# Wind Energy in Colorado

## A Practical Guide for Farmers and Ranchers

## About producing energy from wind

*Photo courtesy of Department of Energy National Renewable Energy Laboratory*

Colorado State University Cooperative Extension

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# Introduction

Colorado State University Cooperative Extension has a mission to help people prosper in their personal and professional lives--both in urban and rural areas. We apply tax dollars from participating federal, state and county agencies to the programs we offer and the agents who deliver them. The purpose of this booklet is to equip ranchers and farmers with enough basic knowledge about wind-generated energy so they can determine if they have the right conditions to invest in and develop wind generation facilities on their property.

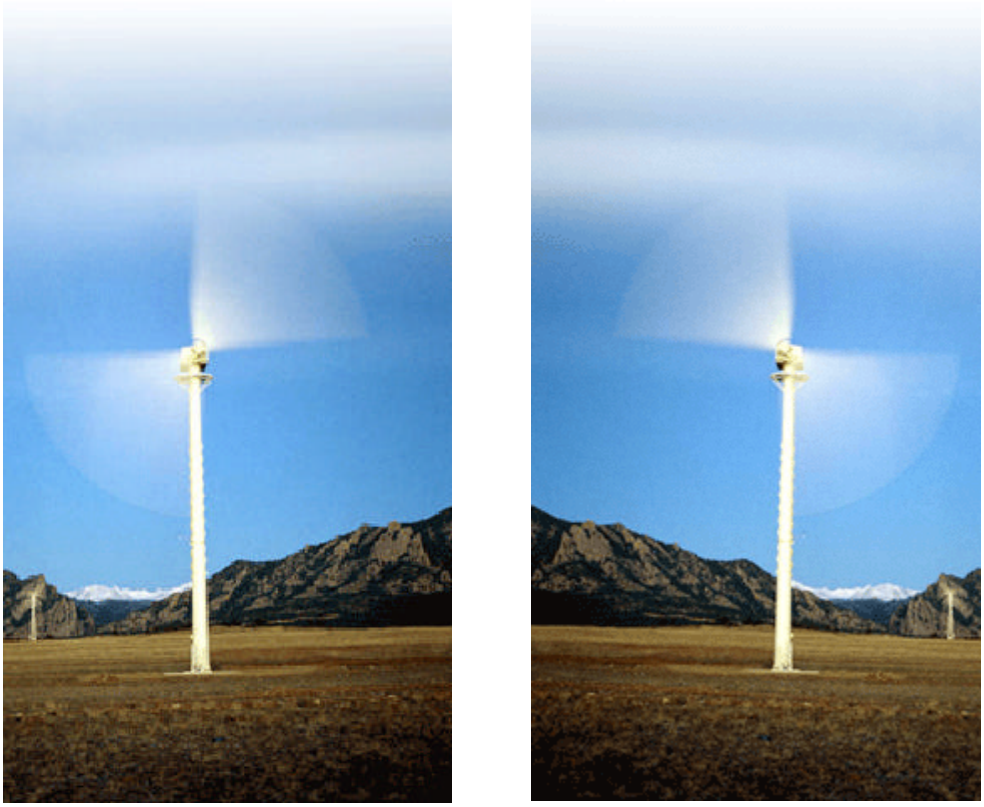
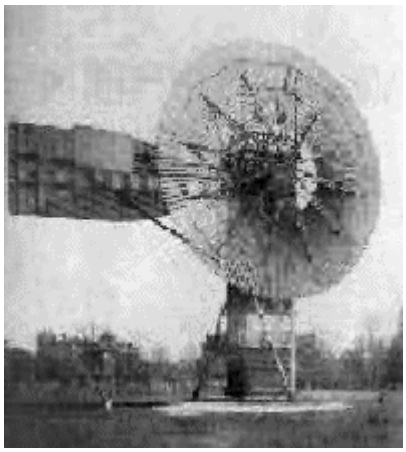


*Photo courtesy of Craig Cox*

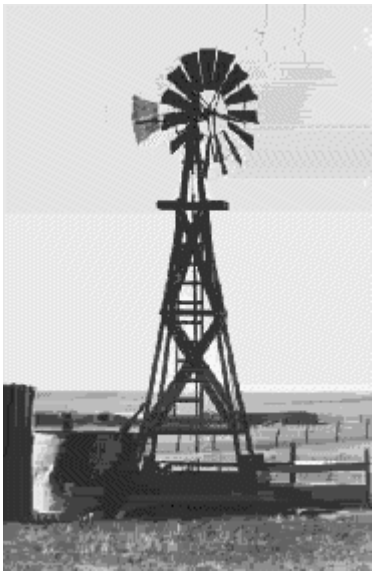
This booklet contains general information only, and should be considered an introduction and primer, not a technical guidebook or installation manual. Keep in mind, too, that your county Extension agent is not a wind expert, even though he or she may have some experience with or knowledge of it. If, after reading this booklet, you are ready to take the next step, refer to the resource pages for web links and contacts to the experts who can help you. For now, however, take a moment and learn the basics of this ancient, yet sophisticated, source of energy.

# The History and Value of Wind

Wind energy is nothing new; in fact, it's actually making a come back. Experts believe that windmills were used 4,000 years ago for grinding grain and pumping water. In the 1800's, approximately 500,000 windmills provided energy for Europe and China. In the 1930's, Americans depended on about 600,000 windmills in rural areas to provide electricity and water.



The Brush Postmill in Cleveland, Ohio, 1888.



Original windmill to generate electricity.

*Photos courtesy of Darrell Dodge*

Europeans never abandoned wind energy, with Germany as the industry leader. Wind power in Germany puts 64,000 people to work. New offshore wind development projects will soon create another 10,000 jobs. This all adds up to an economic base of $5.7 billion per year. Meanwhile, Denmark depends on wind for 20% of its electricity and wind turbines are their biggest export.

In December of 2005, the American Wind Energy Association (AWEA) announced that the U.S. wind energy industry is expected to install about 2500 megawatts (MW) of new wind power each year in the coming years. One megawatt of wind energy can typically power up to 300 homes. AWEA expects the renewed interest in wind could bring the total wind energy generated in the U.S. to more than 10,000 MW, serving 2.4 million homes. For more information on pending projects, go to:
http://www.awea.org/newsroom/wind_energy_news/

According to Craig Cox, Executive Director of the Interwest Energy Alliance, "Agriculture producers recognize renewable energy development as a way to decrease our country's dependency on foreign energy. Farmers and ranchers have been producing the world's safest food and fiber for the lowest price, and I believe they can do the same with energy."

One incentive for building more wind farms in Colorado is the passage of Amendment 37. In November of 2004, the people of Colorado gave a vote of confidence to wind and other renewable resources. The amendment requires that the state's largest electric companies gradually increase use of renewable energy sources to six percent by 2011, and ten percent by 2015. The Union of Concerned Scientists (UCS) analyzed costs and benefits of the standards as outlined in Amendment 37, and concluded that by 2025, Colorado could have:

- $236 million in savings on consumer electricity and natural gas bills
- 2,000 new jobs in manufacturing, construction, operation, maintenance and other industries, particularly in rural areas
- $70 million in additional income and $50 million increase in gross state product
- $709 million in new capital investments
- $15 million in income to rural landowners from wind power and leases
- $107 million in new property tax revenues for local communities

Because Colorado's utilities are now required to purchase energy generated from renewable sources, there are new business opportunities in wind farms. Ranchers and farmers who invest in and build their own farms can possibly sell the energy to utilities if they are close enough to the grid. Or, they can lease their land to investors who absorb the cost of constructing the farm, and who pay a royalty to the landowners.

A watt is an absolute unit of power
1000 watts = kilowatt (kW)
Megawatt = 1 million watts, or 1000 kW
How many kilowatts translate into electricity?

A Kilowatt hour is the unit of work or energy equal to that expended by one kW in on hour.

Even before passing Amendment 37, the business of wind was up and running in northeastern Colorado. In 1998, Public Service Company of Colorado, through its Windsource program, gave consumers the choice of purchasing wind energy that was locally generated on a facility in Ponnequin. It works this way: Consumers purchase energy from their homes in "blocks" which consist of 100 kilowatt-hours of electricity. This costs about $2.50 more than the electricity from traditional sources. On average, one U.S. household uses about 600 kilowatt-hours of electricity per month.

Buying one block of power from these green energy programs each month for a year reportedly has the same environmental benefits as not driving a car 2,400 miles or planting a half-acre of trees.

*Photo courtesy of Alternativeenergyblog.com*

According to AWEA, "In 2005, the U.S. enjoyed its most productive year for wind energy development in history, adding more than 2,400 megawatts of wind energy production to the nation's power grid--enough to serve the equivalent of more than 650,000 homes. It's predicted that 2006 will top that record.

## Why Wind?

There are lots of good reasons why it's wise to invest in and develop wind energy.

**Wind is Good for the Economy:** Wind energy can boost the income of Colorado farmers and ranchers with value-added opportunities, and by diversifying where and how energy is harvested. Rural communities can also benefit from wind operations by:

- Creating many jobs during the construction process and approximately one permanent job for every 10 MW of installed capacity.
- Increasing the local tax base from wind farms.

- Keeping the money that pays for energy within the state, which in turn gets reinvested in the state.
- Attracting wind-industry businesses into the state.
- Leasing their land to utilities while still using at least 95% of the land for its original purpose of ranching and farming.
- Enabling producers access to tradable tax credits and bonding capabilities.

**Wind Moves America toward Energy Independence:** These days, everyone realizes the importance of releasing our dependence on foreign oil and how vulnerable we are to increasing prices. By developing local sources of energy, we also keep our financial investments closer to home. Imagine being able to read by a light or be warmed by heat from a resource right outside your door. Energy independence keeps the power source safe and local.

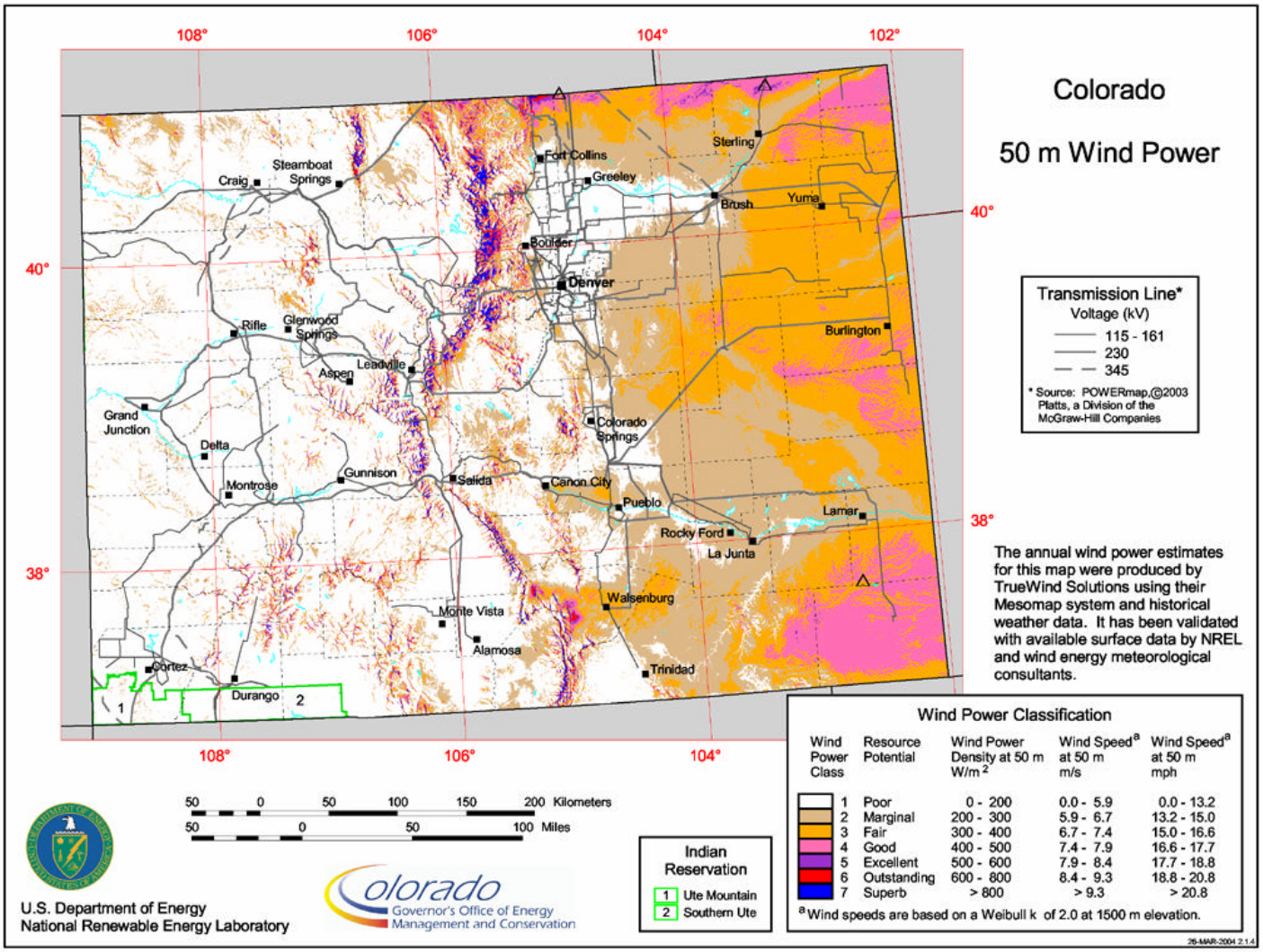
**Wind is Renewable and Sustainable:** Unlike fossil fuels, there is an infinite supply of wind, and it cannot be depleted. Wind is created by a dynamic between the sun's heat and the earth's surface. No matter how much electricity is pulled from wind, it is constantly replenished. Using wind for energy is an intelligent use of resources.

**Wind is Clean:** More than 90% of Colorado's energy is pulled from fossil fuels. Although oil, natural gas, and coal have been affordable and convenient for decades, there is an environmental cost to using them. Air pollution, acid rain, and global warming have prompted us to find cleaner sources of energy. Wind technology is non-polluting and quiet.

*Photo courtesy of NREL*

**Colorado is a good place for wind energy**: According to the National Renewable Energy Laboratory (NREL) in Golden, the state of Colorado alone has enough wind energy to supply nine percent of the electricity consumption for the lower 48 states. That translates into 481 billion kilowatt hours per year of electricity. The average house uses about 600 kilowatt hours per month, suggesting that Colorado's wind could power nearly 67 million homes per year if fully harnessed. In fact, Colorado ranks as the 11th best place in the nation to generate energy from wind.

The map below illustrates wind activity in Colorado. This is a basic reference—but not necessarily a definitive one—that can identify some areas where wind speeds might be conducive for producing energy. Don't rely on this map alone, however, because new information is constantly emerging and it may not include other sites that could generate promising results.



In his State of the Union address in 2006, President Bush declared "Here we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world. Tonight, I announce the Advanced Energy Initiative -- a 22 percent increase in clean energy research at the Department of Energy, to push for breakthroughs in two vital areas: to change how we power our homes and offices, we will invest more in zero-emission, coal-fired plants; revolutionary solar and wind technologies; and clean, safe nuclear energy."

The following month, President Bush visited NREL in Golden and declared that wind energy alone has the potential to supply up to 20% of our nation's electricity.

Wind is one of several sustainable and renewable energy resources that can help us kick our oil habit. Colorado is in the running for being one of the nation's leading suppliers of this valuable and efficient energy source.

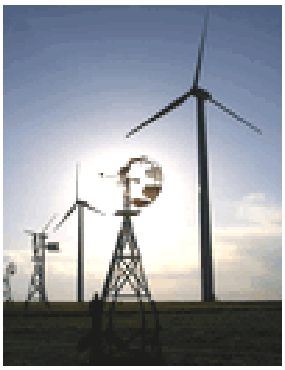


*Photo Courtesy of NREL*

## The Business of Wind for Home… or Sale

Some people install a single, small wind turbine and use the electricity strictly for their own residential or agricultural purposes. Other people, with enough land and incentive, opt for a large turbine, or network of them, that produces energy to sell to local utilities. For example, Paul Neppel, an Iowa farmer with a traditional livestock operation, installed a single 1.5 megawatt wind turbine on his farm. With winds blowing on the average of 17.7 miles per hour, this entrepreneurial farmer sells wind to the local utility for 3.15 cents per kilowatt hour. The power from that turbine feeds into a distribution line on the farm, and supplies power for about 560 homes. It also generates more than $157,000 per year—and some Iowa energy tax credits. Clearly, when the environmental fit is good and utilities are willing to buy, wind energy is a value-added option that's good for increasing profits while still maintaining the lifestyles producers love.

There are dozens of farmers, like Paul in Iowa, who own their own commercial-scale wind turbines who would probably be happy to tell you how they found success. You can start by contacting Paul, who loves to share his successes, and who is available to answer questions about how he went from livestock rancher to wind farmer. Contact him at panep@rconnect.com.

Larger wind farms generate electricity for delivery to consumers, many of whom live significant distances from the wind farms. Because of this, it's necessary to be close to transmission lines that can transport it to substations that, in turn, send it to a main distribution center. From there, it is sold and delivered to users. This grid is referred to as "farm to market."

The biggest wind farm in Colorado, and one of the largest in the nation, is located on a cattle ranch in the southeastern part of the state. Here's how it came to pass.

In the mid 1990's, Governor Roy Romer decided it was time to investigate how Colorado's wind could power the state. He sent representatives to a ranch near Lamar belonging to Helen and Bob Emick. After discussing how the constant winds on the Emick ranch might generate some energy—and extra income—the Emicks allowed wind-measuring devices, or anemometers, to be installed strategically throughout their property, after which the wind speeds were measured for two years.

*Colorado Green Wind Project in Lamar*
*Photo Courtesy of NREL*

The results of the tests were promising and inspired the-now-famous Enron to negotiate with the Emicks about installing their own brand of anemometers on the land for another several years. After Enron closed its doors, General Electric (GE) bought the assets of Enron Wind and took over the Lamar project. Finally, after a total of seven years of testing, they decided the Emick's ranch was a perfect place to invest in a wind farm.

*Wind Measuring Anemometer*
*Photo Courtesy of NREL*

By 2003, 98 turbines were installed on the Emick's land, with an additional ten turbines on two neighboring properties. These 108 1.5 MW windmills were the largest turbines assembled in the US. They are expected to generate 162 MW of energy annually, enough electricity to serve 52,000 average American homes. The power is delivered through a 15-year purchase agreement with Xcel Energy (aka Public Service Company of Colorado). Although wind isn't the utility's only source of electricity, Xcel has touted its low-cost and long-term price stability.

Referred to as the *Colorado Green Project*, and now owned by Shell WindEnergy, Inc. and PPM Energy, the wind farm spreads across 11,000 of the 20,000 family acres dedicated to the Emick's cattle ranch. Less than 2% of the land is occupied by the wind-related equipment, leaving most of the land available for its original uses.

Helen Emick reports that forty acres are required to raise one animal, whereas the 98 turbines on her land occupy far less space and create far more income. She likes the fact that the wind farm generates more income per acre than the cattle. Still, the ranch life belongs to the Emicks, and they can continue living out the lifestyle they love. The cattle, says Helen, like the turbines, too, since they provide much desired shade for the animals.

*Photo Courtesy of NREL*

The personal benefits to Helen and her family have been overwhelmingly positive. "Between what we get for leasing our land, along with the royalties we receive, it has helped our family tremendously. Even if the wind doesn't blow, we get a royalty. It's like having an oil well on the land."

There's an aesthetic advantage as well. Helen considers the windmills beautiful and graceful, and she loves watching them outside her window. Plus, there is no environmental downside. Helen reports that environmental studies were part of the seven years of research conducted prior to erecting the towers.

"The wind farm has been beneficial not only to us," reports Helen Emick, "but to the entire county. We had a slew of bad drought years, and our economy was hit hard. The wind changed that by generating about $1 million per year in taxes for the county. Plus, a single tower produces enough electricity for the entire town of Springfield, located nearby." During the six months it took to construct

the farm, nearly 600 short-term jobs were created, with 14 permanent jobs created in this rural community.

Such glowing reports from someone in-the-know might motivate you to call a construction crew today. But Helen cautions that even with all the benefits to her family and community, it's rarely as easy to start a wind farm as it was for them.

"We didn't do anything. They found us. That's how it works. If you have enough wind, if you're close to the power lines, and if all the conditions are right, they'll find you."

Some of the Emick's entrepreneurial neighbors learned that the hard way. About five farmers and 21 investors banded together to finance and develop their own wind farm after witnessing the success next door. They researched it, hired consultants, and invested time and resources into creating a wind farm with profits that they could all share. They secured the critical relationship with Xcel Energy, who was willing to buy the power they generated. But the ranchers hit an unexpected wall upon finding out that there were no wind turbines currently available. Apparently, the demand for turbines had grown to the point that receiving the hardware became a problem. Consequently, Xcel took its business elsewhere, leaving the investors in a double bind.

Industry experts believe this problem is a reflection of inconsistent federal wind energy policies, specifically the fact that federal tax credits expire and are renewed every few years. Consequently, there's a boom and bust cycle for the demand of turbines that impacts production levels. Once long-term federal policies stabilize and tax credits become consistent, wind turbines will likely be available to the market without extended delays.

As time goes on, hopefully these pioneering ranchers will succeed. But Helen Emick is steadfast when she advises her fellow ranchers that being proactive doesn't always pay off.

Even so, a February, 2006 news release from the Global Wind Energy Council reported that the wind energy sector experienced a record year in 2005 with the installation of 11,769 megawatts (MW), representing a 43.4% increase in annual additions to the global market. This is up from 8,207 MW in the previous year. The total value of new generating equipment installed was over $14 billion. The total installed wind power capacity now stands at 59,322 MW worldwide, an increase of 25% compared to 2004.

Many private and corporate investors are generally not interested in small-scale projects, although there are some, such as John Deere, who do focus on community-based small projects. Most investors are larger corporations looking for robust returns on their investments.

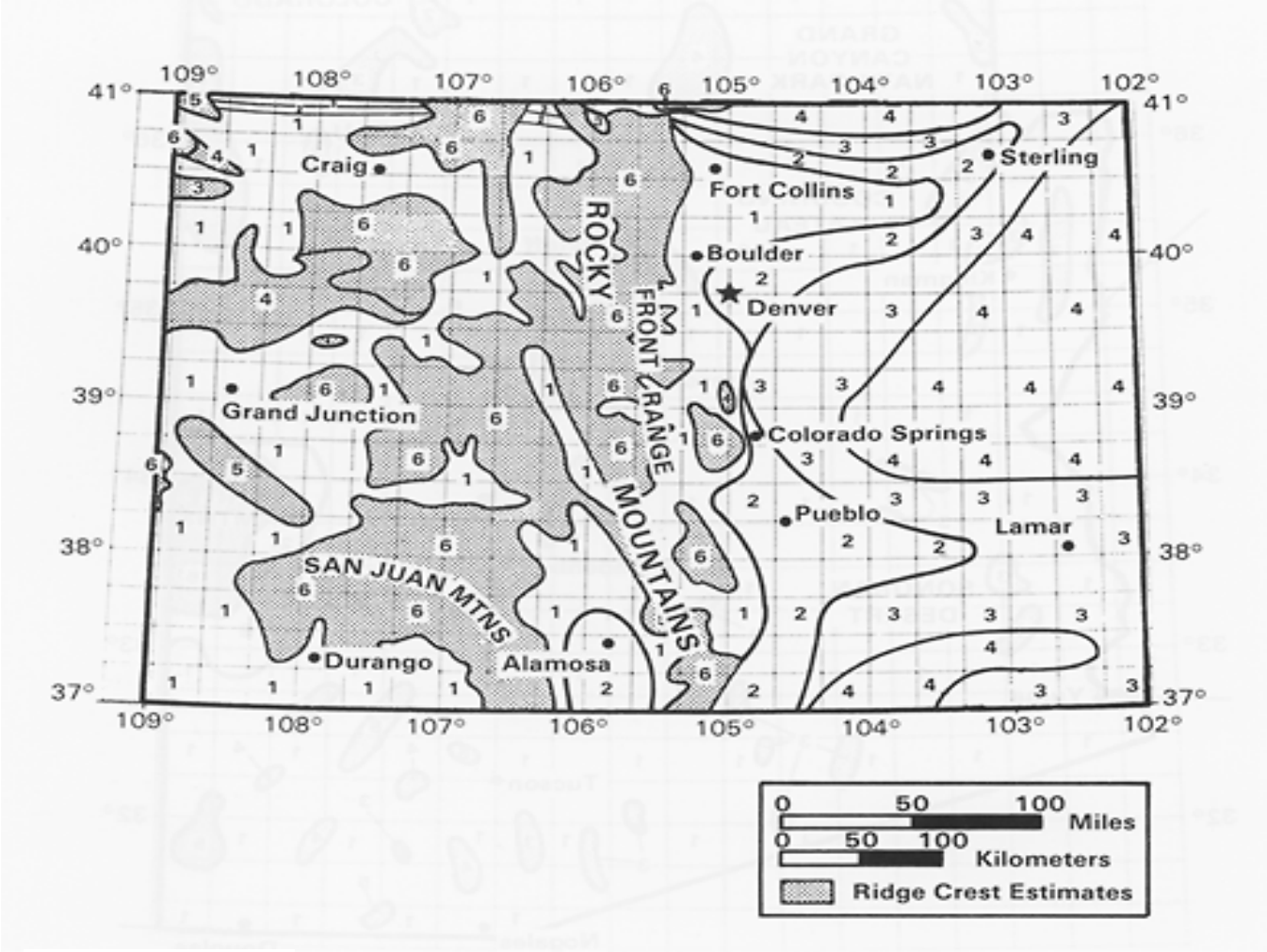
If they believe a property is a promising site for a large facility, they may approach you for a land lease agreement.

Typical land lease agreements pay at least $3,000 annually per turbine. Details of the agreement is negotiated on a case-by-case basis, and you should certainly get legal and financial guidance during the process.

For farmers and ranchers with a willing spirit, a good deal of patience, the right environmental conditions, and a binding contract with a paying utility, the wind industry could mean a lucrative future. To find out about all completed and proposed wind projects in Colorado, go to: http://www.awea.org/projects/colorado.html.

## The Conditions for Wind: Are You Well Suited?

The first step in determining whether investing in wind energy will work for you is to discern if your environmental conditions are suitable. Eastern Colorado is the most likely region in the state to generate consistent wind energy, but there are pockets of wind energy resources throughout the state that could also work.




*Provided by NREL*

The map on page 11 (which complements the map on page 6) is a broad reference for possible wind-energy sites, but if you're serious about investigating the potential on your property, you'll need to look beyond the information here. Even so, it's a good place to start.

The numbers on the map represent wind speeds, with Class 1 being the lowest and Class 7 being the highest. Areas rated as Class 4 or higher are most conducive for large wind turbines. Class 3 areas may have higher wind speeds, but they may not have other appropriate conditions. As technology improves, however, more Class 3 areas could be a good match for utility-scale projects.

Winds averaging 17 miles per hour are the most economically-viable sites for generating electricity. Still, winds as low as 12 miles per hour have also produced affordable energy.

Like the Emicks, it's important to get a technical reading of the wind speeds on your property. The Governor's Office of Energy Management and Conservation (OEMC) is dedicated to helping the people of Colorado learn about and explore renewable options. As such, they have created the Anemometer Loan Program.

Anemometers are wind-measuring devices that are installed on a prospective landowner's property. There are twelve anemometers available for loan on an annual basis. The average test time for the anemometers is about one year. The readings indicate whether a site is suited for turbines. Those who participate in the OEMC's anemometer program are provided with:

- Anemometer
- 20 meter tower (NRG Tall 20 meter tower kit)
- Data logger
- Guidance on tower and equipment installation at the site
- Assistance with data interpretation during period of site monitoring

The OEMC has devised the following steps that outline the expectations of the landowner and OEMC's responsibilities to the landowner for participation in the Anemometer Loan Program:

1. Lease agreement is signed by the Landowner and OEMC.
2. OEMC meets with Landowner to explain the detailed process of the installation.
3. Landowner arranges to pick up four anchors from OEMC at least 10 working days prior to the installation of the anemometer tower or pay for shipment of the anchors to landowner.

4. Landowner completes installation of anchors prior to day slated for tower installation. Installation instructions supplied by OEMC.
5. OEMC provides on-site guidance to Landowner at the time of installation and the time of dismantling anemometer tower. On install and dismantle day, the Landowner must provide five physically able individuals to assist in raising the anemometer tower. Also, the Landowner must supply a vehicle with a trailer hitch or similar apparatus.
6. OEMC delivers the anemometer, tower and equipment on or before installation day.
7. Installation and dismantling of the tower typically takes five hours and, weather permitting, are conducted during morning hours.
8. OEMC provides a data logger, sensors and data interpretation devices. The Landowner has the responsibility to replace data plugs and batteries and to send data plugs, at specifically stated intervals to OEMC for interpretation.
9. Data is collected and summarized for a period of one year.
10. All collected data and technical summary reports are accessible on OEMC's website and available to the public.
11. Data summary is provided to the Landowner at end of monitoring year in both hard copy and CD, including wind direction averages and wind patterns for landowner's site.

Once the test results are in, the OEMC provides free summaries based on raw data collected from the site. To read sample results of wind tests as measured by the anemometers, go to: www.undeerc.org/wind/winddb/COwindsites.asp or www.undeerc.org/wind/states/CO.asp

## The Nuts and Bolts of Building a Wind Farm

If the results of your wind tests are promising, it's time to study the geographical, climatic, and business conditions to determine whether a tower or wind farm will be viable. Hire one or more professional consultants to help you evaluate:

- Weather conditions and the possibility of wind shear, or snow and ice conditions that can disrupt the function of the windmill
- Proximity to grid
- The best long-term business agreement with an interested utility

- Available personal investments
- Partnerships or venture capitalist investments
- In-kind services, as needed, during the onsite loan period
- Possible environmental hazards such as flight paths of birds
- Number of towers being considered and the return on investment (ROI) per tower
- Height of turbine in relation to the land where it's placed
- Appropriate hardware and maintenance agreements

The American Wind Energy Association (AWEA) has the following suggestions that relate to the list above:

### Determine Proximity to Existing Transmission Lines

To keep costs down, try to minimize the amount of transmission infrastructure that has to be installed. High voltage lines can cost thousands of dollars per mile. Whenever possible, availability and access to existing lines should be considered in selecting a site.

### Secure Access to Land

If the towers will extend into neighboring properties, both private and public landowners will expect to be compensated for development that occurs on their land. Royalty or lease agreements need to be discussed with all parties involved. Roads, transmission equipment, maintenance infrastructure, turbines, and more need to be considered. Don't forget that the construction of a wind farm necessitates the use of heavy industrial equipment. Developers will need to invest in roads capable of accommodating significant weight. To do so will require the cooperation of landowners and, in some cases, the local community. Be prepared to answer tough questions.

## Establish Access to Capital

Building a wind farm is not cheap. On average, wind power development costs around $1.25 million per megawatt (MW) of generating capacity installed. You may be looking at just one tower like the farmer in Iowa mentioned before. The total cost of installing his turbine was $1,654,910. He received a $402,500 grant from the USDA rural development program, and he secured a $250,000 interest-free loan from the state of Iowa.

Wind power facilities with multiple turbines can take advantage of economies of scale, especially facilities that are 20 MW or larger. Assuming the average wind turbine is rated at 2,000 kilowatts (kW) in capacity, this means an installation of ten turbines and an initial investment of $20 million dollars.

## Identify Reliable Power Purchaser or Market

To date, wind energy is the most cost competitive renewable energy option on the market. In fact, wind energy's cost has declined so much that it rivals many traditional power generation technologies. Utilities tend to purchase power from what they consider the cheapest and most reliable technology. Customarily, that's been natural gas, but that doesn't mean there isn't a market for wind. Demand for "green power" (electricity from clean sources, such as wind, that is sold to customers at a premium price) and environmental concerns are increasing the number of buyers for wind energy at competitive rates. Before investing thousands of dollars into wind resource assessments, permitting, and pre-construction activities, you'll need to secure tentative commitments from one or more buyers for the wind plants output that range over 20 to 30 years of its operational lifetime. Again, a consultant and developer can guide you so the arrangements you make are legal and fair.

## Address Site and Project Feasibility Considerations

The fact that a site is windy does not mean it is suitable for wind power development. A developer needs to consider many factors in securing a project site. Is there high raptor activity in the area? Are there endangered or protected species that could be jeopardized by the presence of the facility? Is the site's geology suitable and appropriate for industrial development? Will noise and aesthetics be issues for the local community? Will the turbines obstruct the flight path of local air traffic? There are quite a few environmental and social issues that must be addressed in choosing the site of a wind power facility. Wind farms can make great neighbors, but it is the obligation of the developer to ensure that a project proceeds in a fashion that is acceptable to regulators and the local community.

## Understand Wind Energy's Economics

Many factors contribute to the cost and productivity of a wind plant. For instance, the power a wind turbine can generate is a function of the cube of the average wind speed at its site, which means that small differences in wind speed mean large differences in productivity and electricity cost. There are subtle dynamics at play as well. For instance the swept area of a turbine rotor is a function of the square of the blade length (the radius of the rotor's swept area). A modest increase in blade length boosts energy capture and cost-effectiveness. Talking with one or several consultants about the most effective turbine for your property is essential.

Financing methods can make a major difference in project economics as well. Securing significant investment capital or joint ownership of a project can cut your costs significantly. Ask your consultant or the OEMC about federal and state incentives for which your project may qualify. You may be eligible for grant monies, low-interest loans, tax incentives or other financial supports that could reduce costs and encourage more favorable investment. For example, most commercial wind projects rely on the federal production tax credit; the $0.019/kWh incentive can provide as much as a third of a project's revenue.

*Photo courtesy of NREL*

## Obtain Zoning and Permitting Expertise

Weeding through permitting and other legal issues requires the services of a professional familiar with the regulatory environment surrounding wind power development. Legal counsel familiar with the local political climate may be able to help navigate the process.

## Establish Dialogue with Turbine Manufacturers and Project Developers

Every wind turbine is different despite seemingly similar power ratings. Some machines are designed to operate more efficiently at lower wind speeds while others are intended for more robust wind regimes. Investigate the options and compare the performance of existing machines. A listing of utility-scale wind turbine manufacturers can be found at http://www.windustry.org/resources/companies_hfw_manufacturers.htm.

### Secure Agreement to Meet O&M Needs

Wind turbine technology has made great strides in the recent years. Today's machines are more efficient and cost-effective than ever—but they are also more complex. Turbine availability is a major factor in the success of your project, and the consultants you hire to help navigate the right hardware and services available to you are vital to your bottom line. AWEA offers other valuable information that can be found at: http://www.awea.org.

## Business and Financing

There are a wide variety of business arrangements that can structure a viable wind operation and ensure that you get a good ROI. It's very important to consult legal advice and technical professionals who can guide you about what venture capitalists or corporate investors require to work with you. Prior to hiring a consultant, consider the following information provided by Windustry, a non-profit organization that supports, educates and provides technical information to rural landowners, communities, utilities, and other interested parties who want to grow a wind business (http://www.windustry.org).

***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. So you must either contract for maintenance or find yourself climbing your turbine tower now and again with a toolbox in your hand.

***Risk and Return.*** In most business ventures, 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.

*Photo courtesy of Craig Cox*

***Legal Feasibility.*** Depending on the laws of your state or county 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.

There are three basic ways to harness wind energy.

### 1. Contract with Developers

Contracting with a wind developer is the most common way of developing wind sites in the United States. 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. Many developers will sign contracts with landowners for guaranteed payments.

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. Currently, developers typically receive about 3 to 5 cents per kWh for PPAs.

Much of the wind energy produced by developers in the U.S. has been a direct result of states 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 sell rights to their wind energy.

There are three primary types of arrangements landowners and developers make regarding wind energy:

***Leasing Land.*** A developer may lease or rent your land for the life of the turbines, which is usually 20-30 years. You might be compensated with a lump sum or annually through a royalty payment for the amount of electricity produced. Basing the lease on a share of revenues can help capture future increases in the value of wind power. Landowner payments are typically about $3,000 to $5,000 per wind turbine per year- depending on location, wind resource, value of the electricity and other factors. In this arrangement, you retain ownership of your land.

Photo courtesy of Colorado State University

***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 up front. 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 factors to consider in arranging a wind easement.

***Purchasing Land.*** Developers will sometimes purchase your land outright and build their turbines. You reap a one-time profit, but once you've sold the land, you have no access to that wind resource.

### 2. Invest 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 as low cost as possible. If you can sell your wind energy yourself, perhaps with other partners but without a

developer as a middleman, you might earn greater revenue than a fixed lease payment. But you'll also assume greater risk and responsibility.

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 several options:

***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.

***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.

***Limited Liability Company.*** The characteristic factor of a limited liability company 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.

***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.

**3. 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 use, or secure financing for a larger turbine that produces enough electricity for you.

Wind turbines vary greatly in size, and the installed price is in direct proportion to 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 medium to large wind turbines is at least $1,300 per kW installed, which assumes some economies of scale for multiple turbines installed concurrently. Total installation costs for an individual large turbine may be 50% 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 information provided here by Windustry is just the tip of the iceberg. Use them as one of your most reliable resources for putting together a viable project.

As you orchestrate your financial plan, don't forget to investigate the latest status of government tax credits and incentives, and low-interest loans or grants. Available credits, incentives and grants change regularly, so you'll need to check into the most recent policies and opportunities. The good news is that there has been growing momentum from the federal (and some state) governments to support development of renewables. For example:

- The Energy Policy Act of 2005 offered $12 billion in tax breaks and incentives for renewable energy projects.
- The USDA provided more than $19 million to support renewable energy projects through grants and the development of value-added agriculture business ventures.
- In February 2006, the USDA published a notice in the Federal Register announcing the availability of $11.38 million in funding for competitive grants and $176.5 million in authority for guarantee loans in fiscal year 2006 under the Section 9006 Renewable Energy Systems and Energy Efficiency Improvements Program. For more information, go to: http://www.rurdev.usda.gov/rbs/farmbill/index.html.

To learn more about funding and tax credit opportunities through the USDA, go to: http://www.rurdev.usda.gov/rbs/farmbill/section9006rule.pdf or http://www.rurdev.usda.gov/rbs/pub/sep05/legal.htm. To read the 2006 Energy Agriculture Executive summary, go to: http://www.usda.gov/documents/Farmbill07energysum.pdf.

After evaluating your property site, the business climate, credits or incentives, and the amount of time and energy required to get into the business of wind, you decide it's not a viable option you can still support the industry of wind. Most anyone who uses electricity in Colorado has the choice of purchasing wind-generated energy from their local utility. For example, Ponnequin Wind Facility, in northeastern Colorado, provides up to 20 megawatts of power to more than 15,000 customers including more than 300 commercial customers. Xcel Energy purchases that energy, and then offers it to residents and businesses in customer blocks of 100 kilowatt-hours (kWh).

Energy purchased through their Windsource program is slightly more expensive than traditional electricity, (although it was less expensive during the winter of 2005-6 when natural gas costs skyrocketed), but users can decide for themselves how much of the energy they get is generated from wind—including 100% of it. Approximately 20 other utilities in the state offer wind-generated electricity from this program.

Corporations based in other states or countries could become big players in Colorado's wind business. One example is GE Energy which intends to invest $1.5 billion annually in green technologies, including wind and solar energy. GE Energy's 2005 wind revenues increased 300% over 2002. In 2005, GE received orders and commitments that totaled 2,400 megawatts of new wind power capacity worldwide. That adds up to 1,600 wind turbines installed worldwide including 1,100 wind turbines, or a total of 1,650 megawatts, for the United States. This represents 66% of the nearly 2,500 megawatts of new capacity installed in the U.S. in 2005.

This simply illustrates that Colorado wind has the potential to grow into an expanding global industry. It makes sense to tap into it if the fit is right.

## A Brief Look at Hardware

Wind turbines are large, but aren't the only piece of hardware necessary to stir up electricity. Turbines are made up of blades, a nacelle, a tower, wiring and electrical equipment. Sometimes batteries are employed for smaller home and farm-sized turbines. Depending on the size of the operation and whether or not you are delivering energy to the grid, you may also need equipment that connects you to transmission lines.

Small (home and farm-sized) turbines are in the under 100 kW range. Large, commercial scale turbines are usually 600 kW and up. The smaller machines typically produce on-site energy, while commercial machines are nearly always used to sell energy to a power company via the transmission grid.

Three blades are attached to a rotor, capture the wind, and then create electricity. The higher the tower, the greater the wind speed and the more power is generated. Wind power increases exponentially with height so, for example, a tower that is ten feet higher than one next to it will produce notably more energy than the smaller tower.

The blades on towers perform much like airplane propellers. The aerodynamics of the wind, the shape and size of the blade, and the air pressure on both sides of the blade cause it to spin. The energy from the spin is transported to a generator that, then, makes electricity.

*Photo courtesy of NREL*

Large wind farms rely on bigger turbines while small operations use only one or two towers. Small turbines generate 10- or 20-kilowatts

and may only have three or four moving parts, require little maintenance, and are built to last up to 40 years.

Utility-scale wind turbines can kick out from 750 kilowatts to 2.5 megawatts (larger turbines are about to be introduced into the market), and can stand up to 260 feet tall. Blades can extend from 80 to 140 feet long and weigh between 8,000 and 10,000 pounds. Most turbines are categorized as *horizontal axis turbines.* There are new technologies being introduced to the market everyday that employ different designs. Professional consultants can advise you of the equipment that's best for you.

For more information on technical hardware issues, go to: http://www.windpower.org/en/tour.htm and http://www.windustry.org/basics/04-knowwind.htm.

## Environmental Considerations

One of the great arguments for growing the wind energy is that it is clean. Unlike fossil fuels, wind is renewable and sustainable. It doesn't contribute to greenhouse gas emissions. Relatively speaking, wind is clearly a wise choice.


*Photo: Altamont Pass*

Even so, there has been concern about disrupting flight paths for some birds. In the 1980's, a number of dead birds near the Altamont Pass Wind Farm near San Francisco prompted research on how wind turbines might be contributing to those deaths and how these bird deaths could be avoided.

More than 20 years later and referring to data gathered from dozens of studies, we now know that the bird deaths at Altamont Pass were the result of myriad localized factors specific to that one area. Some had to do with the site of the towers; others had to do with the technology used in those pioneering days of wind energy. Indeed, the number of bird deaths attributed to wind towers with today's technology—and strategically placed out of bird flight paths—is now considered very low.

The National Wind Coordinating Committee (NWCC) reports that: "Based on current estimates, wind plant related avian collision fatalities probably represent from 0.01% to 0.02% (i.e., 1 out of every 5,000 to 10,000) of the annual avian collision fatalities in the United States."

Newly engineered turbines also repel birds from perching on the towers and blades. Furthermore, part of site selection depends on bird flight paths promising that bird mortality will not to be a problem. For more information, go to: http://www.awea.org/faq/sagrillo/swbirds.html#2.

Some people think the visual impact of towers is undesirable, while others are concerned about rotor noise. Again, site selection is, in part, determined by how the towers will impact neighboring views. Whether people like the towers or not is a subjective judgment, and modern wind turbines emit very little noise.

## Conclusion

Gas prices are escalating at the pump—and so are tensions with countries that have traditionally provided America with oil, the energy source we depend on most. But with the rising price of oil and other fossil fuels comes the challenge and opportunity to grow renewable energy resources.

Natural gas prices are also increasingly volatile, causing wild, unpredictable price gyrations for consumers, especially during winter months and following supply disruptions such as hurricanes and ruptured pipelines. Although wind energy cannot completely replace our need for and dependence on oil, choosing wind energy, rather than natural gas for electricity, will save us money and contribute to a new understanding of where we can turn to for some of our energy needs.

Never before have the economic and environmental conditions been so conducive for a new and promising future for renewable energy. But corporations cannot act alone. They need the crops, open spaces, wind and sun to produce the energy that can power a nation. As USDA Under Secretary of Agriculture Thomas Dorr said, "The new energy economy is going to be rural. Wind, bio-diesel, biomass and other energy sources all need space; all rely on agricultural inputs and new business models. The potential for rural business is unlimited. It's a top priority of the USDA. Ag producers now have a place at national energy table."

You're invited.

# Websites with Information about Wind Power

**Colorado Governor's Office of Energy Management and Conservation (OEMC)**

This state agency offers an anemometer loan program to help landowners measure their wind resources. The purpose of their program is to support small-scale wind development (primarily for use on-site or for community projects). They currently have seven 20-meter systems, three 30-meter systems, one 50-meter system and one that's on a communication tower. For information, visit the website at http://www.state.co.us/oemc/programs/renewable/anemometer.htm or call 303-866-2309.

**National Renewable Energy Lab (NREL)**

The most important thing you can do as a landowner regarding wind energy is to educate yourself, be knowledgeable, and stay informed. For general information on renewable energy go to: www.nrel.gov

**Interwest Energy Alliance**

The Interwest Energy Alliance is a trade association that represents the nation's leading companies in the wind energy industry, bringing them together with some of the west's leading non-governmental organizations to facilitate consensus-based approaches to new project development and transmission issues throughout the region. www.interwest.org

**Windustry**

This organization's website focuses on the economic development potential of wind energy. It provides the basics of wind energy technology and its benefits, explains how to determine if a location has potential for supplying wind energy, and examines the economic risks and benefits of operating small, distributed wind projects and large-scale wind farms. Farmers can also evaluate the economics of installing a wind turbine to provide electricity for their farm and home. www.windustry.org

**American Wind Energy Association (AWEA)**

AWEA is a national trade association that represents wind power plant developers, wind turbine manufacturers, utilities, consultants, insurers, financiers, researchers, and others involved in the wind industry. In addition, AWEA represents hundreds of wind energy advocates from around the world. www.awea.org

# Resources

**Wind Powering America (US Department of Energy)**

This government site provides general information about wind power development that will help landowners understand the process of developing a wind farm.

http://www.eere.energy.gov/windandhydro/windpoweringamerica/

**The Danish Wind Industry Association's Guided Tour**

This site is great for technical information. http://www.windpower.org/en/tour.htm

**Handbook on Renewable Energy Financing in Colorado**

http://www.colorado.gov/oemc/publications/handbook_rural_co.pdf.

**Western Resource Advocates**

Western Resource Advocates' mission is to protect and restore the land, air and water resources of the Rocky Mountain States. Our team of lawyers, scientists and economists works to promote a clean energy future for the Interior West that reduces pollution and the threat of global warming; to restore degraded river systems and to encourage urban water providers to use existing water supplies more efficiently. http://www.westernresourceadvocates.org/

**California Energy Commission**
http://www.energy.ca.gov/wind/index.html

**Canadian Wind Energy Association (CanWEA)**
http://www.canwea.ca/

**Database of State Incentives for Renewable Energy**
http://www.dsireusa.org/

**The USDA Energy and Renewable Energy Network**
http://www.eere.energy.gov/.

**National Wind Coordinating Committee**
http://www.nationalwind.org/

**WindPower Monthly** (a wind energy news magazine)
http://windpower-monthly.com/

*Photo courtesy of NREL*