Cooperative Small Wind Guide

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NRECA CRN™

COOPERATIVE RESEARCH NETWORK

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Executive Summary

As interest in renewable energy grows, cooperatives may be approached by member-consumers interested in generating electricity with small-scale systems, including wind. Many of the sites across the country that are appropriate for grid-connected small wind systems—100 kW or less—are located in rural areas and served by electric cooperatives.

This guide to small wind systems can help cooperative personnel answer questions and provide information to member-consumers who request it. The guide—intended for member services, engineering, and operations personnel—reviews the various requirements and reasons for cooperative support of member-consumers interested in installing small wind systems and what cooperatives can do to prepare them.

The guide also includes sections on small wind technology basics, the reasons why member-consumers may be interested in small wind systems, what member-consumers expect from you, and guidance on the packet of information that you should prepare for member-consumers.

Another feature of the guide is case studies, which examine the experience of some cooperatives and their members who have installed small wind systems. The seven case studies—in Iowa, Minnesota, North Carolina, Pennsylvania, Texas, Vermont, and Wisconsin—include lessons learned from the perspective of cooperatives and their members. In addition, this guide includes a section on small wind turbine vendors and a list of frequently asked questions (FAQs)—with answers, a short consumer handout, and acknowledgments.

Executive Summary

Cooperatives' Obligations

There are several reasons for cooperatives to be supportive of member-consumers who want to install a small wind system.

1. A legal requirement. The Federal Public Utilities Regulatory Policy Act (PURPA) requires utilities to interconnect with qualifying facilities (QFs), to sell power to QFs, and to purchase QF power at avoided cost. The act also requires utilities to adopt a standard rate at which they will purchase excess power from QFs with a design capacity of 100 kW or less.

2. Self-governance is an important issue for cooperatives. Each cooperative should be able to make decisions about how it will address renewables in its own system. Cooperatives that take a positive approach toward consumers interested in self-generation have found that their efforts can keep members happy, attract positive press coverage, avoid lawsuits, and avoid new government mandates. Other cooperatives have found that failure to work productively with a member-consumer can prompt that individual to complain to state and federal legislators and regulators, which can result in negative publicity for the cooperative and new government mandates.

3. Member-consumer satisfaction is important to cooperatives. If one of your member-consumers wants to install a small wind system, the cooperative can easily be helpful—consistent with the cooperative's obligation to provide safe and affordable electricity service to other member-consumers. With the help of this guide and the National Rural Electric Cooperative Association (NRECA) resources and some local effort, a cooperative can be prepared to assist member-consumers by providing information that is relevant to a small wind system, such as wind energy basics, interconnection requirements, written agreements, rates, and relevant costs. This is an opportunity to work with member-consumers while explaining that the cooperative must protect the safety of all member-consumers and cooperative employees, maintain the integrity and reliability of the grid, and establish mechanisms to ensure cost fairness for all member-consumers.

Executive Summary

How to Use this Guide

Over the next few years, many cooperatives are likely to receive inquiries from consumers interested in generating their own power with small wind turbines. Those consumers will approach cooperatives with their own motivations for pursuing small wind and their own expectations about what the cooperative can and should do to help them. Many consumers will be skeptical of the cooperative.

This guide will help prepare cooperative personnel to work with those consumers. In the spirit of "forewarned is forearmed," this guide discusses some of the most common reasons consumers choose to invest in small wind generators and the expectations many of those consumers have as they begin to look at the investment. This information should help cooperative staff address consumers' concerns and increase consumers' confidence in their co-op's ability to address such questions.

The guide also provides some basic information on small wind generators and the interconnection process, both to give cooperative staff the background they need to understand the impact small wind will have on the cooperative and to allow cooperative staff to answer the most basic questions they may receive from consumers.

Finally, the guide is intended to help cooperative staff develop and assemble the documents needed to help member-consumers interested in small wind. If a cooperative waits to develop interconnection contracts and procedures until a consumer approaches it with a proposal, it may be too late to ensure that the first interconnection goes well. This document will help guide the cooperative personnel responsible for each aspect of connecting a small wind system to the grid—including the member-consumer's application, interconnection process, rates and fees, and written contract. If the directions are followed, the cooperative will be ready when a member-consumer asks about small wind or looks up small wind on the cooperative's Web site; the cooperative will have everything it needs.

Small Wind Basics

SECTION I

Small Wind Basics

The total installed capacity of small wind systems—100 kW or less—operating in the United States in 2006 was an estimated 61 MW, according to the American Wind Energy Association (AWEA). Of this capacity, less than one-third—approximately 15 MW—was grid-connected. Most small, grid-connected wind generators used for residential applications are between 1 kW and 25 kW. Larger grid-connected generators, up to 100 kW, are typically found on small farms and businesses.

The major U.S. companies that manufacture and sell small wind turbines are Abundant Renewable Energy (ARE), Bergey Windpower, Southwest Windpower, and Wind Turbine Industries. In addition, wind turbines manufactured abroad by companies including Eoltec, Kestrel, and Proven are imported for sale into the United States.

Finally, a few U.S. companies remanufacture and sell wind turbines. One is Halus Power Systems (Hayward, California), which rebuilds Vestas turbines formerly used in California wind farms. Another company, Energy Maintenance Service LLC (EMS) of Gary, South Dakota, formerly remanufactured and sold wind turbines. EMS continues to remanufacture wind turbines, but they are now sold through Next Generation Power Systems, Pipestone, Minnesota. Next Generation sells the NG Twelve-Five, a rebuilt German wind generator.

A rebuilt wind turbine is likely to have a new finish, repaired or replaced rotors, an overhauled brake system and gearbox, replaced cables and junction boxes, and a rewound or reconditioned generator, among other improvements and upgrades.

New and Emerging Technology Advances

Numerous improvements have been made to small wind generators over the past few years. These include advanced blade manufacturing methods. Manufacturers are using such techniques as injection molding and compression molding to produce more durable wind rotors. Although these techniques have reduced fabrication time, lowered parts costs, and increased repeatability, they have led to higher tooling costs. Another new technique—reaction injunction molding—has been prototyped but is not yet used in production.

Another improvement entails the use of rare earth permanent magnets. These magnets are replacing ferrite magnets, until now the industry staple. Rare earth permanent magnets, which have superior magnetic properties, result in more compact and lighter wind generators.

Manufacturers also have lowered the "cut-in" threshold—the wind speed at which a turbine begins producing energy, usually about 9–11 miles per hour (mph)—to enable turbine operation at lower wind speeds. Other improvements made by manufacturers include slower rotor speeds to reduce sound levels and alternatives to rotor furling—yawing and/or tiling out of the wind to protect against excessive rotor speeds in high winds—to control rotor speed. Among the alternatives are stall control, dynamic braking, mechanical braking, and pitch control—methods that have been demonstrated in utility-scale wind generators.

Small turbines—10 kW and less—used induction generators in the early 1980s. But those generators, which connect directly to the utility grid, were replaced with permanent magnet generators, which require an inverter to connect to the grid. Now a few companies are reintroducing induction generators in their machines. By eliminating the inverter, these companies seek to reduce the cost of a wind turbine while improving reliability.

According to several experts, inverters are the least reliable component in small wind systems. But some manufacturers are addressing this issue by adapting inverters from the photovoltaic (PV) market for use with wind turbines. By using an existing, proven product, they have lowered the cost of wind-specific inverters and been able to get them to the market more easily.

In addition, manufacturers are designing the electronics in wind generators for safer and more reliable performance. Some models also feature wireless display units for consumer convenience.

There appears to be general agreement among industry experts that no major technology breakthroughs are likely. Rather, companies will continue to improve and refine their products.

To address the relatively high cost of production, some manufacturers—such as Southwest Windpower—are designing turbines that can be produced in high volume and to high quality standards. To increase its market share, however, the small wind turbine industry needs to realize cost breakthroughs and new business models that will get its products to the market, in the view of some industry experts.

Bergey Windpower, for instance, is experimenting with large rotor diameters and more powerful alternators for use in low-wind regimes. In addition, the company's wind turbines have progressed toward lower tip speed ratios—which reduce noise levels—as the cost of permanent magnets has declined. ARE has designed its ARE 442 model with a tip speed ratio of 7, which the company noted is considered slow. But the slow speed comes at a price—more expensive blades and heavier alternators. ARE is also working to eliminate the sound caused by rectifying the output of a very stiff and highly efficient alternator.

Bergey hopes to introduce its third generation of grid-intertie inverters in the spring of 2008. Another company, Wind Turbine Industries, is conducting research on an inverter that will be certified to Underwriters Laboratories (UL) 1741. And ARE is redesigning inverter controls to reduce cost and improve reliability.

There are physical limits to the low-wind performance that is possible in a competitive price range, according to ARE. The only way to achieve significant performance gains is by using larger rotors. But increasing rotor size and controlling a larger rotor at a reasonable cost is a substantial engineering challenge. ARE is considering the use of large rotors and passive pitch control for some of its new models.

Technical Challenges

The United States does not have a system for certifying small wind turbines. The lack of a certification system hinders the ability of consumers to make decisions based on turbine safety, functionality, and durability, and may constrain financial support for state incentives. Three elements are needed to establish certification, according to the Interstate Renewable Energy Council (IREC). One is a turbine hardware performance standard, the second is turbine field tests, and the third is an independent certification body. AWEA, IREC, and the National Renewable Energy Laboratory (NREL) of the U.S. Department of Energy (DOE) are working to establish these components.

PERFORMANCE STANDARDS

At present, small wind turbine performance specifications have not been widely accepted by the small wind turbine community because they are considered too expensive. As a result, consumers often have no realistic and comparable performance ratings for various wind turbines. AWEA has drafted a small wind turbine performance and safety standard that would describe the tests required for turbines. The standard provides a method for evaluating turbine systems in terms of safety, reliability, power performance, and acoustic characteristics. It is derived largely from international standards developed under the auspices of the International Electrotechnical Commission (IEC), including power curve, annual energy performance curve, sound pressure levels, strength and safety test, and duration test. Approval of the AWEA standard is expected in spring of 2008.

FIELD TESTING

Once the AWEA standard is approved, it will provide a basis for testing wind turbines and verifying product claims. The DOE's NREL issued a request for proposal (RFP) in the spring of 2007 asking for commercially available small wind turbines to be tested at the NREL's National Wind Technology Center in Colorado. To be accepted for testing, a wind turbine has to be a commercial product with 12 months of operating history.

In its RFP, the NREL noted that one of the barriers for the distributed wind market is the lack of small turbines that are independently tested and certified. The objective of testing is to provide high-quality, detailed, and independent test results for a number of small turbines and allow them the opportunity to earn certification by an independent certification body.

The NREL has accepted four proposed wind turbines for testing, including Abundant Renewable Energy's ARE 442 turbine and the EW15, a 50-kW wind turbine made by Entegrity Wind, a Canadian company. Bergey chose not to submit a proposal, noting that it conducts testing at the factory. The National Wind Technology Center began testing three of the four turbines in December 2007 and expects to begin testing the fourth in September 2008. Testing is expected to run for 13–15 months. The center will test the turbines on the basis of the IEC standards, as the AWEA performance standard will not be approved in time for the launch of testing.

Through its Small Wind Verification Project, NREL conducted power performance, noise, safety, and duration tests on three small wind turbines. The results are available at **http://www.nrel.gov/wind/pubs_research.html#turbine**, under Small Wind Verification Project. In another study, NREL examined the IEC standard for small wind turbine design through modeling and testing; the results are available at **http://www.nrel.gov/docs/fy03osti/33004.pdf**.

Turbine testing also has been conducted in North Carolina, under the auspices of the Small Wind Initiative. The initiative—supported by the North Carolina State Energy Office, the Tennessee Valley Authority, the DOE, Appalachian State University, as well as several small wind turbine manufacturers—established a small wind technology research and demonstration center on Beech Mountain in the western part of the state. The research and development (R&D) center is located at an elevation of 5,136 feet, with an average wind speed of approximately 18 mph at 164 feet.

Small Wind Basics

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Six turbines were tested at the Beech Mountain R&D site between June 2004 and June 2005: Southwest Windpower's Air X, Whisper 100, and Whisper 500; Bergey's XL.1; African Wind Power's AWP 3.6; and Wind Turbine Industries Jacobs 31-20.

Through its Alternative Energy Institute, West Texas A&M University also has tested small wind turbines, often in cooperation with the U.S. Department of Agriculture (USDA). The results of some of these tests are available at **http://www.cprl.ars.usda.gov/REMM_Publications.htm**. Recent studies of small wind turbines include one on airfoil evaluation [**http://www.cprl.ars.usda.gov/REMM%20Pubs/Evaluation%20of%20Airfoils%20for%20Small%20Wind%20Turbines.pdf**] and one on solid-state sensors for control and data acquisition [**http://www.cprl.ars.usda.gov/REMM%20Pubs/Affect%20of% 20New%20blades%20on%20Noise%20Reduction%20of%20Small%20Wind%20Turbine%20Water%20Pumping%20Systems.pdf**].

CERTIFICATION

Currently, small wind turbines can be certified to the 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.

The formation of a U.S. certification body is under way. An organizational plan for the new North American Small Wind Certification Council (SWCC) has been adopted by the Small Wind Certification Working Group. The organizational plan provides the blueprint for the start-up and launch of the SWCC. The council will work with the small wind industry, governments, and other stakeholders to develop and implement quality certification programs.

The working group includes 15 representatives from several states, small wind turbine manufacturers, and other interested parties as well as three facilitators, including the IREC. In addition, the group has 26 alternates and observers.

The role of the SWCC, which is expected to become operational in 2008, is to verify and certify the results of small wind turbines tested to the AWEA standard. The corporation's initial scope will include newly manufactured turbines that fall below the IEC 61400-2 limit of a swept area of 200 square meters, approximately 65 kW. The SWCC board of directors may consider expanding certification to larger turbines at a later date.

According to the IREC, a SWCC certification label will include rated annual energy (at a one-year average wind speed of 11.2 mph, although this may change), a rated sound level (which cannot be exceeded 95% of the time by average wind speed of 11.2 mph), and rated power (24.6 mph).

The IREC expects the first set of certifications in late 2008 or early 2009, assuming sufficient funds and adoption of the AWEA performance standard. Fees are expected to cover one-third of the first year of expenses, increasing to 100% in the fifth year.

Why Member-Consumers are Interested in Small Wind Systems

Understanding the reasons for member interest in small wind generation may be helpful to cooperatives. When asked why they installed a small wind system, cooperative members tend to give three reasons, according to a small sampling of member-consumers in seven states. In addition to the production of green power, they cite energy independence and reduced utility bills.

ENVIRONMENTAL CONSIDERATIONS

In the 2003 *Home Power* survey, 18% of readers said they supported small-scale renewable energy because of its positive environmental impact. In the 2006 survey, 19% said they were interested in renewable energy because it would minimize their impact on the environment. Some environmentally conscious consumers will choose to invest in a wind turbine even when it does not save them money.

REDUCED UTILITY BILL

Of respondents to the 2006 *Home Power* reader survey, 14% said they supported small-scale renewable energy as a means of reducing their utility costs. Properly sited and installed, the right small wind system could potentially reduce a consumer's utility bill significantly, in some cases by up to 80%. Experts caution, however, that a small wind turbine should not be seen as a moneymaker. Consumer expectations about the economic value of wind investments often outstrip reality. Whether a small wind turbine will actually save a consumer money in the long term will depend on a range of factors discussed in greater detail elsewhere in this guide.

OPERATIONAL COST MANAGEMENT

As volatile energy costs put added pressure on profitable farming operations, small wind systems can provide energy cost stability over the life of the wind turbine. It is sometimes more important—especially to contract livestock operators where margins are prenegotiated—to be able to predict future operating costs, including energy, than basing contracts on current prices. Farm wind turbine systems can offer these types of management opportunities.

OTHER REASONS

In the 2006 survey, 17% said they were interested in experimenting with the technology. Many homeowners are enamored by the new technology and are more interested in being on the cutting edge than even in saving money.

What Your Member-Consumers Want from You

Experience to date indicates that some member-consumers interested in installing a small wind system will want their cooperative to provide them basic information on small wind generators. Some cooperatives will include such information in an information packet. Others will refer consumers to outside organizations that provide information on small wind systems, such as the state renewable energy organization or energy office. The DOE's Energy Efficiency and Renewable Energy (EERE) Web site 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.

The U.S. DOE's Small Wind Electric Systems: A U.S. Consumers Guide [**http://www.windustry.org/small-wind-electric-systems-a-us-consumers-guide**] and the EERE [**http://www.eere.energy.gov/windandhydro/wind poweringamerica/small_wind.asp**] provide information on small wind systems.

This guide offers a draft of FAQs that can be included in the packet that cooperatives prepare for member-consumers. Some of the questions that member-consumers most often asked the cooperatives profiled in the case studies section are included in the draft consumer handout section at the end of this guide.

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Member-consumers may have unrealistic expectations or misperceptions of the cooperative's role. They may expect interconnection to be cheap and easy. They also may expect that there will be no change in the rate they pay. And they may expect to be credited at the retail rate for any excess electricity sent to the grid. Cooperatives will want to be prepared to address those expectations in a productive manner, explaining what the cooperatives' policies are, and explaining how those policies are designed to preserve the safety, reliability, and affordability of electric service for all of the cooperatives' consumers.

INTERCONNECTION

Member-consumers may think that interconnecting a small wind system to the grid can be accomplished easily and cheaply. In some cases they may be right, in others, the process may be significantly more complicated. A small wind system can affect the safety and reliability of the distribution system and the quality of power received by neighboring consumers. The cooperative's technical interconnection rules are designed to address such effects on safety, reliability, and power quality.

Interconnection will also entail costs for the consumer. These include: equipment that must be installed on the consumer's side of the meter to protect the generator and the consumer's own electrical system; equipment that must be installed on the consumer's side of the meter to protect safety, reliability, and power quality on the grid; and possibly upgrades to the distribution system. Such upgrades may be required to address reversed power flows, increased short-circuit voltage, or even to provide three-phase service to the new generator. The consumer will also be expected to pay for the cooperative staff time and resources required to process the interconnection application and to conduct any necessary studies needed to determine whether the generator poses risks to the system, and if so, what upgrades are needed to address those risks. Finally, depending on the choices made by the local system, the consumer may also be required to carry additional liability insurance to protect the cooperative in the event an equipment malfunction causes harm to life or property.

In some cases, the process, fees, and contracts for interconnection will be mandated by state law or regulation. Some states have developed interconnection standards and a few have precertified models of distributed generation (DG) units for interconnection. The comprehensive interconnection rules typically standardize the interconnection applications, review procedures, interconnection contracts, and interconnection fees. They also establish standardized technical requirements for the DG technologies. For more information, see the NRECA's *White Paper on Distributed Generation*.

In a very few situations, particularly in investor-owned utility (IOU) distribution systems, interconnection might be governed by federal regulations established by the Federal Energy Regulatory Commission (FERC) in Order 2006.

In most cooperative systems, the rates, terms, and conditions of interconnection will be established by the cooperative. The NRECA's DG interconnection toolkit contains a wealth of information on interconnection issues to help cooperatives adopt procedures, contracts, and rates that serve those cooperatives' specific needs.

STANDBY CHARGES AND FIXED FEES

Member-consumers may think that by generating their own electricity they can dramatically reduce their monthly electric bill by significantly reducing the amount of energy they buy from the cooperative. Many cooperatives are concerned about consumer-owned generation for exactly this reason. Those cooperatives recover a significant portion of the fixed costs of providing service through their energy charge. If a consumer significantly reduces their usage, they also significantly reduce their contribution toward the cooperative's fixed costs and margin.

To protect themselves from this lost contribution toward fixed costs, some cooperatives have adopted a standby charge or higher fixed monthly fee for consumers with their own generation. Unfortunately, this approach is controversial because it deprives consumers a part of their expected value from self-generation by increasing the minimum bill they must pay regardless of how much power they generate. Manufacturers of distributed generators and environmental advocates firmly oppose standby charges; in some states, standby charges are prohibited by law.

Cooperatives that have adopted standby fees have found that they need to address the concern that standby charges are discriminatory or intended to prevent consumers from installing their own generation. Such fees generally need to be carefully explained to demonstrate that they are intended to ensure rate equity among all member-consumers. It is also important that such fees have been adopted and put on the books long before they are imposed on a consumer-generator. Otherwise, the fee looks more like deliberate discrimination against the individual consumer.

The NRECA's manual on rates, *Developing Rates for Distributed Generation*, provides details on DG costs. It is available in the DG interconnection toolkit.

NET METERING

A member-consumer may expect to receive credit at the retail rate for any net excess electricity sent to the grid, that is, for any generation produced at any particular time in excess of the consumer's load at the time. This is called net metering. Manufacturers of distributed generators and environmental advocates strongly support net metering because it increases the economic viability of small wind generators. Some consumers and government officials believe (incorrectly) that if a utility does not offer net metering then the consumers cannot interconnect to the distribution system or will not be compensated at all for any net excess generation.

On the other hand, most cooperatives either do not offer net metering or limit net metering to a limited number of generation types and sizes of generation. Those cooperatives are concerned that net metering overcompensates consumer-owned generators for their net excess generation. Most cooperatives pay for net excess generation at the level required by the PURPA, which is the cooperatives' avoided cost (the cost that a utility would incur if it had generated the power itself or purchased it from another source).

To limit conflicts, it can be helpful if a cooperative's policy for purchasing net excess generation is adopted well before any consumer seeks to interconnect generation, is extremely clear, and is supported by data demonstrating that the policy is necessary to ensure equitable rates for all consumers on the system. It may help if the materials the cooperative hands to consumers interested in self-generation explain the cooperative policy, explain what net metering is, and if they are different, explain why the cooperative does not offer net metering. An issue paper on net metering is available on the NRECA's Web site [**http://www.nreca.org/PublicPolicy/ElectricIndustry/distributedgeneration.htm**].

The use of two meters or a single advanced meter capable of reading power flows each direction provides a way for member-consumers to pay their fair share of costs for electric service while benefiting from their small wind system. One meter measures electricity coming from the grid and one meter measures electricity being delivered to the grid. This approach is consistent with the PURPA, where the consumer buys power from the cooperative at the retail rate and sells power to the cooperative at the avoided—or wholesale—cost.

Member-consumers may ask about the difference between net metering and net billing. In net metering, the electricity being delivered to the grid by the member-consumer is netted against the electricity being delivered to the member-consumer. The value of power imported and exported, therefore, is the same. Consumers are paid full retail value for the wholesale power they export to the grid. By contrast, net billing nets the value of power exported against the value of power imported, allowing the retail and wholesale power to be valued at different levels. The netting occurs in the billing process. Under both approaches, the consumer has first call on generator output. The utility only buys that portion of the consumer's output that exceeds simultaneous demand. The consumer only buys from the utility that portion of the consumer's load that exceeds the simultaneous output of its generator.

A third option, typically used only for much larger generators than those discussed in this paper, is called dual metering. Under that approach, the consumer's premises are metered separately from the generator. All power produced by the generator is sold directly to the utility. All power used by the consumer is purchased from the utility. The PURPA prohibits utilities from requiring dual metering for QFs.

At present, 42 states and the District of Columbia have some kind of net metering rule. Of those 43 jurisdictions, 24 require rural electric cooperatives (RECs) to offer net metering:

- Arkansas
- California
- Colorado *(cooperatives with more than 5,000 consumers)*
- District of Columbia
- Georgia
- Hawaii
- Kentucky
- Louisiana
- Maine
- Maryland
- Michigan *(those RECs participating in the state's voluntary net metering program)*
- Minnesota
- Missouri
- New Hampshire
- New Mexico
- New York
- Oklahoma *(cooperatives that are regulated by the Oklahoma Corporation Commission)*
- Oregon
- Utah *(certain RECs)*
- Virginia
- Vermont
- Washington
- West Virginia
- Wyoming

In these states, the consumer's meter runs backwards when that consumer sends excess electricity to the grid. Some states prohibit payment to consumers for net exports while other states require utilities to pay consumers avoided cost or credit consumers the full retail price for their excess electricity. Detailed information on state-level requirements for net metering is available at **http://www.dsireusa.org**. The EERE Web site provides a table and a map with state-by-state net metering rules [**http://www.eere.energy.gov/greenpower/markets/netmetering.shtml**]. For more information on net metering, see the NRECA's *White Paper on Distributed Generation and Issues Report*.

Getting Ready for Your Member-Consumers

1. Appoint a single point of contact for interested consumers. Most cooperatives will choose to identify a single point of contact at the cooperative for consumers who are interested in small wind. That point of contact will help avoid confusion for both the cooperative and the consumer, prevent consumers from undergoing an inadvertent runaround, and ensure that consumers are given a single, consistent message about small wind at the cooperative. In many cases the consumers' first interaction with the cooperative concerning a small wind turbine will set the tone for the relationship between the consumer and the cooperative for years to come. A positive interaction with the cooperative's wind or DG expert can put things on the right foot from the beginning.

2. Develop a communication strategy. The first step in preparing to help member-consumers interested in small wind systems is to develop a communication strategy. Intended to promote communication between member-consumers and the cooperative, and between the cooperative and the broader community, the strategy has several aims:

- Encourage member-consumers to talk with you first and to involve you early in their plans for a small wind system
- Explain the cooperative's goals
- Explain the cooperative's responsibilities and the balance that you must achieve among these responsibilities (helping member-consumers, supporting the community, protecting the environment, and maintaining the health of the electricity system)
- Encourage member-consumers to use the handout material that you provide
- Celebrate and advertise to the community and the state government the cooperative's positive achievements

Member-consumers need to know that they should meet with the appropriate cooperative representatives before they purchase a small wind system. This meeting will allow the cooperative and the member-consumer to gain an understanding of mutual and individual expectations. During your meeting with a member-consumer, you also will have an opportunity to explain the cooperative's goals, which include protecting the safety of cooperative personnel and member-consumers, maintaining the integrity and reliability of the grid, and establishing mechanisms to ensure rate equity for all member-consumers. The earlier in its evaluation process a consumer meets with the cooperative the more positive subsequent interactions are likely to be. The consumer will not have firmly established expectations and will not have made a financial outlay in reliance on those expectations. Early warning can also help the cooperative ensure that its processes are in place to adequately address the new wind resource.

An important part of your communication strategy is to encourage member-consumers to use all the materials that you provide, and to contact you with any questions or concerns about the material.

3. Prepare an interconnection packet. After developing a communications strategy, the next step is to prepare an interconnection packet. The packet could include:

- Contact information for the relevant staff members at the cooperative
- A two-page capital cost recovery analysis
- A summary of the interconnection process
- An interconnection application
- The cooperative's interconnection contract
- The DG rates summary sheet

The two-page document on capital cost recovery walks member-consumers through the process that will help them decide whether to buy a small wind system. The document is provided as a separate handout for member-consumers.

Point out that the cooperative understands the complexities of interconnection issues and has streamlined the process to allow safe, reliable, efficient, and cost-effective interconnection of member-consumers' small wind systems. Include a copy of the cooperative's interconnection contract in the packet for member-consumers.

In addition to providing a summary of the interconnection process, you may want to provide a flowchart showing the highlights of the interconnection process. The Iowa Association of Electric Cooperatives (IAEC) has developed a set of communication tools that includes a sample document describing the interconnection process, including a flowchart. The documents are available on the Cooperative Research Network (CRN) Web site [**https://www.cooperative.com/general/resources/ConsumerKit/ConsumerOwnedKit.htm**].

As indicated above, the NRECA's DG interconnection toolkit contains a wealth of information that includes consumer guidelines for interconnection and model interconnection applications and contracts. Cooperatives can draw on this information in developing materials for member-consumers interested in small wind systems.

4. Establish rates and fees. In response to the PURPA, all cooperatives should have developed PURPA compliance procedures in the late 1970s. Those procedures should include rates and fees for QFs, including small wind systems, as well as the rates that the cooperative should pay for the output of such generators.

Small Wind Basics

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Many cooperatives have not received any interconnection requests since 1978, and thus have not dusted off their old PURPA compliance procedures. It may be helpful, therefore, for cooperatives to relook at the potential costs and benefits associated with small wind systems and develop appropriate rate schedules, as discussed in the NRECA's manual on rates, *Developing Rates for Distributed Generation* (available in the DG interconnection toolkit).

The manual provides general background information on rate development and reviews issues related to DG. The section on utility cost structure and rate setting addresses distribution cooperative cost-of-service issues and rate design options. The section on DG issues includes a discussion of requirements contracts, impact on system requirements, and utility costs and interconnection requirements.

The section on the development of DG rates describes considerations and processes involved in evaluating and developing rates that are applicable to DG. As noted in this section, cost analysis and rate design must recognize the specific impacts that each DG application will have on a cooperative's costs and on service to other member-consumers. The final section of the manual outlines an evaluation process for DG applications.

When its evaluation process is completed, a cooperative will have developed:

- A fee schedule for interconnection applications, likely keyed to the size of the generator seeking to interconnect
- A fee schedule or formula for any necessary system impact and facilities studies that may be required for interconnection
- Retail rate structures for consumer-generators that may include higher monthly customer fees or standby charges to recover the cooperative's fixed costs of service (alternatively, some cooperatives may choose to move all consumers to a rate structure under which fixed costs are recovered through a fixed customer charge)
- A rate schedule for purchase of consumer-owned generation, including a predetermined standard rate for all generators with a capacity under 100 kW or a rate schedule reflecting the price that the cooperative's power supplier will pay for such power; such rates may or may not provide for net metering for some types of generation, depending on the cooperative and its individual goals or situation
- Detailed explanations of each fee and rate, with data demonstrating the reasons why the cooperative adopted the specific charges

The detailed explanation may not be handed out to individual consumers, but should be available in the event that the cooperative's charges are challenged in the media, in court, or by the government. Understandably, rates and fees are among the most contentious elements of the interconnection process and are most likely to be challenged by consumers.

5. Develop application guidelines. The application guidelines are an engineering tool. The guidelines establish the technical interconnection process and help to guide the cooperative's engineers as they seek to determine what impact a proposed generator may have on the cooperative and what remedial measures may be necessary to protect the cooperative in light of those impacts.

The NRECA's DG interconnection toolkit includes model application guidelines developed together with the NRECA Transmission and Distribution (T&D) Engineering Committee. The model should be reviewed by each cooperative's engineering team and management to ensure that they meet the needs of the individual cooperative.

Cooperatives also should refer to the small wind applets—software tools—that the CRN has developed to help distribution and planning engineers in assessing and applying wind generation on their systems' distribution feeders. Information is available at **https://crn.cooperative.com/Results/items/2003/CRNResult_03-15.htm**.

6. Develop internal interconnection procedures. It will be very helpful to most cooperatives to have a written internal process for processing interconnection applications. Such procedures explain who in the cooperative is responsible for each aspect of processing the application, the time permitted for each step, and the points in the process when further contact with the interconnection applicant is necessary. The procedures ensure that no applications fall through the cracks and that the cooperative enjoys continued good relationships with consumers applying for interconnection. Unexplained processing delays are among the primary causes of conflict with consumers.

Once the cooperative has adopted internal procedures, it can develop consumer-focused materials that walk consumers through the interconnection procedures, explain the schedule for consideration of the interconnection application, and provide the consumer with deadlines for meeting their obligations in the interconnection process (such as the time within which they must provide any missing data in the application form before their application is deemed withdrawn).

The NRECA's DG interconnection toolkit includes model interconnection procedures that can help cooperatives develop both internal processes and consumer guidance. The model should be reviewed by each cooperative's management and engineering team and modified as necessary to meet the needs of the individual cooperative.

7. Develop an application form. You should also adopt an application form. The form should, when completed, provide contact information and basic engineering information about the member-consumer's proposed facility as well as information needed to ascertain appropriate interconnection requirements. Ask the member-consumer to obtain and verify the accuracy of the information by checking with the manufacturer.

The NRECA's DG interconnection toolkit includes model interconnection applications, including a simplified application for very small generators, and a more complex application form for larger generators. The models should be reviewed by each cooperative's engineering team and management and modified to ensure that they meet the needs of the individual cooperative.

8. Develop an interconnection contract or contracts. Interconnection of even a small generator to a cooperative's distribution system raises a number of questions concerning the parties' respective rights, obligations, and legal liabilities. It is important for those issues to be resolved before interconnection through a interconnection contract. As with all of the other elements of the interconnection process, cooperatives will generally be better off if they have developed an interconnection contract or contracts before any consumer seeks to interconnect a generator.

The NRECA's DG interconnection toolkit includes two model contracts: one very simple contract for certain small generators and a more complex contract for larger generators. Each cooperative's management and lawyers should carefully review the models and modify them as necessary to meet the legal, economic, and policy goals of the individual cooperative.

Case Studies

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Case Studies

Seven cooperatives—and their members—participated in case studies of small wind systems for this guide. The case studies provide geographic diversity, and they cover a wide range of wind turbine sizes, from 1.5 kW to 65 kW.

Each case study looks at the benefits and costs of small wind systems from the perspective of the cooperative as well as the cooperative member-consumer.

One key lesson learned from the case studies is the importance of maintaining an open dialogue between a cooperative and its member-consumers, and the value of striking an agreement that works for all parties.

The cooperatives profiled are:

- East-Central Rural Electric Cooperative (REC), Iowa, (Harry Ruth, CEO and general manager)
- Lyon-Lincoln Electric Cooperative, Minnesota
- Haywood Electric Membership Corporation (EMC), North Carolina
- United Electric Cooperative (EC), Pennsylvania
- CoServ Electric, Texas
- Washington EC, Vermont
- Pierce Pepin Cooperative Services, Wisconsin

East-Central Rural Electric Cooperative

COOPERATIVE REPRESENTATIVE

Harry Ruth, CEO and general manager

COOPERATIVE MEMBERS INTERVIEWED

Dan Isbell: Bergey 1500 (1.5 kW) wind generator, installed in 1999. *Note: Bergey 1500 discontinued in 2002, replaced with Bergey XL.1 (1 kW).*
Tower height: 87 feet.

John Bendickson: Vestas 65 kW wind generator (remanufactured), installed in 2003.
Tower height: 80 feet.

John Bendickson's rebuilt 65 kW wind turbine produces more than enough electricity to meet his needs.

WHAT COOPERATIVE MEMBERS DID AND WHY

Both Isbell and Bendickson decided to install a small wind turbine because they wanted to use renewable energy to generate electricity. Isbell began by metering his electricity use, and set a goal of reducing it by about 25% through energy efficiency and conservation measures. By taking a number of different actions, he reduced his electricity use by 90%.

To determine the wind resource on his property, Isbell used the Iowa Energy Center's wind resource maps [**http://www.energy.iastate.edu/renewable/wind/ maps-index.html**]. Bendickson used the maps on the Iowa Department of Natural Resources' Web site [**http://www.iowadnr.com/energy/wind/ index.html**].

Zoning, permitting. Neither Isbell nor Bendickson had to deal with any zoning or permitting issues. Bendickson hosted an open house about a month after his wind generator was installed so he could talk with his neighbors about the system and answer any questions they might have.

Case Studies

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Project economics, output and cost. Isbell planned to combine a wind generator with a 1.2 kW photovoltaic (PV) system. He calculated that the wind generator would produce 4–5 kWh a day and the PV system, about 2 kWh a day. Because of the excellent performance of the PV system, it produces about 3.6 kWh a day. The wind system produces less than Isbell estimated—about 1 kWh a day. Isbell admits the wind generator has not produced as much energy as he thought it would. The generator's rated output is based on a wind speed of 28 mph, he stated, adding that the wind rarely reaches that speed at his site.

Isbell looked at larger wind generators, in the 3.5–4 kW range, but decided against a larger size because of possible maintenance issues. Because of the terrain, there was no room for guy wires on his site, which meant he had to erect a pyramidal lattice tower. The only way to maintain the turbine was by boom truck or climbing up the tower. He chose the Bergey because of its reliability. "We didn't want to buy a less expensive machine that required maintenance," Isbell said. Since installation in 1999, he has climbed the tower once to scrape rust off the mast. Because of concerns about lightning strikes, Isbell talked with his installer, who suggested using lightning arrestors.

Isbell's wind generator cost $4,500, the tower cost $2,800, and installation cost about $2,400. The inverter, battery disconnect, and wiring cost about $4,000. The total cost was $13,700.

Bendickson wanted to offset all of his electricity use. To determine what wind generator he needed to achieve his goal, he referred to performance data on the Iowa Department of Natural Resources' Web site. After considering a new Bergey 10-kW machine, Bendickson settled on a partly rebuilt Vestas generator from Energy Maintenance Service (EMS), which buys and remanufactures wind turbines from California as well as installing and maintaining new wind generators.

Bendickson settled on the Vestas generator for reasons of cost, availability, and size. He had wanted to spend no more than $20,000 for a wind generator, but spent roughly twice that amount. Bendickson said he seriously underestimated the cost of installation. Nonetheless, he calculated his simple payback—based on an annual output of 45,000 kWh—to be 10 years. Bendickson pointed out that many people who say they cannot realize a payback for their wind generator have not taken into account the generator's resale value. He said that even after his generator—which operated for approximately 18 years before it was rebuilt—has been running for 10–15 years, he could get a price commensurate with what he paid for it.

The installed cost of Bendickson's wind generator was $35,000. He said that worked out to a cost of 50 cents/W. He said the same machine today would cost him $3/W. Bendickson's tower is 80 feet tall, but he noted a 110-foot tower would have been better. Although a taller tower would have boosted his energy production by at least 20%, he decided against it because of the expense.

Incentives. Isbell took advantage of the Iowa Alternate Energy Revolving Loan Program [**http://www.energy.iastate.edu/funding/aerlp-index.html**]. Under the program, the Iowa Energy Center provides up to 50% of the total cost of a project (up to $250,000) at 0% interest for up to 20 years. Matching financing for the project must be obtained from a lender of the applicant's choice. Isbell said the Iowa Energy Center acted as the technical advisor to the bank from which he obtained the second half of the loan.

Bendickson said that he considered the state's Alternate Energy Revolving Loan, but decided against it because of some of the conditions. He does receive the federal renewable electricity production tax credit of 2.0 cents/kWh for electricity sold to an unrelated third party [**http://www.dsireusa.org/library/includes/ incentive2.cfm?Incentive_Code=US13F&State=Federal%C2%A4tpageid=1**]. To become eligible for this incentive, Bendickson applied to the Federal Energy Regulatory Commission (FERC) to become a qualified cogenerator.

Iowa also provided renewable energy tax credits for facilities that began operating on or after July 1, 2005. One, for renewable energy facilities, including wind, provided a credit of 1.5 cents/kWh. The other, specifically for wind energy facilities, provided a 1 cent/kWh credit. Although both credits were available to the residential sector, an applicant could receive a tax credit under only one of these two programs. (The two programs were funded in 2005 and 2006, but they were not renewed in 2007.)

Neither Bendickson nor Isbell was eligible for the tax credit because his system was installed before mid-2005.

In addition, the market value added to a property by a wind energy system is exempt from state property tax for five full assessment years. Iowa law also exempts from state sales tax the total cost of wind energy equipment, including installation.

Finding a vendor/installer. Isbell found a renewable energy supplier online, talked with the technical support staff, and visited the company's store in Wisconsin. He also attended Iowa's renewable energy fair and the Midwest renewable energy fair in Wisconsin, where he talked with wind energy experts. He also visited a home with a small wind system. Isbell found an installer who had a booth at the Iowa fair.

Bendickson did a great deal of research on the Internet, which eventually led him to EMS in South Dakota.

Interaction with cooperative. Isbell purchased a battery bank for his wind and PV systems because his cooperative did not offer net metering when he installed his system. When Isbell contacted the cooperative in 1999, he said those he talked with tried to discourage him from installing a renewable energy system.

Bendickson said that he first talked with the cooperative in 2000 about his plan to buy a small wind system, and was not encouraged to do so. At that time, the cooperative suggested that if Bendickson were to install a wind generator, he should sell all the power to the cooperative.

Both men agreed that as a result of a management change in 2003, the cooperative was much more receptive to small wind systems. Bendickson said that because of the new attitude, he decided in 2003 to go ahead with the installation of a wind turbine. When Harry Ruth, the cooperative's CEO and general manager, heard about Bendickson's plans, he said that the cooperative would be supportive.

COOPERATIVE POLICIES

Interconnection agreement. East-Central Iowa REC has a standard interconnection agreement that members with small power production facilities are required to sign. Under the agreement, which is available on the cooperative's Web site [**http://www.ecirec.coop/prod_serv/renew.shtml**], members must pay for any necessary metering equipment. The member also must purchase comprehensive general liability insurance of not less than $1 million prior to interconnection. East-Central Iowa's interconnection agreement will soon be available at **http://www.lyon-lincolnelectric.coop**.

Isbell was required to pay about $750 for a meter that reads kilowatt-hour flow every 15 minutes. He also paid for a lockable disconnect box.

About a month after his wind generator began operating, Bendickson asked the cooperative to review the safety systems. Cooperative employees did a simulated line failure to test the systems.

Net metering policy. Ruth, CEO and general manager, stated that East-Central Iowa REC offers net metering. Although cooperatives are not required to net meter in Iowa, the cooperative does so to improve public relations and earn goodwill. Moreover, the cooperative expects that only a limited number of members will install wind turbines. "Technically, we offer net metering to any facility less than 100 kW," Ruth stated.

If a cooperative member with a wind generator sends more electricity to the grid than the member buys from the cooperative, the member receives a credit that can be used in any month of the year.

Isbell purchased a battery bank for his wind and PV systems because his cooperative did not offer net metering when he installed his system. But in 2004 the cooperative began to net meter. Isbell's battery bank must be 100% full before he can send excess electricity back to the grid. Under the cooperative's net metering policy, Isbell is credited for his excess electricity at the retail rate of 11.5 cents/kWh, but not until he has sent enough electricity into the grid to reduce his monthly facility charge—about $17—to zero.

Isbell credits Harry Ruth with the change in cooperative policy on net metering. "Harry has made all the difference," he said.

Bendickson buys cooperative power at 11.5 cents/kWh when there is not enough wind to produce all the electricity he needs, and sells any excess power to the cooperative at the wholesale rate of 2.67 cents/kWh. Bendickson said that he has opted for net billing rather than net metering because he generates so much excess electricity that "banking" it would not work for him.

COSTS AND BENEFITS

Member-consumer perspective. In addition to the installed cost and other interconnection charges, Bendickson pays $300–$400 a year for the liability insurance policy on his wind turbine. He said that because of the size of his wind generator, this expense does not impact the system's economics. But he added that this is not necessarily the case for those with smaller wind systems. He knows people who have decided against buying a small wind generator because of the cost of liability insurance.

Both Bendickson and Isbell point to the generation of emission-free electricity as a major benefit. Bendickson added that if distributed generation (DG) produced a larger percentage of power, consumers would benefit from lower cost electricity by avoiding the 7% of power lost in transmission.

Cooperative perspective. Ruth sees no financial benefit to the cooperative from small wind systems, particularly if net metering is available. But it may be beneficial that the cooperative is seen as supporting renewable energy.

Ruth said the cooperative receives a couple of inquiries a month about small wind. To help answer members' questions, the cooperative worked with the Iowa Association of Electric Cooperatives (IAEC) to develop a set of frequently asked questions (FAQs) on small wind systems. The FAQs are available on East-Central Iowa's Web site [**http://www.ecirec.coop/prod_serv/renew.shtml**].

Lyon-Lincoln Electric Cooperative

COOPERATIVE REPRESENTATIVE

Timothy O'Leary, general manager

COOPERATIVE MEMBERS INTERVIEWED

Greg and Kathy Taveirne: Minnesota Windpower's Windharvester E15 (a rebuilt 65-kW machine reconfigured to 35 kW), installed in 1992.
Tower height: 100 feet.

Wayne Hesse: two generators, one a Minnesota Windpower machine (reconfigured to 39.5 kW), installed in 1992, and one a Vestas V-15 (reconfigured to 39 kW), installed in 2000.
Tower height: 80 feet.

Pat McFarland: Vestas V-15 (a rebuilt 65 kW machine reconfigured to 40 kW and marketed as a Vestas E-15), installed in 2000.
Tower height: 85 feet.

Greg and Kathy Taveirne's rebuilt 35-kW wind turbine saves the couple more than $5,000 a year in electricity costs for their farm.

WHAT COOPERATIVE MEMBERS DID AND WHY

The Taveirnes decided to buy a wind generator both as an investment and to reduce their electricity bill. They farm 1,200 acres—half corn, half soybeans—and feed about 4,000 hogs a year. For Hesse, who has 100 acres (80 devoted to corn), energy independence and the ability to produce green power were the main reasons he bought a wind generator. McFarland, who also lives on a farm, bought a wind turbine so he could generate his own power.

To determine the wind resource at his site, McFarland—who lives in southwest Minnesota—installed an anemometer. He collected about six months' of data, which indicated his site had winds of up to 20–25 mph. Hesse used the wind maps available on the Minnesota Department of Commerce's Web site [**http://www.state.mn.us/portal/mn/jsp/content.do?contentid=536887066&contenttype=EDITORIAL&agency=Commerce**]. He lives on Buffalo Ridge in the southwestern part of the state, and when construction began on a commercial wind farm six miles from his land, it convinced him that he had a good wind resource. Minnesota Windpower, the turbine supplier, determined the Taveirnes' wind resource.

Zoning, permitting. Neither McFarland nor the Taveirnes had any zoning issues. When Hesse' second wind generator was installed in 2000, he had to get a land use permit, which cost $50, and he had to check with the city of Tyler to ensure the wind turbine would not be in the flight path of the local airport.

Project economics, output, and cost. The first wind generator that Hesse bought had an estimated output of 75,000 kWh a year, but in fact the machine averages 68,000 kWh a year. The second wind generator—also a 40-kW machine—incorporates newer technology and produces 85,000 kWh a year. The payback period for the first generator, with an installed cost of $31,000, was between eight and nine years. For the second generator, which had an installed cost of $45,000, the payback period was 4.5 years. State incentives helped to shorten the payback period for the second generator.

Hesse estimates that he saved about $8,000 on the installed cost of both generators by doing the foundation work, putting in underground wire, and helping to pour concrete.

The installed cost of McFarland's wind generator was approximately $32,000. Two years after installation, the generator burned out in a wind storm and was replaced by EMS of South Dakota, from which McFarland bought his wind generator. McFarland's generator produces enough electricity from late fall to early spring to cover his electricity demand.

The installed cost of the Taveirnes' generator was $33,500. They use about 95% of the electricity their wind generator produces—60,000–70,000 kWh a year—and send the remainder back to the grid. The Taveirnes estimate their return on investment at 14–15%. Their retail electricity rate is 9 cents/kWh and they save between $5,000 and $5,500 on their electricity bill annually.

EMS provides maintenance service to the Taveirnes, Hesse, and McFarland. The cost—for two visits a year—is between $1,200 and $1,500 annually.

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Incentives. When McFarland was considering the purchase of a wind turbine, he said that incentives did not play a role in his decision.

Hesse said that he considered a USDA 9006 grant, but the application process was too complicated. For his second turbine, Hesse receives a production credit of 1.5 cents/kWh offered by Minnesota. The program was closed to new applicants on January 1, 2005. In addition, he also receives a federal production tax credit of 2.0 cents/kWh for his second turbine, which is available to wind generators in the commercial and industrial sectors. Hesse noted that while the incentive is available on passive income to large corporations and investors, an individual who owns a wind turbine is allowed to take the tax savings on personal income by filing IRS form #8835. He receives approximately $3,400 annually in tax credits for the second turbine.

At the time their generator was installed, no incentives were available, stated Greg Taveirne.

Finding a vendor/installer. EMS, from which the Taveirnes, Hesse, and McFarland bought their wind generators, installed the systems.

Interaction with cooperative. Hesse stated that when he decided to install his first turbine, the cooperative was not very helpful. But it was supportive when he installed the second turbine. A change in cooperative management accounted for the change, according to Hesse. Greg Taveirne stated that, initially, there was some resistance from the cooperative but it is now more supportive. McFarland noted that at first he was seen by the cooperative as a competitor in electricity generation, but now the cooperative is more accommodating.

COOPERATIVE POLICIES

Interconnection agreement. The Minnesota Public Utilities Commission in 2004 established generic standards for interconnecting DG up to 10 MW. The standards include an interconnection application, which Lyon-Lincoln uses for its members. The full text of the standards is available at **http://www.puc.state.mn.us/docs/orders/04-0131.pdf**.

As part of the interconnection agreement, the cooperative requires members who wish to connect their systems to the grid to purchase $300,000 in liability insurance. The amount of the policy is based on Minnesota guidelines, stated Timothy O'Leary, general manager. The cooperative will soon have the interconnection agreement on its Web site [**http://www.lyon-lincolnelectric.coop**].

Net metering policy. Under Minnesota's net metering law, all utilities—including cooperatives—are required to compensate consumers with renewable energy systems of up to 40 kW at the average retail rate.

Hesse estimated that he receives about $9,000 annually for the electricity that he sells back to the grid. Generation from the first turbine accounts for approximately 30% of the total; generation from the second turbine, approximately 70%. McFarland receives an estimated $2,500 annually for the electricity he sells to the cooperative. The Taveirnes receive approximately $300 annually from the cooperative.

COSTS AND BENEFITS

Cooperative member perspective. For the Taveirnes, Hesse, and McFarland, the benefits of a small wind system outweigh the costs, because of the state's net metering policy and state financial incentives.

Cooperative perspective. O'Leary, Lyon-Lincoln's general manager, said that the cooperative's nine members with small wind systems add a small cost to the rest of the membership. The additional cost comes from the state's net metering policy, which requires the cooperative to purchase power from small wind turbines at a higher rate than it buys power from East River Electric Power Cooperative, the cooperative's generation and transmission (G&T).

Case Studies

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Haywood Electric Membership Corporation

COOPERATIVE REPRESENTATIVE

Ken Thomas, manager of marketing and communications

COOPERATIVE MEMBER INTERVIEWED

Louis Mes: Bergey Excel-S (10 kW), installed in 2006.
Tower height: 100 feet.

Louis Mes regularly climbs the 100-foot tower to inspect his 10-kW wind turbine.

WHAT THE COOPERATIVE MEMBER DID AND WHY

Mes installed his wind system because he wanted to use renewable energy to generate electricity. His house was energy efficient, and he wanted to be independent.

Mes set up a weather station with an anemometer, which he monitored for approximately a year. The annual average wind speed was 11–13 mph.

Zoning, permitting. Mes did not have to deal with any zoning or permitting issues. He has 72 acres of land, and planned to site the wind system about 1,000 feet from his house. He said that a petition opposing the wind generator was circulated in the area, but once the generator was installed, neighbors—with one exception—were no longer concerned. In light of the initial opposition, Mes compromised by not installing the generator on a ridge, as originally planned. Instead, the generator was installed about 350 feet from the house, at a cost in efficiency.

Project economics, output, and cost. Mes lives and works in Louisiana, and spends only about one week a month at his North Carolina home. He used an estimated 400 kWh a month at the North Carolina home, and initially considered a wind system of less than 10 kW. But ultimately he bought a 10-kW generator, which was a larger and more expensive machine than he had planned to buy.

Case Studies

SECTION 2

The installed cost of the system was approximately $34,000–$50,000 for the wind generator and the remainder for installation. The system has a battery backup, which increased the total cost of the system by about $2,000. Mes said he does not expect to reach payback on the system, in part because—as a Louisiana resident—he is not eligible for any North Carolina incentives.

Mes climbs the 100-foot tower regularly to inspect the generator. If maintenance is needed, the installer provides it.

Incentives. NC GreenPower—a statewide green-power program—provides a production incentive for grid-connected renewable energy installations, and the state also provides a renewable-energy tax credit of up to $10,500 for residential wind systems [**http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=NC&RE=1&EE=1**]. But, because he is not a resident of North Carolina, Mes does not qualify for these incentives.

Finding a vendor/installer. After several frustrating months dealing with a company that could not certify that the engineering would comply with local ordinances, Mes turned to Bergey. Mes found an installer through the contractor who installed his solar hot water heating system.

Interaction with cooperative. Mes stated that the cooperative has been supportive, but there is a philosophical difference of opinion on net metering.

COOPERATIVE POLICIES

Interconnection agreement. The North Carolina Utilities Commission adopted a simplified interconnection standard in 2005 that applies only to consumers of the state's investor-owned utilities (IOUs). Under the standard, residential consumers with renewable energy systems up to 20 kW are eligible.

Haywood EMC introduced a renewable generator rider in 2005 that allows any member who has a source of renewable energy generation to interconnect with the grid [**http://www.haywoodemc.com/pages/RGR%20Rider.html**]. Members with renewable energy systems of no more than 25 kW are eligible. Under the rider, the member pays a monthly facilities charge of $5.25, and is credited for all energy sold to the cooperative at 2.06 cents/kWh.

Haywood EMC provides an application for interconnection on its Web site at **http://www.haywoodemc.com/pages/renewapp.html**.

Net metering policy. The North Carolina Utilities Commission requires the state's IOUs—but not rural cooperatives—to make net metering available to consumers who own and operate renewable energy facilities of up to 20 kW. Under the requirement, the IOUSs must credit any net excess generation to the consumer's next bill at the utility's retail rate.

Under Haywood EMC's metering policy, a member with a renewable energy system of up to 25 kW is credited with any net excess generation at the avoided cost of 2.06 cents/kWh. The cooperative's retail rate is 9.99 cents/kWh.

COSTS AND BENEFITS

Cooperative member perspective. Despite spending more than he planned for his wind generator, Mes is satisfied with its performance.

Cooperative perspective. "At present, Haywood EMC does not see a significant financial advantage from wind or other renewable energy sources installed by its members," stated Haywood EMC's Ken Thomas, manager of marketing and communications. "The cooperative does expect that such emission-free generation will pay great dividends for the environment in the future," he added. Thomas noted that all renewable energy is expensive to generate and interconnect, but its primary purpose is a cleaner and greener environment. "By adding more renewable energy to the grid, less electricity has to be generated from fossil fuel resources, resulting in better air quality," he said.

Case Studies

SECTION 2

United Electric Cooperative

COOPERATIVE REPRESENTATIVE

Richard Heverley, manager, marketing and member services

COOPERATIVE MEMBER INTERVIEWED

Francis Esposito: Bergey Excel-S (10 kW), installed in 2005. Tower height: 140 feet.

Francis Esposito installed his 10-kW wind turbine to reduce his electricity bill and set a precedent for renewable energy in his area.

WHAT THE COOPERATIVE MEMBER DID AND WHY

Esposito bought a small wind generator because he wanted to reduce his utility bill. He also wanted to set a precedent for renewable energy in his area. Through research on the Internet, followed by a visit to a wind generator installed in a state park, he located a small installation company.

The company—North Coast Energy Systems—performed an on-site assessment of Esposito's property. North Coast used wind resource data from the National Oceanic and Atmospheric Administration (NOAA), Department of Energy's (DOE's) National Renewable Energy Laboratory (NREL), and airports in the area. It also studied Esposito's property for trees, terrain, and other wind-impeding obstacles as well as buried utility lines, accessibility, soil conditions, and grid interconnection conditions. The average annual wind speed on Esposito's site is an estimated 8.5 mph, which North Coast said is on the low side. For this reason, the company recommended a tall tower.

Zoning, permitting. Esposito obtained the required building permit. North Coast obtained clearance for Esposito's 140-foot tower from the Federal Aviation Authority as part of the on-site assessment.

Project economics, output, and cost. Esposito wanted to reduce his electricity bill by at least one-third, so the installer suggested a 10-kW system. Given the turbulence at Esposito's site, the installer recommended a Bergey turbine because of its durability. The installed cost of the wind generator was nearly $56,000.

Esposito has 40 acres of land, with 7 to 8 devoted to corn. He also has a tree farm with 5,000–6,000 blue spruce. Amortization rules enabled him to write off 20% of the cost of the system on his income tax for the first year of operation.

Incentives. Under Pennsylvania law, wind generators are not included in property tax assessments.

Finding a vendor/installer. Esposito relied on Internet research to locate an installer in the region.

Interaction with cooperative. Esposito said that United EC was extremely helpful, but Allegheny Electric Cooperative, United EC's G&T, gave him a hard time when he first asked about interconnecting his wind turbine to the grid. Esposito's installer, North Coast Energy Systems, met with Allegheny to resolve various interconnection issues.

COOPERATIVE POLICIES

Interconnection agreement. United EC, in conjunction with the other member cooperatives of Allegheny Electric Cooperative, developed a list of requirements for the interconnection of DG to the grid. These requirements are reflected in the interconnection agreement that a cooperative member must sign for a grid-connected small wind system.

As part of the interconnection agreement, Allegheny, requires the purchase of a $1 million liability insurance policy. Esposito said the cost of such a policy was so high that it negatively affected the wind system's economics. After discussing the issue with North Coast Energy Systems, Allegheny agreed that Esposito could sign a waiver in which he assumed liability. United EC's Heverley said that while the cooperative will not remove the liability insurance requirement from the interconnection agreement, it would consider allowing other members to sign a similar waiver in the future.

Net metering policy. Pennsylvania requires IOUs to provide net metering to consumers at the retail rate. Under the law, IOUs may not require net-metering consumers to install any additional equipment or carry liability insurance. The law applies only to IOUs. Although Pennsylvania cooperatives are not mandated to provide net metering under this law, it is the cooperatives' position that its members should have the same opportunities to take advantage of renewable energy technology that are available to other state residents, United EC's Richard Heverley stated. The cooperatives do feel, however, that they have a duty to ensure that their members are aware of the liabilities involved in operating a grid-connected generator. Thus, cooperative members are required to carry liability insurance to protect the financial interests of all concerned.

Under Esposito's contract with United EC, which is still valid, the cooperative agreed to credit any excess electricity generation to the next month's bill, at the retail rate of 10.29 cents/kWh, and square up every 12 months. But United EC has since developed a new contract that requires a member's account to be squared up at the end of each month, and pays the avoided cost of approximately 2.6 cents/kWh for any electricity sold to the grid, Heverley stated.

COSTS AND BENEFITS

Cooperative member perspective. Esposito had wanted to reduce his electricity bill by \$60–\$70 a month; in fact, he is reducing it by an average of \$50 a month because the output of the generator is lower than expected.

Esposito has expressed disappointment with the effect of lightning on the inverter. His property—but not the wind generator itself—has been struck by lightning twice. The first strike, which was a ground strike, was absorbed by the surge arrestor. North Coast Energy Systems was able to replace the blown arrestor on site. The second lightning strike was extremely powerful. It struck and destroyed a 50-foot oak tree that was 500–1,000 feet from the wind generator. The ground surge knocked a man to the ground in a nearby field, and ran along the wiring path between the turbine and the building housing the inverter. The current moved so quickly that the fuses and breakers could not respond and the arrestors could not absorb the current. The surge destroyed the main board and other components inside the inverter. The inverter was sent to the inverter manufacturer for repair, and North Coast installed additional lightning protection. All damage was covered by Esposito's homeowner insurance policy.

Cooperative perspective. United EC "wholeheartedly supports small generation initiatives," stated Heverley.

CoServ Electric

COOPERATIVE REPRESENTATIVE

Curtis Trivitt, Senior Vice President, Energy Services

COOPERATIVE MEMBER INTERVIEWED

Bruce Elmquist: Bergey BWC Excel (10 kW), installed in 1984. Tower height: 100 feet.

Bruce Elmquist's 10-kW wind turbine, installed more than 20 years ago, reduces his electricity bill by two-thirds.

WHAT THE COOPERATIVE MEMBER DID AND WHY

Elmquist bought a small wind generator because he wanted to reduce his utility bill by two-thirds or more. He used wind maps provided by NOAA National Weather Service to determine the wind resource at his site. Elmquist found that his property was on the fringe of a good wind resource, with an average annual wind speed of 11.5 mph.

Zoning, permitting. Elmquist had no zoning issues and no building permit was required.

Project economics, output, and cost. Elmquist calculated that a 10-kW wind generator would have to produce 190,000 kWh to pay for itself. He stated the payback period was less than 10 years. To date, Elmquist stated his generator has produced 220,446 kWh, and he has sold 95,370 kWh to the grid. He has reduced his monthly utility bill by an estimated two-thirds.

The installed cost of the wind generator was $22,000.

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In the early 1990s, Bergey replaced the blades and installed new bearings, stated Elmquist. After lightning struck the tower, the blades were replaced for the second time. Elmquist does not have a maintenance contract.

Incentives. At the time Elmquist's wind generator was installed, the federal government provided a tax rebate that allowed Elmquist to deduct $4,000 from his federal income tax. The rebate was eliminated in the mid-1980s.

Under Texas law, renewable energy systems are exempt from property tax.

Finding a vendor/installer. Elmquist did not want to climb the tower to carry out maintenance on the wind generator, so he looked for a relatively maintenance-free machine. He found, through research, that for some wind turbines the cost of maintenance over time exceeded the initial installed cost of the machine.

At the time he was looking for a wind generator, some 430 companies had machines on the market. Elmquist liked the simplicity of the Bergey 10-kW generator and the fact that—unlike many of the other manufacturers—Bergey did not push its products at him. Elmquist said that a local contractor who installed Bergey generators had a Bergey turbine and convinced him to buy one.

Bergey installed the generator, and the local contractor poured the concrete.

Interaction with cooperative. Initially, Elmquist said the cooperative would not let him sell excess electricity to the grid. After several years, the cooperative relented, and agreed to credit Elmquist's account for any excess power at the wholesale rate of 2.6 cents/kWh. Elmquist said that the cooperative has not been supportive.

Elmquist stated that lightning strikes on the cooperative's system feed back to the power lines coming into his house, even though he has installed additional grounding and lightning arrestors.

COOPERATIVE POLICIES

Interconnection agreement. CoServ includes interconnection requirements in Section 340 of its tariff [**http://www.coservelectric.com/billingpayment/tariff.aspx**]. The interconnection agreement is modeled on the example provided in the DG interconnection toolkit of the National Rural Electric Cooperative Association (NRECA), stated Curtis Trivitt, the cooperative's senior vice president for energy. To interconnect with the grid, a cooperative member must purchase a $500,000 liability insurance policy. In addition, the member must pay for the cost of service and metering upgrades required for interconnection.

CoServ's Trivitt stated that under Section 340, cooperative members with grid-connected renewable generation of 50 kW or less can elect to have net metering or be paid the avoided wholesale energy cost for all output. If the member chooses net metering, the cooperative allows excess electricity production to be banked during the current billing period, but production cannot be carried over to the next billing period.

The CoServ board of directors recently considered the Energy Policy Act of 2005's (EPACT) standards and adopted standards on net metering and interconnection services. CoServ's net metering provisions, which apply to on-site generation up to 50 kW, are consistent with those developed by Texas Electric Cooperatives, Inc. (TEC). The interconnection service standard is available on request to qualifying electricity consumers that the cooperative serves in accordance with its tariff.

Net metering policy. Under Texas law, IOUs must offer net metering to their consumers who have renewable energy systems up to 50 kW, but cooperatives are under no obligation to permit net metering. IOU consumers who sell excess electricity to the grid are credited monthly at the avoided cost.

Elmquist selected CoServ's net metering option, and is credited for excess electricity sent to the grid at the wholesale rate of 2.6 cents/kWh.

COSTS AND BENEFITS

Cooperative member perspective. Elmquist is satisfied with the performance of his small wind generator, but expresses disappointment about the cooperative's net metering policy.

Cooperative perspective. Trivitt stated that the benefit of small wind systems is questionable. Those systems in the cooperative's service area do not provide much power during the time that CoServ needs it most—afternoons of summer peak days.

Trivitt noted that most members who are interested in installing a small wind system are surprised that it is not cost effective. "We find that members have difficulty locating a company that will service and repair the system after several years of operation," he said.

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Washington Electric Cooperative

COOPERATIVE REPRESENTATIVE

Bill Powell, director, products and services

COOPERATIVE MEMBERS INTERVIEWED

Therese Teitsch and Gregg Despart: Southwest Windpower Whisper 100 (0.9 kW), installed in 2006.
Tower height: 50 feet.

Bill Half and Ellen Gershun: Bergey Excel-S (10 kW), installed in 2006.
Tower height: 100 feet.

The 0.9 kW wind turbine installed by Therese Teitsch and Gregg Despart at their diversified farm provides the couple with some independence from the grid.

WHAT COOPERATIVE MEMBERS DID AND WHY

Teitsch and Despart decided to install a small wind system because they are environmentally conscious and they wanted to be energy independent. Half and Gershun, too, were driven by an interest energy independence and environmental protection.

Half and Gershun found a contractor, through the Vermont grant administrator's office, who assessed the site's wind resource through wind maps. Of the couple's 256 acres, approximately 4 acres are used to grow organic vegetables and small fruits and 40 acres are used by a local dairy farmer. The property is at an elevation of 1,800 feet.

Teitsch and Despart purchased an anemometer and monitored the wind speed and direction for a year. They have a diversified farm, with fruit trees and berry bushes. They also sell eggs and honey. Spotted Dog Farm, at an elevation of 1,590 feet, is approximately 100 acres, 80 wooded and 20 open.

Zoning, permitting. Half and Gershun did not have any zoning issues. Teitsch and Despart also had no zoning issues, although they notified their neighbors of their plans. Half and Gershun also notified all those whose land abutted theirs of their plans. But because the state's regulator, the Vermont Public Service Board (PSB), has the ultimate authority to award the Certificate of Public

Good that is needed for a utility consumer to net meter, the PSB could overrule local ordinance and permitting requirements. In a few instances, the PSB has disapproved a certificate application for a wind generator because of opposition from adjacent landowners.

Project economics, output, and cost. The total installed cost of Half and Gershun's wind generator was $44,182. Their contractor estimated the payback period at roughly 10 years, based on the current wind maps as well as energy use and cost in previous years. Half and Gershun stated that it's important to have a reasonable cost/benefit ratio over the long term, but it's also important to generate some of their own power. Based on the wind maps, their contractor estimated that their wind generator will produce between 8,000 and 11,000 kWh annually. On the basis of this estimate, Half and Gershun expected to generate more kilowatt-hours than they needed on a regular basis. But they have yet to see a month in which they produce more electricity than they use.

Half and Gershun's contractor provides maintenance for their generator, but they check the nuts and bolts on a monthly basis.

As a first step, Teitsch and Despart made their house as energy efficient as possible. They did not size their wind generator to meet all their electricity needs. Rather, they determined the size based on their experience with a wind generator at a previous residence. In the first year, their present wind generator produced approximately 1,100 kWh. They express some regret about not choosing a turbine with a larger swept area. Teitsch and Despart stated they knew their generator would not have a quick payback, but they wanted some independence from the grid. In addition to their wind turbine, Teitsch and Despart have 2 kW of PV capacity. They currently send about 6 kWh a day—from wind and solar generation combined—to the cooperative, but as their farm expands and diversifies, they expect to use that power themselves.

The installed cost of Teitsch and Despart's generator was $18,600. Dual inverters and battery backup accounted for much of that cost. Despart stated it would have cost between $4,000 and $6,000 more if they had paid a contractor for the installation. Instead, Despart—an electronics technician who designs and installs alternative energy systems—did the work himself. Despart stated that if he had known the guyed tower would go up so easily, he would have doubled its height. He said that bearings or blades might have to be replaced every 5 to 10 years.

Incentives. Teitsch and Despart, as well as Half and Gershun, stated that the availability of a matching 50/50 grant from the state was a key motivating factor in installing a wind generator. The grants—provided under the Vermont Wind Demonstration Program to farms and schools but not to homeowners—are no longer available.

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Vermont also offers a State Rebate Program for small-scale renewables, including wind. Farms are eligible for a rebate of $4/W and individuals are eligible for a rebate of $2.50/W. The rebate for individuals increases to $4/W if the equipment is made in Vermont. Wind systems must be new, grid-connected, have a five-year warranty on major systems and components, and have a UL-listed inverter. The maximum incentive for a wind system is $12,500 for individuals and the lesser of $20,000 or 50% for farms and schools [**http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=VT17F&state=VT&CurrentPageID=1&RE=1&EE=0**].

In addition, Vermont offers a sales tax exemption for renewable energy systems, including wind.

Finding a vendor/installer. Half and Gershun found a contractor through the state grant administrator. They also did research on Bergey machines.

Lightning strikes are an issue for Teitsch and Despart, so they wanted a wind generator with no electrical components—diodes—inside the turbine. That requirement led them to Southwest Windpower's Whisper machine, which has the diodes at ground level.

Interaction with cooperative. Teitsch and Despart say the cooperative was very supportive, in part because Washington EC's Bill Powell himself net meters. Half and Gershun, too, say the cooperative has been very supportive.

COOPERATIVE POLICIES

Interconnection agreement. In Vermont, cooperatives are regulated. Washington EC follows the state interconnection standards for DG. The interconnection application and net metering technical specifications are available at **http://www.state.vt.us/psb/application_forms/application_forms.stm**.

World Energy Council (WEC) accepts the liability coverage included in a member's homeowner's insurance policy, Powell stated. Under the state's net metering statute, a visible lockable disconnect is required, unless waived by the utility. Powell noted that, to date, no utility has waived this specification.

Net metering policy. Under Vermont law, utility consumers may net meter after obtaining a Certificate of Public Good. Half and Gershun obtained such a certificate, as did Teitsch and Despart. Net metering is limited to 150 kW for farms and 15 kW for residential consumers.

As stipulated by Vermont statute, Washington EC provides a single meter that runs backward when the member is sending electricity to the grid. The cooperative manually overrides its billing system to account for the electricity sent to the cooperative, stated Powell. Under Vermont law, the member's credit can be accumulated for a year, he added.

COSTS AND BENEFITS

Cooperative member perspective. Teitsch and Despart are satisfied with the performance of their wind generator, although they think the quality of the controls is not as high as it was in the past. Half and Gershun say that their generator has been reliable to date, although the energy output is roughly half of what they expected.

Cooperative perspective. Washington EC's Powell stated that the cooperative benefits from member self-production—whether wind or solar electric—because it decreases the cooperative's power expense. In addition, he noted, member self-production enhances reliability on WEC's long, nonradial distribution lines. And, he added, it is a meaningful investment by the cooperative's members in their own generation, which supplements what the cooperative is doing in its power portfolio. For members who want to install a small wind system, cost is an issue, but not a barrier, Powell said.

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Pierce Pepin Cooperative Services

COOPERATIVE REPRESENTATIVE

Jeffrey Olson, vice president, engineering and information technology

COOPERATIVE MEMBERS INTERVIEWED

Sharon and Jerold Fleming: Jacobs 31-20 (20 kW), installed in 2007.
Tower height: 120 feet.

Sharon and Jerold Fleming expect their newly installed 20-kW wind turbine to supply all the electricity needed for their farm.

WHAT COOPERATIVE MEMBERS DID AND WHY

The Flemings stated that their interest in a small wind system was sparked by their son. They did research on the Internet and read books about wind energy, which prompted them to look for information on how to finance a small wind system. They contacted the local USDA office to obtain information on grants. Then the Flemings chose a manufacturing company, Jacobs, which in turn referred them to Renewable Energy Team (RET), a Minnesota company that installs wind generators. RET conducted a site assessment for the Flemings.

To determine their wind resource, the Flemings relied on the wind maps provided by Bay Winds, a company that sells Jacobs wind generations. Based on this and other wind maps, the Flemings determined that the annual wind speed on their property averaged between 12 and 15 mph.

The Flemings have 120 acres. They raise cattle on 30 acres, grow hay on another 10 acres, and rent the rest of the land. They identified two farmers in western Minnesota who had Jacobs wind generators, arranged to visit them, and obtained actual production figures from their machines.

Zoning, permitting. The Flemings had to attend a meeting of the town zoning board. They also were required to pay the county $300, publish two notices in the newspaper, and then appear before the county board. The Flemings were the first in their county to negotiate the process, and they asked a representative from RET to accompany them. After several weeks, the county approved the project. Obtaining zoning approval for the wind generator was a drawn-out, frustrating process, Sharon Fleming stated. There was too much paperwork, and a lack of coordination between the township and the county. "We had to present all the same information to the county that we did to the township," she said. In addition, the Flemings paid $100 for a building permit.

The Flemings invited neighbors to see the wind generator and ask questions about it. "We want to assure people that the system looks good and isn't noisy," Sharon Fleming said.

Project economics, output, and cost. The Flemings calculated the energy output of their wind generator very conservatively. To qualify for state incentives, the generator could not exceed 20 kW. The installed cost of the system was $64,700, and the Flemings estimate the payback period at just under 10 years, assuming that they qualified for a USDA grant.

RET will provide maintenance for the first year of the generator's operation. After that, the Flemings could sign a contract with RET for ongoing maintenance.

The Flemings said they encountered additional costs because their electrical system was not up to code and the transformer was not large enough.

Incentives. The state's Focus on Energy program offers grants of 35% or $50,000 for wind systems up to 100 kW. Participating utilities must charge a fee for each meter in their system, with the money being used to fund the program. Under a state law adopted in 2000, Wisconsin utilities are required to collect $1.33 per meter each month for low-income energy assistance and energy efficiency/conservation. If a utility chooses to participate in the Focus on Energy program, the money it has collected for consumers' meters is used for program grants.

Pierce Pepin does not participate in the Focus on Energy program. Instead, the cooperative allocates 67 cents of the $1.33 collected per meter for low-income energy assistance in its service area. The cooperative is using the remaining 66 cents for its Energy Sense program, which focuses on energy efficiency and renewable energy (EERE). Through this program, cooperative members with wind generators of 10–20 kW are eligible for a grant of up to $1,500 [**http://www.piercepepin.com/nrgsense/nrgsense.htm**]. The cooperative is also investigating options for low-interest loans and grant assistance for its members, Olson noted.

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The Flemings had planned to apply for a USDA grant, which would have covered one-quarter of the cost of the generator. But because of confusion about when the application had to be submitted—prior to the start of construction—the Flemings may not be eligible for a grant.

In Wisconsin, a wind energy system is exempt from general property taxes.

Finding a vendor/installer. In choosing a generator vendor, the Flemings insisted on two requirements. One was that the generator be made in the United States. They also wanted to buy a generator from a company that had been in business for decades. They learned that Jacobs was building wind generators in Minnesota, not far from where they live in Wisconsin.

Interaction with cooperative. The Flemings said that the cooperative is excited about their wind project, which is the third one in Pierce Pepin's service area.

COOPERATIVE POLICIES

Interconnection agreement. Wisconsin requires net metering on any DG system with a rated capacity of 20 kW or less. Pierce Pepin recently adopted a revised DG policy that raises this limit to 40 kW.

Pierce Pepin's DG interconnection agreement and process checklist are available on the cooperative's Web site at **http://www.piercepepin.com/Electric/dist_generation.htm**.

Net metering policy. Wisconsin requires net metering for all regulated utilities; this excludes cooperatives. Pierce Pepin's Olson said that the cooperative voluntarily offers net metering. Under the cooperative's DG policy, net metering is offered for any DG system with a nameplate rating of 40 kW or less. Under this policy, the Flemings are credited for any excess electricity they send to the grid at the retail rate of 11.6 cents/kWh.

COSTS AND BENEFITS

Cooperative member perspective. The Flemings would like to have access to incentives, such as the grants under the Focus on Energy program, that could defray the cost of their generator.

Cooperative perspective. Wind generators and other renewable generation larger than 10 kW have the potential to benefit the cooperative system by sending electricity back into the grid, Pierce Pepin's Olson said. But Pierce Pepin needs to maintain a balance between the individual member and the whole membership with regard to system reliability, safety, and cost fairness, he noted.

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Frequently Asked Questions

The CRN asked the cooperatives profiled in the case studies what their members wanted to know about small wind. The following questions were mentioned most often by the cooperatives. You many want to customize the answers in accordance with your cooperative's requirements and circumstances.

1. What would a small wind power system cost?

Suggested response. 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.

2. Are any incentives available for wind power systems?

At present, there is no federal production incentive for small wind systems. 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% 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% 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) Web site at **http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/farm_bill_small_wind_sample_application.pdf**.

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Several states offer incentives that help reduce the installed cost of a small wind system. Among them are California, Ohio, Massachusetts, New York, Vermont, Wisconsin, Iowa, Illinois, Hawaii, and New Jersey. The Database of State Incentives for Renewables and Efficiency (DSIRE) provides detailed state-by-state information on incentives at **http://www.dsireusa.org.**

(Note to cooperatives: If you offer your member-consumers any kind of incentive for a small wind system, provide that information here.)

3. How much electricity can be generated?

You should first determine how much electricity you *want* to generate. Based on your current electricity usage, decide how many kilowatt-hours you would like your wind turbine to generate. Once you know how much energy you want your generator to produce, you can select a turbine size at the right scale to meet your needs.

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.

Your cooperative offers a capital cost recovery analysis worksheet that 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.

(Note to cooperatives: The capital cost recovery analysis is provided as part of this guide.)

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. For additional information on assessing generator energy output, see the *Apples & Oranges '02 Technical Appendix* [**http://www.renewwisconsin.org/wind/Toolbox-Homeowners/Apples%20and%20Oranges%20Technical%20Appendix.pdf**]. This appendix includes calculated estimates of monthly energy outputs for various turbines that are often lower—and more realistic—than the estimates provided by the manufacturers.

4. Does the cooperative buy the extra power I generate? What am I going to be paid? What is net metering? What is avoided cost?

All cooperatives will buy the excess electricity produced by member-consumers from small renewable generators. Your cooperative will buy your excess electricity at a fair rate that also ensures other member-consumers on the system do not bear an undue cost for their electricity.

(Note to cooperatives: Personalize this response by providing information on the rate that you pay member-consumers for their excess electricity.)

Net metering is one tool for valuing and measuring the electricity generated and used by a utility consumer who has a distributed generation (DG) system, such as a small wind generator. 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 consumer exchanges the power it uses one-for-one with the power it exports, and is thus credited at full retail rate for any excess energy it produces.

Net metering is available in 42 states and the District of Columbia. Of these 42 jurisdictions, 24 require all utilities—including rural electric cooperatives, RECs—to offer net metering. The DSIRE 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**]. Some states have adopted net metering because it provides a simple, easily administered way of compensating consumers for their generation, particularly where the customer is unsophisticated, the unit is small, and the output of the unit cannot closely track the customer's demand, as with wind and solar energy. Others have adopted net metering to subsidize the use of environmentally friendly renewable technologies.

Most cooperatives have chosen not to net meter consumer-owned generation because it is a subsidy that raises costs for other consumers on the system. Net metering policies require utilities to pay consumers the retail price for wholesale power. The retail rate utilities charge includes not only the marginal cost of power, but also recovers costs incurred by utilities' for transmission, distribution, generating capacity, and other utility services not provided by the consumer-generator. The policies also require utilities to pay high costs for what is often low-value power. Power from wind and photovoltaic (PV) systems is intermittent, cannot be scheduled or dispatched reliably to meet system requirements. Even those forms of customer generation that could technically be dispatched at times when utilities need the power do not need to enter into operating agreements with utilities in order to obtain net metering under state net metering mandates. Further, net meters allow customers to underpay the fixed costs they impose on the system. A utility has to install sufficient facilities to meet the peak requirement of the consumer and recover the costs of those facilities through a kilowatt-hour charge. When the net meter rolls backwards, it understates the total energy used by the consumer, and thus understates the consumer's impact on the fixed costs of the system. It also understates the consumer's total share of other fixed charges borne by all consumers such as taxes, stranded costs, transition costs, and public benefits charges.

5. How do I get connected to the cooperative grid? Does this cost anything?

Connecting your wind generator to the grid allows you to send excess power to the cooperative as well as buy electricity from the cooperative when you need to.

(Note to cooperatives: Insert information on your interconnection requirements and fees. Include information on the terms and conditions of the agreement that a member-consumer must sign. You may want to explain that the cooperative needs to ensure that the member-consumer's wind generator meets all electrical codes, is synchronized with the grid, and matches the power's voltage frequency and quality, and that cooperative personnel need access to a locked disconnect so the turbine can be isolated from the grid in the event of a power outage.)

6. 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.

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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.

(Note to cooperatives: If you are aware of local permitting and zoning requirements, insert this information.)

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

Your cooperative can provide a capital cost recovery analysis worksheet that you can use to calculate the annual operating cost of your small wind system. 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 × 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.

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8. 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.

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

(Note to cooperatives: Include any resources here that you want to recommend.)

Paul Gipe, a wind energy expert with more than 30 years of experience in the field, has written extensively about wind turbines. Two books that focus on small wind systems are *Wind Power: Renewable Energy for Home, Farm, and Business* [**http://www.wind-works.org/books/wind_power2004_home.html**] and *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**]

Frequently Asked Questions

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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 Web site provides contact information for state energy offices at **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.

Your cooperative can provide a list of vendors.

(Note to cooperatives: a vendor list is available in Section 5.**)**

Vendor List

The prices included for the wind generators in this list do not include the cost of the tower or installation, unless noted.

Abundant Renewable Energy (ARE)

http://www.abundantre.com/ARE_Wind_Turbines.htm

Commercial availability: Two models, ARE 110 and ARE 442, available through dealers in 35 states.

Sales figures: n/a

States with commercial installations: Alaska, Colorado, Idaho, Iowa, Massachusetts, Michigan, Montana, New York, North Carolina, Ohio, Oregon, Texas, Utah, Vermont, Washington, and West Virginia.

Examples of actual installations (in addition to case studies): Two in Newberg, Oregon; two in Martha's Vineyard, Massachusetts.

ARE 110

Technical specifications:	
Rated power (kW)	2.5
Rotor diameter (in feet)	11.8
Swept area (in square feet)	110
Cut-in wind speed (mph)	Starts at 8 and runs down to 5
Rated wind speed (mph)	25
kWh/month at average wind speeds (kWh)	125 (8 mph); 275 (10 mph); 425 (12 mph); 575 (14 mph)
Peak output (watts)	3,000
RPM at rated output	280
Blade material	Molded fiberglass
Tip speed ratio	n/a
Cost (U.S. dollars)	$12,650 for grid-connected system, including wind turbine with slip rings, SMA inverter, voltage clamp, and resistor load; lightning protection system available
Years in production	2
Warranty (years)	5

ARE 442

Technical specifications:	
Rated power (kW)	10
Rotor diameter (in feet)	23.6
Swept area (in square feet)	442
Cut-in wind speed (mph)	Starts at 8 and runs down to 5
Rated wind speed (mph)	25
kWh/month at average wind speeds (kWh)	625 (8 mph); 1,175 (10 mph); 1,825 (12 mph); 2,500 (14 mph)
Peak output (watts)	12,000
RPM at rated output	160
Blade material	Molded fiberglass
Tip speed ratio	n/a
Cost (U.S. dollars)	$39,600 for grid-connected system, including wind turbine with slip rings, two SMA inverters, voltage clamp, and resistor load; lightning protection system available for $2,500
Years in production	2
Warranty (years)	5

Vendor List

SECTION 4

Bergey Windpower

http://www.bergey.com

Commercial availability: XL.1 and Excel models available nationwide.

Sales figures: n/a

State with commercial installations: Installations in all 50 states.

Examples of actual installations (in addition to case studies): Malaga, Washington; Oak Hills, California; Charlotte, Vermont; Tehachapi, California; Norman, Oklahoma; Tuttle, Oklahoma; Fort Hill, Pennsylvania.

BERGEY XL.1

Technical specifications:	
Rated power (kW)	1
Rotor diameter (in feet)	8.2
Swept area (in square feet)	53*
Cut-in wind speed (mph)	5.6
Rated wind speed (mph)	24.6
kWh/month at average wind speeds	55 (8 mph); 115 (10 mph); 195 (12 mph)
Peak output (watts)	1,300
RPM at rated output	450*
Blade material	Pultruded fiberglass**
Tip speed ratio	5.8**
Cost (U.S. dollars)	$2,790
Years in production	6
Warranty (years)	5

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

BERGEY EXCEL-S

Technical specifications:	
Rated power (kW)	10
Rotor diameter (in feet)	23
Swept area (in square feet)	415*
Cut-in wind speed (mph)	8
Rated wind speed (mph)	30
kWh/month at average wind speeds	240 (8 mph); 900 (12 mph); 1,370 (14 mph)
Peak output (watts)	12,000 (at 36 mph)
RPM at rated output	300*
Blade material	Pultruded fiberglass
Tip speed ratio	7.5**
Cost (U.S. dollars)	$29,500 (including inverter)
Years in production	24
Warranty (years)	5

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

Vendor List

SECTION 4

Eoltec Wind Turbines

http://www.pineridgeproducts.com/PRPSite/Welcome.html; **http://www.pvsquared.coop/**; **http://www.eoltec.com/**

Commercial availability: The Eoltec 6 kW is imported from France and sold in the United States by Pine Ridge Products LLC, Belt, Montana; and PV Squared, Greenfield, Massachusetts.

Sales figures: n/a

State with commercial installations: Montana, Massachusetts, New York.

Examples of actual installations (in addition to case studies): n/a

EOLTEC 6 KW

Technical specifications:	
Rated power (kW)	6
Rotor diameter (in feet)	18.4
Swept area (in square feet)	265
Cut-in wind speed (mph)	6
Rated wind speed (mph)	n/a
kWh/month at average wind speeds	294 (8 mph); 558 (10 mph); 892 (12 mph)*
Peak output (watts)	6,000
RPM at rated output	245*
Blade material	Hollow glass fiber with aluminum spar
Tip speed ratio	n/a
Cost (U.S. dollars)	Contact importers listed above for current price
Years in production	6
Warranty (years)	5

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

Vendor List

SECTION 4

Kestrel Wind Turbines

http://www.dcpower-systems.com; **http://www.kestrelwind.co.za/content.asp?PageID=177**

Commercial availability: Kestrel wind turbines are imported from South Africa and sold in the United States by DC Power Systems, Healdsburg, California.

Sales figures: n/a

State with commercial installations: Alaska.

Examples of actual installations (in addition to case studies): n/a

KESTREL E220

Technical specifications:	
Rated power (kW)	0.8
Rotor diameter (in feet)	7.2
Swept area (in square feet)	38.5*
Cut-in wind speed (mph)	6.71
Rated wind speed (mph)	26.8
kWh/month at average wind speeds	58 (8 mph); 104 (10 mph); 1,585 (12 mph)
Peak output (watts)	850
RPM at rated output	1,000
Blade material	Molded fiberglass
Tip speed ratio	n/a
Cost (U.S. dollars)	Contact importer listed above for current price
Years in production	n/a
Warranty (years)	2

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

KESTREL E300I

Technical specifications:	
Rated power (kW)	1
Rotor diameter (in feet)	9.8
Swept area (in square feet)	79*
Cut-in wind speed (mph)	6.71
Rated wind speed (mph)	21
kWh/month at average wind speeds	91 (8 mph); 150 (10 mph); 250 (12 mph)
Peak output (watts)	1,200
RPM at rated output	650
Blade material	Molded fiberglass
Tip speed ratio	n/a
Cost (U.S. dollars)	Contact importer listed above for current price
Years in production	6 months
Warranty (years)	2

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

Vendor List

SECTION 4

KESTREL E380I

Technical specifications:	
Rated power (kW)	3
Rotor diameter (in feet)	12.2
Swept area (in square feet)	120*
Cut-in wind speed (mph)	8.5
Rated wind speed (mph)	28.0
kWh/month at average wind speeds	1,644 (10 mph); 2,691 (12 mph); 3,872 (14 mph)
Peak output (watts)	3,200
RPM at rated output	500
Blade material	Molded fiberglass
Tip speed ratio	120**
Cost (U.S. dollars)	Contact importer listed above for current price
Years in production	1
Warranty (years)	2

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

Vendor List

SECTION 4

Proven Energy

http://www.solarwindworks.com/Products/Wind_Turbines/_/_.htm; **http://www.windandsun.com/**; **http://www.remotepowerinc.com**; **http://www.provenamerica.com/windturbines_publicsectors.html**; **http://www.provenenergy.co.uk**

Commercial availability: Proven wind turbines are imported from the United Kingdom and distributed in the United States by Solar Wind Works, Truckee, California; Lake Michigan Wind & Sun, Sturgeon Bay, Wisconsin; and Remote Power Inc., Fairbanks, Alaska.

Sales figures (for Solar Wind Works): $146,000 (2006); $10,080 (2005); $37,530 (2004)

State with commercial installations: California, Nevada, Colorado, Washington, New Mexico, Arkansas, Minnesota, and Idaho.

Examples of actual installations (in addition to case studies): Mountain Home, Idaho; Truckee, California; Santa Fe, New Mexico; Reno, Nevada.

PROVEN 0.6

Technical specifications:	
Rated power (kW)	0.6
Rotor diameter (in feet)	8.4*
Swept area (in square feet)	55*
Cut-in wind speed (mph)	6
Rated wind speed (mph)	22.5
kWh/month at average wind speeds	42 (8 mph); 83 (10 mph); 124 (12 mph)*
Peak output (watts)	700**
RPM at rated output	500
Blade material	Polypropylene
Tip speed ratio	6.7**
Cost (U.S. dollars)	Contact importers listed above for current price
Years in production	10
Warranty (years)	2, extended warranty available

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

PROVEN 2.5

Technical specifications:	
Rated power (kW)	2.5
Rotor diameter (in feet)	9
Swept area (in square feet)	97*
Cut-in wind speed (mph)	6
Rated wind speed (mph)	26.8
kWh/month at average wind speeds	167 (8 mph); 293 (10 mph); 417 (12 mph)*
Peak output (watts)	2,900
RPM at rated output	300
Blade material	Polypropylene
Tip speed ratio	4.6**
Cost (U.S. dollars)	Contact importers listed above for current price
Years in production	14
Warranty (years)	2, extended warranty available

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

Vendor List

SECTION 4

PROVEN 6

TECHNICAL SPECIFICATIONS:	
Rated power (kW)	6
Rotor diameter (in feet)	18*
Swept area (in square feet)	254*
Cut-in wind speed (mph)	6
Rated wind speed (mph)	26
kWh/month at average wind speeds	417 (8 mph); 667 (10 mph); 1,083 (12 mph)*
Peak output (watts)	6,500**
RPM at rated output	200
Blade material	Wood epoxy composite
Tip speed ratio	5.8**
Cost (U.S. dollars)	Contact importers listed above for current price
Years in production	9
Warranty (years)	2, extended warranty available

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

PROVEN 15

TECHNICAL SPECIFICATIONS:	
Rated power (kW)	15
Rotor diameter (in feet)	29.5
Swept area (in square feet)	254*
Cut-in wind speed (mph)	5.6
Rated wind speed (mph)	26.8
kWh/month at average wind speeds	777 (8 mph); 1,451 (10 mph); 3,080 (12 mph)*
Peak output (watts)	n/a
RPM at rated output	150*
Blade material	Glass epoxy composite
Tip speed ratio	n/a
Cost (U.S. dollars)	Contact importers listed above for current price
Years in production	2
Warranty (years)	2, extended warranty available

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

Vendor List

SECTION 4

Southwest Windpower

http://www.windenergy.com/products/products.htm

Commercial availability: Southwest Windpower wind turbines are available through dealers in all 50 states.

Sales figures: n/a

State with commercial installations: Skystream 3.7 turbines are installed in all 50 states; among the states with the most installations are Pennsylvania (22), Texas (12), Michigan (12), and Arizona (11).

Examples of actual installations (in addition to case studies): n/a

WHISPER 100

Technical specifications:	
Rated power (kW)	0.9
Rotor diameter (in feet)	7
Swept area (in square feet)	38.5*
Cut-in wind speed (mph)	7.5**
Rated wind speed (mph)	28**
kWh/month at average wind speeds	30 (8 mph); 60 (10 mph); 100 (12 mph); 150 (14 mph)
Peak output (watts)	900
RPM at rated output	1,200*
Blade material	3 Polypro/carbon glass reinforced
Tip speed ratio	10.3**
Cost (U.S. dollars)	$2,475, with controller*
Years in production	11
Warranty (years)	5

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

WHISPER 200

Technical specifications:	
Rated power (kW)	1
Rotor diameter (in feet)	9
Swept area (in square feet)	78.5**
Cut-in wind speed (mph)	7**
Rated wind speed (mph)	26**
kWh/month at average wind speeds	70 (8 mph); 125 (10 mph); 158 (12 mph); 260 (14 mph)
Peak output (watts)	1,000
RPM at rated output	1,100*
Blade material	3 Polypro/carbon glass reinforced
Tip speed ratio	13.4**
Cost (U.S. dollars)	$2,995, with controller*
Years in production	11
Warranty (years)	5

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

Vendor List

SECTION 4

SKYSTREAM 3.7

Technical specifications:	
Rated power (kW)	1.9
Rotor diameter (in feet)	12
Swept area (in square feet)	115.7
Cut-in wind speed (mph)	8
Rated wind speed (mph)	21
kWh/month at average wind speeds	100 (8 mph); 240 (10 mph); 400 (12 mph); 500 (14 mph)
Peak output (watts)	2,600
RPM at rated output	325
Blade material	Compression molded fiberglass
Tip speed ratio	n/a
Cost (U.S. dollars)	$5,400*
Years in production	1
Warranty (years)	5

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

WHISPER 500

Technical specifications:	
Rated power (kW)	3
Rotor diameter (in feet)	15
Swept area (in square feet)	176*
Cut-in wind speed (mph)	7**
Rated wind speed (mph)	24**
kWh/month at average wind speeds	170 (8 mph); 330 (10 mph); 538 (12 mph)*
Peak output (watts)	3,200
RPM at rated output	800*
Blade material	2-Carbon reinforced fiberglass
Tip speed ratio	10**
Cost (U.S. dollars)	$7,675, including turbine-integrated batteryless inverter*
Years in production	11
Warranty (years)	5

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

Vendor List

SECTION 4

Wind Turbine Industries

http://www.windturbine.net

Commercial availability: Jacobs turbines are available through dealers in 23 states.

Sales figures: n/a

State with commercial installations: Several states, including California, Minnesota, Iowa, Wisconsin, New York, and Pennsylvania.

Examples of actual installations (in addition to case studies): n/a

Note: De-rated Jacobs 31-20 model available at 10 kW, 12.5 kW, 15 kW, and 17.5 kW.

JACOBS 31-20

Technical specifications:	
Rated power (kW)	20
Rotor diameter (in feet)	31
Swept area (in square feet)	660
Cut-in wind speed (mph)	8
Rated wind speed (mph)	26
kWh/month at average wind speeds	1,644 (10 mph); 2,691 (12 mph); 3,872 (14 mph)
Peak output (watts)	20,000
RPM at rated output	175*
Blade material	Fiberglass over foam*
Tip speed ratio	120**
Cost (U.S. dollars)	$33,500
Years in production	27 (since Wind Turbine Industries Corporation acquired Jacobs energy turbine products)
Warranty (years)	1, five-year warranty available at additional cost

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

** Source: Apples & Oranges, Home Power magazine, September 2002.

Vendor List

SECTION 4

Vendors of Remanufactured Turbines

Halus Power Systems

http://www.halus.com

Commercial availability: The remanufactured Vestas V-17 wind turbine is available through Halus Power Systems, Hayward, California.

Sales figures: n/a

State with commercial installations: California, Oregon, Alaska, New York, Wisconsin, Iowa, Montana, Illinois, Washington, Kansas.

Examples of actual installations (below 100 kW): Neosho, Wisconsin; Nikolski, Alaska; Milwaukee, Wisconsin;

VESTAS V-17

Technical specifications:	
Rated power (kW)	90
Rotor diameter (in feet)	50
Swept area (in square feet)	2,462*
Cut-in wind speed (mph)	7
Rated wind speed (mph)	40
kWh/month at average wind speeds	5,060 (10 mph); 8,198 (12 mph)*
Peak output (watts)	90,000
RPM at rated output	40
Blade material	Fiberglass
Tip speed ratio	n/a
Cost (U.S. dollars)	$80,000–110,000 depending on tower type
Years in production	3
Warranty (years)	1, extended warranty available

* Source: Wind Turbine Buyer's Guide, Home Power magazine, June/July 2007.

Note: Halus previous remanufactured the Vestas V-15, with a rated output of 65 kW, but the company does not expect to obtain any more V-15s.

Next Generation Power Systems

http://www.nexgenpowersystems.com/nextgeneration.php

Commercial availability: The remanufactured NG Twelve-Five wind turbine is available through Next Generation Power Systems, Pipestone, Minnesota.

Sales figures: n/a

State with commercial installations: Minnesota, North Dakota, South Dakota, and Iowa.

Examples of actual installations: n/a

NG TWELVE-FIVE

Technical specifications:	
Rated power (kW)	39.5 kW
Rotor diameter (in feet)	41
Swept area (in square feet)	1,324
Cut-in wind speed (mph)	8.2
Rated wind speed (mph)	30
kWh/month at average wind speeds	1,250 (8.9 mph), 3,333 (11 mph), 5,416 (13.4 mph)
Peak output (watts)	n/a
RPM at rated output	100
Blade material	Fiberglass
Tip speed ratio	9
Cost (U.S. dollars)	$1,500/W
Years in production	3
Warranty (years)	1

Note: The NG Twelve-Five is a remanufactured German wind turbine.

Consumer Handout Packet

You may want to include some or all of the information in the Small Wind Basics section of this guide. The packet of information that you prepare for member-consumers should include a letter from your cooperative. In addition, the Frequently Asked Questions and Vendor List, provided in this guide, should be part of the consumer handout packet. Additional documents—capital cost recovery analysis worksheet, steps to a small wind system, and questions to ask wind turbine vendors—are provided in this guide.

Legal Notice

Legal Notice

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The National Rural Electric Cooperative Association

The National Rural Electric Cooperative Association (NRECA), founded in 1942, is the national service organization supporting more than 900 electric cooperatives and public power districts in 47 states. Electric cooperatives own and operate more than 42 percent of the distribution lines in the nation and provide power to 40 million people (12 percent of the population).

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