

Small Wind Initiative

FOR WESTERN NORTH CAROLINA

**Dennis Scanlin, Brent Summerville
& Mike Dooraghi**

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The Appalachian Mountain region of North Carolina has more than three-quarters of a million acres of land with average annual wind speeds above 4.5 meters per second (10 mph) at 30 meters (98 ft.) height. But very little adoption of wind turbine technology has taken place. With the notable exception of the construction of what was then the world's largest wind turbine in 1978, there has never been a tradition of using wind power in the region.

The Small Wind Initiative (SWI) was established in 2004 to demonstrate and assess small-scale wind turbine technology, to educate the public about the potential of small-scale wind energy production, and to assist people in measuring their wind resources. It has been supported by the North Carolina State Energy Office, the Tennessee Valley Authority (TVA), the U.S. Department of Energy (DOE), Appalachian State University, and several wind measurement and small wind turbine manufacturing companies.



Mike Dooraghi of the SWI team makes the long 120-foot climb up to the Jacobs for some maintenance.

Workshop participants on Beech Mountain at the Whisper 200 grid-tie installation.



SWI's goal is to focus on small-scale wind energy with this project, because more than 80 percent of the windy land in this region is in the lower Class 2 and 3 range, which is not typically considered adequate for utility-scale projects. (Wind resources are classified on a scale from 1 to 7, with Class 7 being the highest.) Smaller turbines have less-significant impacts and will be less controversial than utility-scale wind farms.

Research & Demonstration Site

The central core of this initiative has been the establishment of a small-wind technology research and demonstration center on Beech Mountain in Avery County, western North Carolina. The center is at an elevation of 1,565 meters (5,136 ft.), with an average wind speed of about 8 meters per second (18 mph) at 50 meters (164 ft.), and an average annual power density of almost 600 watts per square meter. This makes it an outstanding wind site. The 3-acre site is being leased from a private landowner and a building permit has been issued to the project for seven years. The site includes two buildings for equipment storage and datalogging, good road access, and a utility grid connection.

The research and demonstration site has become the focal point for a variety of educational activities, including hands-on installation workshops. It is open to the public, and educational displays have been designed and constructed describing the potential of wind energy production in the region, the equipment used at the site, and the estimated performance and cost of each turbine.

The electricity from the turbines runs underground into a building that contains the power conditioning equipment, inverters, batteries, and datalogging equipment. All the electricity produced is being monitored and fed into the Mountain Electric/TVA utility grid system, contributing to TVA's Green Power Switch program.

Turbines

Between June 2004 and June 2005, eight different wind turbines were erected and monitored at the site. Four companies' turbines represent the range of products existing in the marketplace. The turbines at the site during 2005 included products from African Wind Power/Abundant Renewable Energy, Bergey Windpower Co., Southwest Windpower, and Wind Turbine Industries.

Many of the turbines were installed during workshops to expose as many people as possible to the process and technology. Students from the Appropriate Technology program at Appalachian State University and staff members of the Small Wind Initiative were involved in all of the installations. The turbines installed are listed in the table, along with their rated output, tower height, and tower type.

Performance

In addition to demonstrating the technology, SWI has also been involved in assessing the performance of the turbines. We are keeping a log of our activities and repairs, power and energy output, wind speeds and direction, temperature, barometric pressure, solar insolation, wind shear, sound, and avian impacts.

The datalogging system uses a Campbell Scientific CR1000 datalogger, a Windows-based computer, twelve anemometers, seven wind vanes, a temperature sensor, a barometric pressure sensor, and six power transducers. Each turbine is being individually monitored for power and energy production. Wind speed is being monitored at two elevations on each tower, and wind direction is being monitored on each tower as well. Data is being recorded every second. We have constructed power curves of the turbines on our site and have documented that all produce their rated power output.

An activity log has been kept for each turbine at the site. The log documents in text and photographs each of the eight turbines tested. It describes the problems encountered and the repairs undertaken (and can be found at www.wind.appstate.edu/swiwind/swi.php). We have had more than our fair share of problems. The average availability for all the turbines was 79 percent.

Birds

The SWI team met with a regional Audubon Society representative to develop an avian impact study. Using the Audubon procedures, we searched the site for bird carcasses at least weekly and after significant weather events (such as low cloud ceiling and fog). Searches were conducted as early in the day as possible to reduce the chance of carcass removal by other scavenging animals.

Tested Wind Turbines

Batteryless Grid-Tie Turbines	Rated Power (W)	Tower Height (Ft.)	Tower Type
African Wind Power (AWP) 3.6	1,500	105	Guyed tilt-up
Jacobs 31-20	20,000	120	Freestanding lattice
Southwest Windpower Whisper 200	1,000	50	Guyed tilt-up
Southwest Windpower Whisper 500	3,000	70	Guyed tilt-up

Battery-Based Grid-Tie Turbines	Rated Power (W)	Tower Height (Ft.)	Tower Type
Bergey XL.1 (24 V)	1,000	105	Guyed tilt-up
Southwest Windpower Air X (24 V)	400	45	Guyed tilt-up
Southwest Windpower Whisper 100 (48 V)	900	80	Guyed tilt-up
Southwest Windpower Whisper 500 (48 V)	3,000	70	Guyed tilt-up

A “bird sweep” involves inspecting the ground around each tower in a back-and-forth manner, looking for bird carcasses. The inspected area covers the guy-wire diameter, plus about 3 meters (10 ft.). If the tower has no guy wires, the diameter of the inspected area is approximately the tower height. We searched the site under all of the turbines using the Audubon’s recommended procedures a total of twenty times during the fall and spring migration period. In addition, we always kept our eyes open while at the site working on other things. Over the last year, we found what was left of one bird carcass.

Noise

Noise can be a problem associated with any piece of machinery. Most permitting guidelines now being developed for wind turbines around the country address noise, and specify allowable noise at the adjacent property line, the nearest dwelling, or at a certain distance from the turbine. While there is no completely satisfactory way to measure the subjective effects of noise, typically 50 to 60 decibels is considered the maximum allowable, with some exceptions for short-term events.

ANEMOMETER LOAN PROGRAM

A goal of the Small Wind Initiative has been to operate an anemometer loan program to help those in the western part of the state more accurately assess their wind resources.

Anemometers measure the speed of the wind, wind vanes determine the direction of the wind, temperature sensors determine the possible icing of these sensors, and dataloggers collect and store all of this data. These sensors are mounted on a tower at prospective wind turbine sites.

An anemometer loan program provides the public the opportunity to use these towers to determine their own wind resources. This is an important service for both the landowner and the small wind industry in general. The landowner can borrow the equipment instead of making a big financial investment. It is good for the small wind industry because it helps prevent the use of the technology at inappropriate sites, which makes the technology seem like it is ineffective.

This program has also been beneficial to Appalachian State University’s Appropriate Technology program. It has allowed students the opportunity to learn about the process behind wind assessment by getting involved with the construction of these towers. The general public has also had the opportunity to learn about wind assessment through joint ventures between the Small Wind Initiative’s workshops and scheduled anemometer tower installations. There are now more than twenty anemometer loan programs in the United States supported by the DOE’s Wind Powering America program.

The range of 50 to 60 decibels has been described as the noise in a typical house or office building. The SWI used the International Electrotechnical Commission standards for acoustic emission measurement techniques as much as possible for this work. Our study shows that noise from small wind turbines typically tracks the ambient noise fairly closely. Except during high winds, gusting conditions, and while furling, turbines can barely be heard above the ambient wind noise. The amount of time during the year when they exceed the 60-decibel limit being adopted by many communities is less than 1 percent at our very windy site.

Prospective Wind Sites

Another educational goal of the project has been to identify the owners of windy land, and provide them with the information and tools necessary to take advantage of small-scale wind power. A total of 16,000 property owners in our region were identified as having Class 3 or higher wind resources.

A postcard was developed with a brief note indicating that our research has led us to believe that the recipient owns land with good wind resources on it. The card also provides:

- Information about wind energy
- A picture of a small residential wind turbine installation
- Contact information for local companies that sell and install wind turbines
- Contact information for manufacturers of wind equipment
- Upcoming workshops information
- Contact information for the Small Wind Initiative
- Information about the anemometer loan program in western North Carolina
- Incentives for producing electricity with wind energy

We have been contacted by more than 100 of the postcard recipients for additional information. While the numbers are still small, we hope that a seed has been planted that will eventually motivate those with good wind resources in western North Carolina to learn more about wind energy and to adopt the technology.

Investing in Wind

The Small Wind Initiative has created a research and demonstration facility, raised community awareness, contacted owners of windy property, reached out to key decision-makers statewide, established a nationally respected training program, and conducted wind measurements with the hope of increasing the level of acceptance and understanding of wind power in the Southeast. In doing so, the Small Wind Initiative has given hundreds of people the opportunity to experience wind-electric technology firsthand.

Investing in a wind energy system is generally not a step most landowners can make immediately—many may even think about it for years before they make a decision. The education and information provided by the SWI are expected to continue impacting the wind industry and North Carolina’s energy portfolio far into the future.

Access

Dennis Scanlin, Appalachian State University, Dept. of Technology, Boone, NC 28608 • 828-262-6361 • scanlindm@appstate.edu • www.wind.appstate.edu

Brent Summerville, Appalachian State University, Dept. of Technology, Boone, NC 28608 • 828-262-7333 • wind@appstate.edu • www.wind.appstate.edu

Mike Dooraghi, Appalachian State University, Dept. of Technology, Boone, NC 28608 • 828-262-7333 • mojisimo@yahoo.com • www.wind.appstate.edu

North Carolina State Energy Office, 1340 Mail Service Center, Raleigh, NC 27699 • 800-662-7131 or 919-733-2230 • Fax: 919-733-2953 • energyinfo@ncmail.net • www.energync.net

AWS Truewind LLC, 255 Fuller Rd., Ste. 274, Albany, NY 12203, 518-437-8660 • Fax: 518-437-8659 • info@awstruewind.com • www.awstruewind.com • Wind mapping

Campbell Scientific Inc., 815 W. 1800 North, Logan, UT 84321 • 435-753-2342 • Fax: 435-750-9540 • info@campbellsci.com • www.campbellsci.com • Dataloggers

International Electrotechnical Commission, PO Box 131, Ch-1211, Geneva 20 Switzerland • 41-22-919-02-11 •

Fax: 41-22-919-03-00 • info@iec.ch • www.iec.ch • Acoustic standards

NRG Systems Inc., 110 Riggs Rd., Hinesburg, VT 05461 • 802-482-2255 • Fax: 802-482-2272 • info@nrgsystems.com • www.nrgsystems.com • Wind assessment technology (anemometers, dataloggers, etc.)

Omni Controls Inc., 5309 Technology Dr., Tampa, FL 33647 • 800-783-6664 • Fax: 813-971-5117 • sales@omnicontrols.com • www.extech.info • Anemometers & dataloggers

Turbine Manufacturers:

Abundant Renewable Energy, 22700 NE Mountain Top Rd., Newberg, OR 97132 • 503-538-8298 • Fax: 503-538-8782 • info@abundantre.com • www.abundantre.com • AWP 3.6

Bergey Windpower Co., 2200 Industrial Blvd., Norman, OK 73069 • 405-364-4212 • Fax: 405-364-2078 • sales@bergey.com • www.bergey.com

Southwest Windpower, 1801 West Rt. 66, Flagstaff, AZ 86001 • 866-807-9463 or 928-779-9463 • Fax: 928-779-1485 • info@windenergy.com • www.windenergy.com

Wind Turbine Industries Corp., 16801 Industrial Circle SE, Prior Lake, MN 55372 • 952-447-6064 • Fax: 952-447-6050 • wtic@windturbine.net • www.windturbine.net • Jacobs




Western North Carolina Renewable Energy Initiative 2006 Workshop Schedule

- 4/22 Introduction to Small Scale Wind Energy with REI staff
Beech Mountain R& D site
- 5/27-28 Micro - Hydro with Don Harris & REI staff
Appalachian State University
- 6/24-25 PV/Wind Installation Workshop with Shawn Fitzpatrick of the North Carolina Solar Center & REI staff
Beech Mountain R& D site
- 8/27 Introduction to Small Scale Wind Energy with REI staff
SEE Expo in Asheville
- 9/9 Introduction to Small Scale Wind Energy with REI staff
Beech Mountain R& D site
- 9/22-23 Wind Resource Assessment
Appalachian State University
- 10/21-22 Small Scale Wind Energy with Southwest Windpower & REI staff
Beech Mountain R& D site

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