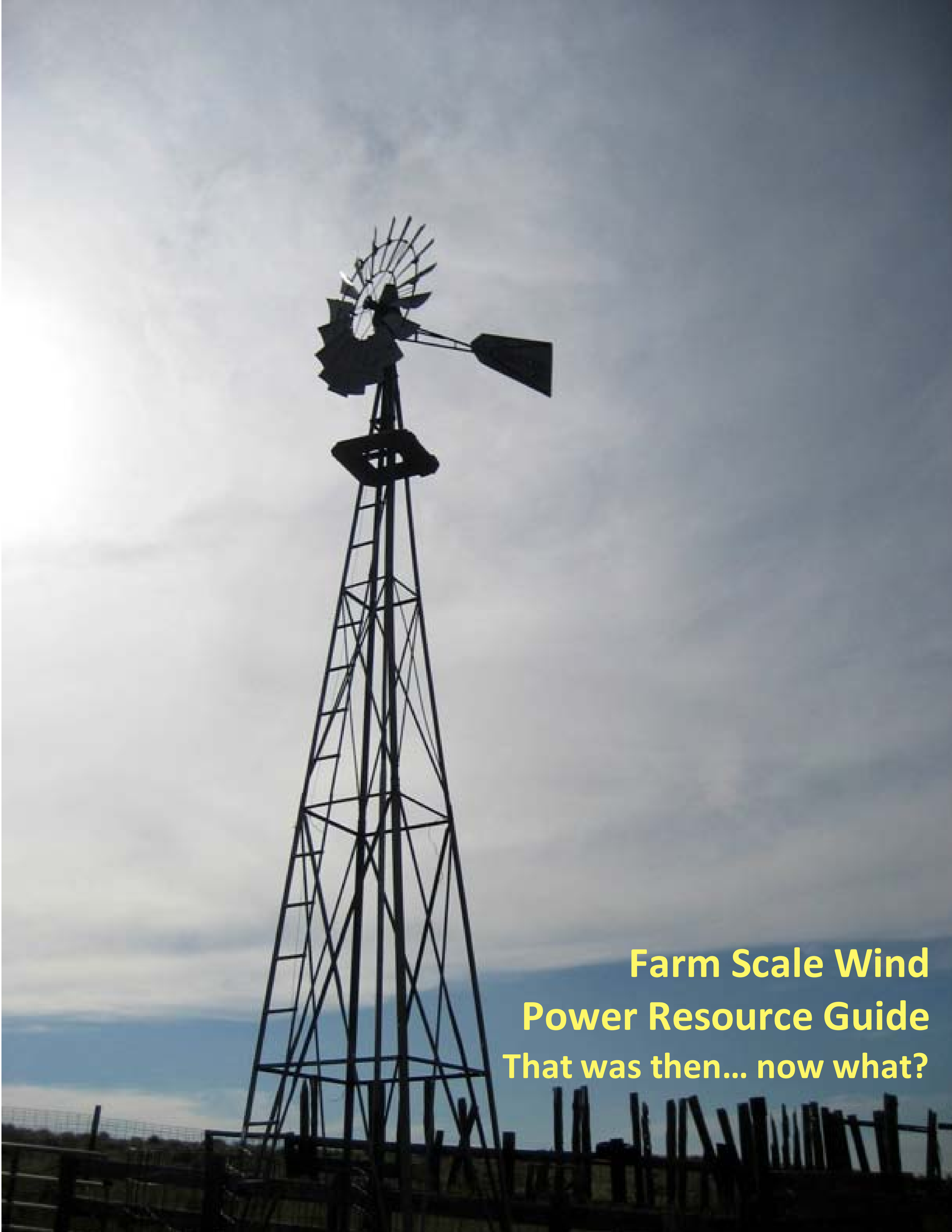


Farm Scale Wind Power Resource Guide

That was then… now what?

This guide was created through a project funded by the Colorado Department of Agriculture Value Added Development Board's Energy Grant program to Baca County. Project partners included iCAST(International Center for Appropriate & Sustainable Technology) , Baca County Conservation District, Rocky Mountain Farmers Union, the National Wind Technology Center at NREL, Southeast Colorado RC&D, USDA Natural Resources Conservation Service, Highline Electric Association, Southeast Colorado Power Association and the Building Systems Program at the University of Colorado, Boulder.

Table of Contents

Project Background

This resource guide is the result of a wind feasibility project conducted by iCAST for Baca County, CO, with funding from the Colorado Department of Agriculture Value-Added Energy Program, in collaboration with the National Wind Technology Center, Rocky Mountain Farmers Union, South East Colorado Resource Conservation & Development, Baca Conservation District, local electric cooperatives and the Building Systems Program at the University of Colorado. iCAST analyzed fifteen different agricultural applications with electricity costs ranging from $1,500/year to over $300,000/year. Using typical estimates of capital costs, O&M, inflation and interest rates, and taking into account potential grant opportunities and other incentives; iCAST concluded that wind power had positive net present value (NPV) for more than half of the fifteen applications. Simple paybacks ranged from 1 to 16 years.

Based on the results of the feasibility studies, we concluded that there are many factors that determine the viability of an investment in wind power. Particularly significant were the *wind resource* on a property and the current *cost and rate structure for electricit*y. Also, it is generally true that larger turbines will cost less than smaller turbines in $/kWh and thus the power generated from larger turbines generally costs less.

In general, it makes good economic sense to consider wind turbines when you have a class three wind resource or better matched up with a consistent load throughout the year *and* your utility allows you to sell back or earn credit for any power you don't use through net metering (running your meter backwards) or net billing (negating your use with the production from the turbine each month).

Case Study Process

The attached case studies are a summary of the feasibility studies completed as part of this project. In an attempt to find appropriate technology solutions to real problems, *i*CAST staff interacted with community members to determine their needs. After a series of meetings, a core group of participants, including producers, utility representatives, researchers, and special interest groups, joined forces to establish a process for conducting these feasibility studies. Reasonable economic assumptions were agreed upon. The next step involved talking with each producer to determine specific energy use patterns. This started with gathering data for two representative years. The data was further broken down for each hour of the average day. This information was then combined with research on the wind industry into HOMER, a renewable energy optimization program created by NREL (the National Renewable Energy Laboratory). HOMER allowed *i*CAST staff to create a scenario with a wind turbine, which was finally put into *i*CAST's financial model to create a comparison between installing a wind turbine versus simply buying energy from the grid. For more information, please contact *i*CAST at (303) 462-4100 or info@iCASTusa.org.

Economic Factors Used in Case Studies

General Rate of Inflation	3.00%

Rate of Future Energy Inflation	
Year 1-5	7.00%
Year 6-10	3.00%
Year 11-15	3.00%
Year 16-20	3.00%
Year 21-25	3.00%
Year 26-30	3.00%

Cost Money (Rate of Return)	8.00%
Grant Amount (% of capital)	25%
Finance with Loan (yes/no)	Yes
Loan Down Payment (% of principal)	10%
Loan Interest Rate	8.00%
Loan Period (years)	10

Accelerated Depreciation Schedule	
Year 1	20.00%
Year 2	32.00%
Year 3	19.20%
Year 4	11.52%
Year 5	5.76%

Income or Business Tax Rate	30%

Production Tax Credit ($/kWh)	0
Sell Back Rate ($/kWh) >25kW	0.029
Sell Back Rate ($/kWh) <25kW	0.049 - 0.055
Renewable Energy Credit ($/kWh)	0

Turbine Capacity	Price Installed
1.8kW	$12,000
10kW	$45,000
20kW	$65,000
50kW	$170,000
100kW	$330,000
250kW	$650,000
600kW	$1,500,000

Reading Case Studies

The case studies presented are summaries of micrositing reports. The first section explains the applications characteristics, including current electrical use and cost. The wind speed rating is in meters per second or "m/s". Multiplying the value by 2.24 will give a Miles per Hour wind speed.

This is followed by a wind turbine recommendation. The hub height represents the height of the turbine and is therefore indirectly the tower's height. The value is in meters and can be multiplied by 3.28 to get a height in feet. This means a 30m tower is 98.4'. The *estimated cost installed* is the total cost of the recommended turbine(s) with installation. This is not the capital cost paid by the property owner because of assumptions such as a 25% grant and a 10 year loan. The table that follows represents the energy generated by the wind turbine and used from the grid. The lower blue section of the bar chart is the energy that comes from the grid while the upper green section is the fraction that comes from wind.

If the current rate structure is not appropriate then another one available at the local utility is recommended. Because the wind is inconsistent, wind power cannot reduce peak usage, which is the cause of demand charge. It is therefore preferred to use a rate structure that does not have a demand charge.

The final section explains the economic scenario if the wind turbine was installed compared to the current scenario. *Net Present Value (NPV) of the Investment* represents the savings in terms of the present value of the money invested. A positive NPV implies a rate of return that is higher than 8% (assumed cost of money), as stated in the economic factors table. The *Simple Payback* represents the time it takes for savings to surpass capital investment.

Uncertainties

The results of the reports provided by *i*CAST are subject to change with variations in weather, power use and economic assumptions. As such, they should be treated as estimates for specific sites, not as guaranteed predictions that carry no risk of deviation. It should also be noted that policy changes could change the economic viability of a wind project. For example, removing the $25 monthly net metering charge could make smaller projects more viable.

Sample Micrositing Map

Case Study 1: Residential Load

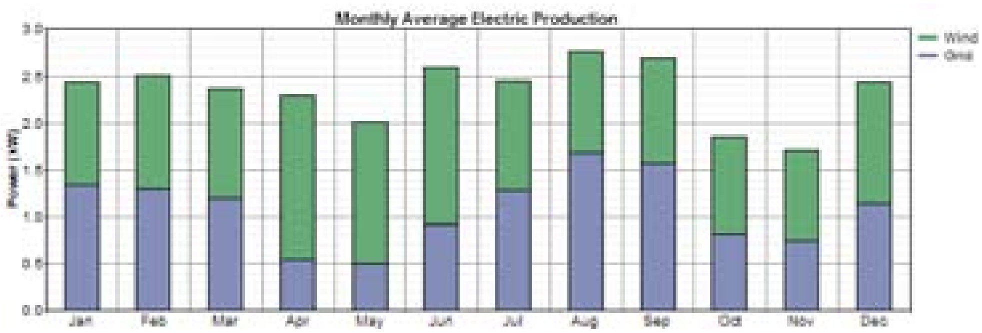
Location: Eastern Colorado
Wind Speed: 5.338m/s @10meters
Wind Class: 3 @ 10meters
Operation: Residence

Power Use for Meter: Home appliances, lights…
Average Electricity Usage/Year: 16,876 kWh
Normal Peak Electricity Demand: 9.24 kW
Average Electricity Cost/Year: $1,872

System Recommendation

Turbine recommendation: 2 x 1.8kW
Hub Height: 30meters
Total Estimated Cost Installed: $24,000

System Lifetime: 25 years
Renewable Energy Fraction: 54%



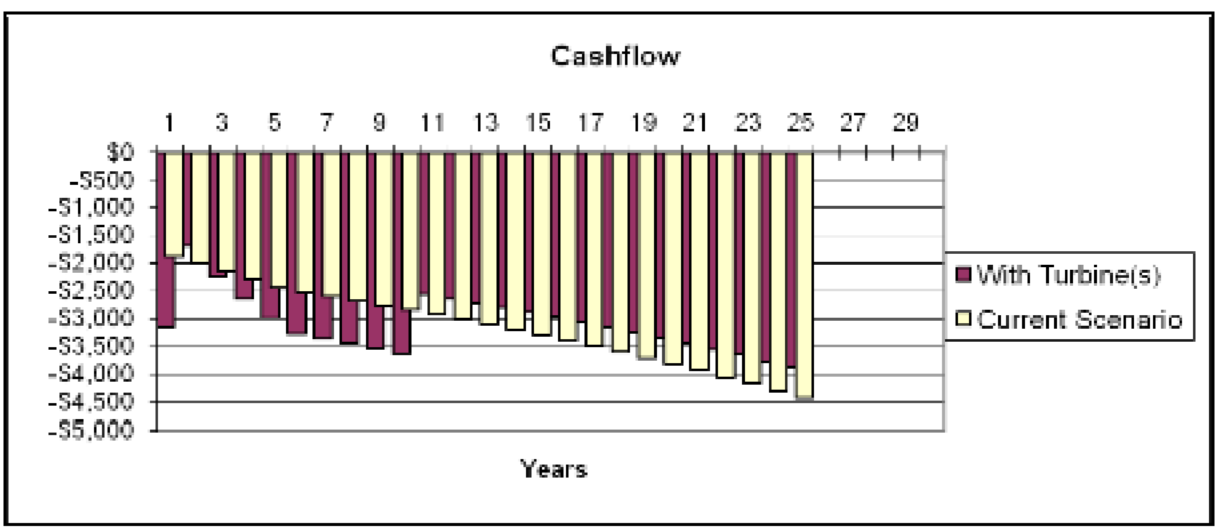
Rate Structure

First set of 1000 kWh	$0.105
Rest of kWh	$0.09
$/month access charge	$16
Demand Charge ($/kW)	$0
Monthly Net Metering Charge	$25

Cost-Benefit Analysis Summary*

Net Present Value of Investment: -$1,984
Total Savings over System Life: $13,845

Simple Payback period: 17 years



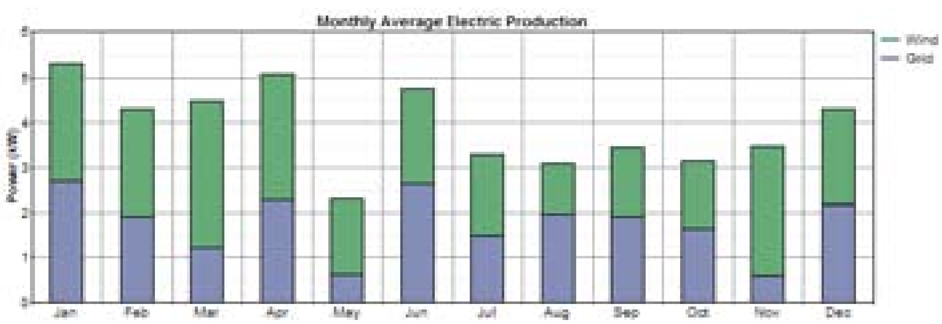
** For explanation of the various Economic Factors: See "Economic Factors used in Case Studies".*

Case Study 2: Commercial Load

Location:	Eastern Colorado	Average Electricity Usage/Year:	27,007 kWh
Wind Speed:	6.36 m/s @ 20meters	Normal Peak Electricity Demand:	18.15 kW
Wind Class:	5	Average Electricity Cost/Year:	$2,652
Operation:	Industrial farm		

System Recommendation

Turbine capacity:	10kW	System Lifetime:	25 years
Hub Height:	30meters	Renewable Energy Fraction:	55%
Estimated Cost Installed:	$45,000		

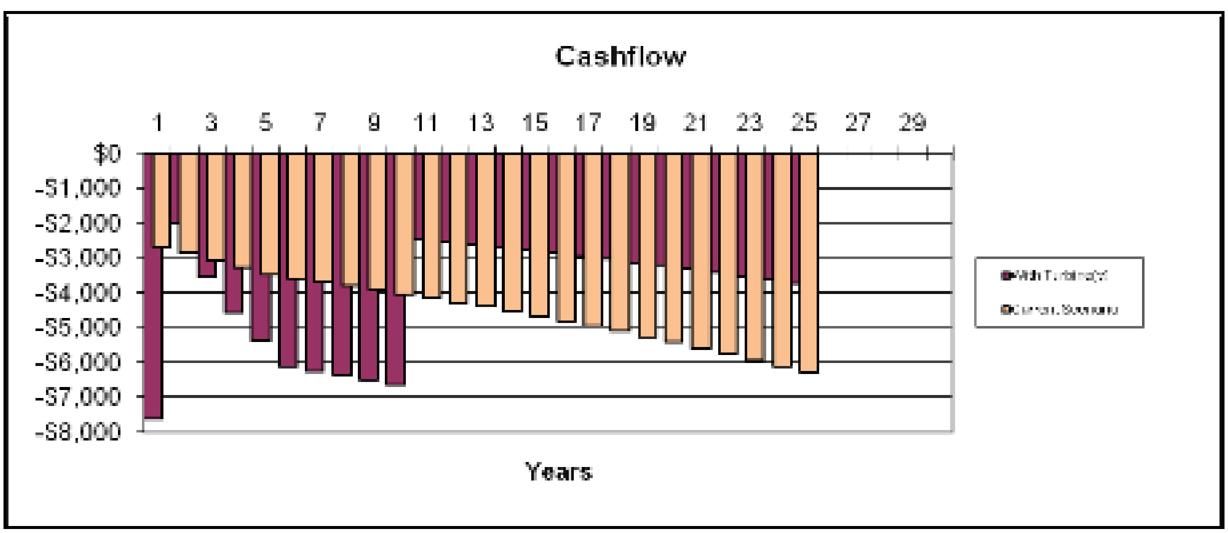


Rate Structure

First set of 1000 kWh	$0.0975	Demand Charge ($/kW)	$0
Rest of kWh	$0.078	Net Metering Charge	$25
$/month access charge	$30		

Cost-Benefit Analysis Summary*

Net Present Value of Investment:	-$5,511	Simple Payback period: 21 years
Total Savings over System Life:	$10,820	



** For explanation of the various Economic Factors: See "Economic Factors used in Case Studies".*

Case Study 3: Mill Load

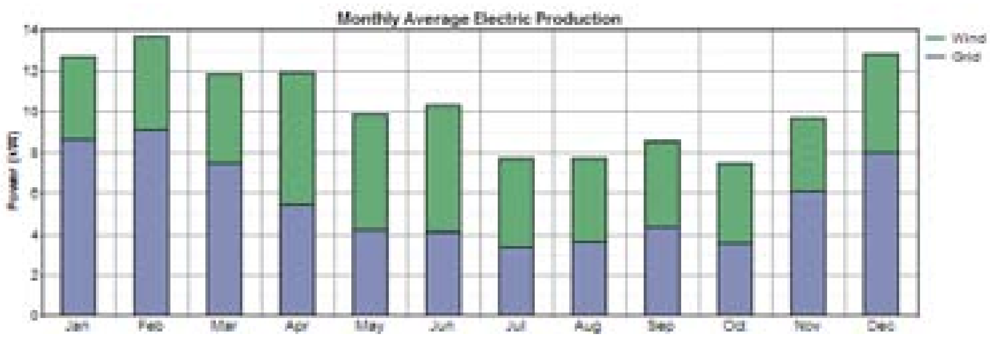
Location: Eastern Colorado
Wind Speed: 5.338m/s @ 10meters
Wind Class: 3
Power Use for Meter: Motors and Equipment

Average Electricity Usage/Year: 76,867 kWh
Normal Peak Electricity Demand: 43.5kW
Average Electricity Cost/Year: $12,259

System Recommendation

Turbine capacity: 20kW
Hub Height: 30meters
Estimated Cost Installed: $65,000

System Lifetime: 30 years
Renewable Energy Fraction: 46%



Current Scenario Rate Structure

Access Charge	$125
Demand Charge	$15/kW
Energy Charge	$.045/kWh

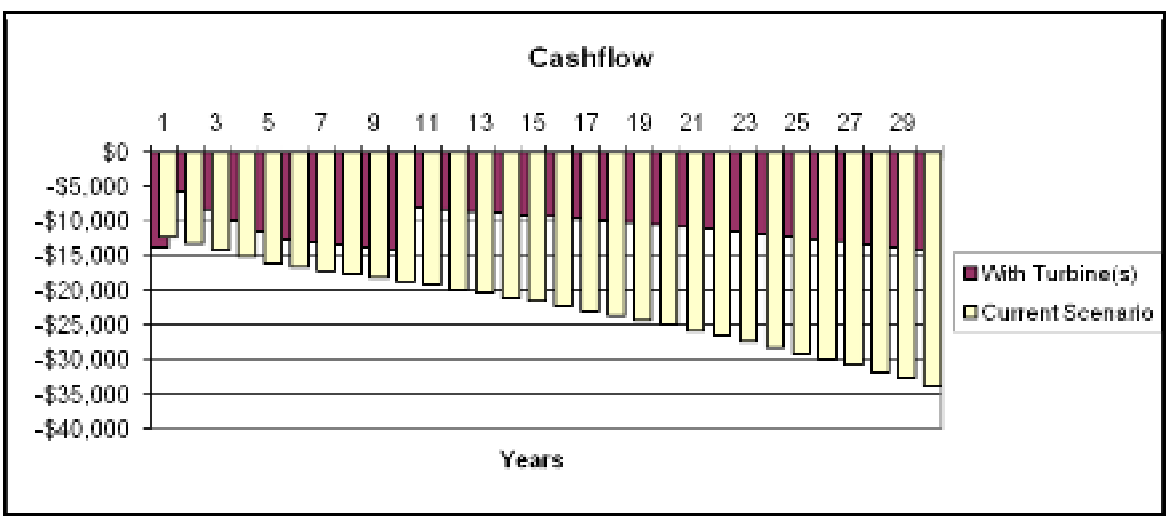
Recommended Rate Structure

First set of 1,500 kWh	$0.14
Rest of kWh	$0.11
$/month access charge	$31
Demand Charge ($/kW)	$0
Monthly Net Metering Charge	$25

Cost-Benefit Analysis Summary*

Net Present Value of Investment: $91,702
Total Savings over System Life: $343,227

Simple Payback period: 2 years



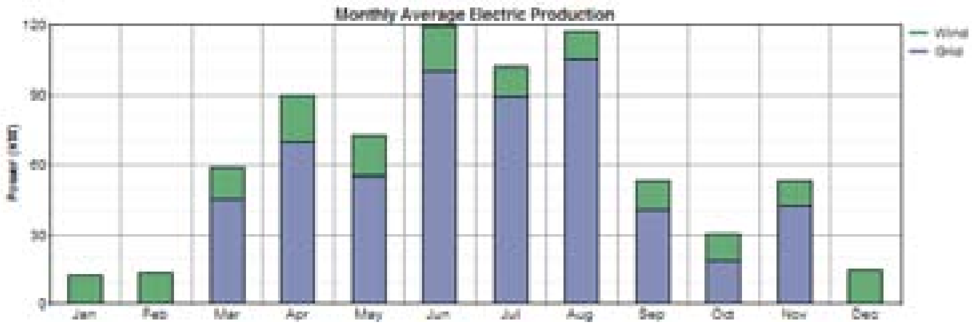
** For explanation of the various Economic Factors: See "Economic Factors used in Case Studies".*

Case Study 4: Irrigation Load

Location:	Eastern Colorado	Average Electricity Usage/Year:	479,520 kWh
Wind Speed:	5.338m/s @ 10meters	Normal Peak Electricity Demand:	134.3 kW
Wind Class:	3 @ 10meters	Average Electricity Cost/Year:	$32,169
Power Use for Meter:	235 HP Irrigation Pumps		

System Recommendation

Turbine capacity:	50kW	System Lifetime:	30 years
Hub Height:	30meters	Renewable Energy Fraction:	23%
Estimated Cost Installed:	$170,000		



Current Scenario Rate Structure

Horsepower charge/month	$1.40
Energy charge ($/kWh)	$.03

Demand Charge ($/kW)

Nov-Mar	$9.50
April-Oct	$14.00

Recommended Rate Structure

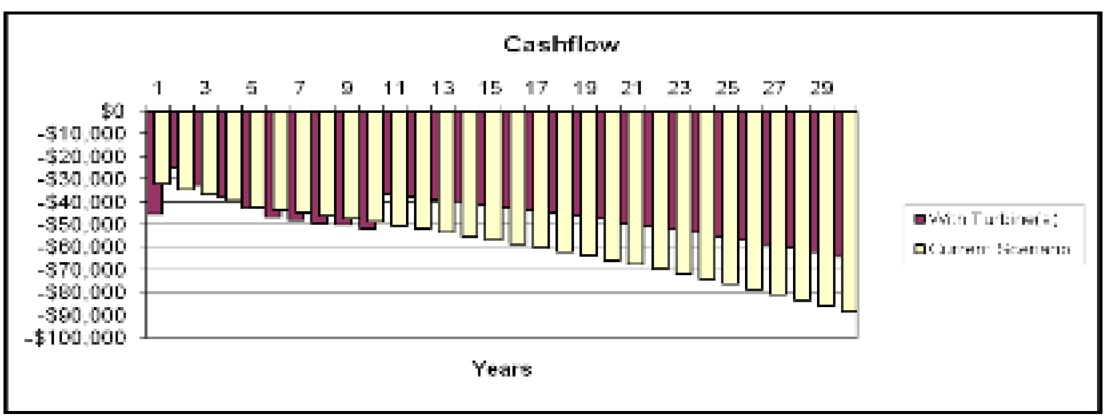
Monthly Net Metering Charge	$25
Nov-Mar	
First set of 100 kWh	$0.095
Rest of kWh	$0.055
Horsepower charge/month	$1.40
Demand Charge ($/kW)	$0

Apr-Oct	
First set of 100 kWh	$0.095
Next set of 150 kWh	$0.055
Rest of kWh	$0.050
$ per Horse Power/month access charge	$1.40
Demand Charge ($/kW)	$0

Cost-Benefit Analysis Summary*

Net Present Value of Investment: $71,694
Total Savings over System Life: $360,840

Simple Payback period: 11 years
Note: years 2,3, and 4 show savings



** For explanation of the various Economic Factors: See "Economic Factors used in Case Studies".*

Case Study 5: Continuous Industrial Load

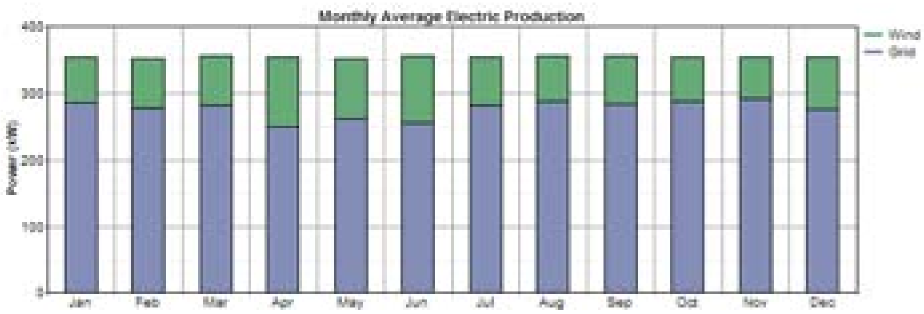
Location:	Eastern Colorado
Wind Speed:	5.338m/s @ 10meters
Wind Class:	3 @ 10meters
Power Use for Meter:	Heating and distilling corn mash for ethanol.

Average Electricity Usage/Year:	3,113,972kWh
Normal Peak Electricity Demand:	403 kW
Average Electricity Cost/Year:	$214,777

System Recommendation

Turbine capacity: 250kW
Hub Height: 75meters
Estimated Cost Installed: $675,000

System Lifetime: 30 years
Renewable Energy Fraction: 22%



Current Rate Structure

Access Charge	$125
Demand Charge ($/kW)	$15
Rate/kWh	.045

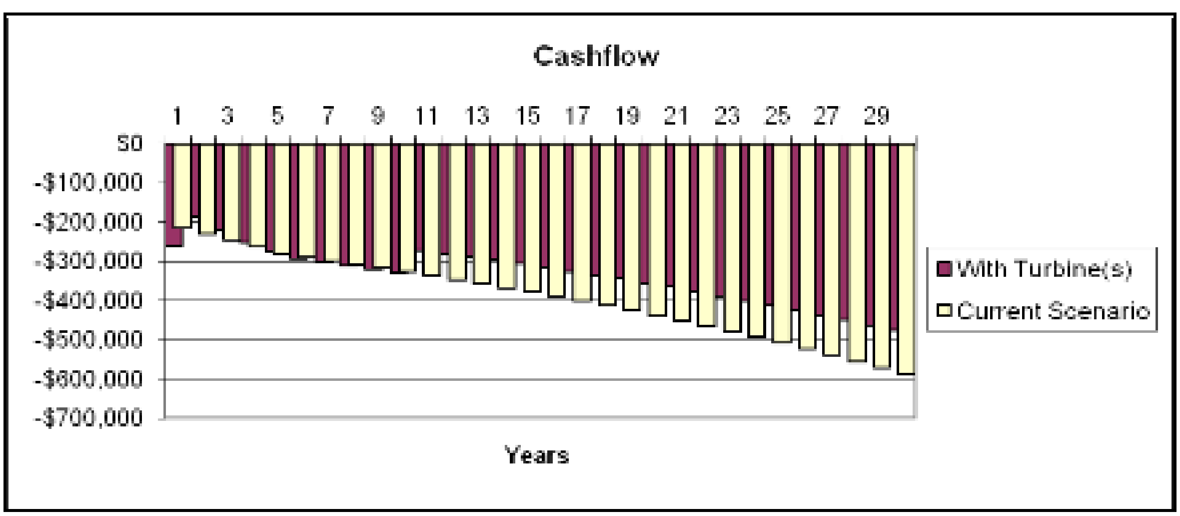
Recommended Rate Structure

First set of 1000 kWh	$0.102
Next set of 300 kWh	$0.085
Rest of kWh	$0.07
Monthly Access charge	$14+$25
Demand Charge ($/kW)	$0

Cost-Benefit Analysis Summary*

Net Present Value of Investment: $384,690
Total Savings over System Life: $1,749,177

Simple Payback period: 2 years



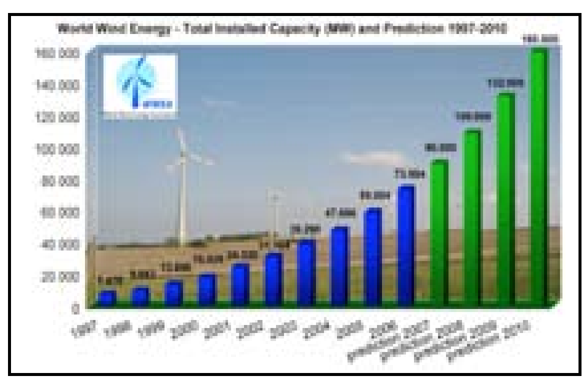
** For explanation of the various Economic Factors: See "Economic Factors used in Case Studies".*

History of Wind Power

Wind power is not new. Although it is impossible to say when the first wind machines were invented, we do know the Persians used windmills to grind grain in 200 BC. In the 14th century, the Dutch developed their signature wind turbines and used them to pump water.

The first electric wind turbine was developed in Cleveland, Ohio by Charles F Brush in 1888. But most wind machines remained used for mechanical loads. By 1930, Denmark had about 30,000 wind machines. The oil crisis of the 1970s saw the development of the California wind farms. During the same time, Denmark chose wind over nuclear after a community named Tvind built its own 1 Mega Watt (MW) turbine. In January of 2007, 36% of Denmark's electricity came from wind.

Wind power today is amongst the fastest growing industries. With turbines ranging from a few Watts to 6 MW, there is a turbine fit for every application.

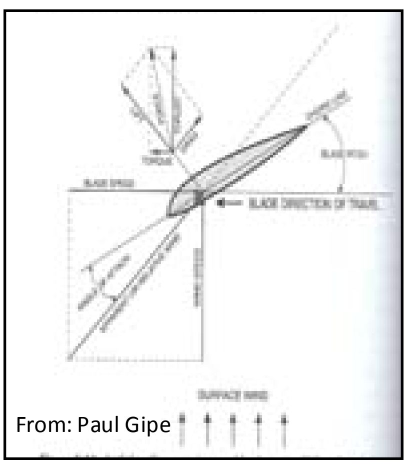


Understanding Wind Turbines

There are two types of wind turbines: vertical axis and horizontal axis. Most modern wind turbines are three-bladed horizontal axis. The blades and hub (or nose) make up the rotor and are usually connected to an asyncronous generator via a gearbox. Smaller turbines and a few large turbine manufacturers use a multipole generator, which allows them to not have an expensive gearbox.

Blades

Most blades are now made of Plexiglas. They are all propelled by lift. In modern blades, 40% of the lift goes towards useful torque. Larger turbines have a constant number of rotations per minute. In smaller turbines, the rotations per minute changes with wind speed, which will change the power output. The higher rotations per minute are also what make smaller turbines noisier. Blades that are twisted along their length will be less noisy and perform better.



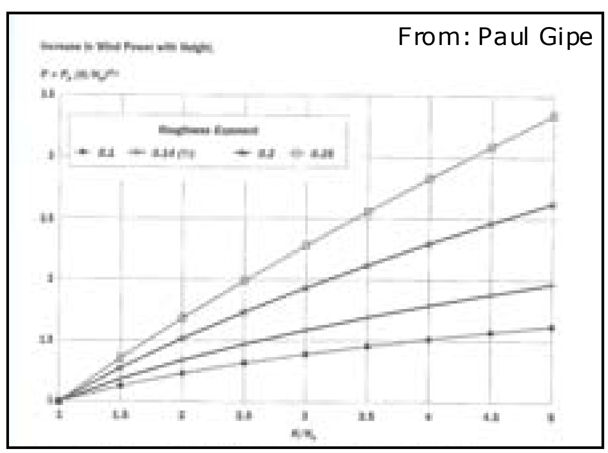
From: Paul Gipe

Towers

The other major piece of a wind turbine is the tower. The least expensive towers are supported by guy wires. However, guy wires use more land area, so some people opt for towers made from a lattice structure, or a single tube column. The tallest tower holds a Furhlander 525 feet on a lattice tower in Laasow, Germany. Typical small wind towers range from 35 to 100ft.

Photo: www.newenergy.info

Wind speed increases as one gets further away from the ground. Bushes, trees, and relief in the landscape create turbulence that slows down the wind. In general, for flat land covered with most crops, a turbine with a hub height of 30 m will produce about 20% more power than a turbine set at 20 m.



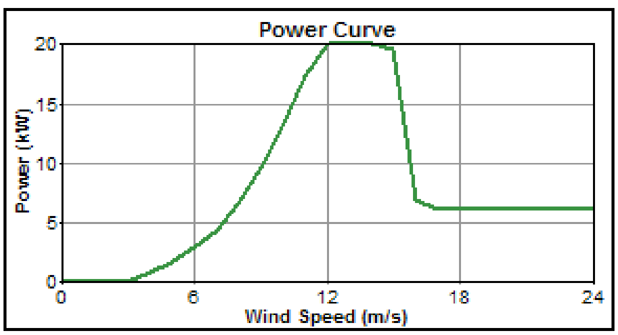
From: Paul Gipe

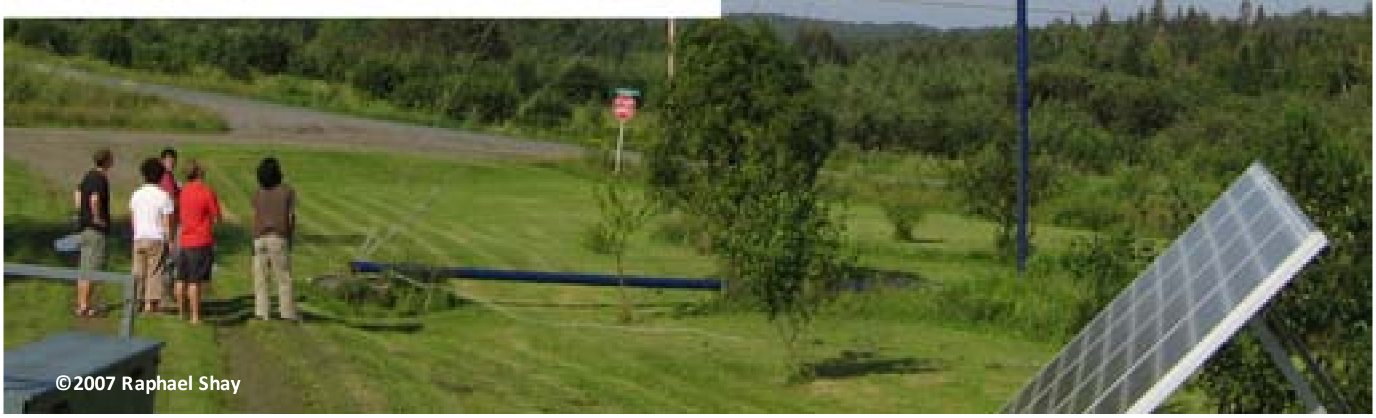
Alternating Current/Direct Current

Turbines usually create Direct Current (DC). Although some appliances can work on DC, they are usually more expensive than traditional appliances, which use Alternating Current (AC). Conventional electrical plugs are AC. A grid-connected turbine or one that will power conventional appliances needs to be equipped with an inverter. Inverters turn DC into AC and some models can connect with the grid.

Power Curve

Each type of wind turbine generates a different amount of electricity at different wind speeds. Some are better at low wind speeds, some better at high wind speeds. The power curve shows how much power can be generated at different speeds.



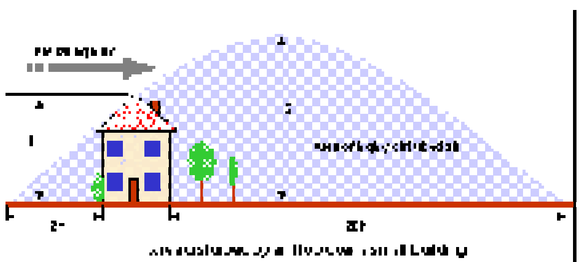


Cut in/Cut out speed

The mechanics of a wind turbine can't generate power if the wind is blowing too fast or too low. So, wind turbines "cut in and out" at different speeds depending on their design. Cut in speeds are important information for low wind areas and usually range around 4m/s. Cut out speeds are important information for high wind areas and usually range around 20m/s.

How does the topography of land affect wind power?

The best location to generate wind power is on the top of a ridge on land that has very low vegetation. Trees, buildings and hedges will reduce the speed of the wind and decrease the amount of power available. A cliff-side is another undesirable location since there will be a lot of turbulence. See the figure bellow for general rules.



Will a storm or tornado destroy a wind turbine?

Possibly. Most wind turbines are designed to withstand wind speeds up to 110 mph, but they can be damaged in extremely high winds during hurricanes or tornadoes, especially if objects are blown into the turbine. We recommend that you insure the wind turbine to protect against damage. One advantage of guyed towers is they can be lowered during hurricanes.

Will lightning damage wind turbines?

If properly installed, wind turbines will be grounded and not suffer damage from lighting strikes. Lightning arrestors and grounding at the grid connection will also provide additional protection against lightning.

What kind of maintenance does a wind turbine require?

Depending on the manufacturer, a wind turbine will require maintenance once or twice a year throughout its lifetime which is usually 25 or 30 years. It's also a good idea to have a turbine checked after a severe storm. Maintenance is usually done as part of a contract with the company who sells you the wind turbine and entails oiling and potentially replacing parts. A good rule of thumb is that it will cost $0.005/kWh for maintenance. Downtime is generally one day per year for maintenance and this and the maintenance cost are taken into account when we create the cost-benefit analysis.

Will wind turbines kill birds?

Appropriately positioned turbines do not pose a threat to birds. Poorly sited wind farms on the other hand can cause problems for birds through habitat loss and damage, and by disturbing migratory paths. Call your state's wildlife authority for more information.

What is a wind class?

A Wind class represents the Wind Power Density in Watts/meters^2. Combines with the swept area of a wind turbine's blades, it is the best way to evaluate the potential power output.

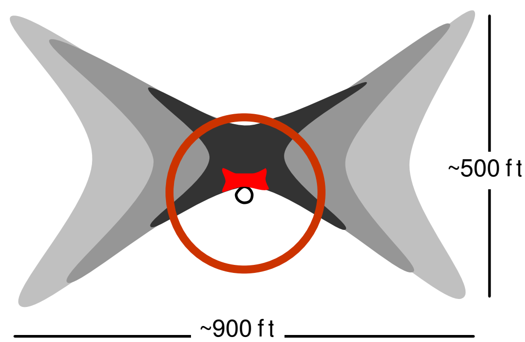
	10m height		50m height	
Wind Power Class	Wind Power Density	Speed (m/s)	Wind Power Density	Speed (m/s)
1	<100	<4.4	<200	<5.6
2	100-150	4.4-5.1	200-300	5.6-6.4
3	150-200	5.1-5.6	300-400	6.4-7.0
4	200-250	5.6-6.0	400-500	7.0-7.5
5	250-300	6.0-6.4	500-600	7.5-8.0
6	300-400	6.4-7.0	600-800	8.0-8.8
7	>400	>7.0	>800	>8.8
From: American Wind Energy Association				

Does a wind turbine make a sound?

Yes, different wind turbines sound differently but during very high winds they will generate the most sound -- between 60 and 100 dB (decibels). So, it's recommended to place the turbines at least 300' away from residences at which point the sound becomes inaudible over the sound of the wind.

Shadows

Wind turbines will cast shadows that may appear to pulse during times of full sun. The diagram below shows and example of the worst cast scenario for shadows cast from a turbine with a 30 m tower. Red and black represent a significant amount of hours of shadow at a location over the course of a whole year. Light gray show several hours of shadows. The large circle in the diagram represents the 300 ft distance it is recommended that the turbine be placed away from trees or buildings.



What is a Renewable Energy Fraction?

It is the amount of energy you use that is produced by a renewable energy system like wind turbines or solar panels. The rest of the energy you use comes from the utility grid or another source such as a diesel generator.

Wind Turbine Applications

When does it make sense to consider wind power?

In simple terms, it makes good economic sense to consider installing wind turbines when you have a consistent class 3 wind or greater, some unobstructed land, relatively high electric rates, and an grid connection policy.

Are there any zoning requirements for locating a wind turbine?

Zoning is the responsibility of local authorities and varies. In choosing a location for a wind turbine, be sure to plan a free space around it in case you want to lower the tower.

What is the best case scenario for wind power?

Because the wind does not blow at constant speed, it's important to consider when during the day and year you use electricity. Good scenarios include using power when the wind is blowing or a consistent power use, like in a factory.

Are wind turbines appropriate for power irrigation pumps on farms?

If enough wind blows during the same months you irrigate, it's likely that wind turbines will make good economic sense for powering irrigation pumps. It should be noted, however, that during months where there is no irrigation, much of the power your turbines generate will be put back onto the grid. This means the sell-back rate for that power will also affect the economic scenario significantly. The sell-back rate for power is significantly less than the retail rate in the United States because the utility still needs to have the generation capacity there in case the wind does not blow. But a low sell-back rate means the wind turbine will lose money during non-irrigating months. However, it will often make up for it during irrigating months.

At what point does your relationship with a utility change from being a customer who generates wind on a small-scale to a large-scale wind power producer?

In Colorado, where this program began, there are no laws stopping a land owner from developing a large wind farm on their property. However, the economics of the situation makes this very difficult. In Colorado, there is no law to force utilities to buy wind power. So, the first thing you would have to do is obtain a "Power Purchase Agreement" with a utility. With that secured, you may be able to finance the building of a wind farm, but will likely need to upgrade utility lines.

Equipment & Costs

What affects the cost of a wind turbine?

Turbine size or power generation capacity is the biggest factor in determining cost, but terrain and distance from the grid connection will also affect cost. Highly technical terrain (rocky, steep slopes or marshy land) will raise the cost of installation and the farther the turbine is from the grid connection, the more you will pay for wiring.

Will the electric rate I pay change if I install wind turbines?

Possibly. The best rate structures for wind power are those that have no demand charge and allow net metering. A demand charge is a fixed price multiplied by the peak 15 minute kW demand. Wind turbines don't impact peak demand because when the wind is not blowing, you will still need to draw power from the grid. If you don't have to pay a demand charge, and the amount of wind power you generate is properly balanced with the amount of power taken from the grid, it makes better economic sense to have a usage-only price rate.

What is a sell back rate?

This is the price rate that the utility pays for the wind power you send onto the grid after you have offset all your use, which is when the net-meter hits zero. It is in $/kWh and may vary according to your power production capacity (in kW). For example, most electricity cooperative or rural electrical association (REA) in Colorado may pay $.0499/kWh if your system is less than 25 kW. Systems larger than 25 kW, you will be paid $.03/kWh by the power producer that the coop or REA buys its electricity from.

How does my existing connection to the grid affect my options for wind power?

The capacity or size of your connection to the grid will determine how much wind power you can produce on your property. For example, if you have a grid connection with a capacity of 60 kVA (kilovolt amps) and a power factor of 0.9 (which is very common), you will be able to install no more than 60 kVA x 0.9 = 54 kW of wind power on your propert. This is usually the Service Entry Capacity but it can be lower depending on the policies. Any more than 54 kW will exceed the capacity of the connection and could destroy the connection gear. Another thing to consider is whether your grid connection is single-phase or three-phase. Single-phase power is used for residential loads, while three-phase power is used for larger commercial loads. The wind turbine you select must have the same phase type as your grid connection. Finally, there may be local regulations that limit the size of the small turbine you can install.

How do I work with my utility to connect to the grid?

You will first need an interconnection agreement with your utility. After undergoing a screening, your site may be approved. All of Colorado follows this process.

Do I need special equipment to connect to the utility grid?

Yes. Renewable energy systems like wind turbines or solar panels require an inverter that converts DC (direct current) electricity to AC (alternating current) electricity which is the type generally used. The inverters also come with a "DC disconnect". This is a safety feature that will stop the power you generate from being put onto the grid when the grid is down so linemen can work on the grid without being electrocuted.

Incentives for Small Wind

What is net metering?

It allows customers to subtract the amount of power they take from the grid with power they produce and send onto the grid. When wind power is being sent onto the utility grid, your meter runs backwards. Many utilities have a policy that allows you to receive a credit or sell extra power onto the grid. Most utilities calculate the amount the meter has run backwards every month, but some do it on a yearly such as New Jersey. Bi-yearly would be even better.

What is dual metering?

It is the scenario where you have two meters between your property and the utility grid. One meter measures the amount of power that you draw from the grid, the other measures the amount you put onto the grid. It is an alternative to net metering and is used so the power you take from the grid can be charged at a price different from the price you get for power put onto the grid. In Germany, dual metering including a high price paid for renewable energy put onto the grid has created a boom in renewable energy production.

What financial incentives or subsidies are generally available for small-scale wind power?

It depends. Wind turbines qualify for accelerated depreciation, and grants are available for farmers from the USDA. Renewable Energy Credits (REC) and Production Tax Credits (PTC) can be available to individuals or small businesses that install wind turbines. However, some wind turbine companies will reduce their price if you enter into a partnership so they can sell Renewable Energy Credits.

What is accelerated depreciation?

Accelerated depreciation is a tax deduction program available for wind turbines that allows the cost of the turbines to be taken off your income taxes over a period of five years instead of over the lifetime of the turbine. If you have a consistent and large enough tax burden over those five years, it makes a big difference in offsetting the cost of the turbines.

What is a Renewable Energy Credit?

Renewable Energy Credits (RECs), also known as "Green Tags", are certificates that generally represent one MWh of power generated from a renewable energy source such as wind or solar power. As a method to mandate the use of renewable energy, a growing number of state governments require that utilities own a certain number of RECs. RECs are generally not purchased from small-scale wind power producers, but can be aggregated by brokers and are sometimes sold through wind turbine manufacturers. RECs are currently in an unregulated market and prices vary greatly according to state, but are generally between $1.00 and $3.00/MWh.

What is a Production Tax Credit?

A Production Tax Credit (PTC) is a federal program that pays power producers $0.019/kWh in a federal tax credit (as of fiscal year 2007). It is not available to small-scale wind power producers unless they have a power purchase agreement with a business that will buy the wind power. Some wind turbine companies will offer a reduced price if customers enter into a partnership with them allowing them to use the PTC. New policies are currently being drafted at the federal level.

Insurance Requirements

Will my homeowners or business insurance policy cover wind turbines?

Yes, generally wind turbines are counted as appurtenant structures which are defined as any uninhabitable structure on your property and are covered against acts of god or vandalism.

Do I need extra insurance for a wind turbine?

Liability insurance is usually required. It will cover repair costs in case the utility's equipment on the grid is damaged by power generated by your wind turbine. Other types of insurance to consider are property insurance and mechanical breakdown coverage.

Further Information

- U.S. Department of Energy Wind Powering America program web site
- American Wind Energy Association, small wind website
- *Small Wind Electric Systems, A U.S. Consumer's Guide* (& state guides)
- Plains Organization for Wind Energy Resource web site
- Danish Wind Industry Association web site

Getting Started On Your Wind Power Project

Wind power is a clean source of energy. The best part is no one owns the wind, which means the energy source is free. The cost of turbines is also constantly getting lower. So even if a wind turbine is not feasible in your case now, look at the possibility again in a couple of years.

But before buying a wind turbine, you need an answer to these questions.

How much wind do I have? Wind is rated by 'Wind Class'. Wind Class represents the Wind Power Density at a specific elevation above ground, which is calculated in terms of Watt/meters^2. Wind speed can also be used.

How much electricity do I use? Electricity use needs to be broken down into a load pattern that describes the peaks and lows in electrical demand.

What's my current rate structure? Utilities charge for access, kWh, kW, Horse Power load or other measurable units.

What's the sellback rate for clean energy? Utilities pay or give credits for excess energy sold to the grid.

Where can I buy a wind turbine? There are hundreds of wind turbine manufacturers around the world. Get the Folkecenter Catalog of 216 Small Windmills at www.folkecenter.net.

What generation capacity would be the most cost effective for my needs? Sizing a wind turbine is very important. Size will impact cost and the quantity of energy sold.

Is there an installer in my area? Some manufacturers provide installation services in specific areas. Independent re-sellers may also be able to provide installation for a fee.

What will the total cost be? Simply put, total cost will include the turbine, tower, foundation, installation, and shipping.

What incentives are available? There are many mechanisms, such as production tax credits, available for clean energy. There may be local, state, or federal incentives available, check at www.dsire.org.

What are the financing terms? Costs can be broken up with loans, financing, and grants.

How long will it take to recoup my investment? An appropriately sized turbine can have a simple payback period of 2 years or less.

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