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Small Wind Power

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About this manual:

This manual is intended to help guide Nebraskans interested in installing small wind turbines. For purposes of this manual, small wind will be considered anything less than 100 kW. A great deal of information can be found on the web about wind turbines. Some of it is good and some not so good. Often these websites leave someone interested in installing wind turbines with more questions than answers. This manual is intended to provide facts and information on the entire small wind turbine installation process from beginning to end and highlight some of the most useful websites that exist.

Why install a small wind turbine?

People have different goals and reasons for installing a wind turbine. It is important to understand and analyze your goals associated with installing a wind turbine to prevent future disappointment. If cost savings is your only goal, a wind turbine might not be right for you because of the large initial cost and the lengthy payback period. Why install then? Wind turbines provide a green method of energy production and do not produce harmful emissions. Wind turbines can provide energy independence from electric companies or provide power at remote locations without grid electricity. They can also be a fun and interesting hobby.

Cost Savings Considerations

Always consider other more cost effective methods to reduce your energy bill before installing a wind turbine. A wind turbine will reduce your electric bill but will require a large initial investment with a lengthy payback period. Improving efficiency in an existing structure is a much more cost effective strategy than installing a wind turbine. Adding insulation, sealing cracks, installing new windows, replacing old appliances with more efficient appliances, and installing CFL lighting will lead to greater cost savings per dollar spent than installing a wind turbine. A list of suggested improvements can be found at http://www.energysavers.gov/pdfs/energy_savers.pdf.

A home energy audit may provide specific improvements for a particular home. These audits are usually done by professionals, but a simplified online home energy audit is available at http://hes.lbl.gov/consumer/. Nebraska offers a home weatherization program for low income families and details can be found at http://www.neo.ne.gov/wx/wxquestions.htm.

Wind Resource

A wind turbine will not produce a significant amount of electricity without an adequate wind resource. Most installers recommend installing wind turbines in locations with annual wind speeds of 10 mph or greater. Wind maps provide a means of estimating wind potential for a given area. In general, Nebraska has an excellent overall wind resource, but buildings, trees, and hills can create turbulence that diminishes wind turbine performance. The amount of electricity produced by a turbine is extremely sensitive to the speed of the wind. Doubling the wind speed will produce eight times the electricity because of the mathematical relationship between wind speed and energy. State wind maps are available at http://www.neo.ne.gov/renew/wind.htm with heights ranging from 30 to 100 meters. Small wind turbines are generally installed at heights below 150 feet or 50 meters.

Site selection

Selecting an appropriate site is critical for the successful operation of a wind turbine. The strength of the blowing wind will affect how much electricity is generated by the turbine. Also zoning laws, buildings, valleys, and trees may affect the placement of a wind turbine. The Nebraska Energy Office has a brochure outlining some basic information about wind turbines that can be found at http://www.neo.ne.gov/reports/NE-small-wind-booklet.pdf. In general the higher you can get a wind turbine the better. Wind turbines should be higher than surrounding buildings and trees to ensure the wind turbine operates in laminar flowing winds. Turbulent wind flows at low elevations near valleys, buildings, and trees. Turbulent wind produces slower, non-uniform wind speeds. Slower wind speeds reduce electricity production and the non-uniformity in wind direction and speed causes the turbine to speed up, slow down, and change directions much more frequently. This adds significant wear and tear to the machine.

Zoning

Before putting up a tower, research is necessary to determine how zoning laws might affect the placement of a wind turbine. Zoning laws vary at different levels of government. A federal zoning restriction on towers exists to protect air traffic. If a tower is greater than 200 feet, a light is needed on top of the tower by Federal Aviation regulations. Special height considerations also exist for turbine installations within ten miles of air strips.

No statewide zoning law exists that specifically affects wind tower construction in Nebraska. However, some counties have zoning regulations which might affect the setback distance of the wind tower from an adjacent property and restrict tower height on smaller sized lots. Wind development is relatively new, so zoning laws affecting wind turbine construction are changing. Municipalities may also have specific zoning regulations that may affect construction within city limits.

Understanding zoning laws before building is crucial to a successful install. Check with your local zoning official to find out if any zoning laws may affect your installation. The County Clerk will be able to help identify a point of contact for a rural area. You should talk to a city or village clerk if you live within city limits. These individuals are listed in your phone book under the governmental pages.

Configuration

Several configurations exist for wind turbine connection and usage. Stand-alone systems and grid interconnection systems with or without battery backup offer unique advantages. Stand-alone systems are usually the most expensive, but provide the greatest energy independence. Stand-alone systems are often hybrid designs that may include wind turbines, solar arrays, diesel backup generators, and batteries to allow for complete off-grid operation. The extra equipment in stand-alone systems significantly increases the project cost. However, such a system could be financially beneficial in remote areas where electric lines are miles away. A utility will charge anywhere from $10,000 to $20,000 per mile of newly installed transmission line. In such situations an off-grid configuration might make sense financially.

More common configurations are those that involve interconnection to the electric grid. Two basic grid interconnection configurations exist, one with a battery bank and one without. Grid interconnection allows the option of net metering which basically allows a turbine owner to be credited for the surplus electricity produced. Currently in Nebraska, systems up to a 25 kW capacity can be interconnected to the grid using state net metering laws. Higher capacity systems can be interconnected under special contracts with the local utility. Connecting your turbine to the grid will require coordination with the electric utility and an electrician. Talk to your local utility before installation to determine electrical requirements needed for interconnection.

Grid interconnection with no battery back-up is the cheapest configuration and requires the least amount of maintenance. Batteries significantly increase the project cost and require additional maintenance and storage consideration. Usually battery banks are stored in small sheds to help maintain optimal operating conditions. Batteries have the potential to produce explosive gas in confined areas, so extra caution and consideration is necessary for a battery-tied system. Battery back-up does make electricity available if the utility power fails. Wind turbines directly tied to the grid will not provide electricity to the owner in the event of a power outage.

Turbine size

Generally wind turbines should be sized to just meet your electrical needs or even a little less if net metering is used. This will give you the best financial benefit from a wind turbine. Net metering in Nebraska is set up on a monthly schedule. If excess electricity is produced by the

turbine at the end of the month, the utility will buy the excess electricity from you at an avoided cost rate. Avoided costs are much lower than retail rates. For example, if the utility charges you 7 cents per kilowatt hour and your turbine offsets all of your energy needs, you will save 7 cents per kilowatt hour. However, if you produce more than what you use in that month, the utility will buy back your surplus electricity at its avoided cost which is only about 3 to 4 cents per kilowatt hour. Generally turbines get more expensive as output increases, so financially it makes sense to size the turbine to meet your electrical needs but not exceed them. Look at your electric bills from the last year and then calculate your average monthly electric usage. This will give you a good starting point for sizing a wind turbine for your specific needs. A typical home in Nebraska uses about 1,000 kWh per month.

Choosing a turbine

Many wind turbine manufacturers exist. Carefully scrutinize the turbine and the manufacturer before purchasing. No standards exist in the small wind turbine industry. One company may give you a nominal turbine size based on an electrical output for a wind speed of 22 mph, while another company may use a wind speed of 25 mph. This creates a great deal of confusion when selecting a turbine. Turbines are sold with an advertised nominal capacity that is based on a wind speed that is rarely achieved. Do not assume your turbine will generate the nominal power rating advertised by the manufacturer. To get an idea of the actual electrical output the turbine will produce, look at the power curve of the turbine's performance and match it with your estimated annual wind speed. Power curves are generally available on manufacturer's websites, but keep in mind this will give you only a ball-park estimate of electricity production. Analyzing power curves will allow you the ability to compare different turbines based on estimated outputs that are actually achievable for your location. Turbine cost can then be compared using this number instead of the nominal capacity. The Small Wind Certification Council has begun certifying wind turbines with standard tests. You can check to see if the turbine you are interested in has been tested by the SWCC at http://www.smallwindcertification.org/.

Turbine warranty is also important in turbine selection. Typical warranties are about five years. Usually the warranties only include parts but not labor. Labor to replace parts can get very expensive. Be sure to look into the warranty package when comparing turbines and consider the costs associated to replace a broken part.

Other things to consider include the turbine manufacturer's reputation and what else is included with the turbine package (tower, wiring, parts, etc.). A list of additional considerations can be found at http://www.ianrpubs.unl.edu/epublic/live/g2022/build/g2022.pdf. An excellent buyer's guide, complete with a spreadsheet that compares many turbines, can be found at http://homepower.com/view/?file=HP137_pg44_Woofenden.

Tower

A tower for a wind turbine can be very expensive. It may even be as much as the turbine itself. In general, the higher the tower, the more power the turbine will generate. Most experts do not recommend putting towers on top of buildings due to wind turbulence, vibration, noise, and safety. Different types of towers exist and it is important to check with the wind turbine manufacturer for compatibility. Some manufacturers require the use of a certain type of tower and will not honor the turbine warranty if an unapproved tower is used. Also depending on the turbine, a special connection adapter might be required for certain tower types. The turbine manufacturer should have this information available.

The four common tower types are guyed lattice, monopole, tilt down, and free standing lattice. Each tower type offers certain advantages and disadvantages. Tower selection is based off of a number of decision factors including cost, visual appeal, height, the amount of land taken up, and equipment needed for installation and future maintenance. A monopole tower is usually considered most visually appealing and takes up the least amount of land because it does not need guy wires. However, monopoles are usually the most expensive and shortest of all tower types. Tilt-down towers are moderately priced and offer the ability to lower the wind turbine for maintenance without a crane, but these towers require guy wires for support which may not be desirable in certain applications. Keep in mind that tower height is crucial for good turbine performance. Taller towers may cost more but are well worth the added expense.

Installation

Installing a turbine can be a difficult and dangerous process requiring a diversified skill set. Pouring a concrete foundation, erecting the tower, and running electrical wiring properly are necessary work for a turbine installation. Using a qualified contractor is highly recommended to prevent injury, equipment damage, and headaches. Here is a list of companies with wind turbine installation experience in Nebraska:

Company Name	Location	Website
BOSCO	Blair, NE	http://boscohvac.com/index.html
Bronte Windpower	Scribner, NE	http://www.brontewindpower.com/
Dixon Power Sys.	Lincoln, NE	http://www.dixonpowersystems.com/
Energy Smart	Omaha, NE	http://www.energysmartcompany.com/
Home Energy Alt.	Gibbon, NE	http://www.nebraskagreenenergy.com/index.html
NRES	Oakland, NE	http://www.nerenew.com/
SWT Energy	Lincoln, NE	http://www.swtenergy.com/
Triad WindGen	Alda, NE	http://www.triadwindgen.com/triad-windgen-home.php
Van Wall Energy	Omaha, NE	http://energy.vanwall.com/

This list is neither comprehensive nor are the companies endorsed or recommend. Be sure to get estimates from several contractors and ask plenty of questions

Permits

Building permits may be required to install a wind turbine in certain areas. A qualified contractor should take care of this or a local official should be able to direct you on how to obtain the required building permits for a wind turbine.

Incentives

A federal tax incentive allows a taxpayer to get credit for 30% of the installation costs on a new wind turbine system through 2016. This makes installing a small wind turbine financially more attractive. Additionally, the USDA offers a grant program (REAP) in which rural businesses and farms can qualify for a grant to offset some of the cost of installing a wind turbine. To qualify for this program, an electric meter that is separate from the residence and is only used for the farm or business must exist because the REAP grant cannot be applied for residential use. Further details about the program can be found at http://www.rurdev.usda.gov/BCP_ReapResEei.html.

Nebraska does not have a statewide tax incentive program for installing wind turbines. However, wind turbines can qualify for the state's low interest loan program available through the Nebraska Energy Office at http://www.neo.ne.gov/.

Local utilities have rebate programs for upgrading or installing various appliances but do not offer anything for installing small wind turbines. The most up to date information on all tax incentives for renewable energy installation can be found at www.dsireusa.org/.

Insurance/liabilities

Check with your homeowner's insurance about wind turbine coverage. Most insurance companies will include wind turbines as part of your homeowner's policy, but you will need to check with your company to find out the specific details. Wind turbines can be fairly expensive and insuring a turbine will help protect your investment through the ever-changing and potentially severe Nebraska weather.

Maintenance

Maintaining your turbine will add years to its working life. The manufacturer should provide a list of maintenance required. Maintenance and equipment availability may influence tower type and turbine choice. For example, you should consider if a crane will be necessary for maintenance or if someone will have to scale the tower. Also consider maintenance costs when calculating the rate of return or a payback period on a wind turbine. These costs are usually minimal from year to year, but can add up over the lifetime of a turbine.

Total costs

In general a wind turbine will take many years for it to pay for itself, often longer than the turbine's expected life. Calculating a payback period can help you decide if buying a wind turbine is financially right for you. Calculators exist to facilitate this endeavor. Keep in mind these calculators only provide rough estimates. A fairly good calculator can be found at http://estimator.solar-estimate.org/index.php?verifycookie=1&page=rightforme&subpage=&oemid=671&type=&external_estimator=1. Another financial calculator can be found at http://www.talentfactory.dk/en/tour/econ/econ.htm. This website also provides a wealth of information about the science and engineering behind wind turbines. Numerous calculators exist online. Always review any assumptions made in the calculation process to ensure you are getting accurate results.

For any questions about this material, please contact:

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