to use both of the state's strongest incentive programs for small wind turbines: (1) ComEd's net metering program and (2) the state grant program. Illinois residents outside ComEd's territory might still be eligible for the state grants if they live in the service territory of another investor-owned utility; however, they will not be eligible for net metering and could only expect to receive the avoided

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## Case Study #2

### Mendota Hills Wind Project, Lee County The First Utility-Scale Wind Project in Illinois

The first utility-scale wind project in Illinois will be online by the end of 2003 in Lee County near Interstate 39, about halfway between Mendota and Rochelle. Sixty-three 800 kW Gamesa turbines are under construction in what will be a 50.4 MW wind farm. The turbines are 210 feet tall at hub height, and the blades reach as high as 290 feet. They have 170-foot diameter rotors, and together will generate enough power for 15,000 homes while turning at a tranquil 25 revolutions per minute. Each turbine is projected to produce about two million kWh annually. The turbine manufacturer, Gamesa Eólica, is based in Spain and is also a majority owner of Navitas Energy of Minneapolis, Minnesota, the project developer/owner.

#### Community Impacts and Benefits

This site was chosen for its wind resource and proximity to power lines big enough to carry this much power to market. The project site is spread across about 2,600 acres, all leased from local farmers. Each turbine and related infrastructure actually only occupies about half an acre. Last spring, Navitas said that it would pay the county nearly \$400,000 in permitting fees plus approximately \$350,000 annually in property taxes, according to initial figures

from the county assessor. The Lee County zoning policy requires developers to pay \$25 per foot of turbine height, which is \$5,250 per turbine in this case. The policy also requires turbines to be set back 1,400 feet from residences (unless a resident agrees to waive this requirement) and 500 feet from roads. The company also estimates that the Mendota Hills project will create about 30 construction jobs and as many as six full-time operations and maintenance jobs.

#### Project Economics

This \$55 million project is mostly financed with private money, but it did benefit from a \$2.75 million grant from the Illinois Renewable Energy Resources Grant Program. The state program no longer offers grants that large, and projects over 2 MW are no longer eligible.

Power generated at the Mendota Hills site is sold to ComEd, a big investor-owned utility in northeast Illinois that serves Chicago and its surroundings. One of ComEd's largest customers, the City of Chicago (along with 47 other local government units), is working toward a goal of getting 20 percent of its electricity from renewable sources.



View of the Mendota Hills Wind Project under construction.

Courtesy of Windustry



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### Case Study #3

#### **Illinois Wind Energy, LLC's Crescent Ridge Wind Project A Permitting Saga from Bureau County, Illinois**

The Crescent Ridge Wind Project was among the first utility-scale wind farms to be permitted in Illinois and has received considerable attention from the local and state media. Prospective Illinois wind developers planning large or small projects can gain significant insight into the permitting process by learning more about Crescent Ridge's experience.

Crescent Ridge Wind Project developers—Illinois Wind Energy, LLC and Tomen Power Corp.—first applied for Conditional Use Permits in Bureau County in July 2002. Their permit was eventually approved six months later in January 2003 after a number of delays and significant public debate. The process involved obtaining approval from the Regional Planning Commission, the County Zoning Board, and finally the Bureau County Board. The permitting process usually takes less than three months, but it stretched to twice that long for this project and several other proposed large wind farms in Illinois during the same time period.

The permitting process was long for Crescent Ridge, despite having extensive documentation to support their permit applications, including an independent Noise Report Study, Avian Impact Study, and a Phase 1 Archaeological Survey. The Noise and Avian Impact Studies are available to the public on the project website: <[www.crescentridgewind.com](http://www.crescentridgewind.com)>. This website also includes a record of the project's news coverage published from the initial project announcement, through the permitting process, and beyond. These articles give great insight into how a community new to wind power might react to the announcement of a large project and demonstrate the need to engage and educate rural communities about wind energy early in the project planning

process. There was a long and public debate about how wind energy would fit into the area's rural landscape.

Crescent Ridge was initially slated to begin operation in the summer of 2003, but the long permitting process and other delays have made the summer of 2004 a more realistic estimate. One of these extra delays, a lawsuit by a group opposed to the project, came after receiving the Conditional Use Permits.

#### **Project Location and Site Description**

The Crescent Ridge project is located in Bureau County, Illinois, about eight miles (12.8 km) southwest of Princeton and three miles (4.8 km) west of Tiskilwa, Illinois. The turbines will be spread across about 2,200 acres of land owned by local farmers. Several county roads (both asphalt and gravel) transect the site, and there are nearly a dozen homes (mostly farm houses and outbuildings) within the project area or immediately adjacent to it. Ownership is entirely private, and all the land is actively farmed.

The Crescent Ridge project will consist of 32 turbines each capable of generating a nameplate rating of 1.5 MW of power. Total nameplate output of the plant will be 48 MW. (Originally, 34 turbines were planned, but permit applications for two turbines were denied.) The energy from the project would be enough to provide at least 15,000 homes (or about 45,000 people) with emission free electricity. Each turbine will consist of a tubular 80 m (262 foot) tower with a 72 m (226 foot) rotor diameter.

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## **Additional Permits/Studies**

### *Phase 1 Archaeological Study*

An archeological study was required because the project will receive grant money from the Illinois Department of Commerce and Economic Opportunity.

### *Noise and Avian Studies*

These are not typically required for a permit, but a county could demand them before issuing a permit. The turbines must comply with the Illinois Pollution Control Board Noise Standards, which are fairly strict in comparison with neighboring states. Nighttime noise levels must be below 30 dBa at residences.

Crescent Ridge will also need to obtain permits to transport heavy loads on township and county roads, a construction permit, and a storm water permit to minimize soil erosion during construction.

## **Additional Bureau County Requirements**

The county and developer negotiated a few conditions on the project, including that the developer must set aside \$500,000 for roads and \$812,600 for decommissioning of the turbines. 1 It's not stated how this money must be set aside, but its certainly another project cost that must be included in an economic analysis.

*Source: News Tribune of LaSalle, IL, July 15, 2003, by David Silverberg.*

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## Case Study #4

### Community Ownership: Midwest Municipal Utility—A Wind Power Pioneer Waverly Light & Power (Waverly, Iowa)

Waverly Light & Power (WLP) was the first utility in the Midwest to invest in wind energy with an 80 kW turbine in 1993. The municipal utility in northeast Iowa began to explore wind power as a way to diversify its energy resources, test more environmentally friendly ways to generate electricity, and respond to the community's interest in wind. The success of the first turbine prompted WLP to invest in two more turbines, 750 kW Zonds. This time the turbines were installed near Storm Lake in northwest Iowa to take advantage of a better wind resource, and the economies of scale of that came with being part of a 259-turbine project.

With advances in technology and costs for wind energy dropping, WLP determined in 2002 that installing a large turbine in the local area made economic sense. The 900 kW NEG Micon turbine cost \$1.1 million and now provides enough annual energy for 261 homes (about 2.2 million kWh). Residents and businesses in Waverly now get about 5 percent of their energy from wind power. The Iowa Department of Natural Resources has a case study that describes the operation and economics of this turbine in detail. It is available on the WLP website: <[www.waverlyia.com/wlp/Wind/case%20study.PDF](http://www.waverlyia.com/wlp/Wind/case%20study.PDF)>.

WLP launched the Iowa Energy Tags program in 2001 to allow citizens from Iowa and around the country to support its wind energy initiatives. For \$50, any consumer or company in Iowa or around the country can buy the equivalent of 2,500 kWh of wind-generated electricity. The cost of WLP's wind turbine investments has been integrated into the rates of all Waverly customers, but this program allows people to contribute extra toward more wind development.

WLP General Manager Glenn Cannon has been the guiding force behind the utility's pioneering efforts in renewable energy. In a 2002 interview with *Wind Powering America*, Cannon outlined his vision for doubling WLP's use of wind power and offered ways to help other municipal utilities follow in Waverly's footsteps. To read the full interview, visit <[www.eere.energy.gov/windpoweringamerica/pioneerscannon.html](http://www.eere.energy.gov/windpoweringamerica/pioneerscannon.html)>.

Another Waverly wind power champion is honored in the names of WLP's four turbines. They are called Skeets 1, 2, 3, and 4 as a tribute to the late Russell "Skeets" Walther, a Waverly farmer who volunteered his land for the first WLP turbine. The 231-foot tall Skeets 4 now stands in the same spot as the



Glenn Cannon standing in front of the original 80 kW Skeets 1

Photo by Tom Wind

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original Skeets 1 as a memorial to Skeets's great commitment to wind power.

*Sources:* Iowa Department of Natural Resources, *Wind Powering America*, and Waverly Light & Power ([www.waverlyia.com/wlp/](http://www.waverlyia.com/wlp/)).



A 750 kW turbine in Moorhead, Minnesota, owned by Moorhead Public Service, another municipal utility. "Capture the Wind" is one of the most popular utility green pricing programs in the nation. Moorhead citizens volunteer to pay extra on their electricity bill each month to support wind energy in their community. More information is available at [www.mpsutility.com](http://www.mpsutility.com).

Photo by Tom Wind

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## Case Study #5

### School Ownership: Eldora, Iowa

#### Reading, Writing, Wind Energy, and Arithmetic

From his office in the small central Iowa town of Eldora, Eldora-New Providence Community School District Superintendent Bill Grove can see the money his district is saving in energy costs every day by tracking the performance of the wind turbine standing on the grounds of the high school.

The 750 kW NEG Micon turbine was installed last fall after years of talks, negotiations, setbacks, and planning with the school board and the local utility. The idea of the Eldora-New Providence Community School District producing its own electricity from wind power was conceived in the mid-1990s when school officials were brainstorming ways to save money. The first step was a meeting with the local utility, IES Utilities, Inc. (now part of the Madison, Wisconsin, based Alliant Energy), that turned out to be crucial to the ultimate success of the project. “The utility vice president’s jaw hit the floor when he realized that we weren’t making any demands, just asking if we could all work together. They’re not used to being approached like that, and it really set a positive tone that served us all well in the end,” said Grove.

The original plan for the project called for installing a 250 kW turbine at the high school, which would have closely matched the electricity needs of that building, the district’s largest electricity user. The first interconnection agreement offered by Alliant would not have produced a positive revenue stream for the school district, however, creating the first of many hurdles for the project. Eventually, by

going through the Iowa Utilities Board, the district secured an arrangement wherein the wind turbine’s electricity would offset the high school’s electricity use, extra energy would be sold to Alliant at the avoided cost rate, and any additional energy needed by the high school would be purchased from the utility at the retail rate.

With the legal issues settled, Grove and the school board hoped to move forward quickly with constructing the wind turbine. They hired wind energy consultant Tom Wind to do a feasibility study and recommend the best site for the turbine. The project’s second major obstacle appeared at this point when the district did not receive a single bid for installing a 250 kW machine. They discovered that most wind turbine manufacturers were moving toward larger, more profitable machines and were phasing out the 250 kW turbines.

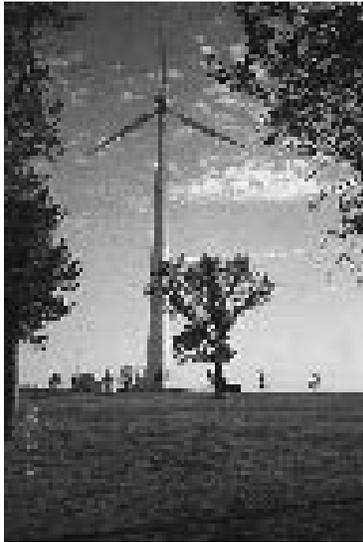
With all the plans revolving around buying a 250 kW turbine, the project easily could have fallen apart with this set back; however, the spirit of cooperation established in that very first meeting with the utility reemerged to save the project. Alliant offered to allow the Eldora-New Providence schools to use the electricity generated by a larger turbine to offset all of



Construction of the school’s wind turbine

Courtesy of Eldora-New Providence Community School District

the district's electricity use, rather than just the high school's consumption. Grove was careful to point out that the utility might not offer this particular arrangement to everyone, but that the benefits of working cooperatively with



225 kW turbine at Lac qui Parle Valley High School in Madison, Minnesota

Photo by Tom Wind

the utility for this project could be a lesson for other schools.

With this new agreement, Tom Wind performed a new feasibility study for a 750 kW wind turbine. The numbers still looked favorable for the revised plan; thus, in late 2001, the school district

tried again to request bids, this time for the larger turbine. The second try proved more

fruitful than the first, and by March 2002, the district contracted with NEG Micon and had a turbine installed on October 21, 2002.

Grove expects the new turbine to generate enough electricity to offset the entire school district's electricity bill and still be able to sell some power back to the utility. The energy savings and the extra revenue from selling electricity should be more than enough to cover the \$97,729 annual loan payment. When the loan is paid off in ten years, all the savings and revenue will simply be extra money for the Eldora-New Providence schools. So far, the turbine is meeting and even exceeding these expectations. (See chart below for details.)

The school district borrowed a total of \$800,000 to finance the project—including the cost of the turbine, consultant and attorney fees, interconnection fees, and an extended five-year warranty—and expects to pay off the loans in ten years. Part of the financing came through a \$250,000 no interest loan from the Iowa Energy Bank, an energy management program run by the Iowa Department of Natural Resources Energy Bureau. The

**Figure 12. Revenue and Production Projections**

<b>Eldora-New Providence Community School District Wind Turbine</b>					
Projected energy savings per year	Annual loan payments for turbine (first 10 years)	Projected annual production from 750 kW NEG Micon turbine	Projected annual revenue from excess energy production (sold at 3.8¢/kWh)	Projected annual profit during first ten years of operation	Projected annual profit and savings after the first ten years
\$90,000	\$97,729	1.5 million kWh	\$19,000	\$12,000	\$109,000
<b>Statistics from January-March 2003</b>					
Energy generated	Energy used	Energy savings	Excess energy generated	Extra income generated	
406,440 kWh	335,433 kWh	\$25,170	71,007 kWh	\$2,698	

Source: Eldora-New Providence Community School District

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remaining \$550,000 was borrowed from the local Hardin County Savings Bank of Eldora at 5.5 percent interest. A slightly lower rate was available from a Des Moines bank, but the school board felt it was important to support the local business. Combined with the no interest loan, the average annual interest is only 2.1 percent. For the first five years, the school district will also pay \$8,000 for a maintenance contract with NEG Micon, but Grove hopes the school district will have its own maintenance crew trained by the end of that time. This low-interest financing package, combined with the area's decent, but not outstanding wind resource, made this project economically viable.

Today, the 160-foot tall turbine stands in a field just behind the high school where students and teachers see it every day. The physics class tracks the electricity production and uses the data for projects and to illustrate many concepts. "We've gotten just what we wanted," said Grove, citing the school's new role as an innovator in both education and environmental protection. Perhaps even more importantly, he said, "We have an inflation-proof investment for the next 25 years."

Eldora-New Providence School Community District is the latest of half a dozen school districts in Iowa to invest in wind energy. Many more schools in Iowa, Minnesota, and around the Midwest are exploring using wind power to reduce their energy costs. Grove alone has received more than a dozen inquiries from other school districts. The Spirit Lake School District in northern Iowa was the pioneer for this kind of project, installing the first of its two wind turbines in 1992. For more information about wind energy and schools or other community-based wind projects, visit <[www.windustry.org/community](http://www.windustry.org/community)>.

Barring special negotiations, a school district in Illinois could expect to receive avoided cost

rates for power generated by a school-owned wind turbine; however, there are significant grants and incentives available in the state that could make a project economically rewarding. For example, schools and school districts are eligible for the Illinois Renewable Energy Resources Grant Program or grants from the Illinois Community Clean Energy Foundation (see Chapter 5 for details). At least one school district in Illinois, Bureau Valley School District in Bureau County, is exploring the possibility of installing a wind turbine to reduce its energy costs. The current plan under exploration is to place a turbine on the high school grounds to provide power for that building and a neighboring elementary school.

*Source: Peoria Journal Star, June 18, 2003, by Bob Morrow.*



750 kW turbine owned by the Spirit Lake Community School District in Spirit Lake, Iowa. This is the second turbine installed by the Spirit Lake schools, having been pioneers with a 250 kW turbine back in 1993.



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## Case Study #6

### A Pioneering Model for Farmer-Owned Wind Projects Minwind I and Minwind II, Luverne, Minnesota

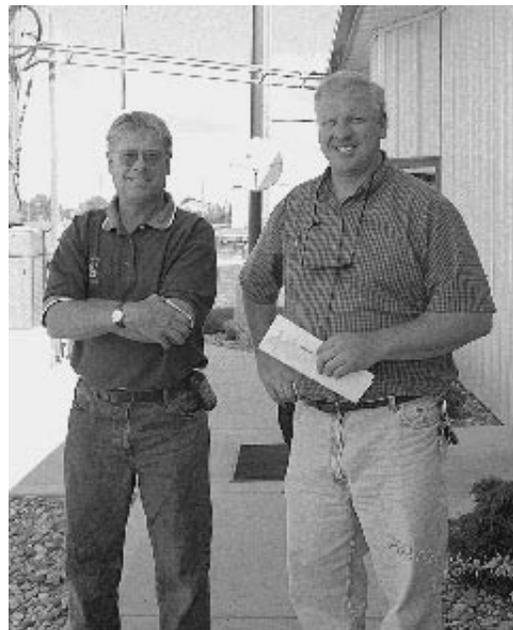
In 2000, a group of farmers in Luverne, Minnesota, began to hatch a plan to build farmer-owned wind turbines in southwestern Minnesota. Their goal was to find an investment that would generate new income for farmers and have economic benefits for the local community. The rapid growth of the wind industry around the country and the great success of wind farming on the nearby Buffalo Ridge made developing wind energy a natural choice. “We wanted a farmer-owned project that would bring economic development, get farmers a return on their investment, and could use local businesses, and contractors to do the work,” said Mark Willers, a project leader and farmer from Beaver Creek, Minnesota.

To develop their idea of farmer-owned commercial wind turbines, the group did extensive research and settled on forming two limited liability companies (LLCs), Minwind I and Minwind II. This format was the best option because it maximized the companies’ ability to use federal tax credits and other incentives for wind energy while maintaining some principles of cooperatives such as voluntary and open membership, democratic member control, and concern for the greater community. Today, a group of Minnesotans could potentially choose to form a cooperative rather than an LLC and still make good use of available tax credits based on a new 2003 state law allowing cooperatives to form with investor members; however, in most states, the better structure for using the production tax credit will be an LLC.

Sixty-six investors from the region eagerly snapped up all the available shares in both companies in only 12 days. All of the members are from Minnesota and are also investors in Luverne’s ethanol plant (Corn-er Stone

Farmers Cooperative), although that was not a requirement for membership. The two companies are carefully structured to give farmers the best return on their investment in the most democratic way possible. Eighty-five percent of the shares must be owned by farmers, leaving the rest available for local townspeople and nonfarmers who could someday inherit shares. Each share gives the owner one vote in the company, and no single person can own more than 15 percent of the shares.

Two companies were formed to take advantage of a Minnesota renewable production incentive that provides 1.5¢/kWh payment for wind projects up to two MW for the first ten years



“We are trying to get farmer ownership of wind projects to the forefront and it has been a challenge, but with dedicated people like Mark Willers [left] and Tom Arends [right], we’re making great strides.” –Dave Kolsrud, Corner Stone Farmers Cooperative

Photo by Lisa Daniels

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of production. Although they coordinate closely, they are governed by separate boards of directors, have different groups of investors, and maintain separate financial books. Willers serves as president of Minwind I, and Tom Arends, another local farmer based in Luverne, is president of Minwind II. Both groups have also relied heavily on expertise from consultants to develop the actual wind project and negotiate the power purchase agreement, and a team of lawyers to determine the business structure.

After the shares were sold, the companies had enough capital to begin developing two nearly identical 1.9 MW wind projects. Construction was completed on both Minwind projects by the fall of 2002. Each project consists of two NEG Micon 950 kW turbines, and all four turbines will be located on the same farm seven miles southwest of Luverne in the southwest corner of the state. The site was chosen because the group wanted to use land owned by one of the project's investors, and this particular farm had the best combination of wind resource and access to transmission lines.

According to Willers, the most difficult step in these projects was not finding capital for the hardware, consultants, or legal fees because the participants were enthusiastic about investing from the very beginning. He believes that it is a myth that farmers do not have the money to finance projects on this scale. (Minwind I and II cost about \$1.6 million dollars each and will be paid off in ten years.) The biggest obstacle, rather, was negotiating a power purchase agreement, a crucial step to moving any wind project forward. The group first had to find a power company that believed they were serious about building the turbines, then one that was willing to buy the power they would generate. Discussions with the local rural electric cooperative were fruitless due to many issues, including interconnection requirements, cost, and a long-term exclusive agreement

with another power supplier. Eventually, after months of negotiation, they entered a 15-year contract with Alliant Energy, which will use the power to help satisfy renewable energy standards in Iowa or Wisconsin. As with any power generation project, establishing a market for the power and negotiating a contract were crucial to allowing these two projects to move forward.

Minwind I and Minwind II are as much about economics and promoting farmer-owned enterprises as they are about developing wind energy. The companies are consciously using local materials and contractors for everything possible, including purchasing concrete from a local business and contracting with a Lake Benton, Minnesota, company to service the machines. Thus, according to Willers, the whole region will see economic development, while farmers get a real return on their investment.

According to Dave Kolsrud, manager of Corner Stone Farmers Cooperative, there is great potential for this project to lead to many more farmer-owned wind enterprises. "Wind energy is changing the landscape of rural America, and we're trying to make farmer ownership of wind energy become significant enough for wind to be considered another crop," he said. Furthermore, according to Tom Arends, "wind turbines are one of the best cash crops to come along for farmers looking for new sources of income."

In fact, after the current two 1.9 MW projects were installed, area farmers and other potential investors immediately began researching more potential sites and models as well as the possibility of doing much larger projects. As of late 2003, plans are well underway for at least seven more under 2 MW projects. Minwind III-IX each received \$178,201 through the USDA Renewable Energy Grant Program (described in Chapter 5) in August.

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Willers hopes expansion will allow many more farmers to participate in this innovative model for wind development, “This model is a way for farmers to take advantage of economies of scale in developing wind, just like the big companies do.”

Willers, Arends, and many others have invested countless hours in developing the Minwind projects, but they believe their efforts have been worthwhile. “We’ve spent an incredible amount of time on this, but we needed to do it for our community and our friends who are farmers,” said Willers.



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## Scenario #1

### Can Illinois Farmers Own Their Own Utility-Scale Wind Turbines?

Wind energy has great potential to be a sound investment for farmers and rural communities, but a utility-scale project is not something to undertake lightly. Installing a large wind turbine requires significant amounts of time, research, and money. This scenario walks you through the many stages of a megawatt scale wind project. We chose to place our hypothetical project in ComEd territory because it offers the highest avoided cost rates in Illinois. Given the wind resource available in Illinois, it would be much more challenging to design a project with a reasonable payback period if you sell power to other utilities in Illinois at their lower avoided cost rates.

Let's say that you have read through this entire handbook, taken a look around your property, and have decided that you have a great site for a wind turbine and are ready to start your own megawatt scale wind project. This scenario will be based on a 1.65 MW turbine, among the largest land-based wind generators in use today. First, you should call your local utility (we will assume it is ComEd in this scenario) and talk to the substation and power line engineer to confirm that the power lines on your property (1) are three phase lines, (2) have sufficient capacity to connect a 1.65 MW generator, and (3) are less than a mile from the proposed wind turbine site. Your site is on a hill or other high place, of course, and clear of any obstructions (like buildings or trees) for at least a quarter mile.

Next, you should call your county's zoning officer to inquire what the rules are for wind turbines and meteorological towers and what permits will be required to install this equipment. When you are sure that you can access a nearby power line and certain that your county will allow a turbine on your site, then it is time to start monitoring the wind speeds at the proposed hub height (at least

165 feet). You will need this information to analyze the economics of your project and to apply for a State of Illinois Renewable Energy Resources Grant. Chapter 2 of this handbook will help you locate companies that can install wind monitoring equipment, as well as how to collect and analyze wind data. A good choice for this size project might be a 50-meter (165 foot) tip-up tower with three anemometers. The second anemometer can provide backup in case the first one fails during cold weather, and the third anemometer can be placed lower on the tower so that you see how wind speeds change with height (this is called wind shear). The anemometers will be connected by wire to a small box with a computer in



The Kas Brothers own two of their own 750 kW wind turbines on their farm in Woodstock, Minnesota.

Photo by David Benson

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it at the bottom of the tower. (The total installed cost will be about \$6,000-\$8,000). Every month you will have to go out to the tower and exchange a memory card and either record the data on your own computer or send it to the company who installed the device. If you were considering a much smaller turbine, you would need a much less expensive wind monitoring device and tower; however, for a megawatt scale project, you will be stuck investing \$6,000 or more on wind measurements with the risk that you might never actually put up a wind turbine. Wind data is essential for calculating your payback period, and banks will not loan you the money without it. Also, note that you will likely have to apply for a county permit to install your wind monitoring tower.

Six months later you will probably start to wonder just how good your wind is. You can start to answer that question by logging onto [www.windustry.org](http://www.windustry.org) and downloading Windustry's WindProject Calculator. You will have to plug in your wind data in the power curve section and choose a wind turbine machine for the worksheet to model the cash flow. When the production numbers appear, you might think you are on your way to becoming a millionaire! Remember, though, if you just entered data from the winter and spring, the rest of the year will not be as windy. The opposite will be true if you have just entered summer and fall data. You will have to wait until you have collected a full year's worth of wind data, or estimate with the help of data from a local airport (available online at [www.noaa.gov](http://www.noaa.gov)) or an experienced wind consultant. It is quite likely that you will decide to hire a wind energy expert at some point in this process to help you analyze your wind data and the economics of your project.

If your wind data is looking good after six months, it is probably time to start thinking about how to finance your turbine. Your first step will be to call the Illinois Department

of Commerce to obtain the latest guidelines and application for the State of Illinois Renewable Energy Resource Grant Program. (Fiscal year 2004 guidelines are included in the Appendices.) This is also a good time to apply for county zoning permits, which will take three to six months to process. When you have a full year of wind data, you can submit your application to the state with the expectation that you will have a response about two months later. If you decided to build a 1,650 kW turbine, you would be eligible for a grant to cover 30 percent of the cost of the machine and its installation. This turbine, foundation, and interconnection will cost about \$1,900,000, but the grants are limited to \$500,000, which is a little less than 30 percent of the total cost. A 1,650 kW machine will make efficient use of a low wind resource, so this scenario will give you a good ratio of cost to kilowatt-hours of production, part of the state grant program's evaluation criteria.

You should also contact your local banker to begin discussions for a loan to pay for the rest of the turbine. It could take some time and even a conversation with a wind energy expert for your local banker to get familiar with what makes a good wind project. It is also time to get a firm quote on the turbine and its installation from the turbine dealer or manufacturer. There are other grant and loan programs to consider such as the USDA renewable energy program (described in Chapter 5). This is a good time to hire a CPA/attorney to help create your business plan to take best advantage of the wind/renewable energy incentives. You will see that your business model must be carefully structured in order to qualify for particular incentives, and your business model will be eligible for some and not others. Chapter 8 describes various business structures in more detail.

Your next task is to contact the ComEd administrator responsible for working with connecting and buying energy from qualifying

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facilities. You should request an interconnect. Negotiating the interconnection and power purchase agreement will take an additional three months and several thousand dollars in legal fees.

At this point, you will have spent at least \$17,000 and 17 months planning this project. You still need to pay your 20 percent share of the initial equity investment to close on the financing. You can see that this is a full-time job, and there is a great deal involved with entering into the energy production business. You will need to be both persistent and patient with the process, while assembling a team of qualified consultants—that is, if you do not plan to become a legal, financial, tax, electrical, transmission, construction, meteorological, public relations, and utility expert yourself. See the chart on the following page for a summary of the projected costs and return for this scenario. These numbers are directly from the Windustry WindProject Calculator. Based on the estimated numbers we used for this analysis, if you receive an Illinois state grant or another similar grant, you can expect your investment to pay for itself in less than ten years, after which you will be debt free and making money.

## Hypothetical 1,650 kW Wind Project in Illinois Economic Summary

### Results

0.30	Net annual turbine capacity factor (gives average power output 495 kW).
4,375,198	Annual kWh of generation for turbine, billed to utility.
\$1,500,000	Total cost of wind turbine(s) after state grant of \$500,000.
\$500,000	Initial capital investment in wind turbine (80% from equity partner).
\$1,000,000	Amount borrowed from bank; interest rate 8%.
15.2%	Internal rate of return over the life of the turbine; assumes full use of PTC.
10	Number of years until debt free. (Debt prepayments were not made.)
4.1	Number of years until cumulative after-tax cash flow exceeds down payment.
5	Number of years to achieve positive net present value, at 8% interest rate.
\$1,259,661	Cumulative cash returned over study period.
<b>\$759,661</b>	<b>Cumulative net cash flow returned after deducting down payment.</b>
\$899,817	Cumulative savings in income tax over period, uses double declining depreciation.
\$228,046	Maximum income tax saved in any year. (Use it or lose it.)

### Assumptions

The Federal Production Tax Credit (at \$0.015 kWh) was taken since the turbine(s) was new.

The Buyback Rate was \$0.0350 / kWh—that's the average from ComEd.

### Turbine Expenses

\$15,000	Annual operations and maintenance expense per wind turbine.
\$10,000	Annual property tax per wind turbine.
\$17,000	Annual insurance cost per wind turbine.
\$6,000	Annual parts and equipment reserve per wind turbine.
10.0%	Percentage discount in costs for each additional wind turbine (except property tax).
3.0%	Annual escalation factor in above costs.

Based on calculations from the Windustry WindProject Calculator. Please note that this analysis is based on general estimates for wind resource and costs in Illinois. Your results could differ significantly. The calculator works only as well as the numbers you put into it.

TABLE SHOWING ECONOMIC EVALUATION OF WIND TURBINE COMPONENTS - 2.02 MW PROJECT IN DENALI

Year	Principal and Interest Payments for Borrowed Funds					Wind Turbine With Depreciation and Disposal	Annual Operating Expenses					Cash Expenditures					Electricity Savings From Sale of Revenue	Revenue From Sale of Turbine	Business/Income Tax Savings	Total Savings Including Tax Savings
	Beginning Principal	Annual Payment	Interest	Ending Principal	Equity Provided (Cash From Savings)		Reserve From Sale to Utility & Green Premium	Operation & Maintenance Expenses	Property Tax and Insurance	Equipment Reserve, Cost, or Lease	Total Expenditures	Loan Payments	Total Maint. & Other Expenses	Total Expenditures	Electricity Savings	Revenue From Sale of Turbine				
2006	(\$1,000,000)	\$1,460,029	\$392,006	\$608,023	\$392,006	\$1,000,000	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2007	\$639,073	\$1,460,029	\$374,678	\$264,395	\$374,678	\$639,073	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2008	\$264,418	\$1,460,029	\$358,813	\$125,605	\$358,813	\$264,418	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2009	\$125,605	\$1,460,029	\$344,272	\$66,333	\$344,272	\$125,605	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2010	\$66,333	\$1,460,029	\$330,859	\$33,071	\$330,859	\$66,333	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2011	\$33,071	\$1,460,029	\$318,488	\$16,640	\$318,488	\$33,071	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2012	\$16,640	\$1,460,029	\$307,159	\$8,320	\$307,159	\$16,640	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2013	\$8,320	\$1,460,029	\$296,872	\$4,160	\$296,872	\$8,320	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2014	\$4,160	\$1,460,029	\$287,626	\$2,080	\$287,626	\$4,160	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2015	\$2,080	\$1,460,029	\$279,400	\$1,040	\$279,400	\$2,080	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2016	\$1,040	\$1,460,029	\$272,194	\$520	\$272,194	\$1,040	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2017	\$520	\$1,460,029	\$266,008	\$260	\$266,008	\$520	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2018	\$260	\$1,460,029	\$260,832	\$130	\$260,832	\$260	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2019	\$130	\$1,460,029	\$256,566	\$65	\$256,566	\$130	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2020	\$65	\$1,460,029	\$253,201	\$32	\$253,201	\$65	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2021	\$32	\$1,460,029	\$250,736	\$16	\$250,736	\$32	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2022	\$16	\$1,460,029	\$249,169	\$8	\$249,169	\$16	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2023	\$8	\$1,460,029	\$248,387	\$4	\$248,387	\$8	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2024	\$4	\$1,460,029	\$248,293	\$2	\$248,293	\$4	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2025	\$2	\$1,460,029	\$248,250	\$1	\$248,250	\$2	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		
2026	\$1	\$1,460,029	\$248,225	\$0	\$248,225	\$1	\$1,000,000	\$27,208	\$6,000	\$40,000	\$2,490,008	\$2,490,008	\$1,077,279	\$1,000,000	\$1,000,000	\$1,000,000	\$1,077,279	\$1,077,279		

Investment	Equity										Income Tax Impact Due to Change in Business										Total Income Tax Impact				
	Return on Investment/Net Cash Flows					I= Percentage of Wind Generator Claimed as Business Expense					Income Tax Impact Due to Change in Interest Income					Federal Production Incentive Tax Credit on kWh Sale					Capital Gain from the Sale of Turbine				
	Savings Less Expend. After Taxes (31)	Cumulative of Initial Cash Outlay Returned (32)	% Prepayment on Loan Principal (33)	Remaining Cash (34)	Cumulative Sum of Cash Flows (35)	Cumulative Present Value 0.08 (36)	Tax Depr. + Sec 179 5 Year MACRS (A)	Maintenance & Other Expenses (B)	Interest on Loan (C)	Electric Bill Savings & Revenue (D)	Total Net Change in Expenses (F)	Income Tax Savings (G)	Change in Interest Income (H)	Income Tax Savings (I)	Rate \$/kWh Ok (J)	Income Tax Savings (K)	Sale Proceeds (L)	Added Income Tax (M)	Total Income Tax Savings (N)						
\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0						
\$43,989	\$122,092	\$182,737	\$115,786	\$79,384	\$101,332	\$300,000	\$48,000	\$80,000	-\$153,040	\$274,960	\$94,181	-\$22,500	\$4,523	\$0	\$67,378	\$0	\$0	\$0	\$166,081						
\$45,309	\$182,737	\$195,171	\$115,786	\$79,384	\$101,332	\$480,000	\$49,320	\$74,478	-\$153,040	\$450,757	\$154,396	-\$22,500	\$4,523	\$0	\$69,128	\$0	\$0	\$0	\$228,046						
\$46,667	\$115,786	\$182,737	\$115,786	\$79,384	\$101,332	\$288,000	\$50,678	\$68,513	-\$153,040	\$254,151	\$87,053	-\$22,500	\$4,523	\$0	\$70,878	\$0	\$0	\$0	\$162,454						
\$49,504	\$73,374	\$288,000	\$73,374	\$68,942	\$3,697	\$172,800	\$52,076	\$62,072	-\$153,040	\$133,908	\$45,867	-\$22,500	\$4,523	\$0	\$72,628	\$0	\$0	\$0	\$123,018						
\$50,985	\$41,983	\$110,924	\$41,983	\$110,924	\$30,153	\$172,800	\$53,515	\$55,116	-\$153,040	\$128,390	\$43,977	-\$22,500	\$4,523	\$0	\$74,378	\$0	\$0	\$0	\$112,878						
\$52,508	\$10,358	\$121,282	\$10,358	\$121,282	\$36,197	\$172,800	\$54,996	\$47,603	-\$153,040	\$35,958	\$12,316	-\$22,500	\$4,523	\$0	\$76,128	\$0	\$0	\$0	\$92,967						
\$54,077	\$8,512	\$129,794	\$8,512	\$129,794	\$40,796	\$86,400	\$56,519	\$39,488	-\$153,040	-\$57,033	-\$19,535	-\$22,500	\$4,523	\$0	\$77,879	\$0	\$0	\$0	\$62,866						
\$55,691	\$5,960	\$135,754	\$5,960	\$135,754	\$43,777	\$0	\$58,088	\$30,725	-\$153,040	-\$64,228	-\$22,000	-\$22,500	\$4,523	\$0	\$80,066	\$0	\$0	\$0	\$62,589						
\$57,352	\$3,554	\$139,308	\$3,554	\$139,308	\$45,423	\$0	\$59,701	\$21,261	-\$153,040	-\$72,078	-\$24,689	-\$22,500	\$4,523	\$0	\$81,816	\$0	\$0	\$0	\$61,650						
\$89,968	\$63,674	\$202,982	\$63,674	\$202,982	\$72,732	\$0	\$61,363	\$11,039	-\$153,040	-\$80,639	-\$27,621	-\$22,500	\$4,523	\$0	\$84,004	\$0	\$0	\$0	\$60,906						
\$88,209	\$62,517	\$265,500	\$62,517	\$265,500	\$97,558	\$0	\$63,072	\$0	-\$153,040	-\$89,968	-\$30,816	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,294						
\$86,398	\$61,327	\$226,826	\$61,327	\$226,826	\$120,108	\$0	\$64,832	\$0	-\$153,040	-\$88,209	-\$30,214	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$61,650						
\$84,533	\$60,101	\$386,927	\$60,101	\$386,927	\$140,570	\$0	\$66,643	\$0	-\$153,040	-\$86,398	-\$29,593	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,507						
\$82,615	\$58,840	\$445,767	\$58,840	\$445,767	\$159,119	\$0	\$68,507	\$0	-\$153,040	-\$84,533	-\$28,955	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,432						
\$80,640	\$57,541	\$503,308	\$57,541	\$503,308	\$175,915	\$0	\$70,426	\$0	-\$153,040	-\$82,615	-\$28,298	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,375						
\$78,607	\$56,205	\$559,513	\$56,205	\$559,513	\$191,105	\$0	\$72,400	\$0	-\$153,040	-\$80,640	-\$27,621	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,309						
\$76,515	\$54,829	\$614,342	\$54,829	\$614,342	\$204,826	\$0	\$74,433	\$0	-\$153,040	-\$78,607	-\$26,925	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,242						
\$74,361	\$53,413	\$667,756	\$53,413	\$667,756	\$217,203	\$0	\$76,525	\$0	-\$153,040	-\$76,515	-\$26,208	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,186						
\$122,145	\$91,906	\$759,661	\$91,906	\$759,661	\$236,921	\$0	\$78,679	\$0	-\$153,040	-\$74,361	-\$25,471	-\$22,500	\$4,523	\$0	\$0	\$0	\$0	\$0	\$62,130						
\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$80,896	\$0	-\$153,040	-\$72,145	-\$24,711	-\$22,500	\$4,523	\$0	\$0	\$50,000	\$10,050	\$0	\$30,239						

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## Scenario #2

### Can a Small Wind Turbine Be Economical in Illinois?

For farmers with high energy costs and windy land, generating their own electricity with a small wind turbine can be a good economic choice. This scenario will apply to Illinois residents who are customers of ComEd because it is the only utility in the state to offer a net metering program. (It is offered on an experimental basis for wind projects under 40 kW. Projects enrolling in this program carry the risk that ComEd will decide to discontinue the program at the end of its five-year trial period.)

You might be interested in a small wind turbine for a variety of reasons; anything from saving money on your energy bill to wanting to protect the environment by generating clean energy. Maybe your farm uses a lot of electricity in the fall for drying corn; let's say 50,000 to 60,000 kilowatt hours every year. You could install a wind turbine that would generate about this much power (say a 35 kW turbine), and through ComEd's net metering program, you could be paid the equivalent of \$0.09 for every kilowatt-hour produced on an annual basis.

Your first step is to contact ComEd and speak with the substation and power line engineer to confirm whether you have three or single phase power lines on or near your property (within a few hundred feet of the turbine site) that have capacity for your proposed 35 kW wind turbine. Your site should be on top of a hill, in a clear area, as far away from houses and trees as possible; however, it is also important that your site not be more than a few hundred feet from the transformer and interconnect because the wiring will cost approximately \$7 per foot. The transformer might need to be upgraded for a few thousand dollars.

Next, you should call your county's zoning officer to inquire about the rules for installing

an 80-foot turbine on your property and the steps you need to take to obtain a permit. When you are certain that you can connect to a power line near your site and that you will be able to get the proper permits, it is time to start monitoring the wind speeds at 80 feet or as high as possible. If you want to apply for a State of Illinois Renewable Energy Resources Grant (and you should if you want the project to be economical), you will need some justification that your site has enough wind to make your project work, but not necessarily a full year of wind data. Chapter 2 of this handbook provides some suggestions for low cost methods of gathering wind data. For example, you could install an old water pumping windmill tower on your site and use a pipe to extend the tower enough to place an anemometer 65 feet above the ground. The anemometer will record average wind speeds, which must be collected monthly. You will have to be vigilant about making sure the anemometer is constantly working. A hail storm in the summer could damage the instrument, or winter ice might freeze it for days, causing you to miss some windy weather.

In this scenario, we will assume that you use your own money (rather than borrowing from a bank) to pay for the turbine. For this situation, you might choose to use an E-15, a used turbine that once stood in California, but is now offered by a firm that specializes in refurbishing, selling, and maintaining these machines. It has a 50-foot diameter rotor and comes with an 80-foot lattice tower. These are good machines and, with proper maintenance, should last another 20 years. An E-15 will cost \$63,000 installed and ready to run, \$43,000 without foundation and installation, or as little as \$15,000 without the refurbishing. (This last option would make for an ambitious project if you really want to do all the work yourself.) This turbine is estimated to generate 50,000

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to 60,000 kWh per year on an 80-foot tall tower. This is a fairly short tower, making it extra important to avoid a site with buildings or trees within 500 feet, or better yet, a quarter mile. (In general, Windustry offers a caution about buying used wind turbines. It is very much like buying a used car—it works better if you know about the machinery and follow a few practical guidelines. Ask questions about the machine—how and where it was used before and why it is now available. Also, ask questions of the people you are dealing with—ask for references from the vendor’s other customers, find out if they stand behind their maintenance, and how long the initial warranty is.)

If wind data and financial analysis make the project appear feasible, you should call the Illinois Department of Commerce and request an application for the Renewable Energy Resources Grant Program. At the same time, you should apply for county permits, which will take three to six months to process. When you have gathered all the necessary information, you can submit your grant application with the expectation that you will get an answer in about two months. With a 35 kW turbine, you will be eligible for a grant for up to 50 percent of the cost of the machine and associated equipment required for its installation. The turbine, foundation, and interconnect together cost \$65,000-\$70,000, so you will be eligible for a \$32,500-\$35,000 grant. In this case, we will assume you requested \$32,000.

This is also a good time to hire an accountant to determine how much of the Federal Production Tax Credit you can use. The accountant will probably tell you that if you manage the turbine operations yourself and do most of the work yourself, you will be able to use the PTC. It is now valued at 1.8¢/ kWh or approximately \$900 if your turbine produces 50,000 kWh in a year.

Next, you will contact the ComEd administrator responsible for net metering interconnects and power purchase agreements to request an interconnect. This and the power purchase contract will take you another one to three months to negotiate. The process will require some consultation with ComEd engineers and a ComEd final inspection before the turbine can operate.

At this point, you will have spent at least ten months and \$1,000. If your state grant application is successful, you can expect your investment to pay for itself in about 12 years. You can make more money on the project if you do your own turbine repairs and maintenance. See the chart below for a summary of costs and returns on this investment. The numbers come directly from the Windustry WindProject Calculator, available online at <[www.windustry.org](http://www.windustry.org)>. These numbers can help you decide if this kind of project is within your time and monetary budget. Do not assume that this scenario will be exactly the same as your real project.

## Hypothetical 35 kW Wind Project in Illinois Economic Summary

### Results

0.18	Net annual turbine capacity factor (gives average power output 6.3 kW)
55,188	Annual kWh of generation for turbine
\$33,000	Total cost of wind turbine(s) after state grant of \$32,000
\$33,000	Initial capital investment in wind turbine
\$0	Amount borrowed from bank; interest rate 8%
4.7%	Internal rate of return over the life of the turbine; assumes full use of PTC
1	Number of years until debt free (paid for without debt)
12	Number of years until cumulative after-tax cash flow exceeds down payment
18	Number of years to achieve positive net present value, based on 4% interest
\$47,142	Cumulative cash returned over study period
<b>\$14,142</b>	<b>Cumulative net cash flow returned after deducting down payment</b>
\$2,143	Cumulative savings in income tax over period; uses double declining depreciation
\$3,087	Maximum income tax saved in any year. (Use it or lose it.)

### Assumptions

The Federal Production Tax Credit (at \$0.018 kWh) is used.

The Buyback Rate is \$0.090 / kWh—an average for ComEd.

### Turbine Expenses

\$800	Annual operations and maintenance expense per wind turbine
\$200	Annual property tax per wind turbine
\$600	Annual insurance cost per wind turbine
\$200	Annual parts and equipment reserve per wind turbine
10.0%	Percentage discount in costs for each additional wind turbine (except property tax)
3.0%	Annual escalation factor in above costs

Based on calculations from the Windustry WindProject Calculator. Please note that this analysis is based on general estimates for wind resource and costs in Illinois. Your results could differ significantly. The calculator works only as well as the numbers you put into it.



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## Appendices

- I. Glossary of Terms Related to Wind Energy and Electricity
- II. Full Guidelines and Application for State of Illinois Renewable Energy Resources Grant Program
- III. Wind Energy Easement Guidelines, Prepared for Windustry by Willeke & Daniels of Minneapolis, Minnesota
- IV. Avoided Cost Rate Schedules from Selected Illinois Utilities:
  1. Commonwealth Edison Company
  2. Central Illinois Public Service Company
  3. Illinois Power Company
  4. Central Illinois Light Company



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## Appendix I. Glossary

### Definitions of Key Terms

Acronyms and jargon are ubiquitous in the energy industry. The following definitions should help decipher information in this handbook and in other sources and help you learn to “talk the talk.”

#### Common Energy Units

Watt (W)	A measure of electrical power
Kilowatt (kW)	1,000 watts
Megawatt (MW)	1,000,000 watts or 1,000 kilowatts
Gigawatt	1 billion watts or 1,000 MW
Terawatt	1 trillion watts
Kilowatt-hour (kWh)	The use of 1 kilowatt (e.g., operating an electric space heater) for one hour—consuming one kilowatt-hour of electricity
British Thermal Unit (BTU)	The amount of heat needed to raise one pound of water one degree Fahrenheit at sea level; one kilowatt-hour equals 3,412 BTUs.

#### *Parts of a Wind Generator*

**Base** - The base is made of concrete and steel and supports the whole structure.

**Blades** - Modern wind turbine blades are designed like airplane wings, using lift to capture the wind’s energy.

**Gearbox** - Gears increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1,200 to 1,500 rpm, the rotational speed required by most generators to produce electricity. The gearbox is a costly (and heavy) part of the wind turbine.

**Generator** - Usually an induction generator that produces 60-cycle AC electricity.

**Nacelle** - The nacelle houses the gearbox and the generator and sits on top of the tower. Rotors are mounted on the nacelle, and in large turbines, they are big enough for technicians to stand inside.

**Rotor** - The blades and the hub together are called the rotor.

**Tower** - The tower supports the nacelle and blades, while containing the electrical conduits and providing access to the nacelle for maintenance.

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*Other Terms*

**Annual Average Wind Speed** – Average annual wind speed is simply the average wind speed calculated from data collected over many years. It is important to make sure that the height that the data was recorded is known. This will enable the financial analysis to be more precise.

**Average Annual kWh Generation** – This is the average annual power output for a turbine. In the next section, it will be used to refer to the average power output for more than one turbine in an array as well.

**Cooperative** – A form of utility in which all users own shares. Cooperatives are common in rural areas that are expensive to serve because of the long distances between users. Frequently, the government contributes in various ways to rural cooperatives to reduce costs to individual owner/users.

**Cost-of-Service Ratemaking** – A system for establishing prices in which a utility is reimbursed for the legitimate costs it encounters in serving customers plus a specific percentage for profit.

**Demand-Side Management (DSM)** – The process of managing the consumption of energy. DSM programs include, for instance, offering discounts on new, high-efficiency appliances so that consumers get rid of their older, less-efficient models.

**Deregulation** – The process of removing restrictive regulations on previously regulated companies.

**Distributed Generation** – A small-scale power-generation technology that provides electric power at a site closer to customers than central station generation. The term is commonly used to indicate non-utility sources of electricity, including facilities for self-generation.

**Energy Policy Act of 1992 (EPAct)** – A federal statute that, among other things, established additional forms of non-utility generators. It also permitted nongenerator-owning municipalities to purchase wholesale electricity, thus opening the door to municipalization.

**Environmental Impact Statement** – A thorough study of each proposed electric utility project with potential for significant environmental impacts, including evaluation of alternatives and mitigation.

**Environmental Quality Board** – State agency that adopts environmental rules, monitors their effectiveness, and revises as appropriate; provides technical assistance to interpret and apply rules.

**Federal Energy Regulatory Commission (FERC)** – An independent regulatory agency within the U.S. Department of Energy that has jurisdiction over interstate electricity sales, wholesale electricity rates, natural gas and oil pipeline rates, and gas pipeline certification. It also licenses and inspects private, municipal, and state hydroelectric projects and oversees related environmental matters.

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**Generation** – The conversion of other forms of energy into electricity through the use of equipment. Generation is measured in kilowatt-hours.

**Green Energy** – A popular term for energy produced from renewable energy resources or, sometimes, from clean (low-emitting) energy sources.

**Green Marketing** – Selling green energy.

**Grid** – A network of power lines or pipelines used to move energy.

**Independent Power Producer (IPP)** – An electricity generator that sells power to others but is not owned by a utility.

**Independent Systems Operator (ISO)** – An impartial, independent third party responsible for maintaining secure and economic operation of an open access transmission system on a regional basis. It provides availability and transmission pricing services to all users of the transmission grid (e.g., Midwest Systems Operator or MISO).

**Investor-Owned Utility (IOU)** – A utility with stock-based ownership (e.g., ComEd).

**Municipal Utility or Muni** – A utility owned by a city. Generally, surpluses in revenues over expenditures are contributed to the city budget.

**Production Tax Credit (PTC)** – Provides the owner of a qualifying facility with an annual tax credit based on the amount of electricity that is generated. By focusing on the energy produced instead of capital invested, this type of tax incentive encourages projects that perform adequately.

**Public Utility Regulatory Policies Act (PURPA)** – A 1978 federal law that requires electric utilities to purchase electricity produced from certain efficient power producers (frequently using renewable energy or natural gas). Utilities purchase power at a rate equal to the costs they avoid by not generating the power themselves. State regulatory agencies establish the rate based on local conditions.

**Public Utility Commission (PUC) or Public Services Commission (PSC)** – A state government agency responsible for the regulation of public utilities within a state or region. A state legislature oversees the PUC by reviewing changes to utility laws, rules, and regulations and approving the PUC's budget. The commission usually has five commissioners appointed by the governor or legislature. The PUC focuses on adequate, safe, and universal utility service at reasonable rates while also trying to balance the interests of consumers, environmentalists, utilities, and stockholders. (This function is performed by the Illinois Commerce Commission.)

**Renewable Energy** – Energy derived from resources that are regenerative or for all practical purposes cannot be depleted. Types of renewable energy resources include moving water (hydro, tidal, and wave power), thermal gradients in ocean water, biomass, geothermal energy, solar energy, and wind energy. Municipal solid waste (MSW) is also considered by some to be a renewable energy resource.

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**Renewables Portfolio/Energy Standard (RPS or RES)** – A minimum renewable energy requirement for a region’s electricity mix. Under an RES, every electricity supplier would be required to provide some percentage of its supply from renewable energy sources. RES proposals frequently ease that requirement by including a tradable credit system under which electricity suppliers can meet the requirement by buying and selling renewable generation credits.

**Restructuring** – The process of changing the structure of the electric power industry from one of guaranteed monopoly over service territories to one of open competition between power suppliers for customers.

**Rural Electrification Administration (REA)** – An agency of the U.S. Department of Agriculture that makes loans to states and territories in the U.S. for rural electrification and for providing electricity to persons in rural areas who do not receive central station service. It also furnishes and improves electric and telephone service in rural areas, fosters energy conservation and on-grid and off-grid renewable energy systems, and studies the condition and progress of rural electrification.

**Swept Rotor Area Diameter** – Swept rotor area diameter is simply the diameter of the circle through which the turbine blades rotate. This is approximately twice the rotor diameter.

**System Benefits Charge (SBC)** – A required fee (also known as a public benefits charge) from all electricity customers to fund programs aimed at the public good that may no longer be feasible for the utility to provide in a competitive electricity market. These programs include energy conservation, support for renewable energy use, low-income assistance, and research and development.

**Turbine** – A device for converting the flow of a fluid (i.e. air, steam, water, or hot gases) into mechanical motion that, in turn, produces electricity.

**Unbundling** – The process of separating a service into component parts and permitting customers to buy each separately. Utility unbundling, overseen by regulators, generally requires utilities to ensure that the price of each service accurately reflects the cost of that service (plus a margin for profit). In this way, unbundling helps ensure that customers pay for what they receive and are not forced to subsidize services they do not use.

*Sources:* Windustry, National Renewable Energy Laboratory, and AWEA

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## **Appendix II. Guidelines and Application for State of Illinois Renewable Energy Resources Grant Program**



**RENEWABLE ENERGY RESOURCES  
PROGRAM**

**SOLAR THERMAL, PHOTOVOLTAIC, BIOMASS, WIND,  
and HYDROPOWER**

**REQUEST FOR PROPOSALS**

**GUIDELINES AND APPLICATION**

**Fiscal Year 2004**

**Submittal Deadline 4:30 p.m. Monday, December 22, 2003**



**ILLINOIS DEPARTMENT OF COMMERCE AND ECONOMIC OPPORTUNITY  
BUREAU OF ENERGY AND RECYCLING  
ALTERNATIVE ENERGY DEVELOPMENT SECTION  
620 EAST ADAMS STREET  
SPRINGFIELD, ILLINOIS 62701**

Rod R. Blagojevich  
Governor

Jack Lavin  
Director

## SECTION 1

## GENERAL INFORMATION

**1.1 PURPOSE.** The Illinois Department of Commerce and Economic Opportunity (the Department) administers the Renewable Energy Resources Program (RERP) in order to foster investment in and the development and use of renewable energy resources within the state of Illinois. The Department is interested, to the extent funds are available, in funding projects that demonstrate potential to increase the utilization of renewable energy technologies in Illinois. The focus of the RERP includes wind, solar thermal energy, photovoltaic systems, dedicated crops grown for energy production, organic waste biomass, hydropower that does not involve new construction or significant expansion of hydropower dams and biogas stationary fuel cells. Descriptions of eligible and ineligible projects are set forth in Section 2 of this RFP.

**1.2 AUTHORITY.** 20 ILCS 687, Renewable Energy, Energy Efficiency, and Coal Resources Development Law of 1997, Article 6 Section 6-1 through 6-7, authorizes the Department to administer the state's Renewable Energy Resources Program.

**1.3 ANTICIPATED FUNDING.** The Department expects to award up to \$2.5 million under this solicitation. The Department may issue a subsequent solicitation in February 2004 if funding is available. Award decisions are at the sole discretion of the Department.

**1.4 DEFINITIONS.** The terms used in this document shall have the meanings set forth below. Words and terms not defined here, if defined in the Environmental Protection Act [415 ILCS 5], shall have the meanings as defined therein.

"Act" means the Public Utilities Act.

"Agricultural Residues" are organic wastes remaining from a plant crop, such as corn stover.

"Applicant" means (i) an Illinois unit of state or local government, association, public or private school, college or university, (ii) a not-for-profit organization or private company licensed to transact business in Illinois or (iii) individual(s) proposing an renewable energy resources project in Illinois.

"Applicant Investment" means the amount of funds to be contributed to the Project, including, but not limited to all personal contributions, other private financial partners or contributors, and any public funds received or anticipated to be received by the Applicant.

"Application" means a request for program funds including the required information, forms and attachments as prescribed in this RFP.

"Biogas" means a mixture of methane and carbon dioxide produced through bacterial action.

"Dedicated Crop" means non-consumable crops grown specifically for energy production.

"Entity" means any applicant submitting an application to the Department.

"Fuel Cell" means a device without moving parts that uses the chemical energy in hydrogen and oxygen to produce electricity.

"Grantee" means an Entity that has been awarded a grant.

"Hydropower" means generating electricity by conversion of the energy of running water.

"Installer" means a licensed, bonded, and insured contractor doing business within the state of Illinois.

"Organic Waste Biogas" means methane produced by animal manures, municipal solid waste, and waste water sludge.

"Organic Waste Biomass System" means any device designed to use biogas as a source of fuel to produce electricity or process heat.

"Performance Period" means the length of time the Grantee is required to operate the Project and submit information/data to the Department.

"Photovoltaic Cells and Panels" means semiconductor materials that convert sunlight directly to electricity. These components are part of a photovoltaic system.

"Photovoltaic System" means a stationary ground, roof, or wall mounted system. Furthermore, a Photovoltaic System shall consist of Photovoltaic Cells and Panels, inverters, mounting systems, associated wiring, and devices used to protect the system. Batteries and other electrical storage devices are not included as part of the system and may not be used as a matching contribution on the part of the Grantee.

"Project" means an eligible renewable energy resources project that the Department agrees to fund through an RERP grant.

"Project Start Date" means the date that the Notice of Grant Award is signed by both the Grantee and the Department

"Project Commencement Date" means the date that all necessary procurement is complete, equipment is installed and operational and all project tasks have commenced. The project commencement date may not exceed six months after the Project Start Date.

"Proprietary, Privileged or Confidential Commercial Information" means any process or design exclusively owned under trademark, patent or in the process of becoming patented, or other information that falls within an applicable exemption under the Illinois Freedom of Information Act.

"Solar Thermal Energy" means rooftop or ground-mounted panels to collect and transfer heat for space, water heating, and/or electric generation.

"Wind" means the natural and perceptible movement of air parallel to or along the ground.

**1.5 FREEDOM OF INFORMATION ACT/CONFIDENTIAL INFORMATION.** Funded proposals are subject to disclosure, in response to requests received under provisions of the Freedom of Information Act (5 ILCS 140/1 et seq.). Information that could reasonably be considered to be proprietary, privileged or confidential commercial or financial information should be identified as such in the proposal. The Department will maintain the confidentiality of that information only to the extent permitted by law. If the applicant has a special need to maintain the confidentiality of proprietary or privileged information, please attach a supplemental letter of explanation.

## **1.6 PREVAILING WAGE REQUIREMENTS**

Recipients are responsible for determining if their projects will trigger compliance with the Illinois Prevailing Wage Act (820 ILCS 130/0.01). The Department will not render a legal opinion as to the applicability of the Prevailing Wage Act to any project. Questions regarding the applicability of Prevailing Wage requirements may be referred to the Illinois Department of Labor at (312) 793-2800 or (217) 782-6206. Attorney General Opinion No. 00-018, which addresses applicability of Prevailing Wage requirements, may be accessed on the Attorney General's web sit at [www.ag.state.il.us/opinions/00-018.htm](http://www.ag.state.il.us/opinions/00-018.htm).

**1.7 JOB CREATION/RETENTION REPORTING.** Recipients will be required to submit reports documenting the number of jobs created, retained or lost during the course of the agreement term as a result of the Project.

**1.8 ENVIRONMENTAL APPROVALS.** Funded projects will be subject to review by the following Illinois agencies: departments of natural Resources, Historic Preservation, Agriculture, and the Illinois Environmental Protection Agency. Recipients will be required to comply with requirements established by said agencies relative to their respective reviews. Recipients will be responsible for coordinating directly with the applicable agencies. Any requirements communicated to the Department shall be incorporated into the incentive agreement awarded as of its execution date, or if received from the applicable agency subsequent to execution, as an addendum to the incentive agreement. Recipients will be contractually obligated to comply with such requirements. Prior to notification of compliance by the applicable agency, Recipients may request disbursement of funds only for the following purposes: administrative, contractual, legal, engineering or architectural/engineering costs incurred which are necessary to allow for compliance by the Recipient of requirements established by the external agency. Funds will not be disbursed for any activity that physically impacts the project site until the Department receives the appropriate sign-off from the applicable agencies.

**1.9 REJECTION OF APPLICATIONS.** The Department reserves the right to reject any proposal that does not comply with the requirements of these guidelines and approved program initiatives. Unsuccessful applicants who wish to discuss the evaluation of their proposal should submit a written request to this effect to the address listed in Section 4.1.1

The submission of a proposal under these guidelines confers no right upon any applicant. The Department is not obligated to award any grants under this program, to pay any costs incurred by the applicant in the preparation and submission of a proposal, or pay any grant-related costs incurred prior to the Project Start Date.

## **SECTION 2** **GRANT ELIGIBILITY CRITERIA**

**2.1 ILLINOIS LOCATION.** Eligibility is limited to projects physically located in the state of Illinois.

**2.2 CUSTOMER OF PARTICIPATING UTILITY REQUIREMENT.** An applicant must be a customer within the service area of an investor-owned electric or gas utility or a municipal gas or electric utility or electric cooperative that imposes the Renewable Energy Resources and Coal Technology Development Assistance Charge as defined in 20 ILCS 687 Article 6.

**2.3 ELIGIBLE PROJECTS.** Eligibility is limited to Projects proposing (i) to use dedicated energy crops or agricultural residues to produce electricity, or (ii) to purchase and install renewable energy generation equipment of the following types:

- 2.3.1 Any new wind power system that is rated in accordance with the American Wind Energy Association (AWEA) criteria, has successfully completed at least one year of field-testing, and has a nameplate capacity of at least 5 kilowatts. Projects larger than 201 kW must have at least one year of professional meteorological data at the specific project site at the appropriate altitudes. Projects of up to 200 kW must have either site-specific data or otherwise justify the wind resource to the satisfaction of the Department.
- 2.3.2 Any new photovoltaic power system that is Underwriters Laboratories (UL) listed or has successfully completed at least one year of field testing and has a rated design capacity of at least 2 kilowatts of electricity.
- 2.3.3 Any new solar thermal water or space heating system that has been approved by the Solar Rating and Certification Corporation or a comparable organization and is designed to produce in excess of 10 kilowatts or equivalent or contains at least 200 square feet of collectors.
- 2.3.4 Any new organic waste biomass system that has successfully completed at least one year of field-testing. The system must be designed to produce and/or use biogas as a source of fuel to produce electricity or heat.
- 2.3.5 Any new hydropower system that will not involve new construction or significant expansion of hydropower dams. The Department will evaluate proposals on a case-by-case basis.
- 2.3.6 Any new stationary fuel cell designed to use hydrogen produced from solar energy, wind, ethanol or biogas to produce electricity.

**2.4 INELIGIBLE PROJECTS.** The following projects are not eligible for funding under this RFP: Projects located outside the state of Illinois, geothermal energy systems, or energy projects involving the incineration, burning or heating of waste wood, tires, garbage, general household, institutional and commercial, industrial lunchroom or office waste, landscape waste, or construction or demolition debris.

**2.5 MAXIMUM GRANT AMOUNTS; APPLICANT INVESTMENT.** The maximum grant amounts available for each project category are listed below. The Department is not obligated to provide the maximum grant amount. This is a competitive solicitation for limited grant funds. Projects that are cost-effective, and have an Applicant Investment that exceeds the minimum requirement will receive additional consideration.

Photovoltaic Systems	50 percent up to a maximum of \$5.00 per watt with a maximum grant of \$150,000
Wind 5 kW to 200 kW	50 percent up to a maximum of \$2.00 per watt with a maximum grant of \$50,000
Wind 201 kW to 2000 kW	30 percent with a maximum grant of \$500,000
Dedicated Crops Grown for Energy Production and/or Agricultural Residues	50 percent with a maximum grant of \$500,000
Solar Thermal Energy	50 percent with a maximum grant of \$150,000
Organic Waste Biogas (Electrical Production)	50 percent with a maximum grant of \$225,000
Organic Waste Biomass (Heat Production)	50 percent with a maximum grant of \$150,000
Fuel Cell	25 percent with a maximum grant of \$225,000
Hydropower	25 percent with a maximum grant of \$350,000

- 2.5.1 **PRIOR COSTS NOT ELIGIBLE.** Costs incurred by an Applicant prior to the Project Start Date may not be applied against the Applicant Investment requirement.

- 2.5.2 ALLOWABLE EXPENDITURES. Grant funds may only be expended for actual eligible purchase and installation expenses for eligible equipment or for processes related to electrical generation from agricultural residues or dedicated energy crops. The Department reserves the right to review applications and negotiate lower grant amounts.

## 2.6. ADDITIONAL REQUIREMENTS

- 2.6.1 License. An installer of the renewable energy system must be licensed to transact business in the state of Illinois and maintain appropriate types and levels of insurance coverage.

## SECTION 3 APPLICATION EVALUATION PROCESS

**3.1 GENERAL EVALUATION.** The Department will evaluate every timely submitted proposal in the following manner: Proposals will be evaluated (i) to determine whether the proposed project meets the project eligibility criteria specified in Section 2 of the RFP; and (ii) to determine whether, based on the information supplied in the application documentation, the proposal demonstrates sufficient likelihood of actual project development. Proposals satisfying requirements (i) and (ii) will be evaluated on the basis of the price and non-price evaluation criteria specified in Section 3.2 below.

**3.2 EVALUATION CRITERIA.** The Department shall utilize two evaluation categories of equal weighting: price considerations and non-price considerations.

- 3.2.1 Price – Projects shall be evaluated on the basis of the Department support requested as expressed in cents per kWh or cents per therm over the first two years of project operations, with a preference for smaller incentive payment requests per kWh, in order to better allow for the best leveraging of the limited funds available for the Program.
- 3.2.2 Non-Price – Projects shall be evaluated on the basis of non-price criteria, including relative economic development benefits and relative public education benefits, with a preference for:
- 3.2.2.1 Projects demonstrating a business model with market transformation potential.
  - 3.2.2.2 Projects with greater direct job creation impacts (direct temporary and permanent jobs related to the project).
  - 3.2.2.3 Projects with greater indirect job creation impacts (projects utilizing equipment suppliers with a greater business presence in the state of Illinois or projects supporting the local agricultural economy).
  - 3.2.2.4 Projects located in an area determined by the Department to have a greater relative need of economic development.
  - 3.2.2.5 Projects demonstrating the ability to achieve a Project Commencement date no later than December 31, 2004 .
  - 3.2.2.6 Projects providing public education benefits.

## **SECTION 4 PROPOSAL DUE DATE AND SUBMITTAL REQUIREMENTS.**

**4.1** The Department must receive all proposals under this RFP on or by 4:30 p.m. December 22, 2003. Proposals received after this deadline will not be evaluated.

4.1.1 The Department will accept proposals at the following address:

Illinois Department of Commerce and Economic Opportunity  
Bureau of Energy and Recycling  
Alternative Energy Development Section  
620 East Adams Street  
Springfield, IL 62701-1615  
Attention: Rex Buhrmester  
217/557-1925 TDD 800/785-6055

4.1.2 The Department will not accept faxed or electronically submitted proposals.

4.1.3 Required Information. Each proposal submitted under this RFP must include all of the information required in the proposal application documentation set forth in the Appendices of this RFP.

## **SECTION 5 GRANT AGREEMENT**

**5.1 PAYMENT SCHEDULE.** The grant agreement will specify the conditions of payment and the payment schedule. The Department reserves the right to determine the appropriate payment structure on a project specific basis.

**5.2 REPORTING REQUIREMENTS/PROJECT MONITORING.** Grantees will be required to submit monthly progress and expenditure reports in accordance with the requirements of the grant agreement. The Department reserves the right to structure reporting requirements on a project specific basis. The Department project manager will monitor the Grantee's compliance with the terms of the grant agreement.

**5.3 GRANT DURATION/PERFORMANCE PERIOD.** The grant term/performance period will be determined on a project specific basis. Grantees will be required to certify the project commencement date to the Department

The Agreement may require up to 24 months of performance data following the Project Commencement Date.

The Department will negotiate an incentive agreement with the successful applicant(s).

**5.4 OWNERSHIP/USE OF EQUIPMENT.** The grant agreement will specifically prohibit the sale, lease, transfer, assignment, or encumbrance of any equipment or material purchased with grant funds, without the express written approval of the Department for the duration of the grant term. In the event of a Grantee's failure to comply with this requirement, the agreement will provide that the Department may, at its discretion, require the Grantee to return all grant funds provided by the Department, require the Grantee to transfer to the state ownership of equipment and material purchased with grant funds and bar the Grantee from consideration for future

funding. The Department reserves the right to require the Grantee to give it a purchase money security interest in equipment purchased with grant funds for the duration of the grant term.

**5.5 DISSEMINATION OF INFORMATION/TECHNOLOGY TRANSFER.** Grantees will be contractually required to allow the Department access to the project site and the ability to obtain, publish, disseminate or distribute any and all information obtained from the project (except any data or information that has been negotiated as being confidential or proprietary), without restriction and without payment or compensation by the Department.

**5.6 STATE NOT LIABLE.** Recipients shall hold the state of Illinois harmless from any and all claims, demands, and actions based upon or arising out of any services performed by recipients or by their agents or employees under a grant agreement. The Department, by entering into a grant agreement, does not pledge or promise to pledge the assets of the state nor does it promise to pay any compensation to the grant recipients from any moneys of the treasury or the state except such moneys as shall be appropriated and paid to the recipient by the Department.

**5.7 INDEMNITY.** The recipient agrees to assume all risks of loss and to indemnify and hold the Department, its officers, agents and employees, harmless from and against any and all liabilities, demands, claims, damages, suits, costs, fees, and expenses, incidents thereto, for injuries or death to persons and for loss of, damage to, or destruction of property because of the recipient's negligence, intentional acts or omissions. In the event of any demand or claim, the Department may elect to defend any such demand or claim against the Department and will be entitled to be paid by the recipient for all damages.

**5.8 INSURANCE.** The recipient shall provide Workers' Compensation Insurance or the same, as required, and shall accept full responsibility for the payment of Unemployment Insurance, premiums for Workers' Compensation, Social Security, and retirement and health insurance benefits, as well as all income tax deductions required by law for its employees who are performing services specified by the grant agreement. 2.10.4 Access - recipients shall permit any agent authorized by the Department, upon presentation of credentials, access to the renewable energy project site during normal business hours, for which a grant has been applied.

**5.9 RETURN OF FUNDS.** The recipient shall return to the Department any and all funds that are determined by the Department to have been spent in violation of the grant agreement.

**APPENDIX A: Application Cover Page**  
 Illinois Department of Commerce and Economic Opportunity  
 Renewable Energy Resource Program  
 Application for Grant Funding

**A.1 Owner Information**

\_\_\_\_\_  
 Name of Applicant (individual, governmental agency or organization)

\_\_\_\_\_  
 Street Address

\_\_\_\_\_  
 E-Mail address

\_\_\_\_\_  
 City

\_\_\_\_\_  
 State

\_\_\_\_\_  
 9 digit Zip Code

\_\_\_\_\_  
 Telephone Number

\_\_\_\_\_  
 SSN (only if individual applicant)

\_\_\_\_\_  
 FEIN

\_\_\_\_\_  
 County of Project

\_\_\_\_\_  
 Project Location/Address (if different from above)

\_\_\_\_\_  
 Project Manager/Contact Person

\_\_\_\_\_  
 Telephone Number

\_\_\_\_\_  
 Fax Number

**A.2 Verification of Renewable Energy Resources and Coal Technology Development Assistance Charge must be provided.**

If the applicants electric or gas utility is listed below and if the applicant is a current customer of one of those utilities at the address indicated above, please provide a copy of a recent bill. If your utility is not listed below, or if you are a customer at a different address, please attach a letter from your utility stating that the applicant is serviced by an investor-owned/municipal gas or electric utility of electric cooperative that imposes the Renewable Energy Resources and coal Technology Development Assistance Charge as defined in Public Act 90-561. The Department will verify this information before issuing a grant to the applicant.

FOR GAS DISTRIBUTION	FOR ELECTRIC DISTRIBUTION
Central Illinois Light Company	Central Illinois Light Company
Ameren CIPS	Ameren CIPS
Consumers Gas Company	Commonwealth Edison Company
Illinois Gas Company	Illinois Power Company
Illinois Power Company	Interstate Power Company
Alliant-Interstate	Mid American Energy Company
Mid American Energy Company	South Beloit Water, Gas and Electricity Company
North Shore Gas Company	Ameren UE
Nicor Gas Company	
South Beloit Water, Gas, and Electricity Company	
The Peoples Gas, Light & Coke Company	
Ameren UE	
United Cities Gas Company	

**APPENDIX A: (cont.)**

**A.3. System Information**

\_\_\_\_\_  
Make                                      Model                                      Warranty Period                                      Year of Manufacture

\_\_\_\_\_  
Date of purchase                                      System Size (Watts)                                      Date the system will be installed

\_\_\_\_\_  
Name, Address, and Telephone Number of entity that performed or will perform the installation

\_\_\_\_\_  
License number, proof of insurance, and bonding of the Installer

-----  
**A.4. Type of Project** (Check the appropriate box for proposed project.)

- |  |  |
|--|--|
| <input type="checkbox"/> Solar Thermal                 | <input type="checkbox"/> Organic Waste Biomass (Electric)        |
| <input type="checkbox"/> Photovoltaic Cells and Panels | <input type="checkbox"/> Dedicated Crops & Agricultural Residues |
| <input type="checkbox"/> Wind                          | <input type="checkbox"/> Hydropower                              |
| <input type="checkbox"/> Organic Waste Biomass (Heat)  | <input type="checkbox"/> Fuel Cell                               |

-----  
**A.5. Organization Legal Status**

- |   |   |
|---|---|
| <input type="checkbox"/> Individual   | <input type="checkbox"/> Corporation not providing or billing medical and/or health care services |
| <input type="checkbox"/> Owner of Sole Proprietorship   | <input type="checkbox"/> Non resident alien individual  |
| <input type="checkbox"/> Partnership  | <input type="checkbox"/> Estate or legal trust  |
| <input type="checkbox"/> Tax-exempt hospital or extended care facility                        | <input type="checkbox"/> Foreign corporation, partnership estate or trust                         |
| <input type="checkbox"/> Governmental entity  | <input type="checkbox"/> Other not-for-profit organization  |
| <input type="checkbox"/> Corporation providing or billing medical and/or health care services | <input type="checkbox"/> Other  |

-----  
**A.6. State Legislative Districts**

Senate District \_\_\_\_\_ Representative District \_\_\_\_\_ Congressional District \_\_\_\_\_

-----  
**A.7. Financing Information**

A.7.1 Total grant amount request: \$ \_\_\_\_\_

A.7.2 Total estimated energy production (kWh or therm) of the project over the first two years following the commencement date: \_\_\_\_\_

A.7.3 The total value of the Department support request (A.7.1) divided by the estimated energy production (A.7.2), as expressed in cents per kWh or cents per therm: \_\_\_\_\_

**APPENDIX A: (cont.)**

A.7.4 Total Project Cost \$ \_\_\_\_\_

A.7.5 Total Applicant Investment (cash) \$ \_\_\_\_\_

A.7.6 Sum of Financial Partner Investments (cash) \$ \_\_\_\_\_

A.7.7 Sum of other Public Funds: \$ \_\_\_\_\_

A.7.8 Sum of all any other Investment sources: \$ \_\_\_\_\_

**A.8. Applicant Certification.** The applicant certifies that:

- It is not in violation of the prohibitions against bribery of any officer or employee of the state of Illinois as set forth in 30 ILCS 505/10.1.
- It has not been barred from contracting with a unit of state or local government as a result of a violation of Section 33E-3 or 33E-4 of the Criminal Code of 1961 (720 ILCS 5/33 E-3 and 5/33 E-4)
- It is not in violation of the Educational Loan Default Act (5 ILCS 5/33 E-3 and 5/33 E-4).
- As of the submittal date, the information provided in this application is accurate, and the individuals signing below are authorized to submit this application.

Authority/Approvals - The recipient agrees that all authorizations required to perform the project have either been obtained or will be obtained no later than 60 days following the project start date set forth in the Notice of Grant Award issued by the Department.

Legal Compliance – The recipient agrees that the project complies with all applicable state, federal and local environmental and zoning laws, ordinances and regulations and that all permits, licenses, etc., required to perform the project have either been obtained or will be obtained no later that 180 days following the project start date set forth in the Notice of Grant Award.

\_\_\_\_\_  
Authorized Official/Owner (signature)

\_\_\_\_\_  
Project Manager (signature)

\_\_\_\_\_  
Typed/Printed Name

\_\_\_\_\_  
Typed/Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

\_\_\_\_\_  
e-mail address

\_\_\_\_\_  
e-mail address

**APPENDIX B**  
Proposal Requirements

**RENEWABLE ENERGY GRANT APPLICATION DOCUMENTATION.** All applicants shall include documentation of the following:

- B.1** History - a brief history of the applicant, including its legal organization.
- B.2** Narrative Description of the Project - including a summary description of the project and the components used, and the size of the system in terms of watts.
- B.3** Detailed Statement of Work - a description of proposed tasks and deliverables.
- B.4** Project Budget - all costs must be directly identifiable and eligible for grant reimbursement. Expenses must be documentable and traceable to the grant. See Appendix C for additional information.
- B.5** Pertinent Experience - a brief description outlining experience of the applicant or project manager.
- B.6** Proposed Project Timetable - the work program to be carried out under the grant must specify a timeline for major project milestones and activities including the anticipated start and end date of each activity.
- B.7** Merits – brief description of the merits of the project per the Evaluation Criteria as provided in Section 3.2, with a suggested maximum length of two pages.
- B.8** Name, address, license number, and proof of insurance, of the Installer.

**APPENDIX C**  
Proposal Budget

**C.1 Summary of Budget**

	Total Costs	Applicant Contribution	Contributions From Other Sources	State Funding Requested
A. Contractual Services	_____	_____	_____	_____
B. Equipment/Materials	_____	_____	_____	_____
C. Costs Associated With Agricultural Residues or Dedicated Crops	_____	_____	_____	_____
Total	_____	_____	_____	_____
Percent of Total	_____ 100			

**C.2 Contractual Services** (List all subcontracts for design, construction, repair, or maintenance, and fees for legal, financial, artistic or other professional services. Subcontracts must be explained in detail and attached to the end of this section. Include license number and address)

	Total Costs	
1. _____	\$ _____	\$ _____
2. _____	\$ _____	\$ _____
3. _____	\$ _____	\$ _____
4. _____	\$ _____	\$ _____
5. _____	\$ _____	\$ _____
6. _____	\$ _____	\$ _____
7. _____	\$ _____	\$ _____
SUBTOTAL	\$ _____	\$ _____

**APPENDIX C: (cont.)**  
 Proposal Budget

**C.3 Equipment/Materials** (List all items of equipment to be purchased valued greater than \$100.)

	Total Costs	State Funding Requested
1. _____	\$ _____	\$ _____
2. _____	\$ _____	\$ _____
3. _____	\$ _____	\$ _____
4. _____	\$ _____	\$ _____
5. _____	\$ _____	\$ _____
6. _____	\$ _____	\$ _____
SUBTOTAL	\$ _____	\$ _____

**C.4 Agricultural Residue and Dedicated Crops**

	Total Costs	State Funding Requested
1. _____	\$ _____	\$ _____
2. _____	\$ _____	\$ _____
3. _____	\$ _____	\$ _____
4. _____	\$ _____	\$ _____
5. _____	\$ _____	\$ _____
6. _____	\$ _____	\$ _____
SUBTOTAL	\$ _____	\$ _____

**C.5 Financial Partners and all Other Sources of Investment** (Specify in reasonable detail. Include phone number, contact person and address)

	Total Investment
1. _____	\$ _____
_____	
_____	

2. \_\_\_\_\_ \$ \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. \_\_\_\_\_ \$ \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. \_\_\_\_\_ \$ \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SUBTOTAL \$ \_\_\_\_\_

Project Total \$ \_\_\_\_\_ State Funds Requested Total \$ \_\_\_\_\_  
Attach addition budget pages if necessary

**C.6 Financial Partnerships and Other Investment Sources, Letter or Guidelines.**

Provide letters from each financial partner or funder indicating the amount of their support and the project commencement date expected for their participation.

In the event of funding by private foundations or public sources, if such a letter is not yet available, indicate the anticipated source (USDA program name, etc.) and supporting documentation or guidelines for the anticipated source.



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**Appendix III. Wind Energy Easement Guidelines,  
Prepared for Windustry by Willeke & Daniels of  
Minneapolis, Minnesota**





# Wind Energy Easements

Prepared by

**Robert R. Nardi**  
Willeke & Daniels  
210 Ridgewood Avenue  
Minneapolis, MN 55403  
(612) 870-4000

Presented by

**John H. Daniels, Jr.**  
Willeke & Daniels  
210 Ridgewood Avenue  
Minneapolis, MN 55403  
(612) 870-4000

*Attached is a Wind Energy Easement Outline that discusses in some detail various provisions that can be found in wind energy easement agreements. The purpose of the outline is to give you a general idea of what types of provisions might be contained in any easement agreement or easement option agreement that may be presented to you by wind energy developers in an effort to obtain certain wind energy easements over all or a portion of your land. It is not a comprehensive discussion of the topic and is meant only to be a guide.*

*A wind energy easement agreement, like any easement agreement, is a legally binding agreement that needs to be carefully reviewed and understood before executing it. A wind energy easement agreement will have a long term effect on you and your land. It will effect not only you but future generations. It is important that you not agree to or execute any easement agreement or easement option agreement until you have discussed it with your attorney and he or she has had an opportunity to review it. It is strongly advised that upon receiving a wind energy agreement or option agreement that you take it to your attorney along with the attached outline for his or her review.*

*When approach by a wind energy developer with a wind energy agreement or when just considering the prospects of such an agreement, the following are the some of the questions that you should ask yourself and/or the developer:*

- 1. How much of my land is going to be tied up and for how long?*
- 2. How much are they going to pay me and how are payments to be received?*
- 3. Are the proposed payments adequate now and will they be adequate in the future based on what I am giving away?*
- 4. If a lump sum payment is being offered for long term rights am I really being adequately compensated?*
- 5. Does the proposed method of payment or the easement itself present any adverse tax consequences to me?*
- 6. Are they actually going to develop my land or are they just trying to tie it up?*
- 7. Are they willing to guarantee that a specific number of wind energy turbines will be built on my land or are they at least willing to guarantee me certain minimum payments?*
- 8. If payments are to be based on revenues generated by the wind energy turbines, how much information are they willing to disclose concerning how their revenue will be determined?*
- 9. What easement rights is the developer able to later sell or transfer without my consent and how might such transfer or sale effect me? Will the original developer still be liable to me if the new developer or owner of the easement rights does not pay me or otherwise defaults?*
- 10. What are the developer's termination rights? Can the developer simply terminate the easement at any time and if so how does that effect future payments?*
- 11. What are my termination rights and are they easily exercised?*
- 12. If the easement is terminated either voluntarily or involuntarily what happens to the wind energy structures, and related facilities located on my land? Is the developer required to remove everything, including underground cables and foundations, and if so how soon and at whose cost?*

## **Windustry**

2105 First Avenue S  
Minneapolis, MN 55404  
612.374.2261 phone  
612.374.2601 fax



# Wind Energy Easements

---

## I. General Nature of Wind Energy Easements

- A. Gives the Easement Holder the right to the use of all or a portion of the Landowner's land for the following:
  - 1. *For the purpose of constructing and maintaining a wind energy conversion facility.*
  - 2. *For the transmission of the energy generated by the wind energy conversion facility.*
- B. These easement rights are usually exclusive to the Easement Holder.

## II. Form of Agreement Granting Easement

- A. Option Agreement
  - 1. *Provides for the exclusive right to purchase easement rights.*
  - 2. *Right must be exercised within a specific period of time. Period of time can vary from months to years.*
  - 3. *Should contain details as to what easement rights can be purchased and all terms and conditions of such easement rights. In some cases a copy of the complete easement agreement that is to be executed by the parties upon the exercise of the option is attached to the option agreement as an exhibit.*
  - 4. *Should contain legal description of the real property subject to the option.*
  - 5. *Should set forth the amount and method of payment for the option.*
- B. Easement Agreement
  - 1. *Provides for an exclusive easement or easements.*
  - 2. *Should contain the specific rights and obligations of both the Landowner and the Easement Holder.*
  - 3. *Details of what these types of easement agreements usually provide for and should provide for are discussed below.*

## III. Wind Energy Easement Provisions

- A. Legal description of the land subject to the easement.
  - 1. *Legal description should be limited to only that portion of the land that is reasonably needed for the proper exercise of the easement rights be granted.*
  - 2. **Avoid grants of easements over large blocks of land when only a portion is going to be used, unless payment for the easement rights are based on total number of acres and Landowner is comfortable tying up the land.**
  - 3. *Party seeking the easement may want to tie up a much land as they can get even though only a small portion of it will be used.*
  - 4. *Typically the party seeking the easement will want to make use of the property as follows:*
    - a. Construct on certain portions of the land the wind turbines that will generate the energy and the related physical structures including those that will convert the energy into electricity.
    - b. Install power lines or cables over certain portions of the land that will carry the electricity to the power company.
    - c. Have access from public roads to and from the land where the wind turbines and other physical structures are located.
- B. Term of Easement
  - 1. *Usually the easement will be a perpetual or permanent easement and will terminate only by voluntary termination on the part of the Easement Holder or involuntary termination as a result of a default on the part of the Easement Holder.*
  - 2. **Landowner should consider negotiating an easement that automatically terminates after a specific number of years.**
  - 3. **Landowner should avoid automatic renewal periods.**
  - 4. *Landowner should check with tax advisor as to any possible adverse tax consequences that may result from granting a perpetual easement as opposed to an easement for a specified number of years. For example, a perpetual easement may constitute a sale of land for income tax purposes.*

- 
- C. Payment for Easement Rights
1. *Most difficult part of negotiating easement agreement.*
  2. *Matters to consider:*
    - a. If easement agreement calls for different phases than it may be appropriate to have different consideration for each phase.
      - (i) *Preliminary phase when Easement Holder is determining whether to build wind facilities on the land, or where to build them on the land or how many to build.*
      - (ii) *Construction phase*
      - (iii) *Operational phase*
    - b. The length of time the land may be tied up without any construction of a wind energy facility.
    - c. Appropriate to consider smaller payment amounts for portion of the easement property that can be continuously used in the Landowner's farming operation.
    - d. **Because most easement agreements do not require that a minimum number of wind turbines be built, consideration should be given to minimum payments regardless of how many are built.**
    - e. Be careful of payments that are based on a percentage of gross operating proceeds even if gross operating proceeds are defined as all gross receipts from the sale of electricity generated by the wind turbines located on the land.
      - (i) *Need to have access to power agreement between Easement Holder and power company so as to be able to determine what Easement Holder is being paid for the power generated by the wind turbines.*
      - (ii) *Power agreement may provide for larger payments to the Easement Holder in early years and smaller payments in later years making any payment schedule calling for a increase percentage of gross operating proceeds in later years misleading.*
    - f. **Avoid lump sum payments for long term easement rights.**
    - g. When any method of payment is to begin when construction commences, make sure the easement agreement describes what constitutes the "commencement of construction."
    - h. **Provision should be made for the complete reimbursement of the Easement Holder if the Easement Holder incurs penalties or is subject to reimbursement obligations as a result of the land being taken out of conservation reserve programs. Prior to executing an easement agreement, Easement Holder should review any existing conservation program contracts to determine if there will be any adverse consequences as a result of the proposed easement.**
    - i. Landowner should consult with tax advisor to make sure the method of payment does not have any adverse tax consequences presently or in the future.
- D. Typical rights that Easement Holder will want.
1. *Right to conduct certain activities on the land prior to constructing any wind energy facilities. These activities may include the following:*
    - a. Erection of meteorological towers.
    - b. Taking soil samples
    - c. Release of weather balloons.
  2. *Right to construct and install wind energy facilities and in connection with such activity construct and install the following:*
    - a. Foundations, concrete pads and footings;
    - b. Wind turbine units;
    - c. Guy wires, support fixtures, anchors, and fences;
    - d. Buildings needed for maintenance of wind turbine units and maintenance and storage of related equipment;

- 
- e. Electrical transformers and energy storage facilities;
  - f. Electric transformers, electric distribution and transmission towers and lines either above ground or underground;
  - g. Substations or switching facilities for the purpose of connecting to transmission system;
  - h. Private roads providing access from public roads to the wind energy facilities.
3. *Most easement agreements will have a catch all provision which will give the easement holder the right to engage in all other activities reasonably determined to be necessary or useful to accomplish the general purpose of the easement. **Landowner should avoid such a catch all provision.***
- E. Typical Rights Reserved by Landowner.
- 1. *Right to use land for grazing.*
  - 2. *Right to harvest crops.*
  - 3. *Right to conduct other farming or agricultural activities on the land.*
  - 4. *Right to construct improvements on parts of the land if necessary and incident to farming or other agricultural activities.*
  - 5. *All of the above rights are usually subject to such activities not interfering with or creating a risk of damage to or injury to the wind energy facility or the Landowner or Landowner's livestock.*
  - 6. **Landowner should take great care in reserving any rights that are unique to the Landowner's farming operations.**
  - 7. *Any of the above rights should be exercisable by Landowner without the consent of the Easement Holder or if consent is required, then such consent should not be unreasonable withheld.*
- F. Minimum Duties and Obligations of Easement Holder.
- 1. *Keep the land free from liens such as mechanic liens.*
    - a. Usually require the immediate removal by Easement Holder of any such liens.
    - b. May allow the Easement Holder the option of contesting the validity of the lien.
      - (i) This right to contest should be at no cost to Landowner.
      - (ii) As a minimum Easement Holder should indemnify Landowner against any costs, expenses or damages Landowner incurs as a result of such lien.
      - (iii) Landowner may want to require Easement Holder to post bond or escrow sufficient proceeds to cover the cost of removing the lien if Easement Holder is going to contest the lien.
      - (iv) Landowner may be required to cooperate with Easement Holder if such cooperation is needed in order to remove lien.
  - 3. *Comply with all federal, state and local laws.*
  - 4. *Obtain and comply with all permits.*
    - a. Should be at no cost to Landowner.
    - b. Landowner may be required to cooperate with Easement Holder in seeking permits.
  - 5. *Not use, store, dispose or release hazardous substances on the land.*
    - a. Easement Holder may be allowed to use hazardous substances in its normal business operations provided such use is not harmful to Landowner and is in full compliance with all applicable laws.
    - b. Easement Holder should indemnify Landowner with respect to any claims made against Landowner resulting from such hazardous substances.
- G. Minimum Duties and Obligations of Landowner.
- 1. *To allow the Easement Holder the quite use and enjoyment of the land without interference so long as the Easement Holder is not in default under the terms of the easement.*
  - 2. *Landowner is not to engage in any activity that would impede or decrease the output or efficiency of the wind energy.*
  - 3. *Landowner is not to interfere with the wind speed or direction.*

- 
4. *Not use, store, dispose or release hazardous substances on the land.*
    - a. Landowner should be allowed to use hazardous substances in its normal business operations provided such use is not harmful to Easement Holder and is in full compliance with all applicable laws.
    - b. Landowner should indemnify Easement Holder with respect to any claims made against Easement Holder resulting from such hazardous substances.
  5. *Landowner to cooperate with Easement Holder in obtaining any necessary subordination agreements or approvals from existing lien holders.*
    - a. Existing mortgages on land may require approval of easement grant.
    - b. This should be done at no cost to Landowner.
    - c. **Landowner should be careful of provisions that allow the Easement Holder to payoff any existing prior lien and deduct the payoff amount from amounts owed Landowner under the easement.**
  6. *Landowner to assist and fully cooperate with Easement Holder in obtaining land use permits, building permits, environmental impact reviews or any other approvals required for the construction or financing of the wind energy facility. Such assistance and cooperation should be at no cost whatsoever to Landowner.*
- H. Taxes and Utilities
1. *Easement Holder should be required to pay any increase in real estate taxes as a result of the installation of the wind facility.*
  2. *Easement Holder should not be required to pay increase if due to improvements made by Landowner or result from an increase in the underlying value of the land.*
  3. *Easement Holder should be required to pay and personal property taxes levied against any wind facility.*
  4. *Easement Holder should be required to pay all water, electric, telecommunications and other utility service used by the wind facility.*
- I. Easement Holder's Assignment Rights.
1. *Easement Holder normally wants complete right to assign all or any portion of their easement rights to another without the need for consent or approval of the Landowner.*
  2. *Such a right of assignment can include the following:*
    - a. Right to finance wind power facilities by having a mortgage placed on the Easement Holder's interest.
    - b. Right to grant co-easements or subeasements.
    - c. Right to sell or otherwise transfer the easement to another party.
    - d. Right to grant to a utility company the right to construct, operate and maintain electric transmission, interconnection and switching facilities on the land.
  3. *These assignment provisions usually allow the original Easement Holder to be released from any further obligations or duties under the easement if the party receiving the assignment agrees to assume all responsibilities of the Easement Holder.*
  4. **Landowner should consider requiring original Easement Holder to continue to be liable for the performance of all duties and obligations under the easement after any assignment.**
  5. *Easement Holder should be required to give written notice to the Landowner of any assignment including the name, address and phone number of the party receiving the assignment.*
- J. Indemnification Provisions
1. *Usually will be mutual*
  2. *Usually provide for indemnification for damages arising out of :*
    - a. Any operations or activity of the indemnifying party on the land;
    - b. Any negligent or intention act or omission on the part of the indemnifying party;
    - c. Any breach of the easement agreement;

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- d. In some provisions, indemnification by the Landowner may include actions of the Landowner's tenants;
- K. Insurance Provisions.
1. *Easement agreement should require that Easement Holder maintain appropriate liability insurance covering all of its activities on the Landowner's land and should name the Landowner as additional insured.*
    - a. The policy should contain sufficient liability limits to protect Landowner.
    - b. The policy should also provide that it cannot be cancelled without at least 30 days written notice to Landowner.
  2. *Easement Holder should be required to provide Landowner with yearly certificates of insurance.*
  3. *Some easement agreements require that the landowner also have appropriate liability insurance naming the Easement Holder as an additional insured.*
- L. Specific Rights that may be given to Easement Holder's Lender.
1. *Lender is not liable for any of the Easement Holder's obligations under the easement until such time as the lender's mortgage is foreclosed.*
  2. *Neither the Landowner or Easement Holder can modify the easement without the lender's approval*
  3. *Lender has the right at any time to cure any default of the Easement Holder.*
  4. *Landowner is required to give lender notice of any default by the Easement Holder.*
  5. *If Landowner is entitled to terminate the easement as a result of a default on the part of the Easement Holder, the Landowner must give notice to the lender and lender must be given an opportunity to cure.*
  6. *If lender needs to foreclose its mortgage in order to cure the default, lender must be given reasonable period of time to foreclose. **With such a provision, Landowner should consider a provision that requires that any monetary default be cured by lender pending such foreclosure.***
  7. *Upon foreclosure and the agreement by the lender to assume all of the obligations under the easement, the Landowner must recognize the lender as the new Easement Holder.*
  8. *Landowner may be required from time to time to execute on behalf of the Easement Holder and in favor of Easement Holder's lender certificates indicating whether any defaults currently exist under the easement (estoppel certificates). Landowner may want to limit the number of times such documents need to be provided to Easement Holder's lender.*
  9. *Easement may contain a provision that requires the Landowner to cooperate and negotiate in good faith any amendments to the easement agreement that may be reasonably necessary for any lender to effectuate or preserve its lien. **Landowner should cautious about agreeing to such a provision.***
- M. Condemnation Provisions
1. *The easement should provide for what happens to the easement and easement rights in the event the easement property is taken by condemnation.*
  2. *Some easement agreements provide that the parties either amend the easement agreement to relocate the wind facilities or at the Easement Holder's option terminate the easement agreement. **Landowner should also have the right to terminate the easement agreement.***
  3. *The Landowner should be entitled to receive all condemnation payments except the Easement Holder should be entitled to any amount awarded to compensate for:*
    - a. The removal or relocation of the wind facility;
    - b. Loss or damage to any wind facility which Easement Holder cannot remove or is required not to remove; or
    - c. Loss of use or value of the easement.
  4. *The Easement Holder will want the right to participate in any settlement discussions involving the Landowner and the condemning authority.*
- N. Default and Termination
1. *Events that normally constitute default on the part of the Easement Holder and allow for the termination of the easement:*

- 
- a. Failure to make payments to the Landowner after written notice of such overdue payment.
    - (i) *Some easement agreements provide up to thirty days written notice to Easement Holder before Landowner can terminate easement.*
    - (ii) Landowner should consider a shorter period of time for written notice such as ten days**
  - b. A failure to perform any other material term of the easement agreement that continues for thirty days after written notice to Easement Holder.
    - (i) *If it will reasonably take Easement Holder longer than thirty days to cure default, most easement agreements allow for such additional time.*
    - (ii) *Any additional time granted in easement agreement should be limited, for example, not to exceed 180 days.*
  - c. Easement Holder files for protection or liquidation under Bankruptcy laws.
2. *Some easement agreements provide that if the Easement Holder has assigned portions of the easement to others, such other easement holders have the right to cure their pro rata portion of the default. **Such a provision is not advisable unless it results in the entire default being cured.***
  3. *Some Easement Agreements give the Easement Holder the right to voluntarily terminate the easement by simply giving the Landowner written notice of such termination.*
    - a. With this type of a provision, Landowner should be allowed, as a minimum, to keep all payments made to date.
    - b. Landowner may also want to require that a termination fee is due upon such termination or that a portion of the lost future payments be paid.
    - c. Landowner should be careful of any termination provision that allows the Easement Holder the right to retain a portion of the easement.**
  4. *Every easement agreement should provide that upon termination, the Easement Holder is required to execute a quit claim deed in favor of the Landowner releasing the easement.*
    - a. Obtaining a quit claim deed in an involuntary termination situation may be difficult.
    - b. Landowner should consider a provision which would allow the Landowner to terminate the easement by simply filing an affidavit with the county recorder or registrar of titles attesting to the default, the notice given to Easement Holder of said default, and the failure of Easement Holder to cure the default within the cure period.
    - c. Another option would be to allow for the Landowner to recover costs and expenses, including attorneys' fees, if Landowner is forced to go to court to obtain a release of its easement.
  5. *The easement agreement should require that upon termination, the Easement Holder must remove all wind facilities from the land.*
    - a. Easement Holder should be required to remove the wind facilities within a specific number of days such as 90 or 180 days.
    - b. The easement agreement should specify exactly what constitutes removal considering there may be materials under ground such as footings or cables. Some agreements specify that everything above ground and to a depth of four feet must be removed.
- O. Miscellaneous Provisions
1. *The manner in which notices are to be given to each party.*
  2. *The easement agreement may only be amended by a written documents executed by all parties.*
  3. *Easement agreement is to be interpreted under the laws of Minnesota.*
  4. *Any waiver of a term or condition of the easement agreement must be in writing and executed by all parties in order to be binding.*
  5. *Should have a provision that provides that attorneys' fees are recoverable by a party who is forced to bring an action to enforce the terms of the easement agreement.*

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6. *A provision which suspends performance of an obligation when the party who is to perform such obligation is unable to do so due to unforeseen events such as strikes, floods, civil disturbance, etc. Landowner should be careful when reviewing what matters are to be considered unforeseen events.*
7. **Landowner should be careful about agreeing to the following types of provisions:**
- a. Confidentiality provisions which prohibit Landowner from disclosing information pertaining to the terms and conditions of the easement.
  - b. Provisions that require both parties to execute such additional documents and take such action as may be reasonably necessary to carry out the intent and purpose of the easement.
  - c. Provisions that require that if consent of one party is required for the other party to do something, such consent cannot be unreasonably withheld.
  - d. Provisions that require the parties to convert Easement Holder's interest to whatever will qualify for tax credits, benefit or incentive for alternative energy expenditures.
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**RIDER 4  
PARALLEL OPERATION OF CUSTOMER'S GENERATING FACILITIES**

**Applicable to All Rates and Special Contracts  
(Except Those Specifically Excluding Rider 4)**

**AVAILABILITY.**

This rider is available for service to any customer operating an electricity production facility in parallel on the same installation in conjunction with the Company's service.

**SERVICE OPTIONS.**

A customer operating a Qualifying Facility, as defined in 83 Illinois Administrative Code Part 430, may elect service under either Option A or Option B. A customer operating a generator which does not so qualify may only take service under Option C.

**Option A**

- \* Sale of the entire output of the Qualifying Facility to the Company, and purchase of all of the customer's electricity requirements from the Company or a Retail Electric Supplier (RES).

**Option B**

- \* Use of the output of the Qualifying Facility to provide a portion of the customer's own electricity requirements, and purchase of the customer's remaining requirements from the Company or a RES. A customer electing this option may sell to the Company any excess of the output of the Qualifying Facility over the customer's own requirements for electricity.

**Option C**

- \* Use of the output of a generator to provide a portion of the customer's own electricity requirements, and purchase of the customer's remaining requirements from the Company or a RES. A customer taking service under this option may deliver to the Company any excess output of the generator over the customer's own requirements for electricity, but will not be compensated for such deliveries.

**COMPENSATION.**

Only customers operating a Qualifying Facility will receive compensation, as provided by this rider, for output delivered to the Company. Each customer served hereunder must enter into a written contract with the Company incorporating the provisions of this rider and the stated Administrative Code.

**Level of Compensation**

**Option A**

Unless the customer negotiates a different compensation arrangement with the Company pursuant to 83 Illinois Administrative Code Part 430, the customer electing this option shall be entitled to sell the output of the Qualifying Facility to the Company at the following rates per kilowatt-hour determined in accordance with Section 430.80 of that Administrative Code:

(Continued on Sheet No. 64)

**RIDER 4  
PARALLEL OPERATION OF CUSTOMER'S GENERATING FACILITIES**

(Continued from Sheet No. 63)

**COMPENSATION (CONTINUED).**

**Level of Compensation (Continued)**

**Option A (Continued)**

For Customers with Nameplate Generating Capability Less Than 1,000 Kilowatts.

	<u>Summer</u> <u>Months</u>	<u>All Other</u> <u>Months</u>	
*	6.06¢	3.97¢	for all kilowatt-hours supplied during Energy Peak Periods.
*	2.42¢	2.15¢	for all kilowatt-hours supplied during Energy Off-Peak Periods.

\* A customer who has a Qualifying Facility that has a total nameplate capability of ten kilowatts or less may elect to sell electricity to the Company on a non-time-of-day basis at 3.79¢ for all kilowatt-hours supplied during Summer Months and 2.82¢ for all kilowatt-hours supplied during all other months.

For Customers with Nameplate Generating Capability of 1,000 Kilowatts or More.

	<u>Summer</u> <u>Months</u>	<u>All Other</u> <u>Months</u>	
*	5.89¢	3.87¢	for all kilowatt-hours supplied during Energy Peak Periods.
*	2.37¢	2.11¢	for all kilowatt-hours supplied during Energy Off-Peak Periods.

Any electricity requirements provided by the Company for the customer at the premises shall be provided under the applicable tariff provisions.

**Option B**

A customer electing this option shall purchase electricity requirements, to the extent they exceed the output of the Qualifying Facility, under the Company's otherwise applicable tariff provisions if the Company provides such electricity requirements.

A customer electing Option B who delivers energy to the Company shall be entitled to compensation at the rate specified under Option A (unless different compensation is negotiated), provided the customer has arranged for the necessary metering as herein specified.

**Option C**

A customer taking service under this option shall purchase electricity requirements, to the extent they exceed the output of the generator, under the Company's otherwise applicable tariff provisions if the Company provides such electricity requirements.

A customer taking service under Option C who delivers energy to the Company shall not be compensated for the electricity.

(Continued on Sheet No. 64.10)

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## **Appendix IV. Avoided Cost Rate Schedules from Selected Illinois Utilities**

- 1. Commonwealth Edison Company**
- 2. Central Illinois Public Service Company**
- 3. Illinois Power Company**
- 4. Central Illinois Light Company**



**RIDER 4  
PARALLEL OPERATION OF CUSTOMER'S GENERATING FACILITIES**

(Continued from Sheet No. 64)

**CHARGES FOR SERVICE AND METERING FACILITIES.**

A customer taking service under this rider will be subject, as provided herein, to charges which are related to Company facilities that are necessary for operating generating facilities in parallel, whether normally or infrequently, with the Company's system.

The customer shall reimburse the Company in accordance with Riders 6 and 7 for the cost of metering facilities and any other facilities the Company must install to connect the customer's electric service to the Company's system, to the extent the cost of such facilities exceeds the cost of facilities the Company would provide as standard under its otherwise applicable tariff provisions. In addition, the customer shall reimburse the Company for any operating and maintenance expenses it incurs because of the connection of the customer's generating equipment to the Company's system. The amount of such reimbursement may be based on flat charges of general applicability to the extent practical.

- \* If the customer has a Qualifying Facility with a nameplate rating of ten kilowatts or less and the customer elects service under Option B, the customer may also elect, in order to save the costs of wiring and meter rental, to forego compensation for the kilowatt-hours delivered to the Company. In such a case, the metering shall be as required by the otherwise applicable rate, but with detents to allow only the registration of the electricity sold to the customer by the Company or RES, as applicable.
- \* If the customer does not have a Qualifying Facility, the metering shall be as required by the otherwise applicable rate, but with detents to allow only the registration of the electricity sold to the customer by the Company or RES, as applicable.

The customer shall install or, if installed by the Company, shall pay for any equipment that may be required by the Company for reasons of safety or to prevent interference with service to other customers. The equipment to be installed by the customer shall include, but shall not be limited to, a disconnect device to which the Company has access and which it can lock in an open position to disconnect the customer's generating facility from the Company's system.

**TERM OF SERVICE.**

A customer electing service hereunder for operation of a Qualifying Facility must choose either Option A or Option B, and must take service under the option selected for at least 12 months before a change in option may be made.

A customer electing service under this rider may terminate such service at any time, but cannot again commence service hereunder for a period of at least twelve months.

(Continued on Sheet No. 64.20)

**RIDER 4  
PARALLEL OPERATION OF CUSTOMER'S GENERATING FACILITIES**

(Continued from Sheet No. 64.10)

**GENERAL.**

A customer served hereunder may be disconnected by the Company from its system whenever, in the sole opinion of the Company, such action is required by an emergency, for reasons of safety, or due to interference with service to other customers. A customer served hereunder shall also be subject to the Company's reasonable requirements with respect to the facility's output voltage level and the production of reactive power.

- \* A customer taking service hereunder shall indemnify the Company against any and all loss resulting from an overload of the Company's facilities installed hereunder so long as the capacity of such facilities is adequate under the customer's contract with the Company for electric power and energy supply and/or delivery service.

Under certain low load conditions on the Company's system, when the supply of electricity to the Company would not permit the Company to avoid costs, the Company may refuse delivery of electricity from customers with generating capability of 1,000 kilowatts or more. Such customers may be required to pay for any special costs incurred to provide for giving them notice or disconnecting their generation from the Company's system at those times.

For the purposes hereof, the Summer Months shall be the customer's first monthly billing period with an ending meter reading date on or after June 15 and the three succeeding monthly billing periods.

Energy Peak Periods, for purposes hereof, shall be the hours of 9:00 a.m. to 10:00 p.m. on Monday through Friday, except on days on which the following holidays are generally observed: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day and, if one of the foregoing holidays occurs on a Tuesday or Thursday, the immediately preceding Monday or immediately following Friday, respectively. Energy Off-Peak Periods shall be all other hours.

Payment by the Company to the customer for energy purchased at the prices specified under Option A shall be monthly on or before the due date applicable for service, if any, provided by the Company to the customer.

Service hereunder is subject to the provisions of the 83 Illinois Administrative Code Part 430 and any requirements of the Company necessary to implement the provisions of that Code. The Company and the customer may, by contract, subject to approval of the Illinois Commerce Commission, modify any of the provisions contained herein or in the otherwise applicable tariff.

- \* Except as specified above, all other provisions of the applicable rate shall apply.

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**RATE 14 - ELECTRIC POWER PURCHASES FROM QUALIFYING FACILITIES**

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**AVAILABILITY**

Available upon application by any Customer served under any service rate who qualifies as a “Qualifying Facility” as defined in 83 Illinois Administrative Code, Part 430. These provisions are for purchase of electric energy or electric energy and capacity from Qualifying Facilities (hereinafter referred to as “Customer”) by Central Illinois Public Service Company (hereinafter referred to as “Company” or “CIPS”) under the provisions of 83 Illinois Administrative Code, Part 430 of the Illinois Commerce Commission. Applicant should obtain and review a copy of 83 Illinois Administrative Code, Part 430.

**RATE FOR PURCHASE BY COMPANY FROM CUSTOMER**

1. Standard Time-Differentiated Energy Rate

Summer Rate

2.30 cents per kWh for all kWh in the on-peak period (1)

2.30 cents per kWh for all kWh in the off-peak period (3)

Winter Rate

2.30 cents per kWh for all kWh in the on-peak period (2)

2.30 cents per kWh for all kWh in the off-peak period (3)

Rate pursuant to Section 430.80(a) of 83 Illinois Administrative Code.

- (1) Summer on-peak rate shall apply during the hours between 10 A.M. and 10 P.M. on Monday through Friday (except for certain holidays) during the monthly billing period ending about June 1 (billing cycle 6) of each year and the following three consecutive monthly billing periods.
- (2) Winter on-peak rate shall apply during the hours between 10 A.M. and 10 P.M. on Monday through Friday (except for certain holidays) during the monthly billing period ending about October 1 (billing cycle 6) of each year and the following seven consecutive monthly billing periods.

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Date Effective, August 15, 2003

Issued by G.L. Rainwater, President  
607 East Adams Street, Springfield, IL 62739

\* Asterisk denotes change

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**RATE 14 - ELECTRIC POWER PURCHASES FROM QUALIFYING FACILITIES**

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- (3) Off-peak rate shall apply during weekends, the days on which the following holidays are observed in Illinois: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day and remaining daily hours not specified in (1) and (2) above.

\* 2. Voltage Level Adjustment

When Customer agrees to deliver energy to existing company facilities at an available voltage of 138 KV and above, a premium of 0.08 percent of the applicable rate will be paid.

When Customer agrees to deliver energy to existing Company facilities at an available high voltage (34.5 KV - 69 KV), a premium of 1.08 percent of the applicable rate will be paid.

When Customer agrees to deliver energy to existing Company facilities at an available primary voltage (2.4 KV - 13.8 KV), a premium of 3.16 percent of the applicable rate will be paid.

When Customer agrees to deliver energy to existing Company facilities at an available secondary voltage (less than 2.4 KV), a premium of 8.03 percent of the applicable rate will be paid.

3. Negotiated Rates

Rates other than those specified in this Section may be available by specific contract agreement subject to Illinois Commerce Commission approval.

**TERMS AND CONDITIONS**

Service hereunder is subject to the general "Terms and Conditions" of this Schedule and the following further conditions.

**CONTRACT**

Whether or not purchases are made by Company under the Standard Rate, Company shall not be required to make any purchase from Customer until Company and Customer have entered into a written service agreement with special contract arrangements for such purchases. Any such agreement shall be filed with the Commission for approval. Furthermore, subject to the approval of the Commission, the agreement may modify any of the provisions contained herein or in any otherwise applicable provisions.

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\* Asterisk denotes change

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**RATE 14 - ELECTRIC POWER PURCHASES FROM QUALIFYING FACILITIES**

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**GUIDELINE TECHNICAL REQUIREMENTS FOR CUSTOMER PARALLEL OPERATION  
WITH CENTRAL ILLINOIS PUBLIC SERVICE COMPANY**

1. Introduction

The minimum technical requirements for safe parallel operation of Customer-owned electrical generating facilities with the CIPS system are set forth below. These requirements shall serve as a guide for CIPS and Customer engineering when planning for operation of Customer-Owned electrical generating facilities. Such facilities may have specific requirements other than those set forth herein as a result of each installation's unique nature.

2. General Technical Requirements

A. Metering

Parallel generating facilities connected to the CIPS system have two alternative methods of metering: (1) Option I, and (2) Option II.

Option I - Under this metering configuration, each meter, with detents, will register the cumulative non-coincident energy and/or demand over the billing period. Whenever the qualifying facility generates electricity, the coincident generation is consumed on-site thus reducing the energy and/or demand registered by the first meter. Any excess energy and/or capacity not required by the qualifying facility, will be delivered to the utility and registered by a second meter. The individual meters will separately record all energy delivered to the Company by the Customer and delivered to the Customer by the Company.

Option II - This metering arrangement consists of three meters with detents. The first is the pre-existing meter and two meters are added to record the energy and/or demand requirements to and from the Customer. Any other metering arrangements shall be the subject of negotiations consistent with tariff provisions, and Company approval.

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607 East Adams Street, Springfield, IL 62739

\* Asterisk denotes change

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**RATE 14 - ELECTRIC POWER PURCHASES FROM QUALIFYING FACILITIES**

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B. Other Requirements

- (1) All Customer installations shall adhere to any applicable requirements of the National Electrical Safety Code, the National Electric Code, OSHA, and CIPS "Rules and Specifications for Electric Service" and "Safety Rules", as well as the applicable provisions contained in the Company's "Operating, Metering and Equipment Protection Requirements for Operation of Customer-Owned Generation Facilities", as revised from time to time.
- (2) Customer will bear all "costs of interconnection" as defined in 83 Illinois Administrative Code, Part 430, of parallel operation over and above the normal cost to serve the load, or the cost the Company would have incurred if it had not engaged in interconnected operations but instead generated or purchased an equivalent amount of electric energy.

If the Company incurs "costs of interconnection", as defined above, the Company shall be reimbursed for such costs plus all carrying costs over a period of time not greater than the length of the contract for electric power purchases between the Company and Customer.

- (3) Each party shall indemnify the other party, its officers, agents, and employees against all loss, damage, expense and liability to third persons for injury to or death of persons or injury to property, including but not limited to consequential damages, interest, punitive damages, Customer's fees and court costs, proximately caused by the indemnifying party's construction, ownership, operation, or maintenance of, or by failure of, any of such party's works or facilities used in connection with this tariff. The indemnifying party shall, on the other party's request defend any suit asserting a claim covered by this indemnity.

**STANDARD PAYMENT PROCEDURE**

The Company shall prepare a statement of charges for energy and/or capacity delivered by the Customer to the Company and a bank draft will be drawn in the name of the Customer, for the amount shown on the statement. The bank draft and the statement will be sent to the Customer within fourteen days (twenty-one days for residential Customers) after the date of issue of the Customer's bill from the Company. Payments made after the periods outlined above shall have added an amount equal to 3% (5% for residential and commercial Customers) of the net charge on Customer statement.

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607 East Adams Street, Springfield, IL 62739

\* Asterisk denotes change

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**RATE 14 - ELECTRIC POWER PURCHASES FROM QUALIFYING FACILITIES**

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When the last day of any payment period falls on a day other than a business day of the Company, such period will be automatically extended to include the next following business day.

Days considered to be other than a business day of the Company shall include Saturdays, Sundays, and the following holidays: New Year's Day, Lincoln's Birthday, Washington's Birthday, Good Friday, Memorial Day, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving Day, (Friday following Thanksgiving Day), Christmas Eve (the last day of regular work schedule prior to Christmas Day), Christmas Day, and New Year's Eve (the last day of regular work schedule prior to New Year's Day). Whenever a holiday falls on Sunday, the following Monday will not be considered a business day.

Payments from the Company received by mail shall be considered as having been received as of the date of postmark on the envelope. Where the postmark is illegible or absent, the payment shall be deemed timely if it is received by the Customer not more than two (2) full business days after the due date printed on the Customer's bill.

Payment arrangements other than "Standard Payment" may be available by specific contract agreement subject to Illinois Commerce Commission approval.

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Date of Filing, June 29, 2001

Date Effective, August 13, 2001

Issued by G.L. Rainwater, President  
607 East Adams Street, Springfield, IL 62739

\* Asterisk denotes change

**ILLINOIS POWER COMPANY  
 SCHEDULE OF RATES FOR ELECTRIC SERVICE**

RIDER P  
 Parallel Generation Service

(Filed in compliance with Section 430.60 of 83 Illinois Administrative Code)

1. Availability

Any Customer located in territory served by Utility may take service under this rider subject to the following conditions:

- (a) that Customer enter into a written contract with Utility, and
- (b) that Customer is a qualifying facility as defined in the Code of Federal Regulations, Title 18, Chapter I, Subchapter K, Part 292, Subpart B .

This rider is subject to the Standard Terms and Conditions of Ill. C. C. No. 31.

2. Conditions of Service

- (a) Phase and voltage of Customer's interconnected generation shall be identical to that provided by Utility.
- (b) Customer and Utility agree to indemnify each other for any tortious damages to any person or property resulting from any connection with work or services to be performed hereunder.
- (c) Customer shall pay the cost of interconnection including initial and future transmission, distribution, metering, service and other facilities costs necessary to permit interconnected operations with Utility.

3. Rates

The following charges and credits shall apply:

- (a) Facilities Charge - Customer shall pay for interconnection costs in accordance with Section 4(b) herein.

\* (b) Energy Credit

(1) Standard Energy Rate

The following energy credits shall apply to all energy delivered by Customer into Utility's system at the following voltages:

		<u>Summer Season</u>		
		<u>Credit</u>		
<u>For All Kwh Delivered In the Billing Period</u>		<u>138 kv, 69 kv &amp; 34.5 kv</u>	<u>12.47 kv and 4.16 kv</u>	<u>2.4 kv and below</u>
All kwh delivered during On-Peak Periods	1.51¢ per kwh	1.56¢ per kwh	1.64¢ per kwh	
All kwh delivered during Off-Peak Periods	1.18¢ per kwh	1.20¢ per kwh	1.24¢ per kwh	
<u>Winter Season</u>				
<u>For All Kwh Delivered In the Billing Period</u>				
All kwh delivered during On-Peak Periods	1.34¢ per kwh	1.37¢ per Kwh	1.43¢ per kwh	
All kwh delivered during Off-Peak Periods	1.21¢ per kwh	1.23¢ per kwh	1.28¢ per kwh	

\* Asterisk indicates change



**PURCHASES OF ALTERNATIVE POWER FROM QUALIFYING FACILITIES  
 RATE 28**

*Electronic replication of sheet that is on file with ICC. Content is the same although font and format*

**Availability:**

To any small power production facility or cogenerator which is a "qualifying facility" as defined by Title 18, Chapter I, Subchapter K, Part 292, Subpart B, of the Code of Federal Regulations, and who offers to sell capacity and/or energy to the Company in compliance with the conditions of this rate.

Central Illinois Light Company recommends that any applicant for this rate review 83 Illinois Administrative Code 430 as further reference to the privileges and requirements of service under this rate.

In accordance with 83 Illinois Administrative Code 430, this tariff is subject to annual review by the Illinois Commerce Commission; at that time, or any other time, the Company may revise this tariff with the approval of the Illinois Commerce Commission.

**Alternative Power Purchase Rates (by Company from Qualifying Facility):**

\* Time-of-Day Energy Purchase Rates in Cents Per Kwh:

<u>Summer</u>	<u>Secondary Voltage (Less than 2.4 Kv)</u>	<u>Primary Voltage (2.4 Kv to 13.2 Kv)</u>	<u>Subtransmission Voltage (34.5 Kv and 69 Kv)</u>
On-Peak	1.95¢	1.78¢	1.74¢
Off-Peak	1.63¢	1.52¢	1.50¢
 <u>Winter</u>			
On-Peak	1.83¢	1.68¢	1.65¢
Off-Peak	1.53¢	1.43¢	1.41¢

The on-peak periods are Monday through Friday and shall be local time:

<u>Summer</u>	<u>Winter</u>
10:00 a.m. to 10:00 p.m.	7:00 a.m. to 10:00 p.m.

The off-peak period consists of all other hours during the week.

\* Asterisk indicates change.

Issued - June 30, 2003

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Issued by - G. L. Rainwater, President  
 Peoria, Illinois

**PURCHASES OF ALTERNATIVE POWER FROM QUALIFYING FACILITIES  
 RATE 28**

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Days on which the following holidays are observed in the Company's service territory are excluded from these on-peak periods: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

The summer billing period shall commence with service rendered on June 1, and continue through September 30. All other months shall be considered winter.

\* Non Time-of-Day Energy Purchase Rates in Cents Per Kwh:

	<u>Secondary Voltage (Less than 2.4 Kv)</u>	<u>Primary Voltage (2.4 Kv to 13.2 Kv)</u>	<u>Subtransmission Voltage (34.5 Kv and 69 Kv)</u>
<u>Summer</u>	1.74¢	1.61¢	1.58¢
<u>Winter</u>	1.65¢	1.54¢	1.51¢

The summer billing period shall be the qualifying facility's first monthly billing period with an ending meter reading date on or after June 1, and the three succeeding monthly billing periods. All other billing periods shall be considered winter.

**Negotiated Purchase Rates:**

In lieu of the standard energy purchase rate (above), a qualifying facility may enter negotiations with the Company for different purchase rates and terms and conditions. Any contract entered into as a result of negotiations will, in general, be based upon more exacting standards of delivery as outlined in 83 Illinois Administrative Code 430.80(b) and 430.80(c).

**Metering Options:**

The qualifying facility will have the choice of one of the two metering options outlined in 83 Illinois Administrative Code 430.70. A different metering configuration may be arranged under a negotiated purchase rate contract.

**Purchase Rate (by Qualifying Facility from Company):**

The Company will provide electricity to the qualifying facility in accordance with the charges and provisions of the appropriate rate(s) filed with the Commission.

\* Asterisk indicates change.

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 Peoria, Illinois

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**PURCHASES OF ALTERNATIVE POWER FROM QUALIFYING FACILITIES  
RATE 28**

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**Payments:**

The owner/operator of a qualifying facility may choose to receive payment from the Company in one of two ways:

- (Option No. 1) As a monetary credit to any bill due to the Company for service supplied in the same month to the owner/operator under another of the Company's rates; or
- (Option No. 2) As a direct payment from the Company, due within 28 days of the meter read date.

If Option No. 1 is chosen and, in any month, the amount owed to the qualifying facility exceeds the amount owed to the Company, the Company will make a direct payment for the difference within 28 days of the meter-read date.

The option chosen, either initially or subsequently, will remain in effect for not less than 12 consecutive billing periods and may be changed only with 30 days prior written notice to the Company.

**Terms and Conditions:**

Service is governed by the Company's General Terms and Conditions, and, as added to or superseded by, the following specific terms and conditions.

Any customer who desires to make energy available to the Company under the arrangements of this rate shall submit to the Company, in writing, the information required under Title 18, Chapter I, Subchapter K, Part 292, Subpart B, Section 292.207 of the Code of Federal Regulations; and, as an aid in determining compliance with Company standards of service, the facility and equipment specifications.

A customer with electric generating equipment shall not connect such equipment to the Company's system without the written approval of the Company. The Company's approval is in no way a guarantee or warranty to the qualifying facility of its equipment and does not limit the qualifying facility's liability in operating such equipment.

The qualifying facility shall furnish, install, operate and maintain in good order and repair, without cost to the utility, any such relays, locks and seals, breakers, automatic synchronizer and other controls and protective apparatus which in the opinion of the Company, and in accordance with good engineering practices, will maintain the Company's standards of service.

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**PURCHASES OF ALTERNATIVE POWER FROM QUALIFYING FACILITIES  
RATE 28**

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The immediate and future costs of interconnection, as defined in 83 Illinois Administrative Code 430, Section 430.30, will be borne in full by the qualifying facility. The Company will furnish to the owner/operator in advance, cost estimates of necessary work and, at the completion of the work, will present a bill payable by the customer within 21 days.

The terms and conditions of 83 Illinois Administrative Code 430 shall apply to all qualifying facilities which are interconnected to the Company's system under this rate.

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Issued by - W. M. Shay, Vice President  
Peoria, Illinois









