# Small Wind Guide

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Legal Notice

This guide was created for the benefit of National Rural Electric Cooperative Association (NRECA) members and their consumer-members as part of the Cooperative Research Network's (CRN) Cooperative Small Wind Guide. Some content is specific to Cloverland Electric Cooperative (net metering and interconnection).This work contains findings that are general in nature. Readers are reminded to perform due diligence in applying these findings to their specific needs. Neither CRN nor NRECA nor Cloverland Electric Cooperative assumes liability for how readers may use, interpret, or apply the information, analysis, templates, and guidance herein or with respect to the use of, or damages resulting from the use of, any information, apparatus, method, or process contained herein. In addition, neither CRN, nor NRECA, nor Cloverland Electric Cooperative warrants or represents that the use of these contents does not infringe on privately held rights.

Thank you for requesting information about small wind systems and the interconnection process. This guide provides basic information and resources to assist our members.

Our mission is to protect the safety of cooperative personnel, members and others and maintain the integrity and reliability of the grid. Because small wind systems can affect the safety and reliability of the distribution system, we have developed technical interconnection rules that address those safety and reliability impacts. These rules ensure that we can continue to provide you and all other members with safe and reliable electric service.

We are ready to help you by providing information and answering questions. We want to give you the tools you need to help you make an informed decision about a small wind system.

In this packet, you will find the following documents:

- Steps to walk you through the various issues associated with a small wind system
- Helpful questions you may want to ask wind turbine vendors before purchasing a small wind system
- Frequently Asked Questions (FAQs)
- Net Metering
- Capital Cost Recovery Analysis Worksheet
- Interconnection Process and Application

We look forward to working with you. If you have any questions, please don't hesitate to contact our engineering department at 1-800-562-4953, ext. 316.

# Ten Steps to a Small Wind System

1. **Determine how much electricity you use and what it costs, annually and by the kilowatt-hour. Then, find ways to make your home more efficient and reduce your energy use.**

Start by calculating your average electricity bill. The U.S. Department of Energy (DOE) provides some rules of thumb in its *Small Wind Electric Systems: A U.S. Consumer's Guide*
http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/small_wind/small_wind_guide.pdf

Then, conduct an energy audit of your home to identify ways of using energy more efficiently and ways of reducing energy use. Implementing energy efficiency opportunities will almost always offer a quicker return on your investment and additionally may enhance the viability of a wind turbine project through a lower capital expense associated with a smaller turbine that will satisfy the new lower energy load. This could lower your electricity bill significantly. The National Rural Electric Cooperative Association (NRECA) recently reviewed several websites that host online energy audits. The review identified one website—Home Energy Saver—as among the best.
http://hes.lbl.gov

2. **Determine your site suitability and wind resource.**

**Site suitability.** Most experts recommend you have at least one acre of land if you are considering the installation of a small wind system. Smaller parcels may be suitable if adequate tower setbacks can be achieved.

Examine your site for potential turbulence. When wind flows around buildings, trees and other structures in the landscape, it slows down or becomes turbulent. A wind turbine should be placed in a location where turbulence is minimized. It also should be placed upwind of buildings and trees.

In addition, you should determine the "roughness"—the terrain and density of vegetation on the landscape—within a radius equal to 20 times the tower height, in the prevailing wind direction.

Information on determining site suitability is available at:
Small Wind Electric Systems: A U.S. Consumer's Guide
http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/small_wind/small_wind_guide.pdf
Small Wind Industry Implementation Strategy (SWIIS) Consortium's website
http://www.smallwindindustry.org/fileadmin/ewea_documents/documents/projects/swiis/technology/050406SWTsiting050405.pdf

**Wind resource.** Wind speed varies from year to year, season to season, with the time of day, and with the height above ground. For a grid-connected wind system, an average annual wind speed of 10 mph is usually considered the cutoff. Most experts recommend average annual wind speeds between Class 2 (11.5 mph at hub height) and Class 4 (13.4 mph at hub height). Class 3 sites have average wind speeds of 12.5 mph at hub height. Hub height is the distance from the ground to the center of the turbine rotor.

A small increase in average wind speed results in a large increase in power produced. A site with an average wind speed of 15 mph contains nearly 54 percent more energy than a site with an average wind speed of 13 mph. The ideal wind resource has relatively stable high speeds. If your trees and vegetation are permanently deformed because of constant wind exposure—known as "flagging"—you may have a good wind resource to generate electricity.

There are several websites with wind resource maps. One is the National Renewable Energy Laboratory's (NREL's) Wind Energy Resource Atlas of the United States http://rredc.nrel.gov/wind/pubs/atlas. You can also access state wind maps at http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp.

NREL also provides a United States Annual Wind Resource Potential Map, where you can find a location by zip code http://mapserve2.nrel.gov/website/wind_resource1/viewer.htm.

3Tier Group is a forecasting company that provides information on average wind speeds by hub height and city, address, or geographic coordinates. The model, called First Look, can be found at http://firstlook.3tiergroup.com.

You can measure the wind speed at your site using an anemometer on a tower, but this can be expensive. One option is to review data from nearby sites such as airports or state-administered meteorological stations. But airports tend to be sited in sheltered locations, so data on wind speeds may not be a reliable indicator of wind speeds at your site. Computer models are available that can help you estimate your wind resource.

Although the wind at a given site may blow more frequently from the west, more wind energy at that same site may come from different directions. You should find out which directions have the best winds for electricity production to help with micrositing.

You may want to find an installer at this point. Be sure to ask for references, licenses and certifications, proof of insurance, and a performance bond. A good installer can do a site assessment for you.

**At this point, you should talk to the cooperative about what you are considering.**

### 3. Determine how much electricity you want your wind generator to produce. Select turbine and calculate tower height based on that output.

*Energy output.* An installer also can look at your historic electricity usage and the amount of energy you want a small wind generator to produce. With this information, the installer can help you select a turbine size and tower height.

Most small turbine manufacturers provide an estimated monthly energy output in kilowatt-hours. Experts caution consumers about taking these figures at face value, however. The Capital Cost Recovery Analysis Worksheet will enable you to determine the annual energy output—in kilowatt-hours—of a given small wind system.

*Turbine features.* Once you know how much electricity you want your wind generator to produce, monthly or annually, you can look at the specifications of all turbines matching that output. Important features to consider include the rotor diameter and the turbine's revolutions per minute (rpm). Turbines with a lower rpm tend to be quieter and last longer.

The amount of power that a turbine will produce is determined mainly by the diameter of its rotor and its tower height. The diameter defines the rotor's swept area—the quantity of wind intercepted by the turbine. The larger and higher the swept area (the area through which the rotor blades spin) of the generator's rotor, the more electricity it can produce. Swept area is the feature that will help you compare the output of one wind generator with another.

For more information on selecting a turbine, see *Home Power* magazine's "Wind Turbine Buyer's Guide" http://www.homepower.com/files/featured/TurbineBuyersGuide.pdf.

*Other considerations.* Look for turbines with a good track record and a good warranty—five years, if possible. Some experts believe that weight matters; in their view, the heavier the machine, the more robust it is. They say a heavy-duty wind generator is more likely to handle sites with stronger winds or turbulence than a lighter turbine. But lighter weight turbines typically have lower "cut-in" wind speeds and produce more power in lower winds.

Tower height. One of the most common installation mistakes is mounting a wind turbine on a tower that is too short. A rule of thumb for tower height is that the wind generator should be at least 30 feet above any trees, buildings, or other structures within 500 feet. Taller towers result in higher wind generation because of reduced ground drag. An additional 40 feet on a tower can substantially increase the power available—by as much as 200 percent—and return the incremental initial investment with greater energy generation revenues over the lifetime of the turbine. But taller towers also are more expensive. The question you need to answer is whether the increased tower height is economically justified compared with the increased electricity production. Information on how to answer this question is available on Renew Wisconsin's website at http://www.renewwisconsin.org/wind/Toolbox-Homeowners/Towers percent204-Tower percent20Costs percent20versus percent20Power.pdf.

### 4. Find out what incentives—rebates, buydowns and loans—are available, and whether you qualify for a U.S. Department of Agriculture (USDA) Section 9006 grant.

The Database of State Incentives for Renewables & Efficiency (DSIRE) provides detailed information on each state's incentives that apply to renewable energy systems, including small wind. You can access the database at http://www.dsireusa.org.

The Farm Security and Rural Investment Act of 2002, which expired September 30, 2007, included a provision—Section 9006—that provided grants of $2,500 to $500,000 or up to 25 percent of the eligible costs of rural renewable energy projects. The Farm Bill Extension Act of 2007, which continues agricultural programs through 2012, provides $500 million in grants for small-scale renewable energy projects.

The grants are only available for agricultural producers that earn at least 50 percent of their income from agricultural products. Small rural businesses also are eligible. But the application process for a grant or loan under Section 9006 can be complicated and time-consuming. A sample application form is available on DOE's energy efficiency and renewable energy (EERE) website.
http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/farm_bill_small_wind_sample_application.pdf

### 5. Determine estimated installed cost of system and calculate return on investment.

A rule of thumb for estimating the cost of a small wind system is $4–$10 per installed watt. The total installed cost is the cost of the wind generator and tower plus the cost of permitting, installation and interconnection to the grid.

The payback for a small wind system is the amount of time it takes for the system to pay for itself in energy savings. You can calculate the payback for a given small wind system by using the capital cost recovery analysis worksheet provided in your cooperative's information packet for member-consumers.

### 6. Determine what zoning regulations, if any, apply to the installation of a wind turbine, and what permits—building, electrical—are required. Talk with your neighbors about your plans.

**Zoning.** Zoning regulations vary from state to state, and from one local jurisdiction to the next. Contact your local county officials to learn about zoning laws. These laws may include height restrictions and may require that a wind turbine be set back from your property line. The standard setback for a small wind system is calculated as a distance from the property line equal to the height of the tower. Sometimes, the setback requirement restricts where a tower can be installed. In many cases, local municipalities do not have any zoning regulations that apply to the installation of wind turbines and towers. As a result, a zoning hearing often becomes part of the processes that an applicant must go through before a building permit is issued.

At zoning hearings, neighbors are allowed to express any concerns they might have about the small wind system. Preparation for these types of meetings is key. The more answers you have ready for questions that are likely to arise, the easier the process will be.

Information on zoning issues is available on the Renew Wisconsin website, on the Small Wind Toolbox page http://www.renewwisconsin.org/wind/windtoolbox.html. Scroll down to *Toolbox—Information for Homeowners and Installers*, and look for documents *Zoning 1* through *Zoning 6.*

**Permitting**. Contact your local building inspector, board of supervisors, or planning board to learn whether you will need to obtain a building permit. They will provide you with a list of requirements, which will probably include a site plan, a structural analysis on the foundation and tower, and an electrical one-line diagram. At this stage, talk with neighbors about your plans and listen to any of their concerns. If there are any other small wind turbine owners in your area, talk with them about any concerns their neighbors had and how they dealt with those concerns.

**Aviation and Other Government Related Entities**. You may be required to file certain forms and documents with the Federal Aviation Administration, the Department of Defense or Homeland Security. For more information, visit the following websites:
https://oeaaa.faa.gov/oeaaa/external/portal.jsp
https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showLongRangeRadarToolForm
https:/oeaaa.faa.gov/oeaaa/external/content/7460-1.pdf

### 7. Ask your cooperative about its interconnection requirements, including costs and liability insurance.

**If you have not already talked with your cooperative about your plans, do so now.** Discuss the steps you have taken to get to this point, and provide information on the small wind system you are considering. You need to make sure that the system meets the cooperative's criteria for interconnection.

### 8. Call and speak with a small wind system installer/dealer (if you haven't already done so).

Ask any current small wind system owners in your area for references. In addition, contact the manufacturer of the wind turbine you are interested in for recommendations and suggestions for authorized installers.

Another option is to ask your state's renewable energy organization or energy office. DOE's EERE website provides contact information for state energy offices http://www.eere.energy.gov/state_energy_program/seo_contacts.cfm. Regional organizations, such as the Midwest Renewable Energy Association (MREA) http://www.the-mrea.org might also be able to help.

Once you have a short list of installers/dealers, contact at least three of them for quotes for the equipment and installation. Question any quote that appears to be too high or too low.

**Some questions to ask when considering an installer are:**

- Does the company have experience installing grid-connected systems? What models?
- Does the company use licensed and certified contractors? Is the company insured?
- Does the company have any consumer complaints, judgments or liens against it?

- Will the company help with the applications required by the local building permitting agency and the utility for grid-connected systems?
- How much, if any, of the work will be contracted out?
- When will construction begin and how long will it take?
- What warranty is offered on the installation (covering workmanship for tower and turbine assembly, electrical, and foundation work)? Will the company accept a performance bond?
- Does the company do service and repairs on the equipment?
- Will the company provide references of previous consumers?

The North American Board of Certified Energy Professionals has decided to create a certification program for small wind turbine installers, with the first examination planned for 2008. The knowledge, skills and abilities required for the installation and maintenance of a small wind system are discussed in the board's task analysis at http://www.nabcep.org/Monticello/userfiles/File/SmallWindTA1206FINALv1.0.pdf.

### 9. Order the turbine and tower.

Before actually placing an order, ask the manufacturer or installer for the names of consumers who have installed the same make and model. Contact those consumers to ask about machine performance and reliability and support from the manufacturer. Ask if the system is meeting their expectations.

Ensure that the manufacturer offers at least a one-year warranty with an optional extended five-year warranty for all hardware, and that the inverter is Underwriters Laboratories (UL) listed.

If you plan to purchase a rebuilt or remanufactured wind generator, find out the history of the machine, obtain the remanufacturing report the specific turbine that you will be purchasing, be sure there is a warranty, ask about a maintenance contract, and ask about the availability of spare parts.

Additional information is available in the *Wind Turbine Buyer's Guide* at http://www.homepower.com/files/featured/TurbineBuyersGuide.pdf.

### 10. Contract for installation of your small wind system.

This is the final step. If you did not contract for the installation of your wind generator with the manufacturer, contact the installer you found in step 8 and arrange for installation.

# Frequently Asked Questions

## What would a small wind power system cost?

There are several aspects of cost: the cost of the wind generator, the cost of the balance of the plant (the power electronics, tower, installation), the cost of interconnection (including any required engineering studies to ensure that the wind system can be integrated with the grid without impacting the quality or reliability of service to neighboring cooperative consumers, and any upgrades needed to the distribution system), and the cost of maintenance from a reliable service provider.

Small wind systems are usually rated in kilowatts (kw) of generating capacity, and range in size from less than 1 kw to 100 kw. Uninstalled, a 10-kw small wind system is likely to cost between $28,000 and $36,000. Installation costs can range from $6,000 to $22,000, depending on the site conditions. As a rule of thumb, a 10-kw wind turbine system—installed—can cost from $40,000 to $50,000, depending on the type and height of the tower, not counting interconnection and maintenance costs.

## Are any incentives available for wind power systems?

The Emergency Economic Stabilization Act of 2008, H.R. 1424, includes a new, federal-level investment tax credit to help consumers purchase small wind turbines for home, farm or business use. Owners of small wind systems with 100 kilowatts (kw) of capacity and less can receive a credit for 30 percent of the total installed cost of the system, not to exceed $4,000. The credit is available now through December 31, 2016. For turbines used for homes, the credit is limited to the lesser of $4,000 or $1,000 per kw of capacity.

The Farm Bill Extension Act of 2007, which continues agricultural programs through 2012, provides $500 million in grants for small-scale renewable energy projects. The grants are only available for agricultural producers that earn at least 50 percent of their income from agricultural products. Small rural businesses also are eligible. But the application process for a grant or loan under Section 9006 can be complicated and time-consuming. A sample application form is available on the Department of Energy's (DOE's) energy efficiency and renewable energy (EERE) website.
http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/farm_bill_small_wind_sample_application.pdf

## How much electricity can be generated?

The turbine size must not exceed your annual electricity needs. The nameplate capacity of the wind generator may not exceed 30 kilowatts (kw).

It is also necessary to look at local conditions. The wind speed on your site—at the height at which you intend to erect your wind turbine—is a critical factor in estimating your energy output. National wind speed tables provide estimates, but the wind speed at your location could vary considerably from those tables. It is worth noting that utilities planning to install commercial turbines collect two years of data on wind speed. Many small wind advocates

argue that meteorological data is not necessary for small wind generators. Nevertheless, energy output is directly correlated to wind speed and wind speeds can vary greatly depending on location and height. If you choose not to erect a “meteorological tower” to measure wind speeds at your site, talk to your turbine vendor to get the best possible wind data for your location.

The capital cost recovery analysis worksheet enables you to calculate the kilowatt-hours a small wind system will generate annually given assumptions about the size of the wind turbine and estimated wind speeds at your site. Most small turbine manufacturers provide an estimated monthly energy output in kilowatt-hours at a particular wind speed. Experts caution consumers about taking these figures at face value, however.

## What is net metering? *

Net metering is a tool for valuing and measuring the electricity generated from renewable resources and used by a utility consumer for all or part of their electricity needs. Under net metering, when a consumer uses electricity supplied by the cooperative, the electricity meter moves forward. When the consumer’s wind generator produces more electricity than the consumer needs at any particular time, the excess is fed back into the grid, and the meter rolls backwards. The following website provides a table on state rules, regulations and policies—including net metering and interconnection. http://www.dsireusa.org/summarytables/reg1.cfm?&CurrentPageID=7&EE=0&RE=1.

Availability: The net metering program is open to all residential and commercial consumers who operate renewable electric generators that are interconnected with the cooperative’s system and generate all or a portion of their own retail electricity.

Enrollment: The enrollment period continues to October, 2010. Participants enrolling in net metering will be allowed to continue in the program for a minimum of ten years.

Generator: The electric generator must be fueled by a qualified renewable energy resource as outlined in the Generator Interconnection Requirements approved by the Michigan Public Service Commission. The generator must be installed on consumer’s premises, serve only that premises and sized to meet the customer’s electric needs. The nameplate capacity of the generator must not exceed 30 kw and may not exceed the consumer’s annual energy needs in kilowatt-hours (kwh).

Interconnection Process:

Contact Cloverland Electric Cooperative’s Engineering Department
Complete and Submit Interconnection Application (Non-refundable Application Fee-$100)
Interconnection Study By Cooperative
Interconnection, Inspection and Operating Agreement

Generator Interconnection Requirements: All application fees, procedures and requirements are contained in the Michigan Public Service Commission's Interconnection Standards Rules (R 460.481-460.489) and the Commission-approved Generator Interconnection Requirements.

Member is required to submit electrical diagrams and schematics documenting the interconnection and technical specifications of the interconnection equipment as part of the Interconnection Agreement and Application. Cooperative reserves the right to refuse any system design it deems unsafe and/or improperly engineered. Interconnection equipment must be UL-1471 approved for grid tie applications and meet IEEE 519 and 1547 standards.

Facilities must be designed and operated in parallel with Cloverland's system without adversely affecting the operation of Cloverland's equipment, other members' services or presenting any safety hazards.

The interconnection rules and requirements will determine whether any additional equipment is required for the interconnection and to calculate and determine the assignment of costs. The member is responsible for all the costs incurred by the cooperative to install the appropriate metering technology to separately measure the member's consumption and generation above the cost of a standard meter.

The co-op will replace your current electronic meter with a bi-directional billing meter and install a separate generation meter. These meters ensure proper billing credit for any excess generation. All metering equipment will be installed, maintained, read and owned by the cooperative.

Fees: Member is responsible for all installation costs and any required upgrades to the utility service. Other fees include an interconnection application of $100.00.

Billing Process: Consumers will be billed for the total amount of electricity (kwh) used at the premises. The bill will include a credit for the amount of electricity generated on-site up to the amount of the monthly billed consumption.

Net Excess Generation (NEG): For any energy generated beyond the current month's consumption (billing period) you will receive Net Excess Generation credits (NEG). These NEG credits, if any, carry over to the next billing period and used to offset the energy charges in the next billing period.

Monthly Rate: Members continue to pay retail price for all purchase power based on MPSC-approved rate schedules. The NEG credit is currently the applicable retail rate.

** On October 6, 2008, Governor Granholm sign SB213 into law. SB 213, known as PA 295, includes a provision directing the Michigan Public Service Commission to establish a statewide net program no later than 180 days after the effective date of the Act. New administrative rules are under development. For the latest developments, visit http://www.michigan.gov/netmetering and http://www.michigan.gov/customergeneration*

## What, if any, permits and inspections are required to operate a wind turbine?

You will need a building permit to install a wind turbine. Start by contacting your county planning or permitting department. Find out what zoning regulations apply to nondwelling structures on your property.

Ask if small wind systems are specifically addressed by local ordinance, and if so, get a copy of the ordinance. You will need to know the permitting procedures and what documentation is required for your turbine. Check local land-use codes carefully for special zoning ordinances that authorities may have overlooked.

Zoning regulations may limit the height and placement of your wind turbine, so a special-use permit or variance may also be needed. A zoning variance is a project-specific exception from existing zoning regulations. You will need to comply with the conditions of that permit or variance, which usually pertain to minimum lot size, maximum tower height, setback (the distance from the property line that a turbine must be sited), and electrical code compliance. In addition, you may have to submit a structural plan drafted by an engineer, but documents from your turbine manufacturer or dealer may be sufficient.

If you have to appear at a public hearing seeking a conditional use permit or variance, be prepared to answer questions about your project. A hearing may turn out to be a mere formality, but be ready for anything that might come up. Here are some tips: Seek the support of your neighbors before the hearing. Compile documented factual information to reassure anyone worried about noise, visual impact, possible affects on wildlife, and property values. Planning and zoning officials may be unfamiliar with small wind systems, so be prepared to explain the basics.

Fees for building permits, use permits, zoning permits, and “plot plans” can range from $400 to $1,600. There may be other fees for public notification, hearings and environmental impact studies costing from a few hundred to several thousand dollars. If a fee seems inappropriate or excessive, you may be able to get it reduced or waived. Find out what you are being charged for and offer to provide documentation or information that makes the fee unnecessary.

## What kind of payback can I expect in terms of breaking even?

The payback period for a small wind system can range from several years to several decades, depending on the cost of the system and the average annual wind speed at the hub height—the distance from the ground to the center of the turbine rotor. The average speed is often more critical to the payback period than the initial installed cost, according to some experts.

You can also calculate the simple payback of a small wind system by the following formula, assuming the wind turbine is properly sized not to exceed your demand:

(Installed cost including interconnection costs and any necessary system upgrades, $) ÷ (kwh/y x Retail price of electricity, $/kwh – annual operation and maintenance [O&M] cost, $/yr) = years

The annual O&M cost may include insurance premiums, maintenance calls, service contracts and the net present worth of long-term repairs.

## How reliable are wind turbine systems? Will I have to perform much maintenance?

Most wind turbines are designed for a long life and operate completely automatically. Obtain at least two references from the company that produces and/or sells the wind generator model that you are considering. Ask those owners about the generator's reliability and its maintenance requirements.

Find out what maintenance the turbine manufacturer recommends. Small wind experts recommend an annual inspection of your wind turbine. Check bolts and electrical connections, and tighten if necessary. Also check and replace any worn leading edge tape on the blades. After 10 years, the blades or bearings may need to be replaced.

If you do not have the expertise to maintain your wind generator, find out what companies provide maintenance services in your area. Makes sure the companies give references, and ask what a service contract will cost.

As one small wind expert has noted, if you do not change the oil in your automobile, you're unlikely to carry out maintenance on your wind turbine.

## Where can I find out more about wind turbines and where to buy them?

Paul Gipe, a wind energy expert with more than 30 years of experience in the field, has written extensively about wind turbines. The following two books focus on small wind systems:
*Wind Power: Renewable Energy for Home, Farm, and Business*
http://www.wind-works.org/books/wind_power2004_home.html
*Wind Energy Basics: A Guide to Small and Micro Wind Systems*
http://www.wind-works.org/books/wind_energy_basics.html.

Other sources of information include:

- The U.S. Department of Energy's (DOE's) *Small Wind Electric Systems: A U.S. Consumers Guide*
  http://www.windustry.org/small-wind-electric-systems-a-us-consumers-guide
- The DOE's Office of EERE http://www.eere.energy.gov/windandhydro/windpoweringamerica/small_wind.asp
- *Home Power* magazine's article "Wind-Electric Systems Simplified"
  http://www.homepower.com/files/beginner/WindPowerBasics.pdf

To find a wind turbine dealer or installer, ask any small wind system owners in your area for references. In addition, contact the manufacturer of the wind turbine you are interested in for recommendations and suggestions for authorized dealers.

Another option is to ask your state's renewable energy organization or energy office. DOE's EERE website provides contact information for state energy offices at http://www.eere.energy.gov/state_energy_program/seo_contacts.cfm.

# Questions to Ask Vendors and Distributers

1. **How reliable is the rated energy output? How did you calculate the output? What wind speeds did you use?**
   Experts advise ignoring peak output and power curves provided by vendors. Rather, look for the monthly or annual energy numbers—in kilowatt-hours—for the turbine, estimated for the average wind speed that you expect or have measured at your site. If the turbine manufacturer or distributor does not provide energy production estimates, find another manufacturer.

2. **Is the inverter UL listed?**
   If the inverter is not UL listed, find another vendor. Most utilities require that an inverter have a UL 1741 certification for interconnection with the grid. As part of the certification, the inverter is required to fail open in the absence of power on the grid.

3. **What is the estimated total installed cost? What does the turbine cost? What does the tower cost? How much is installation estimated to cost?**
   It is important to know the total installed cost of a wind turbine system to ensure sufficient budgeting for the system. Budget for installation labor expenses as well as the cost of equipment rental, concrete and rebar, electrical components, shipping, and sales tax.

4. **How long is the warranty? What does it cover? Parts? Labor? Can it be extended? If so, what will it cost?**
   Warranties range from one to five years. The longer the warranty, the better. Make sure the warranty covers labor as well as parts. Cooperative members should ask owners of wind systems purchased from the same vendor about performance and reliability before making a decision on an extended warranty, if available.

   If you live in an area that is prone to lightning strikes, you should strongly consider the option of lightning protection. At present, only one U.S. vendor—Abundant Renewable Energy (ARE)—offers such protection with its machine. But third-party vendors can design and install adequate protection systems.

5. **What are your credentials? How long have you been in business? How many turbines have you sold? Have your turbines been certified?**
   Look for vendors that have been in business for at least five years, or have acquired the product line of another vendor. In addition, cooperative members should ask the vendor for the names of at least two people who have installed a wind turbine that is the same as, or similar to, the model the cooperative member is interested in. Currently, there is no U.S. small wind certification process, but small wind turbines can be certified using the International Electrotechnical Commission (IEC) standard—IEC 61400-2—for testing wind turbine power performance. This standard is increasingly used by U.S. manufacturers in their wind turbine designs.

# Capital Cost Recovery Analysis

As interest in renewable energy grows, some cooperative member-consumers are considering the purchase of a small wind system. If you are interested in installing a small wind system to replace all or some of the electricity that your cooperative provides, talk with our engineering department about your plans.

Before you decide to buy a small wind system, however, you should consider the economics to determine whether such a system will lower your monthly electricity costs. This capital cost recovery analysis, prepared by the Association of Illinois Electric Cooperatives (AIEC),* will enable you to determine the annual operating cost of a small wind system and compare that cost to the cost of the electricity that you purchase.

## INFORMATION REQUIRED FOR THE CAPITAL COST RECOVERY ANALYSIS

| | |
|---|---|
| 1. ENTER THE TOTAL COST OF PURCHASING AND INSTALLING THE GENERATING EQUIPMENT INCLUDING ANY INTERCONNECTION AND SYSTEM UPGRADE COSTS: | $ _____ |

| | |
|---|---|
| 2. ENTER THE AMOUNT OF GRANTS, TAX CREDITS, OR OTHER FUNDING NOT REQUIRED TO BE REPAID BY THE MEMBER FOR THE PURCHASE AND INSTALLATION OF THE GENERATING EQUIPMENT: | $ _____ |
| 3. SUBTRACT LINE 2 FROM LINE 1 TO DETERMINE THE NET COST OF THE EQUIPMENT: | $ _____ |
| 4. ENTER THE ESTIMATED AMOUNT OF ANNUAL MAINTENANCE COST OF THE GENERATING EQUIPMENT (INCLUDE ANY ANNUAL OPERATION COSTS, INCLUDING INSURANCE PREMIUMS IF ANY): | $ _____ |

| Table 1 | | | | | |
|---|---|---|---|---|---|
| Years | 7.5 percent Capital recovery Factor | 6.5 percent Capital recovery Factor | 5.5 percent Capital recovery Factor | 4.5 percent Capital recovery Factor | 3.5 percent Capital recovery Factor |
| 1 | 1.0750 | 1.0650 | 1.0550 | 1.0450 | 1.0350 |
| 3 | 0.3845 | 0.3776 | 0.3707 | 0.3638 | 0.3569 |
| 5 | 0.2472 | 0.2406 | 0.2342 | 0.2278 | 0.2215 |
| 10 | 0.1457 | 0.1391 | 0.1327 | 0.1264 | 0.1202 |
| 15 | 0.1133 | 0.1064 | 0.0996 | 0.0931 | 0.0868 |
| 20 | 0.0981 | 0.0908 | 0.0837 | 0.0769 | 0.0704 |
| 25 | 0.0897 | 0.0820 | 0.0745 | 0.0674 | 0.0607 |
| 30 | 0.0847 | 0.0766 | 0.0688 | 0.0614 | 0.0544 |
| 35 | 0.0815 | 0.0713 | 0.0650 | 0.0573 | 0.0500 |
| 40 | 0.0794 | 0.0707 | 0.0623 | 0.0543 | 0.0468 |

| | |
|---|---|
| 5. Enter from Table 1 either: (a) the interest rate of borrowed funds to purchase the generating equipment, or (b) the interest rate that would be received on the money used to purchase the generating equipment: | ____ |

(Pick the closest interest rate from the table)

| | |
|---|---|
| 6. Enter from Table 1 the number of years the generating equipment can be expected to operate or the number of years for the loan: | ____ |

(Pick the closest number of years from the table)

| | |
|---|---|
| 7. Enter the capital cost recovery factor from Table 1 above: | $ ____ |

(Locate the interest rate in the top row of table 1 that you entered on line 5. Proceed down that column to the number of years corresponding to the entry on line 6. Enter the capital recovery factor indicated in that box on line 7.)

| | |
|---|---|
| 8. Enter the estimated percent of time the generating equipment will operate (enter as a whole number): | _____ percent |

(A wind turbine may operate 25 percent to 40 percent of the time depending upon your geographic location. But you should confirm by independent analysis the percent your specific generating equipment is likely to operate.)

| | |
|---|---|
| 9. Multiply (8) x 8760/100 = the number of hours per year of operation | _____ |
| 10. Enter the rated capacity of the generating equipment in kilowatt (kw) | _____ kw |
| 11. Multiply (9) x (10) = kilowatt-hour (kwh) per year (generated) | _____ |
| 12. Enter your cooperative's average cost per kilowatt-hour for the energy you purchased during the last 12 months ($/kwh): | $ _____/kwh |

(Excluding any monthly facility charge or consumer charge.)

## CALCULATION OF ANNUAL OPERATING COST OF EQUIPMENT

The total annual operating cost (TOC) of equipment is calculated by:

| | |
|---|---|
| 13. Multiply the net cost of the generating equipment (Line 3) by the capital recovery factor from line 7 | $ _____ |
| 14. Add the annual maintenance cost of the equipment (line 4): | $ _____ |
| 15. To determine the TOC of the equipment, add lines 12 and 14: | $ _____ |
| 16. Divide line 15, the TOC of the equipment, by line 11, the kilowatt-hours to be generated each year: | $ _____/kwh |

(Line 16 is the TOC for the generating equipment per kilowatt-hour.)

| | |
|---|---|
| 17. Cooperative average cost per kilowatt-hour from line 12: | $ _____/kwh |

* *Calculation form developed by Carl Dufner, vice president of engineering for the AIEC. To order brochure copies of the original AIEC form contact Angie Bingenheimer at the AIEC, 217-529-5561, abingenheimer@aiec.coop.*

# Interconnection Application

**Instructions:** Anyone expressing interest to install generation which will interconnect with Cloverland Electric Cooperative's (CEC) System should file this application. This application should be completed and returned to the address listed below in order to begin the process along with a $100 non-refundable application fee. This application is used by CEC to perform a preliminary interconnect review. The applicant shall complete as much of the application as possible. The applicant will be contacted, if additional information is required. The response may take up to 15 business days after receipt of all the required information.

| | | |
|---|---|---|
| **MEMBER/APPLICANT (REQUIRED)** | | |
| Company/Member-Applicant's Name | | |
| Representative: | Title: | |
| Phone: | Fax: | Cell: |
| Address/City/State/ Zip Code: | | |
| E-Mail Address: | | |
| | | |
| **LOCATION OF GENERATION SYSTEM INTERCONNECTION** | | |
| *Street Address, Legal Description, or GPS Coordinates* | | |
| **PROJECT DESIGN/ENGINEERING** | | |
| Company: | | Representative: |
| Title: | | |
| Phone: | Fax: | Cell: |
| Address/City/State/ Zip Code: | | |
| E-Mail Address: | | |
| **ELECTRICAL CONTRACTOR (If Applicable)** | | |
| Company: | | Representative: |
| Title: | | |
| Phone: | Fax: | Cell: |
| Address/City/State/ Zip Code: | | |
| E-Mail Address: | | |
| **GENERATOR SUPPLIER (If Applicable)** | | |
| Company: | | Representative: |
| Title: | | |
| Phone: | Fax: | Cell: |
| Address/City/State/ Zip Code: | | |
| E-Mail Address: | | |

| GENERATOR | | |
|---|---|---|
| Manufacturer: | | Model: |
| Type (Synchronous Induction, Inverter, etc): | | Phases: 1 or 3 |
| Rated Output (Prime kw): | Standby kw: | Frequency: |
| Rated Power Factor ( percent): | Rated Voltage (Volts): | Rated Current (Amperes): |
| Energy Source (Gas, hydro, wind, etc.): | | |

| TYPE OF INTERCONNECTED OPERATION (Check all that apply) | | |
|---|---|---|
| **Interconnection/Transfer Method** | | |
| *Open _____* | *Closed _____* | *Soft Loading _____* |
| *Extended Parallel _____* | *Inverter _____* | |
| **Proposed Use of Generation** | | |
| *Peak Reduction _____* | *Standby _____* | |
| *Energy Export Sales _____* | *Cover Load _____* | |
| **Duration Parallel** | | |
| *None _____* | *Limited _____* | *Continuous _____* |

| ESTIMATED LOAD INFORMATION |
|---|
| The following information will be used to help properly design the interconnection. This information is not intended as a commitment or contract for billing purposes. |
| **Minimum anticipated load (generation not operating): kw: _____ kVa: _____** |
| **Maximum anticipated load (generation not operating): kw: _____ kVa: _____** |

| ESTIMATED START/COMPLETION DATES | |
|---|---|
| Construction Start Date: | Completion/Operational Date: |

| DESCRIPTION OF PROPOSED INSTALLATION AND OPERATION |
|---|
| Attach a single line diagram showing the switchgear, transformer and generation facilities. Give a general description of the manner of operation of the generation and co-generation. |

| APPLICATION ACKNOWLEDGEMENT AND AGREEMENT |
|---|
| With this application, CEC is requested to review the proposed Generation System Interconnection, identify the additional equipment and costs involved with the interconnection of this system CEC's system and to provide a budgetary estimate of these costs. It is understood that the estimated costs supplied by CEC will be determined using the information provided. The applicant also agrees to supply as requested, additional information, to allow CEC to better review this proposed Generation System Interconnection. By signing below, the applicant agrees and acknowledges they have read CEC's Interconnect Requirements for Generation System and will design, operate and maintain the Generation System and Interconnection with these requirements. |
| **Applicant's Name (Print):** |
| **Applicant's Signature:** |
| **Date:** |

CEC Application for Interconnection of Generation System (Revised May, 2007)