



Wind Powering America's Wind for Schools Project

Summary Report

I. Baring-Gould and C. Newcomb

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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Abbreviations & Acronyms

BSU: Boise State University

CSU: Colorado State University

DOE: U.S. Department of Energy

INL: Idaho National Laboratory

JMU: James Madison University

KSU: Kansas State University

kW: kilowatts

MSU: Montana State University

NAU: Northern Arizona University

NEED: National Energy Education Development Project

NPPD: Nebraska Public Power District

NREL: National Renewable Energy Laboratory

RBEG: Rural Business Enterprise Grant

SDSU: South Dakota State University

UNL: University of Nebraska

USDA: U.S. Department of Agriculture

VCWE: Virginia Center for Wind Energy

WAC: Wind Applications Center

WPA: Wind Powering America

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1 Introduction

As the United States dramatically expands wind energy deployment, the industry is challenged with developing a skilled workforce to support it. In 2008, the U.S. Department of Energy (DOE) issued a report¹ describing a 20% wind energy future by 2030, which noted that 500,000 new annual full-time equivalent jobs would be created under this scenario.

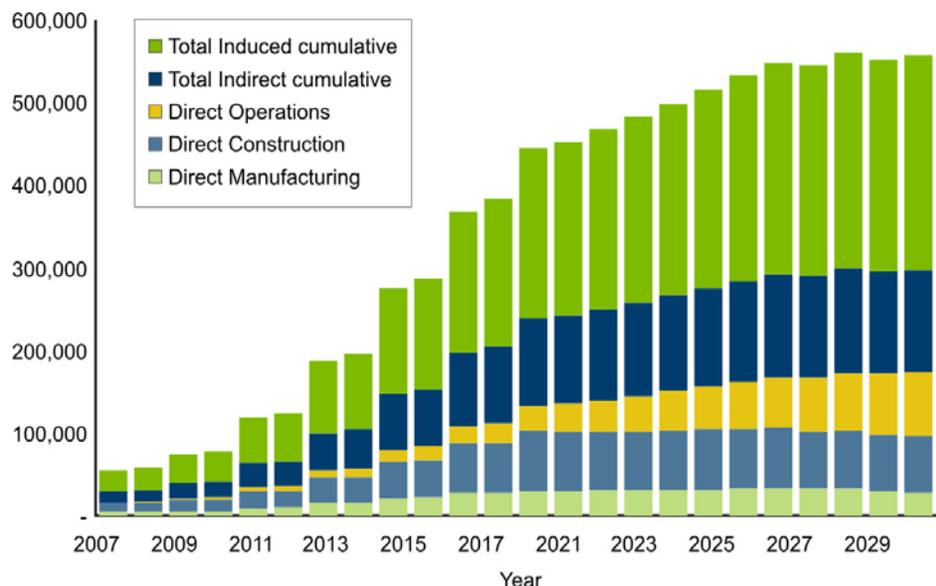


Figure 1. A 2008 U.S. Department of Energy report outlined a 20% wind energy by 2030 scenario, noting that 500,000 new jobs would be created in the wind industry.

In FY08, the DOE's Wind Powering America (WPA) initiative launched the Wind for Schools project in six states (Colorado, Idaho, Kansas, Montana, Nebraska, and South Dakota) to address workforce development needs and public resistance to wind energy deployment. In 2010, five more states were selected for Round 2 (Alaska, Arizona, North Carolina, Pennsylvania, and Virginia) from 25 qualified applicants who responded to a competitive request for proposals² to expand Wind for Schools activities. This second round of funding began supporting projects in FY10 and is expected to last for approximately 3 years.

Wind for Schools focuses on K-12 and university educators and students to counter the trend of reduced numbers of U.S. students entering science and engineering fields. The project's goals are to:

- Equip college and university students with an education in wind energy applications
- Engage American communities in wind energy applications, benefits, and challenges
- Introduce K-12 teachers and students to wind energy.

¹ The report is available at www.nrel.gov/docs/fy08osti/41869.pdf

² Issued on October 23, 2009

The project's methods are as follows:

- Build in-state capacity to provide technical assistance for large, community, and distributed wind projects by providing hands-on “living laboratories” for K-12 and university students
- Develop within each state a center of knowledge and excellence at a respected university that is available to address future wind-related deployment and technical issues
- Develop college-level wind energy programs, incorporating wind curricula and small turbine installations at community schools
- Work with the American Wind Energy Association, the National Energy Education Development (NEED) Project, WindWise, the KidWind Project, and others on K-12 curricula to incorporate interactive wind energy education into the classroom (see the Teacher Training Activities & Curriculum Development section for more information)
- Use a low-cost replicable system for installation at host K-12 schools so that the schools and communities can cover project implementation costs
- Work collaboratively with communities and local utilities to implement cost-effective and community-supported school energy projects
- Provide technical assistance and training to universities by national laboratory staff
- Implement a low-cost data collection system with international accessibility
- Integrate information from a variety of school wind projects
- Provide a process for selected state programs to identify and then develop community relations, allowing them to eventually seek other public or private funding to ensure long-term sustainability of the WACs
- Develop a process so that states interested in developing programs without DOE support can use the tools, methodology, and knowledge gained through the Wind for Schools project (see the Wind for Schools Affiliate Program section for more information).

The Wind for Schools project teams are organized as follows:

- **WACs:** The WACs are formed at universities in each participating state to train engineering students in wind applications analysis and deployment. WAC students gain valuable experience by providing technical assistance to school installations.
- **State facilitator:** The facilitator assists in developing Wind for Schools projects in each state by identifying candidate K-12 schools and working with the community, teachers, school administration, local utility, and the WAC to implement the project.
- **Host school, science teacher, school administration, and community:** A Wind for Schools host school owns the small wind turbine, assists in its installation, and implements wind energy educational curricula. The host school also provides land for the project, interconnection, facilities, and nominal financial support and agrees to make data from the turbine public.

- **WPA/National Renewable Energy Laboratory (NREL)/DOE:** WPA, NREL, and DOE provide technical and financial assistance to the WAC and facilitator over the first few years of the project in each state to help implement the activity. They also provide wind measurement equipment to assess potential school sites and assist in curricula development at the university and K-12 levels.
- **Community:** The community (including the local utility and business groups) assists in project development, funding, and implementation.
- **State government:** The state government may provide funding support for the wind turbines.

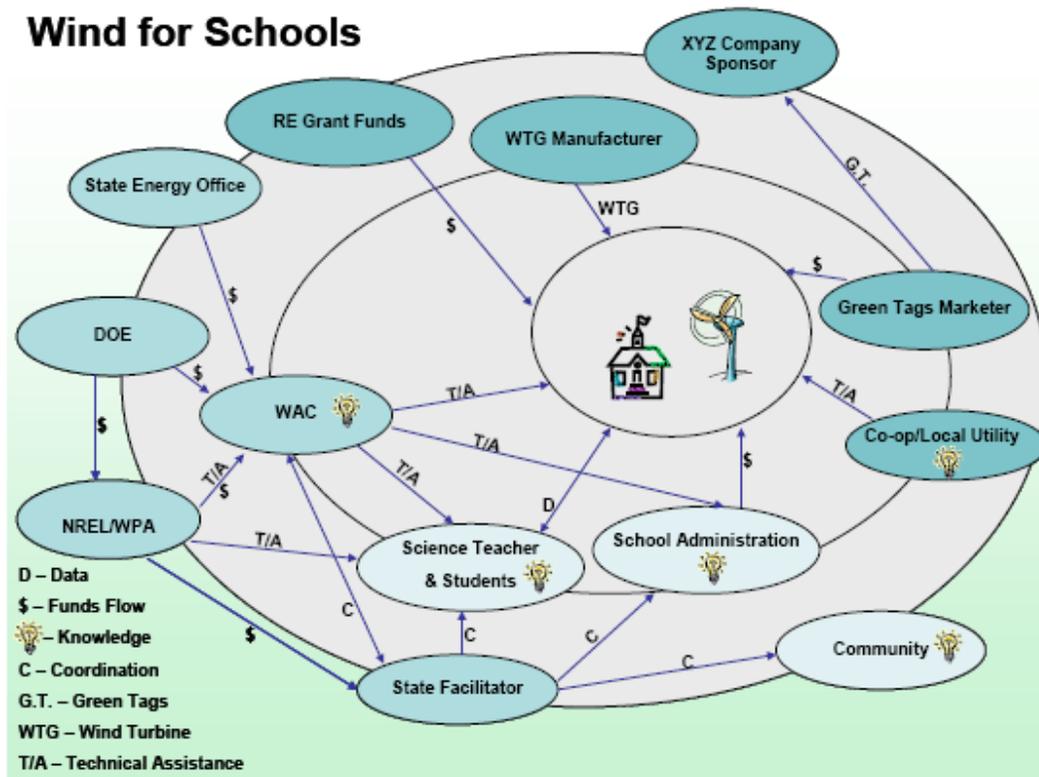


Figure 3. Schematic of the Wind for Schools project

The project’s results to date are:

- Eleven states have active programs. This report provides an update from each state.
- At the university level, more than 60 students graduated in 2011 with active involvement in the WACs.
- As of May 2012, approximately 100 turbines have been installed at host schools, impacting many thousands of students. This represents an activity cost share of approximately \$1.035 million (all funding for host school installations comes from non-DOE sources).

- Teacher-training programs have been implemented in all Round 1 participating states and several Round 2 states.
- There is strong interest in developing programs in additional states (including Texas, Illinois, and Iowa) and a defined affiliate program that allows these interested schools and states to participate in the program at no cost to DOE.
- New curricula for the K-12 and university levels have been developed to support educational opportunities for students. Wind for Schools also supports teacher training and curricula developed by the NEED project, the KidWind Project, and Windwise Education. The project's influence is apparent by the increased numbers of students who elect to take these courses and engage in wind-related projects. There is also a corresponding increase in the number of students who choose to pursue wind energy careers.
- A wind turbine data collection and storage mechanism is under development and collecting data for 40% of the turbines currently installed. This is the first step to allowing data from turbines to be incorporated directly into curricula at the K-12 and university levels. Idaho National Laboratory (INL) designed the database, but INL staff require additional funding to upgrade the software to deal with recurring issues (difficulties exporting data, database crashing from multiple simultaneous data request) and to provide the necessary maintenance required to ensure that the turbines communicate. The current database system is not sustainable because it requires constant monitoring and troubleshooting, and INL does not have the funds to maintain the current system or transition to a more reliable system.

This report provides an overview of the Wind for Schools project to date. Section 2 outlines teacher-training activities and curriculum development. Section 3 discusses the affiliate program that allows school districts and states to replicate the program.

Section 4 is dedicated to state reports, providing an update on activities and progress in the 11 states in which the Wind for Schools project operates. Program funding support was divided into Round 1 (beginning in FY08) and Round 2 (beginning in FY10 or FY11), so the progress levels among states reported here can vary widely, depending on the initial funding date. Also note that during the first year of funding, the state teams are laying the foundation for projects and seeking partners and additional funding; as a result, school projects may not be installed until the second or third year.

Table 1 summarizes the Wind for Schools turbine locations. As of June 1, 2012, 99 turbines have been installed as part of the program. Many other partner schools without turbine installations also benefit from Wind for Schools project activities.

The recent cost increase of rare earths and other materials has resulted in a nearly 10% increase in material costs for the Skystream wind turbine and an overall cost increase of 30%, making these projects even more difficult to implement in rural schools.

Furthermore, the recent rare earth elements cost increase resulted in Southwest Windpower delaying release of its new Skystream 600, which many schools had planned to install.

Table 1. Wind for Schools Project Installations as of June 1, 2012

School	Location	Install Date
Skyline High School	Idaho Falls, ID	2007
Cascade Middle School/Cascade High School	Cascade, MT	2008
Cedar Rapids Public School	Cedar Rapids, NE	2008
Concordia High School	Concordia, KS	2008
Elkhorn Valley School	Tilden, NE	2008
Ell-Saline Junior/Senior High School	Brookville, KS	2008
Fairfield High School	Fairfield, MT	2008
Fairfield High School	Langdon, KS	2008
Greenbush Education Center	Greenbush, KS	2008
Jerome Middle School	Jerome, ID	2008
Kansas State University	Manhattan, KS	2008
Montana State University	Bozeman, MT	2008
Sanborn Central	Forestburg, SD	2008
Sleeping Giant Middle School/Park Senior High School	Livingston, MT	2008
Stanford High School	Stanford, MT	2008
Sterling High School	Sterling, KS	2008
Walton Rural Life Charter Elementary	Walton, KS	2008
Arriba-Flagler Consolidated School District High School	Flagler, CO	2009
Blue Valley Junior/Senior High School	Randolph, KS	2009
Burlington High School	Burlington, CO	2009
Dakota Valley School District	North Sioux City, SD	2009
Diller-Odell Public School	Odell, NE	2009
Douglas School District	Box Elder, SD	2009
Elkton School District	Elkton, SD	2009
Faith School District	Faith, SD	2009
Hayes Center Public School	Hayes Center, NE	2009
Kit Carson School District	Kit Carson, CO	2009
Memorial Middle School	Sioux Falls, SD	2009
Pocatello Community Charter School	Pocatello, ID	2009
Pretty Prairie Junior High School	Pretty Prairie, KS	2009
Selby School District	Selby, SD	2009
Shelley High School	Shelley, ID	2009
Sherrod Elementary School	Palmer, AK	2009
Stratton High/Middle School	Stratton, CO	2009
Walsh High School	Walsh, CO	2009
Appanoose Elementary School	Pomona, KS	2010
Bancroft-Rosalie Public Schools	Bancroft, NE	2010
Bloomfield Community Schools	Bloomfield, NE	2010
Fergus High School	Lewiston, MT	2010
Forsyth High School	Forsyth, MT	2010
Glasgow High School	Glasgow, MT	2010
Hope Street Academy	Topeka, KS	2010
Loup City Public Schools	Loup City, NE	2010
Midway Middle School	Rigby, ID	2010
Miller School District	Miller, SD	2010
Mt. Edgecumbe High School	Sitka, AK	2010
Mullen Public Schools	Mullen, NE	2010
Norris Public Schools	Firth, NE	2010
Papillion-LaVista Public Schools	Papillion, NE	2010

School	Location	Install Date
Richard McKenna Charter High School	Mountain Home, ID	2010
Rigby High School	Rigby, ID	2010
Solomon Schools	Solomon, KS	2010
Townsend Elementary - Middle School/Broadwater High School	Townsend, MT	2010
U.S. Coast Guard Station Juneau	Juneau, AK	2010
Valier Elementary and Middle School/ Valier High School	Valier, MT	2010
Wellington Middle School	Wellington, CO	2010
Wessington Springs School District	Wessington Springs, SD	2010
West Point Public Schools	West Point, NE	2010
Wolf Point High School	Wolf Point, MT	2010
Yankton School District	Yankton, SD	2010
Alleghany High School	Sparta, NC	2011
Avery County High School	Newland, NC	2011
Brookings School District	Brookings, SD	2011
Cape Hatteras Secondary School of Coastal Studies	Buxton, NC	2011
College of Albemarle, Dare Campus	Manteo, NC	2011
College of the Albemarle - Edenton	Edenton, NC	2011
Crawford Public Schools	Crawford, NE	2011
Creighton Public Schools	Creighton, NE	2011
Eudora High School	Eudora, KS	2011
First Flight Middle School	Kill Devil Hills, NC	2011
Garden County Public Schools	Oshkosh, NE	2011
Henley Middle School	Crozet, VA	2011
Hyannis Public Schools	Hyannis, NE	2011
Jefferson West Middle/High School	Meriden, KS	2011
JP Knapp High School	Currituck, NC	2011
Lake Andes School District	Lake Andes, SD	2011
Logan View Public Schools	Hooper, NE	2011
Mitchell Technical Institute	Mitchell, SD	2011
Northern Arizona University	Flagstaff, AZ	2011
Northumberland Middle/High School	Heathsville, VA	2011
Northwestern Arctic Career and Technical Center	Nome, AK	2011
North Wilkes Middle School	North Wilkesboro, NC	2011
Orme School	Mayer, AZ	2011
Penn State	University Park, PA	2011
Pleasanton Public Schools	Pleasanton, NE	2011
Ponderosa High School	Flagstaff, AZ	2011
Ponderosa High School	Parker, CO	2011
Saint Michael Indian School	St. Michaels, AZ	2011
South Dakota School of Mines and Technology	Rapid City, SD	2011
University of Alaska (Mat-Su campus)	Palmer, AK	2011
Watauga High School	Boone, NC	2011
West Holt Public Schools	Atkinson, NE	2011
Williams Elementary/Middle School	Williams, AZ	2011
Begich Middle School	Anchorage, AK	2012
Brookings High School	Brookings, SD	2012
Nederland Middle/High School	Nederland, CO	2012
Park County RE-2 School District	Fairplay, CO	2012
Circle High Schools	Towanda, KS	2012
Halstead High School	Halstead, KS	2012

2 Teacher-Training Activities & Curriculum Development

One important element of the Wind for Schools project is teacher-training activities and curriculum development. The program has partnered with the KidWind Project and the NEED Project to achieve these goals.

2.1 The KidWind Project

The KidWind Project focuses on four areas:

- Teacher training and outreach, accomplished via conducting WindWise Workshops and training Wind Senators
- Product and kit development
- Curriculum development (e.g., WindWise curriculum and other open source lessons)
- The KidWind Challenge.

Contracted work with the Wind for Schools project includes the following activities:

- Funding for six Wind Senators in Arizona, Idaho, Alaska, Kansas, Pennsylvania, and South Dakota. WPA paid 60%, and the individual WACs paid the remaining 40%.
- Funding for WindWise curriculum development to expand and nationalize the current WindWise curriculum, including adding a lesson on offshore wind projects.

2.2 The NEED Project

The NEED Project provides:

- Teacher training and support through 1-day, partial day, or multi-day workshops
- Wind curriculum at the primary, elementary, intermediate, and secondary levels correlated to all state science standards and updated annually
- Curriculum for schools with turbine installations
- Energy curriculum, including the science of energy, sources of energy, electricity, transportation options, and conservation and efficiency
- Energy careers information and activities
- Offshore energy curriculum
- Hands-on classroom kits
- A bi-monthly newsletter providing additional classroom activities and energy careers information.

Through the Wind for Schools project, the NEED Project provides the following resources:

- Wind for Schools curriculum, developed with the Wind for Schools project team for schools with turbine installations
- Teacher training for educators in Wind for Schools states in coordination with the WACs
- Hands-on wind kits provided to each workshop attendee from Round 1 states
- Hands-on wind kits provided to each WAC for distribution to workshop attendees from Round 2 states
- Support for WACs and educators in Wind for Schools states.

It should be noted that when Colorado teacher and 2010 NREL summer intern Mike Kelley conducted a survey of Wind for Schools project participants, he found that the teacher training and curriculum development part of the Wind for Schools project did not meet expectations. In his final report, Kelly concluded:

“The availability of teacher training is a significant shortcoming of the current implementation of Wind for Schools. Offering more frequent training in closer proximity to the Wind for Schools sites would improve this situation.”

Regarding curriculum, Kelly reported:

“At the high school level, there is a call for a more complete curriculum, one that includes a more detailed and analytical inquiry into topics such as site planning, environmental concerns, cost benefit analysis, wind turbine selection process, and careers... The WindWise materials should be made available to the participants in the Wind for School program...”

As a result of this feedback, beginning in FY10 the program placed a greater emphasis on addressing these issues (for example, additional investments were made in WindWise curricula). The WAC teams also emphasized curriculum development and implementation.

3 Wind for Schools Affiliate Program

To accommodate the many stakeholders who are interested in the Wind for Schools project, WPA developed a Wind for Schools affiliate program. Individual K-12 schools or states that join the affiliate program will not receive financial support from DOE and NREL, but they will receive access to technical assistance, program websites, and information. The program is designed to support schools that wish to implement wind-related educational curricula and install a Wind for Schools wind turbine system or states that intend to implement a statewide program.

In both cases, a key element of the program is to install small wind turbines at K-12 schools to be used in combination with age-appropriate, hands-on wind energy curricula taught in science classes. The standard Wind for Schools system is further described in the Wind for Schools Project Power System Brief³. Other turbines can be included in the system if appropriate. State-based programs would support the implementation of a WAC at a local engineering university or college to lead efforts to implement Wind for Schools systems at multiple state K-12 schools.

The two affiliate programs are described in detail below.

3.1 Individual K-12 Wind for Schools Affiliate Program

The K-12 Wind for Schools affiliate program is designed to support the implementation of an education program at a K-12 school with staff interested in incorporating wind energy into existing educational programs.

3.1.1 Program Support

Although the DOE's Wind for Schools project will not provide monetary support to an affiliate K-12 program, it will provide support in other areas. As a Wind for Schools K-12 affiliate, a school's staff will gain access to:

- Project implementation documents, including interconnection specifications and foundation information
- Hardware and software developed for the Wind for Schools system at costs equivalent to those paid by other Wind for Schools host schools
- Limited technical assistance during the implementation of the Wind for Schools system
- Program-sponsored teacher-training programs
- The Wind for Schools host schools' system database to support expanded educational opportunities
- The Wind for Schools environmental benefit sales process to allow the affiliate school to obtain outside funding to support the system implementation

³ Available at www.nrel.gov/docs/fy09osti/45685.pdf

- The NEED Project’s curricula kits on a short-term loan basis to enable schools to complete the full NEED curricula model (as available).

3.1.2 Program Expectations

The Wind for Schools program team expects that a school or school system interested in joining the affiliate program would engage in the following tasks:

- Incorporate the NEED Project’s wind curricula into science classes
- Install a Skystream (or equivalent) wind turbine at the school and utilize specific hardware (approved as appropriate for any state incentives)
- Install a compatible data logger and make the data from the wind turbine available on the Wind for Schools website so that other schools can access it for educational purposes
- Obtain all necessary funding to implement the project (the Wind for Schools project will offer some support in obtaining funds)
- Assume responsibility for all turbine maintenance and engage with all relevant organizations (such as the local utility or energy cooperative) that would support maintenance
- Conduct education and outreach to the local community
- Report on installation(s) and share data pertaining to system costs.

If a school is unable to install a Wind for Schools system due to a lack of available land, permitting, or wind resource, the school may become an affiliate if staff members are interested in implementing the NEED Project’s wind curricula and using data from other Wind for Schools system installations.

3.1.3 Expected Costs

An individual system, excluding staff time to cover the development costs, is approximately \$20,000 (this includes the turbine, tower, control package, and curricula). Operational funding for the system is not expected to be significant and would likely involve an annual inspection and the potential for minor service-related issues. The Wind for Schools project can assist in identifying funding sources but will not provide direct funding.

3.1.4 Application Process

School staff members interested in becoming a Wind for Schools K-12 affiliate should contact Charles Newcomb at 303-384-7020 or charles.newcomb@nrel.gov.

3.2 Statewide Wind for Schools Auxiliary Program

The statewide auxiliary program is designed to mirror the current Wind for Schools activities in other states. This includes implementing a WAC at a state-based university, creating a state facilitator position (if needed), and funding related program elements. The program goals would reflect those of the existing Wind for Schools project, including:

- Educating future wind applications personnel at universities
- Installing Wind for Schools systems at approximately five host K-12 schools per year
- Engaging with communities to convey the benefits and discuss the issues related to an expanded wind energy application.

3.2.1 Program Support

By agreeing to establish a state-based Wind for Schools auxiliary program, a state program will gain access to a broad array of support services, including:

- Project implementation documents, such as interconnection specifications and foundation information
- National program-produced Wind for Schools publications
- Benefits of lessons learned by other states that have already implemented the program
- Hardware and software developed for the Wind for Schools system at costs equivalent to those charged to other Wind for Schools projects
- Limited technical assistance during the implementation of the Wind for Schools systems
- Program-sponsored meetings, training programs, and informational summits
- The Wind for Schools system database to support expanded educational opportunities
- The Wind for Schools environmental benefit sales process to allow the affiliate school to obtain outside funding to support the system implementation.

3.2.2 Program Expectations

A comprehensive, state-based Wind for Schools auxiliary program will be expected to:

- Provide funding and operational support to install a Wind for Schools system at the WAC to facilitate training and educational opportunities for students at a college or university
- Identify funding for a state facilitator to work with the WAC and K-12 host schools on project implementation and integrate the state participants into the national Wind for Schools project
- Obtain all funding necessary to implement the program (some support for this process will be available through the national program on a case-by-case basis)
- Perform or promote education and outreach to local communities
- Purchase wind assessment/measurement systems to support resource assessments at schools (these systems are typically provided to the WAC and also provide an educational opportunity for students at the university or associated community colleges)

- Implement NEED-based teacher-training program(s)
- Purchase NEED curriculum kits for loan to K-12 host schools (typically through the WAC)
- Report installations and share data on system costs
- Attend national Wind for Schools summits and other related meetings
- Provide partial funding or support for wind equipment at host schools
- Ensure that each host school activity meets the requirements as defined above for individual K-12 school programs.

3.2.3 Expected Costs

A fully comprehensive Wind for Schools state program including WAC, state facilitator, and initial equipment funding is approximately \$175,000 per year for 3 years. This assumes that a small amount of the state funding, such as \$8,000 to \$10,000 per host school, will be applied to wind turbine hardware. Typical funding would include:

- WAC: \$60,000 per year
- State facilitator: \$30,000 per year
- Host school system funding: \$50,000 per year (assumes ~five systems per year)
- State-based project oversight: \$10,000 per year
- Meteorological towers: \$25,000 (first year)
- Wind for Schools teacher training: \$25,000 (second and third years).

3.2.4 Application Process

Any state organization interested in hosting a Wind for Schools K-12 affiliate activity should contact Charles Newcomb at 303-384-7020 or charles.newcomb@nrel.gov

3.3 Wind for Schools Equivalent Wind Systems

The Wind for Schools project has identified Southwest Windpower's Skystream 3.7 wind turbine as the primary turbine to be implemented at host K-12 schools. This turbine system was selected based on the following attributes:

- Manageable size (the nameplate power capacity of 2.4 kilowatts [kW] is small enough to avoid a net-metering conflict with the local utility or power cooperative and to allow installation using local resources)
- Primary AC power production (ensures simple interconnection with a school's electrical systems)
- Guyed lattice and monopole tower options at multiple heights to ease installation

- Integrated data acquisition with Web-based monitoring capabilities
- Manageable total system cost that includes significant turbine price discounts from the manufacturer
- Proven company track record with a commitment to expand support for school-based wind systems and a nationwide support infrastructure to allow long-term installation, warranty, and maintenance support.

Other turbine technologies and sizes would be applicable, but they should be selected for their ability to meet the basic requirements listed above and to provide performance data for other Wind for Schools partners.

4 State Reports

4.1 Alaska (Round 2)

Thirteen Alaska schools applied to install wind turbines in 2010; however, several of these schools encountered hurdles (e.g., limited funding, limited staff to dedicate to the project, hesitation from the school board and/or Borough) and placed their projects on hold. The 2011 letter of intent was distributed in October 2010. Eighteen schools applied, including several schools that previously applied and are continuing to work toward installing turbines.

The application deadline for 2012 installations closed on October 15, 2011, and the WAC received letters of intent from the following schools: South High School, Anchorage; William Memorial School, Napakiak; Colony Middle School, Palmer; Birchwood ABC School, Chugiak; and Polaris K-12, Anchorage.

Table 2 summarizes the six Wind for Schools installations in Alaska to date, and Figure 4 shows project locations⁴ in the state.

4.1.1 Alaska WAC Activities

Examples of Alaska WAC activities include the following:

- Each WAC student is assigned to a school that applied for a turbine. The students create the project plans for each site, including wind maps, site assessments, and financial plans.
- The WAC participated in the first KidWind Challenge in Alaska in 2011, along with 12 schools and more than 40 teams. Because many communities are remote, organizers scheduled nine competitions, shipping a portable wind tunnel to each one. Fifteen teams from 11 communities registered for the 2012 Challenge, and the WAC will again bring the event to the remote communities. The WAC team developed a teacher resource page to serve as a clearinghouse of information on the KidWind Challenge, including resources for curriculum, using the KidWind kits, blade design, wind tunnels assembly, using the Veriner equipment, and the student multi-media presentation requirements. A graduate student is working with the Wind for Schools project, focusing on the KidWind Challenges in southeast Alaska.
- A planning group is working to create a 1-credit Web-based course that will be offered in the 2013 spring semester.

⁴ Note for all state maps: Some projects are in close proximity to others, which may be represented on the map as a single point of interest. See the online map at www.windpoweringamerica.gov/schools/projects.asp to zoom in for more detailed views.

WAC

University of Alaska - Fairbanks
www.uaf.edu/acep/alaska-wind-diesel-applic/

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Under contract: Round 2

Number of installations: 6



- Although as of the end of 2011 the University of Alaska-Fairbanks does not offer 3-credit wind energy courses, there are plans to expand education options (including developing a Wind-Diesel Academy). However, the University of Alaska currently sponsors three 1-credit Introduction to Wind Energy courses in rural Alaska in Dillingham, Nome, Bethel, and Kotzebue. Table 3 shows student demographics.

Table 2. Alaska Installations Summary

Install Date	Location	Project Details
February 2012	Begich Middle School, Anchorage	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 - Begich began working on a turbine installation in 2010. The school paved the way for small wind in Anchorage by being the first approved applicant for the municipality's Wind Energy Conversion System Administrative Site Plan Review process - Begich received a \$40,000 legislative funding award for the project
October 2011	Northwestern Alaska Career and Technical Center (NACTEC), Nome	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 - NACTEC is a joint-venture regional vocation training center between the Bering Straits School District and Nome Public Schools - In September 2011, students from the villages of Golovin, Koyuk, Nome, Shaktoolik, and Teller participated in a NACTEC renewable energy course, working with Bering Straits Development Company construction workers to construct the tower foundation. Students gained hands-on experience in excavation, building forms, pouring concrete, and wiring rebar - The turbine will be used as a hands-on educational tool
April 2011	University of Alaska Mat-Su Campus, Palmer	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 - The Wind for Schools project is a natural fit for the college, which established a Renewable Energy Occupational Endorsement Certificate, the first program of its kind in the United States. The program was designed in conjunction with an industry steering committee to help meet the growing need for energy expertise in Alaska
December 2010	U.S. Coast Guard Cutter Maple Moorings facility, next to Mt. Edgecumbe High School, Sitka	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 - Donors: U.S. Coast Guard (donated turbine at ~\$8,000, provided in-kind assistance with planning and installation), Mt. Edgecumbe High (\$4,000), City of Sitka Electrical Department (\$5,000), Southwest Windpower (40% discount on the tower and foundation), Lynden Cargo (free shipping), Renewable Energy Alaska Project (\$1,000 donation toward the turbine cost), Sitka Ready Mix and Jacoby Construction (in-kind donations) - Math and physics teacher Matt Hunter championed the project after seeing a newspaper advertisement for the Wind for Schools project
October 2010	U.S. Coast Guard facility, Juneau	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 - Donors: U.S. Coast Guard (donated turbine, installed data acquisition system) - As a result of this installation, in 2011 several schools participated in the KidWind Challenge in Juneau
November 2009	Sherrod Elementary School, Palmer	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 - Project cost: ~\$29,000, not including in-kind contributions - Donors: Matanuska Electric Association, Mat-Su Borough, Mat-Su Borough School District, Local Rotary 5010, JD Steel

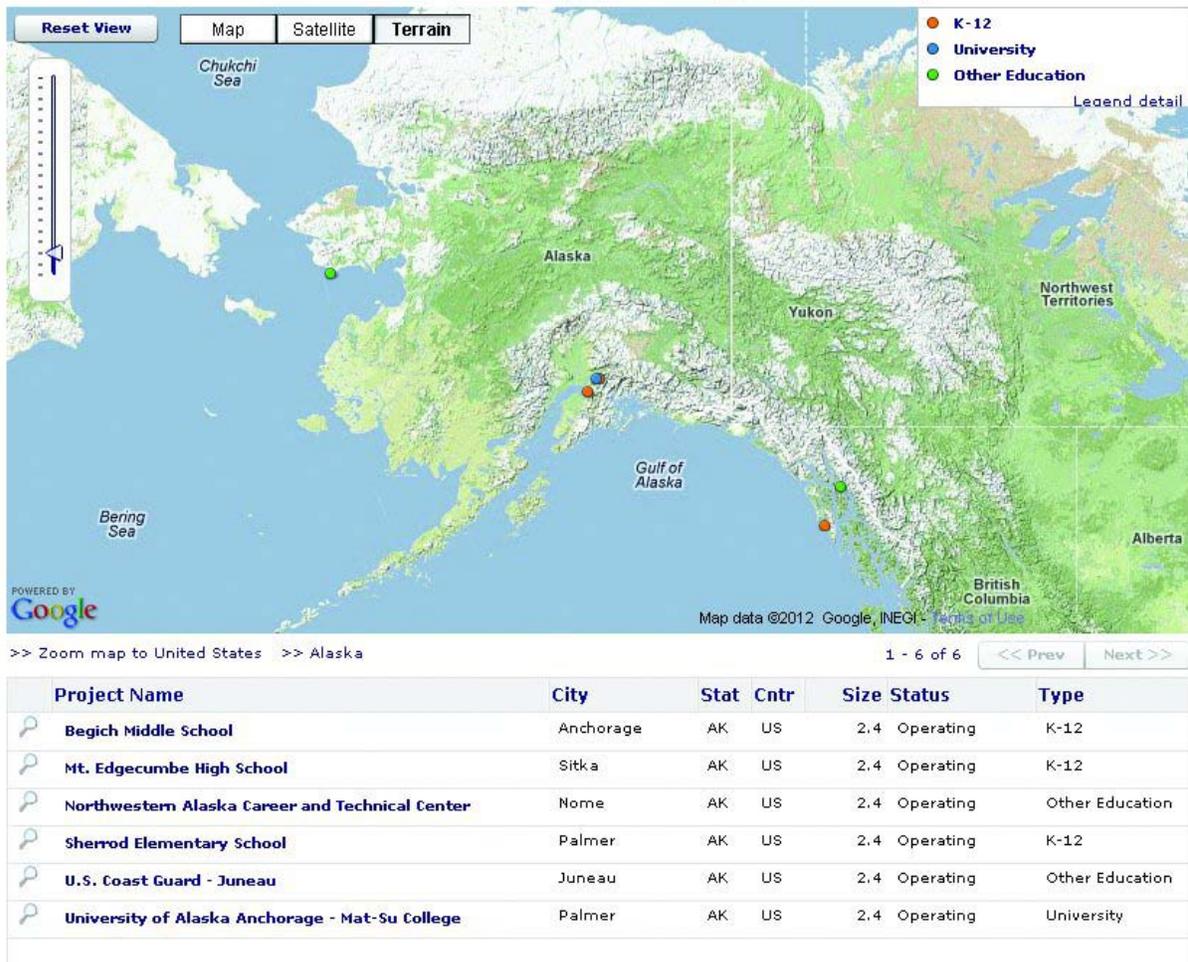


Figure 4. Alaska Wind for Schools project locations

Table 3. Demographics of Students in the University of Alaska's Introduction to Wind Energy Courses

Students in Wind Energy Courses	Caucasian	African-American	Hispanic	Native Alaskan	Asian-American	Foreign	TOTAL
Students	20 (M) 5(F)			30 (M) 10(F)			50(M) 15(F)

4.1.2 Curricula and Teacher-Training Activities

Examples of Alaska curricula and teacher-training activities include the following:

- The Alaska WAC created Alaska-specific curricula. Members have partnered with Alaska Pacific University’s graduate program in outdoor education and work with graduate students to create wind energy curricula for grades K-6, as well as energy efficiency curricula. The team is also developing wind energy courses at the WAC host school.

- The Alaska WAC hosted a Wind for Schools Energy Educator’s webinar in August 2010 for teachers who could not attend training in Anchorage. The webinar provided an introduction to the project and the application process, as well as project steps, turbine installation, wind energy basics, KidWind Project and NEED Energy Kits, and Wind for Schools curricula.

4.1.3 Funding Update

According to the Alaska team, the greatest hurdle is lack of funding. This issue makes it difficult to organize teacher training and make it accessible to interested educators. The greatest hurdles for the schools appear to be generating enough project funding and garnering support from the school district. Funding must be addressed on an individual school basis.

The team gained the support of several project sponsors immediately after implementing the program in the state and continues to seek additional partners. The most significant partnership has been with the U.S. Coast Guard, which donated the turbines for the Juneau and Sitka projects. The Coast Guard is investigating the possibility of acquiring additional turbines to install at schools near other bases in Alaska. The Coast Guard also made significant in-kind donations of time, expertise, and the use of heavy equipment.

Lynden Transport, Lynden Air Cargo, and Alaska Marine Lines have donated up to \$6,500 in shipping costs for participating schools in 2010 and 2011. This donation covers the costs of barging the turbine, tower, and foundation from Seattle to Alaskan communities. The companies anticipate increasing the donation level as more schools participate.

4.1.4 Testimonials

"These students will gain experience with wind power that could lead to real job opportunities in their own villages maintaining, installing, and operating wind systems. They may also start thinking about wind as a possible alternative to the costly diesel that many communities now rely on for powering their communities."

Matt Hunter, math and physics teacher, Mount Edgecumbe High School, Sitka, Alaska

"What we learn in Sitka will help us make strategic decisions regarding how to implement wind energy at other Coast Guard facilities, particularly at remote sites in Alaska. We are excited about this project that helps us in our objectives as well as helps the school and community."

Sudie Hargis, energy program specialist, U.S. Coast Guard

4.2 Arizona (Round 2)

The Arizona Wind for Schools project team has developed successful systems for fundraising, managing turbine installations, performing teachers' workshops, engaging teachers, and performing direct education in K-12 classrooms, including special program areas such as partnerships for service learning with university and community college students and a Wind Energy Ambassadors project.

The Wind for Schools project team works closely with Northern Arizona University's (NAU's) Sustainable Energy Solutions Institute and its staff and researchers to collaborate on projects and to develop advisory functions for the Wind for Schools project. The program team is also working closely with several partner schools and with Southwest Windpower (headquartered in Flagstaff) to pursue funding for renewable energy installations at Native American schools.

Table 4 summarizes the five Arizona Wind for Schools installations to date. Planned installations for 2012 include the Moencopi Day School in Tuba City, the Hopi Day School in Kykotsmovi, and the N.A.T.I.V.E. Joint Technical Education District High School in Kayenta.

4.2.1 Arizona WAC Activities

Examples of Arizona WAC activities include the following:

- Assisting with research or capstone projects in the electrical engineering, visual communications, environmental sciences, speech and communication, economics, management, mechanical engineering, and German classes at NAU. WAC members give presentations on wind energy and the Wind for Schools project in several of these classes. All student employment and much of the core staff time are funded through sources that were leveraged by DOE funding.
- Developing a First-Year Seminar at NAU for undergraduates in collaboration with the Global Learning Community Program, which allows for teaching as many as 20 freshmen about wind energy as it can be applied in Arizona communities. The First Year Seminar program encourages direct application of theory, both inside and outside of the classroom. The NAU SkyStream installation and other community installations will serve as living laboratories to give students up-to-date information and technical training. This class will also provide a pool of students to serve on an action research team, partnering with Flagstaff teachers to present wind energy lessons and activities.

WAC

Landward Institute at Northern Arizona University (NAU)
www.landward.nau.edu/windforschools.html

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Under contract: Round 2

Number of installations: 5

- Working with Southwest Windpower, NextEra Energy Resources, and other utility and industry partners to develop summer internships. Southwest Windpower hired two students for design work in spring 2011 and also offered seats in the company's dealer/installer training program to students from Coconino Community College's Alternative Energy Technician program in exchange for the trained individual performing one Wind for Schools installation.
- Performing wind turbine design challenges for middle and high school students in Gallup, New Mexico (November 2010), middle school students from five Navajo Nation schools at an Engineering Science Day at NAU (April 2011), 7th-grade science students at Flagstaff Junior Academy and 7th-grade science students at Mount Elden Middle School (June 2011).

Table 4. Arizona Installations Summary

Install Date	Location	Project Details
November 2011	NAU's Applied Research & Development building, Flagstaff	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 on a 70-foot monopole tower - The student-funded NAU Green Fund provided \$25,000 for the installation - Southwest Windpower donated the turbine and tower - All project labor (including electrical design, ground work, and the installation) was donated through NAU partnerships
November 2011	The Orme School, Mayer	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 on a 45-foot tower
October 2011	Saint Michael Indian School, St. Michaels	<ul style="list-style-type: none"> - Turbine: Skystream 3.7 on a 55-foot tower - NAU secured \$100,000 in funding for renewable energy and energy efficiency infrastructure improvements - Saint Michael Indian School used private funding to cover the installation costs for its solar PV and solar thermal installations (part of the \$100,000) - NAU's construction department covered the Skystream installation costs (~\$4,000)
October 2011	Williams Elementary/Middle School, Williams	<ul style="list-style-type: none"> - Turbine: Skystream 3.7
July 2011	Ponderosa High School, Flagstaff	<ul style="list-style-type: none"> - Turbine: 160-Watt Air Breeze - Donors: Southwest Windpower (donated turbine), Arizona Public Service (\$5,000), NextEra Energy, Prometheus Renewables - High school students coordinated and performed a public meeting to present the project to neighbors, parents, and other Flagstaff high school students - The turbine is part of a hybrid solar and wind energy off-grid installation designed by NAU students, who are also designing and performing energy education activities with the high school students - NAU students worked with the installation company and Coconino Community College students in the alternative energy technician program. The community college students receive lab service learning credits for assisting with the installation - A success story about this project is available on the Wind Powering America website at www.windpoweringamerica.gov/filter_detail.asp?itemid=3236

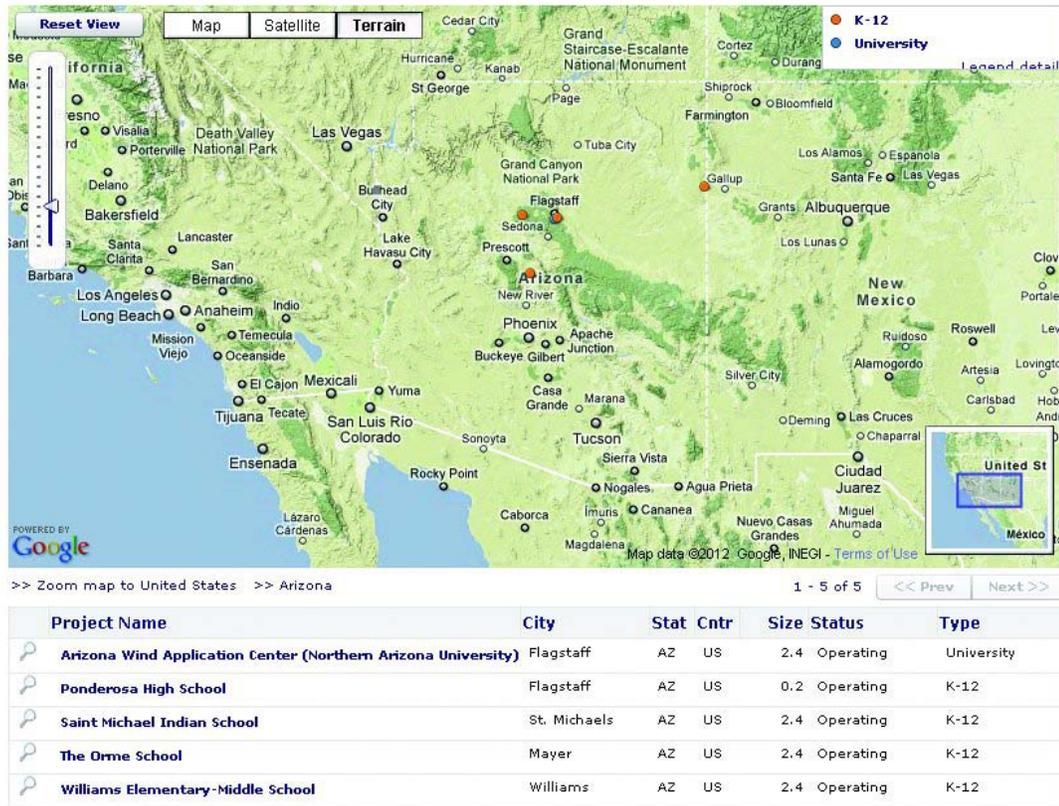


Figure 5. Arizona Wind for Schools project locations

4.2.2 Curricula and Teacher-Training Activities

The Arizona WAC has promoted curricula development and teacher training by:

- Collaborating with the NATIVE Joint Technical Education District (includes Kayenta, Tuba City, Pinyon, Window Rock, and several other school districts) to plan renewable energy technology curriculum at multiple potential installations
- Working with Coconino Community College students to help them earn lab service learning credits for working on Wind for Schools project installations and for teaching wind energy concepts in partner K-12 schools. Coconino has a program in which high school students can enroll in the alternative energy technician program, earning credits at their high schools while they work toward community college degrees
- Pairing NAU student interns with Flagstaff teachers to create wind energy curriculum and activities and research wind power initiatives. Activities include devising wind energy lesson plans to give to teachers, creating activities for hands-on wind energy learning, creating Powerpoint presentations for teachers to present to classes, presenting wind energy lessons to students in classes and helping with their activities, assisting with wind-related field trips, and assisting teachers with renewable energy curriculum by helping in class and developing more lesson plans

- Partnering NAU student interns with the communications department at the university to integrate wind energy into the curriculum (for example, journalism and public speaking courses)
- Presenting wind energy concepts to high school environmental science students at Northland Preparatory Academy
- Performing anemometer activities with 2nd-grade students at Killip Elementary School
- Partnering NAU students with a Flagstaff Arts & Leadership Academy high school environmental science teacher and a Flagstaff Junior Academy middle school science teacher to present wind power lessons and activities and help with field trips.

The Arizona WAC has engaged in many teacher-training activities. Examples include:

- The team worked with NEED Project organizers to recruit teachers for the March 2011 teachers' workshop in Ft. Defiance. The NEED Project provided 14 wind energy kits for different age groups, four of which were loaned to the STAR school.
- A graduate assistant worked with the NEED Project and Paradise Valley School District's Center for Research in Engineering, Science, and Technology to host a February 2011 wind energy teachers' workshop for 20 teachers from more than a dozen Arizona schools.
- WindSenator Jeff Hines at Northland Preparatory Academy in Flagstaff is leading teachers' workshops in northern Arizona and teaching wind energy lessons from the KidWind and NEED Projects in his middle school science class.
- Mansel Nelson led a teachers' workshop in Grants, New Mexico in December 2010 for 20 teachers from the Navajo Nation.

4.2.3 Funding Update

- The Arizona Technology and Research Initiative Fund, governed by the Arizona Board of Regents, awarded nearly \$50,000 to the Arizona Wind for Schools project to supplement DOE funding for the July 2010-June 2011 fiscal year. Some of this funding was reallocated to fund student internships for the spring 2011 semester. Additional reallocation of this funding supported a teachers' workshop at Shonto Preparatory Technology High in May 2011 and partially supported two student workers during summer 2011. This funding also covered the costs of a structural engineer's calculations for permitting the Ponderosa High School wind turbine installation.
- NextEra Energy Resources, the largest wind developer in the United States, has been working to develop several wind projects in northern Arizona. The Arizona Wind for Schools project team developed a relationship with NextEra managers to determine whether anyone is interested in working with a local school in each NextEra project development area. The team received \$60,000 in funding support.
- NAU is developing a Sustainable Energy Solutions Institute, which will serve as an umbrella entity to support all efforts in sustainable energy education, research, and outreach at NAU, including the Wind for Schools project. The Arizona Board of Regents' Technology and Research Initiative Fund funded the establishment of this institute for FY11 and FY12 and will

provide some support to leverage the Wind for Schools project and its funding. The Institute will allow the Wind for Schools project to pursue much greater sources of funding through university connections and with outside entities than it could without this larger support organization.

4.3 Colorado (Round 1)

In 2009, the Colorado WAC and the Colorado Governor's Energy Office selected six rural schools to participate in the Wind for Schools project: Arriba-Flagler Consolidated School District High School in Flagler, Burlington High School in Burlington, Kit Carson High School in Kit Carson, Stratton High School in Stratton, Walsh High School in Walsh, and Wellington Middle School in Wellington. Each school received a \$5,000 grant from the Governor's Energy Office to help purchase and install a Skystream 3.7 turbine. Students and staff from the Colorado WAC helped to design the installations, and NREL agreed to purchase the renewable energy certificates⁵ from the first projects. The WAC has installed three more projects since then: Ponderosa High School in Parker, Park County School District in Fairplay, and Nederland Middle/High School in Nederland. Planned projects for 2012 include Cherry Valley Elementary in Franktown, Flagstone Elementary School in Castle Rock, and Florence High School in Florence.

The following table summarizes the Colorado installations. Note that the initial six installations were among the first for the Wind for Schools project, and WAC Director Kostrzewa provided extensive documentation of each project to aid future installations. We have included his project documentation here after the summary table.

Table 5. Colorado Installations Summary

Install Date	Location
April 2012	Nederland Middle/High School
March 2012	Park County RE-2 School District, Fairplay
January 2011	Ponderosa High School, Parker
February 2010	Wellington Middle School, Wellington
December 2009	Arriba-Flagler Consolidated School District High School, Flagler
December 2009	Burlington High School, Burlington
December 2009	Kit Carson School District, Kit Carson
December 2009	Stratton High/Middle School, Stratton
November 2009	Walsh High School, Walsh

⁵ Renewable energy certificates represent the environmental attributes of power produced from renewable resources. By separating the environmental attributes from the power, clean power generators are able to sell the electricity they produce to power providers at a competitive market value. The additional revenue generated by the sale of the renewable energy certificates covers the above-market costs associated with producing power made from renewable energy sources.

WAC

Colorado State University (CSU) - Fort Collins

www.engr.colostate.edu/ALP

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Under contract: Round 1

Number of installations: 9

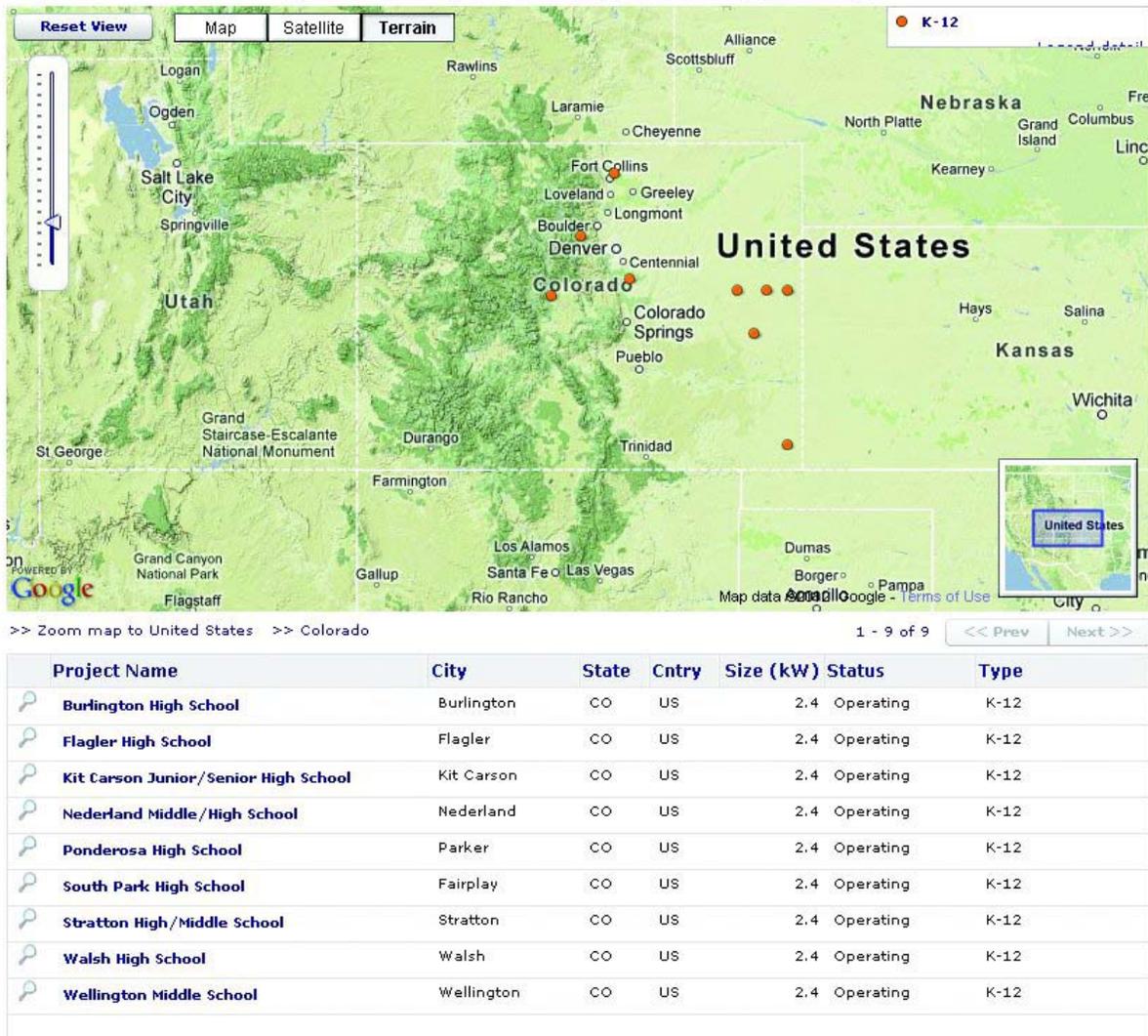


Figure 6. Colorado Wind for Schools project locations

4.3.1 Walsh High School

On November 4, 2009, Walsh High School became the first Colorado Wind for Schools project school to install a Skystream wind turbine. The school installed a 45-foot, three-piece sectional tower on a 12-foot pier foundation and connected to the service at the bus building. Sand Arroyo Energy LLC from nearby Springfield installed the turbine, and the electric utility is Southeast Colorado Power Association, the local Touchstone Energy Cooperative and member co-op of Tri-State Generation and Transmission. Following some issues to reconfigure the voltage to the turbine, it began generating power on December 3, 2009. Communications were established to the turbine via the Skyview 2.0 software on December 16, 2009. The dedication ceremony was held on February 5, 2010.

Table 6. Walsh High School Project Cost Summary

Item	Vendor	Estimated Cost	Actual Cost
Skystream 3.7 Wind Generator	Southwest Windpower	\$3,727	\$3,727
Skystream 3.7 Sectional Monopole Tower - 45'	Southwest Windpower	\$3,214	\$3,214
Foundation drill & pour	WT Contractors, Ulysses	\$1,950	\$1,950
Anchor bolt kit	Sand Arroyo Energy LLC	\$605	\$605
Turbine/tower erection	Sand Arroyo Energy LLC	\$2,500	\$1,500
Skylevel kit	Sand Arroyo Energy LLC	\$0	\$90
Electric wiring & disconnect boxes	McDonald Electric	\$375	\$725
Inspection Fee	McDonald Electric		\$120
Electrician	McDonald Electric	\$325	\$1,108
TOTALS			
		\$12,696	\$13,039

Funding sources for the Walsh turbine:

- Colorado Governor's Energy Office: \$5,000 grant
- NREL renewable energy credit purchase: \$2,500
- Cooper Clark Foundation: \$4,000 grant
- School contribution: \$1,539.

4.3.2 Kit Carson School District

On December 14, 2009, Kit Carson School District installed a turbine on a 45-foot, three-piece sectional tower on a SMaRT foundation. The service was connected to a meter located about 250 feet away that serves the community park lighting and building (the school pays for the electric service through this meter). Advanced Energy Systems LLC from Denver installed the turbine, and the electric utility is K.C. Electric Association, the local Touchstone Energy Cooperative and member co-op of Tri-State Generation and Transmission. Communications were established via the SkyView 2.0 software between the turbine and a computer in the science room in December 2009.

However, the science teacher soon noticed that the turbine shut down prematurely in 14-mph winds. He shut down the electric service to the turbine at the service connection to avoid damage to the turbine. A blade imbalance was originally suspected, but this was ruled out after a February 2010 site visit by WAC Director Kostrzewa, who confirmed that the blades were installed correctly and the brake was set in moderate winds. A short in the inverter was suspected, and Southwest Windpower shipped a new wind turbine and blade set to the school. Tim Olsen of Advanced Energy Systems and Kostrzewa replaced the turbine on April 30, 2010. The turbine was deemed fully operational, and communications were established to the school.

Table 7. Kit Carson School District Project Cost Summary

Item	Vendor	Estimated Cost	Actual Cost
Skystream 3.7 Wind Generator	Southwest Windpower	\$3,727	\$3,727
Skystream 3.7 Sectional Monopole Tower - 45'	Southwest Windpower	\$3,214	\$3,214
SMaRT foundation kit	Southwest Windpower	\$768	\$768
Foundation excavate/pour/install	Advanced Energy LLC		\$380
Backhoe for trenching	Rebeltec Communications LLC		\$75
Trenching (198 feet)	Rebeltec Communications LLC		\$198
Concrete for foundation (5.5 SX)	Halde Redi-Mix, Inc.		\$687
Turbine/tower erection	Advanced Energy LLC		\$4,300
Computer for Skyview	Dell		\$615
TOTALS		\$7,709	\$13,964

Funding sources for the Kit Carson turbine:

- Colorado Governor's Energy Office: \$5,000 grant
- NREL renewable energy credit purchase: \$2,500
- Cooper Clark Foundation: \$4,000 grant
- Kit Carson Rural Development: \$250 grant
- Kit Carson State Bank: \$250 grant
- School contribution: \$1,964.

4.3.3 Stratton High/Middle School

Stratton High/Middle School installed a wind turbine on December 15, 2009. The school installed a 45-foot, three-piece sectional tower on a SMaRT foundation. The service was connected to the school’s main meter located near the football field. Advanced Energy Systems LLC from Denver installed the turbine, and the electric utility is K.C. Electric Association, the local Touchstone Energy Cooperative and member co-op of Tri-State Generation and Transmission. Communications were established to the turbine via the Skyview 2.0 software.

Due to insufficient clearance for the fence surrounding the transformer, the turbine did not begin generating power until the electrical permit was approved on December 15, 2009. The school was the first Colorado Wind for Schools project to register its turbine with the Center for Advanced Energy Studies site at Idaho National Laboratory, and results were available online on January 14, 2010.

Table 8. Stratton High/Middle School Project Cost Summary

Item	Vendor	Estimated Cost
Skystream 3.7 Wind Generator	Southwest Windpower	\$3,727
Skystream 3.7 Sectional Monopole Tower - 45'	Southwest Windpower	\$3,214
SMaRT foundation kit	Southwest Windpower	\$768
Foundation excavate/pour/install	Advanced Energy Systems	\$2,278
Turbine/tower erection	Advanced Energy Systems	\$2,277
Electric wiring & disconnect boxes	Advanced Energy Systems	\$172
Electrician	Advanced Energy Systems	\$560
TOTALS		
		\$12,996

Funding sources for the Stratton turbine:

- Colorado Governor's Energy Office: \$5,000 grant
- NREL renewable energy credit purchase: \$2,500
- Cooper Clark Foundation: \$4,000 grant
- School contribution: \$1,496.

4.3.4 Burlington High School

Burlington High School installed a wind turbine on December 18, 2009. The school installed a 45-foot, three-piece sectional tower on a SMaRT foundation. The service was connected to the school’s main meter. Eastern Plains Wind Energy LLC from Bennett installed the turbine, and the electric utility is Burlington Municipal Utilities. Communications were established to the turbine via the Skyview 2.0 software, and the turbine began generating power on December 18, 2009.

Table 9. Burlington High School Project Cost Summary

Item	Vendor	Estimated Cost	Actual Cost
Skystream 3.7 Wind Generator	Southwest Windpower	\$3,727	\$3,727
Skystream 3.7 Sectional Monopole Tower - 45'	Southwest Windpower	\$3,214	\$3,214
SMaRT foundation kit	Southwest Windpower	\$768	\$768
Foundation excavate/pour/install	Eastern Plains Wind Energy	\$3,100	\$3,100
Turbine/tower erection	Eastern Plains Wind Energy		
Electric wiring & disconnect boxes	City of Burlington-In Kind		\$500
Electrician	City of Burlington-In Kind		\$500
TOTALS			
		\$10,809	\$11,809

Funding sources for the Burlington High School turbine:

- Colorado Governor's Energy Office: \$5,000 grant

- NREL renewable energy credit purchase: \$2,500
- Cooper Clark Foundation: \$4,000 grant
- School contribution: \$1,496.



Figure 7. Limited funding didn't deter Burlington High School science teacher Jim Jones, who dug the foundation for his school's turbine by hand. Photo from Mike Kostrzewa, Colorado State University, NREL/PIX 16847

4.3.5 Arriba-Flagler High School

Flagler High School installed a wind turbine on December 20, 2009. The school installed a 45-foot, three-piece sectional tower on a SMaRT foundation. The service was connected to the school's main meter. Eastern Plains Wind Energy LLC from Bennett installed the turbine, and the electric utility is K.C. Electric Association, a member co-op of Tri-State Generation and Transmission.

The turbine ordered was for 208V, three-phase service, but the service at the connection point is single-phase 120V. Communications could not be established between the turbine and the school. The science teacher installed the SkyView software on a laptop and established communications with the turbine. He ran Southwest Windpower's gridfix software patch and reconfigured the turbine, allowing the turbine brake to release and begin generating power on January 12, 2010. At the time, the turbine was operational but not communicating to the school.

The team worked with Southwest Windpower (beginning in January 2010) for 6 months to develop a solution using an external antenna. The WAC director and an undergrad student visited the school in July 2010 with a white Laird fiberglass omni-directional antenna and a Swann high-gain antenna. The strength at the base of the tower was about -75 db, but the signal never progressed above about -65 db, and it dropped off just before reaching the building. Discussions with technical staff at Southwest Windpower narrowed the problem to the transmission of the signal rather than signal reception, and this then led to the antenna connection as the likely culprit. Southwest Windpower sent a replacement inverter and contracted with Cheyenne Wind Energy Inc. to make the repairs on September 8, 2010. Communications were established at the school (the signal was -74 to -80 dbm while inside the server room).

Table 10. Arriba-Flagler High School Project Cost Summary

Item	Vendor	Estimated Cost	Actual Cost
Skystream 3.7 Wind Generator	Southwest Windpower	\$3,727	\$3,727
Skystream 3.7 Sectional Monopole Tower - 45'	Southwest Windpower	\$3,214	\$3,214
SMaRT foundation kit	Southwest Windpower	\$768	\$768
Foundation excavate/pour/install	Local contractor	\$500	
Turbine/tower erection	Eastern Plains Wind Energy	\$3,100	\$3,100
Electric wiring & disconnect boxes	Est.	\$100	
Electrician	Local electrician	\$400	
TOTALS			\$11,809

Funding sources for the Arriba-Flagler turbine:

- Colorado Governor's Energy Office: \$5,000 grant
- NREL renewable energy credit purchase: \$2,500
- Cooper Clark Foundation: \$4,000 grant
- School contribution: \$500.

4.3.6 Wellington Middle School

Wellington Middle School installed a wind turbine on February 15, 2010. The school installed a 45-foot, three-piece sectional tower on a 17-foot pier foundation. The turbine was connected to the school's electrical meter through the electrical room, about 360 feet from the school and another 150 feet through the building to the service connection. HydroElectric LLC from Bellvue installed the turbine. The electrical permit was approved in June 2010, and the interconnection agreement with Xcel Energy was completed in August 2010. The turbine was then energized, communications were established to the turbine via the Skyview 2.0 software, and the turbine began generating power on August 13, 2010.

Table 11. Wellington Middle School Project Cost Summary

Item	Vendor	Estimated Cost	Actual Cost
Skystream 3.7 Wind Generator	Southwest Windpower	\$3,727	\$3,727
Skystream 3.7 Sectional Monopole Tower - 45'	Southwest Windpower	\$3,214	\$3,214
Skystream 3.7 Accessories and Parts	Southwest Windpower	\$1,477	\$0
Foundation excavate/pour/install	Hydroelectric, LLC	\$3,926	\$6,900
Turbine/tower erection	Hydroelectric, LLC	\$0	\$3,900
Testing, Permitting, and Inspection	EEC (Local geotech engr.)	\$2,250	\$2,493
Boring	Colorado Boring	\$7,246	\$7,000
Electrical Design	Local electrician	\$5,000	\$4,593
Electrical Parts, Labor, and Permit	Local electrician	\$6,026	\$10,561
Site Restoration	Hydroelectric, LLC	\$3,500	\$750
TOTALS			
		\$36,366	\$43,138

Funding sources for the Wellington turbine:

- Colorado Governor's Energy Office: \$5,000 grant
- Colorado Department of Local Affairs: \$7,500 grant
- NREL renewable energy credit purchase: \$2,500
- New Belgium Brewing: \$5,000 grant
- Brendle Group/Northern Colorado Clean Energy Cluster: \$800 grant
- Wellington Alumni Association: \$1,000 grant
- Community Foundation: \$2,174 grant
- Bohemian Foundation: \$9,492 grant
- PSD Facilities: \$3,000
- Wellington Middle School contribution: \$2,500
- STEM loans: \$6,872.

4.3.7 Ponderosa High School

Ponderosa High School⁶ was selected as one of two schools to be included in the 2010 Colorado Wind for Schools project. A subsurface soils investigation was conducted in July and used to secure a foundation design from Tower Engineering Professionals in August. In September, the

⁶ A feature story about this installation is available on the Wind Powering America website at www.windpoweringamerica.gov/filter_detail.asp?itemid=3007

school district selected Tim Olsen of Denver-based Advanced Energy Systems as the installer through an RFP process. The WAC and the Douglas County School District met with Pikes Peak Regional Building Department officials to begin the permitting process. The Colorado WAC helped district personnel in applying for the zoning approval in early October in time for a meeting with the Douglas County Planning Board in November. The turbine was installed on January 15, 2011.



Figure 8. Ponderosa High School in Parker, Colorado installed its turbine in January 2011.
Photo by Frank Oteri, NREL/PIX 18440

4.3.8 Park County RE-2 School District

Certified Skystream dealer Ted Palpant of Colorado Solar Energy, Inc. in Buena Vista, Colorado, installed the project. The district received CSU's \$10,000 grant award in October 2011, and the foundation was excavated soon after. Westward Hoe, Inc. of Fairplay donated the excavation and trenching, and Everist Materials of Silverthorne donated the concrete. The crew assembled the tower and the turbine after the concrete was poured and finished. The Colorado Solar Energy crew and Kostrzewa assembled the turbine and erected the tower on November 16, 2011. The electrical connection was completed on December 9, and the turbine was operational in early 2012.

4.3.9 Nederland Middle/High School

Tim Olsen from Advanced Energy Solutions, his crew, Kostrzewa, and Scott Bassett from Bassett & Associates assembled the turbine and erected the tower in October 2011. The school hosted a ribbon-cutting and dedication ceremony on November 10. An interconnection agreement with Xcel Energy must be approved before the turbine can be energized.

4.3.10 Colorado WAC Activities

The Colorado WAC team has managed the Colorado anemometer loan program since 2008. Prior to 2008, the Governor's Energy Office managed the program, contracting with local installers and sending the raw wind data to the University of North Dakota for analysis. With WPA support, a contract was secured with the Governor's Energy Office to establish the Colorado anemometer loan program at CSU. WAC Director Michael Kostrzewa oversees a team of student installers and wind resource analysts. They install anemometer towers across Colorado, analyze the wind resource, update the wind data from all of the historical sites in the program, and publish all data online⁷. All CSU WAC students have an opportunity to work on the program to learn 1) how to site and install a tower for wind prospecting and development, 2) how to analyze wind data, and 3) how to site, permit, and install a small-scale wind turbine.

4.3.11 Curricula and Teacher-Training Activities

Examples of teacher-training activities include the following:

- CSU hosted a half-day KidWind Project workshop in January 2012 for approximately 20 K-12 teachers. The workshop provided information and training for teachers interested in the KidWind Challenge in 2012.
- CSU's Department of Mechanical Engineering hosted the 2011 KidWind WindSenator training on the CSU campus on July 24 – 29, 2011 for about 30 attendees. Six educators from Colorado attended. After this year's training, Colorado now has seven WindSenators. Based on the success of this workshop, CSU hopes to host this training in future years.
- The NEED Project hosted a wind energy workshop for teachers at Kit Carson School in August 2010.
- The WAC team worked with the Colorado Governor's Energy Office to select two Colorado educators to attend the KidWind WindSenators teacher training in Malta, New York, in August 2010. Walsh Elementary School teacher Janet Chenoweth and Rick Shin (formerly with the NREL education program) represented Colorado, and each received a \$2,500 grant to cover tuition.

4.3.12 Funding Update

In September 2011, CSU proposed a \$112,000 project to Don Anderson of Enterprise Products Company for an application to the Colorado Department of Public Health and Environment to use Supplemental Environmental Project funds to fund three to four wind turbine projects at Colorado schools. The funding was approved and will be used in 2012 for the projects in Douglas County and Fremont County.

⁷ See www.engr.colostate.edu/ALP for an overview and the latest status of the program.

Colorado is a Round 1 state, and the Colorado WAC is now transitioning away from DOE funding. In November 2011, Larry Flowers from the American Wind Energy Association secured a challenge grant from the Colorado Renewable Energy Collaboratory for a match of \$20,000 when the WAC raises \$40,000. The WAC launched a website that allows online giving⁸. Finally, Susan Innis of Vestas and Mark Jacobson of Invenergy LLC are recruiting donations from other Colorado wind energy entities.

4.3.13 Testimonials

“It’s a great fit for our area in that wind is something we deal with all of our lives around here. It’s great to see it finally put to some productive use.”

Kyle Hebbard, superintendent, Walsh School District, Colorado

“These wind turbine projects represent another important way all regions of Colorado are participating in our New Energy Economy. Educating today’s young people about the benefits and mechanics of renewable energy systems prepares them for a wealth of future opportunities and demonstrates the crucial role our rural communities can play in mapping out a new energy future for Colorado and the country.”

Bill Ritter, former Colorado Governor

“When we were working on the Wind for Schools project, which is an awesome program, we kind of saw this as the tip of the iceberg.”

Bill Peisner, school counselor, Wellington Middle School, Colorado (referring to plans to expand on Wind for Schools with a two- classroom, net-zero science lab that will use renewable energy)

⁸ <https://advancing.colostate.edu/1929>

4.4 Idaho (Round 1)

Although the Idaho Wind for Schools team succeeded in installing turbines at seven schools, the team has suffered several setbacks since the beginning of 2011. The Public Utility Regulatory Policy Act size limit in the state was reduced from 10 MW to 100 kW, the sales tax rebate for qualifying renewable energy machinery was not renewed, and three educational reform bills were passed. As a result, few schools in the state are interested in installing turbines. Another setback involved the Dehryl Dennis Technical Center project in Boise, which never progressed past the planning stage due to external forces beyond the WAC's control (see Section 4.4.1 for more information on this project). Finally, the Idaho Wind Working Group held its final meeting on March 14, 2012.

As a result of these setbacks, the Idaho WAC team now focuses on INL database improvements, curricula development, and outreach activities instead of school turbine installations. The table below summarizes the seven turbines installed to date by the Idaho Wind for Schools team.

WAC

Boise State University (BSU)
<http://coen.boisestate.edu/WindEnergy>

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Under contract: Round 1

Number of installations: 7

Table 12. Idaho Installations Summary

Install Date	Location	Project Details
October 2010	Midway Middle School and Rigby High School, Rigby (two installations)	<ul style="list-style-type: none"> - Midway Middle School and Rigby High School each received \$10,666 from Rocky Mountain Power's Blue Sky Grant. Students assisted with the ground assembly of the turbine with guidance from BSU WAC personnel - The Blue Sky Grant funds were used to purchase the turbines, 45-foot towers, gin-poles and hinge plates, and foundation bolt kits. Funds were also used to pay for the net metering fees, the electrical permits, and electrical materials - H & H Utility Contractors Inc. provided a small crane, bucket truck, and crew to erect the towers and turbines. Aldon Hanson donated the rebar and the forms for the foundation. Tupper Excavation donated digging and trenching equipment and labor to run the conduit. Curtis Electric donated electrical labor
August 2010	Richard McKenna Charter High School, Mountain Home	<ul style="list-style-type: none"> - A dedication ceremony was held on September 20, 2010 - BSU purchased the Skystream system, the interface kit, and the foundation bolt kit using remaining funds from a Tidwell Foundation donation - The school purchased the tower and paid for the net metering fee, the electrical permit, soil samples and engineering drawings, the wire, conduit, an electrical meter, and the meter housing- Lowe's donated concrete, and AC Lot donated the rebar for the

Install Date	Location	Project Details
		foundation. Doug Mayne donated the digging equipment and the concrete labor, Mark Hiddleston of H&H Utility donated the truck and winch for the tilt-up tower, and Grubb Brothers Signs donated the display sign
August 2009	Pocatello Community Charter School, Pocatello	<ul style="list-style-type: none"> - Pocatello Community Charter School received \$12,500 in funding from the Lowe's Toolbox for Educators, more than double the amount requested - In April 2009, the Pocatello planning and zoning committee approved the permits to erect a Skystream on a 45-foot monopole tower. Many community members testified in support of the turbine project; nobody testified in opposition. The committee unanimously approved the permits - Many parents and local businesses contributed to the effort. Program partner H & H Utility Contractors Inc. provided a crane and bucket truck to erect the tower at no cost - On September 23, 2009, the public attended a dedication and ribbon-cutting ceremony that celebrated "Pocatello's First Wind Turbine." The mayor was the event's keynote speaker
July 2009	Shelley High School, Shelley	<ul style="list-style-type: none"> - Shelley High School received \$4,000 in funding from the Lowes Toolbox for Educators, which covered the costs of the turbine and foundation bolt kit - Local donations paid for conduit and wiring, a backhoe contractor, concrete for the foundation, and the electric meter - Contractors poured the foundation in June 2009, and on July 28, 2009, Shelley-based LC Insulation erected the turbine
October 2008	Jerome Middle School, Jerome	<ul style="list-style-type: none"> - Students assisted with the ground assembly of the turbine, with guidance from BSU WAC personnel - The Jerome School District spent ~\$3,900 to purchase a 45-foot monopole tower and apply for permits and interconnection agreements - H & H Utility Contractors, Inc. provided a small crane, bucket truck, and crew to erect the tower and turbine - The BSU WAC used \$4,600 from a Tidwell Idaho Foundation donation to purchase the turbine, bolt kit, and related equipment - Community supporters included Starr Corporation, Portneuf Electric-Brett, Power by Jake, Lee Nunnally Masonry Inc., Platt Electric, and Triple C Concrete - Permitting was more of a challenge than anticipated. Jerome Middle School is a new school co-located with a recent housing subdivision. A large, coordinated group of local residents attended the planning and zoning meeting to speak against granting the conditional use permit. A smaller number of people testified in favor. WAC leader Todd Haynes and then-state facilitator Brian Jackson testified in favor and answered questions regarding the turbine. The commission granted the permit - The Jerome installation generated positive press. Project sponsors, local news media, and other interested parties from the local community participated in a turbine dedication ceremony on November 12, 2008
August 2008	Skyline High School, Idaho Falls	<ul style="list-style-type: none"> - The installation was a collaborative effort among INL, Idaho Falls Power, Wheeler Electric, and the Idaho Falls School District #91

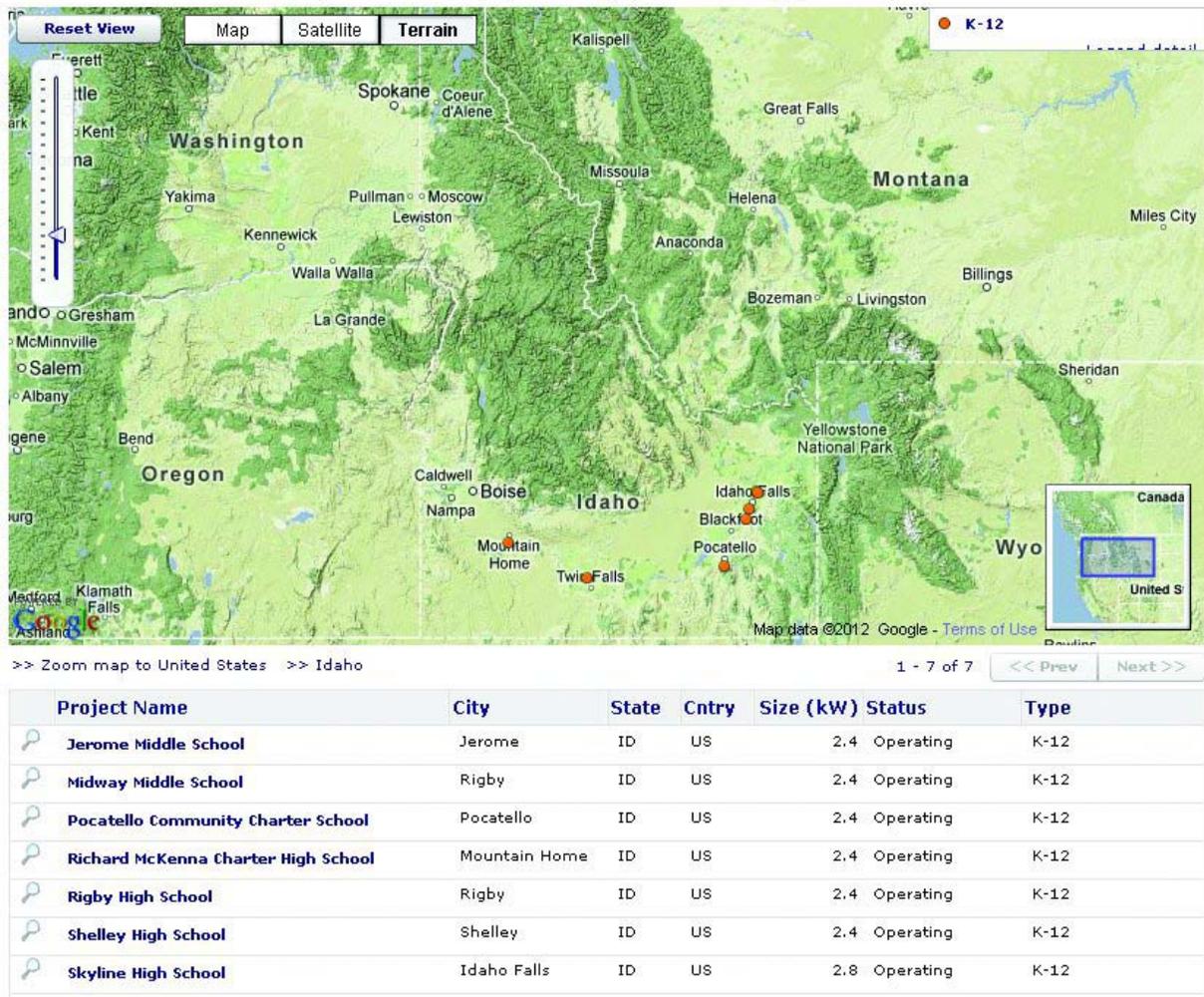


Figure 9. Idaho Wind for Schools project locations

4.4.1 The Installation that Didn't Happen: Dehryl Dennis Technical Center

Although the planned Dehryl Dennis Technical Center project in Boise never made it past the planning stage, the planning process details are provided here to show how external forces beyond the WAC's control can sometimes halt a project.

Teacher champion James Cupps received a \$50,000 Department of Labor grant for, among other objectives, installing a Wind for Schools project turbine. The school is located near the Boise Airport, so the installation required Federal Aviation Administration approval. In July 2010, the Administration determined that a Skystream turbine would not pose a hazard to air navigation and that no additional lighting or markings would be necessary. A required noise study was conducted. Building and conditional use permits for a 45-foot tower and Skystream were issued, and remaining project funds were secured.

In October 2010, the Boise School District denied Cupps' request to install the turbine, even though he had already secured more than adequate funds for the project and had begun securing permits.

Furthermore, Ada County began drafting a restrictive wind ordinance that would not allow a turbine on the property. As a result, Cupps decided to spend his grant funds on alternative projects and not pursue a Wind for Schools turbine installation.

4.4.2 Idaho WAC Activities

Examples of Idaho WAC activities include the following:

- The group designed and maintains a comprehensive website (<http://coen.boisestate.edu/WindEnergy>) that includes information on wind energy, the Wind for Schools project, Idaho wind data, BSU's wind-energy research activities, industry links, and a roster of BSU alumni working in the wind industry. Thirteen Boise State graduates currently work in the wind industry (two of those students were Wind for Schools interns).
- The BSU WAC is collaborating with partners at INL to collect, analyze, and post meteorological data from potential wind sites around the state. Data are posted on two websites (INL posts the older data, BSU posts data from summer 2008 to the present at <http://coen.boisestate.edu/WindEnergy/WindData/index.asp>). Most data were collected with anemometer towers provided by WPA's anemometer loan program.
- The Idaho State Kidwind Collaborative took place in April 2012.
- Gardner and Todd Haynes, the BSU WAC principals, serve on Idaho Strategic Energy Alliance task forces. Haynes left Boise State for INL but remains on the wind taskforce. Gardner serves on the biofuels task force. Wind task force members include representatives from Idaho Power, Avista, Rocky Mountain Power, Idaho Public Utilities Commission, Idaho Department of Commerce, Ridgeline Energy, Renaissance Engineering & Design, John Deere Renewables, RES America, and McDevitt-Miller Law Firm.
- Idaho WAC members worked with Ada County staff in 2012 regarding the local wind ordinance. Although a restrictive wind ordinance passed there in 2011, the county decided to update it by increasing the sound at the property line from 35dB to 60dBA.
- In July 2010, the BSU WAC discussed renewable energy and wind energy with five groups of high school students at a youth rally. About 80 high school students from Idaho, Wyoming, Oregon, Washington, and Alaska attended the discussions. This event was part of a weeklong high school student conference sponsored by Pacific Northwest electric co-ops and municipal utilities.
- In February 2010, Haynes met with and offered advice to a dozen middle school students engaged in the St. Joseph's School Science Olympics on the importance of balancing turbine rotors. St. Joseph's students took first and second place in the local competition, and 17 students advanced to the national competition at the University of Illinois.



Figure 10. Turbine at Richard McKenna Charter High School in Mountain Home, Idaho. Photo from Todd Haynes, NREL/PIX 18602

- The Renewable Energy Systems ME 426/526 course is offered at BSU as an upper-level technical elective for engineering students. More than 120 undergraduate and graduate students have successfully completed this course. Paul Dawson, a mechanical engineering professor who specializes in atmospheric science and understands wind energy resource assessment techniques, teaches the course. (Dawson is also the principal investigator on a research project to forecast power output from a 42-MW wind facility.) The course covers wind, solar, and geothermal energy, but wind is the prevalent topic.

Table 13. Boise State University Enrollment for Renewable Energy Systems (ME 426/526)

Semester	Undergraduates	Graduates
Fall 2011	29	5
Fall 2010	12	16
Fall 2009	9	0
Fall 2008	9	3
Spring 2007	18	1
Spring 2006	12	8
Totals	89	33
122 total		

- Over the years, students in the capstone design class for both mechanical engineering and electrical and computer engineering have chosen senior projects supplied by partners in the wind industry. To date, BSU engineering students have completed nine senior projects. In addition, a required senior class on fluid systems design (ME424) required wind turbine design as a project component in fall 2010. Students were provided with a standard DC motor/generator and asked to design a wind turbine that would fit within a volumetric constraint. The turbines were tested in the college wind tunnel.

4.4.3 Curricula and Teacher-Training Activities

Idaho WAC members have engaged in the following curricula development activities:

- The WAC collaborated with College of Southern Idaho and Idaho State University Energy Systems Technology and Education Center to develop wind energy technician training programs. Both programs verbally committed to their tech students performing maintenance on the Wind for Schools Skystream turbines as necessary. The BSU WAC will coordinate the maintenance (order parts, schedule bucket trucks, and make arrangement with K-12 schools), but wind tech students from the colleges will perform the maintenance.
- James Cupps of the Dehryl Dennis Technical Center created an advisory board of renewable energy experts in Idaho to assist him with a new course series, Introduction to Renewable Energy. The two-semester class is a joint venture with College of Southern Idaho and Idaho State University, where students will receive joint credit at all participating institutions. State Facilitator Cardon sits on the advisory board committee.
- The WAC designated March as Idaho KidWind Collaborative Month. Rather than travel around the state hosting KidWind challenges or expecting students and teachers to travel to compete, the team is drafting KidWind Collaborative rules to distribute to teachers who have participated in a KidWind or NEED training. Although teachers are free to make the classroom challenges as complicated (electricity generation, lift, aesthetics, gears, building a nacelle or generator) or as simple (electricity generation only) as they choose, the WAC is limiting the official collaborative to electricity generation only for simplicity's sake. During the month of March, teams will test their turbines in their own classrooms and send the results to the WAC, who will post the results online and provide contact information so that students at different schools can e-mail or Skype about their designs and experiences. The WAC is emphasizing collaboration and has decided to not award prizes but rather to allow students to design, build, have fun, and learn from each other.
- Teacher interns Katie Cutler and Shari Blom from the Jerome School District are creating and modifying lesson plans and compiling teacher resources. The WAC team identified "teacher information overwhelm" as a major issue and will address it by asking teachers to review available lesson plans, identify the "best" lesson plans (based on limited preparation time, high student involvement, and low cost), alter them to fit Idaho State standards, and compile them on a standardized lesson plan template for distribution on the WAC website. They are also compiling supporting materials, such as presentations, videos, and websites to assist teachers with wind energy curricula integration. To date, Cutler and Blom have created two week-long lesson plans from scratch (one for elementary school and one for middle school) that use the INL database; can be used in math, science, or language arts classes; and satisfy a wide variety of state standards. They will create a comparable lesson plan for high school students and will alter existing lesson plans instead of creating them from scratch.

The Idaho WAC has also engaged in the following teacher-training activities:

- In March 2012, the WAC presented to the Idaho Environmental Educator's Association Conference. The educators received training in applying wind energy concepts and the INL database into the classroom.

- The Idaho WAC has compiled a list of approximately 25 “key wind educators” around the state and is contacting them to learn how they are integrating wind energy into their classrooms. The team is creating a wind educators network to share ideas and lesson plans with other teachers. The WAC is also planning a pilot KidWind challenge for the 2011-2012 school year, with the intent that the winners of the challenge will take their turbines to the Invent Idaho Competition.
- In July 2011, WAC members presented a workshop at the Idaho Science, Technology, Engineering, and Mathematics Summer Institute at the College of Southern Idaho to show teachers how to use the INL database and to practice teaching sample lesson plans using the Wind for Schools turbine data. At the same time, a wind educator gave a similar presentation at the same conference held concurrently at Northern Idaho College.
- In June 2011, the WAC organized a Wind Educators Summit and invited key wind educators from around the state to participate in a 2-day intensive hands-on training. Sixteen educators attended. Each K-12 educator received a KidWind kit and a wind meter for use in next year’s KidWind Collaborative, as well as KidWind training, materials, presentations, and other supporting materials for lesson plans. The teachers participated in two KidWind challenges (electricity generation and lift) and received training, practice, and lesson plans using the INL database.
- In July 2010, Idaho Science, Technology, Engineering and Mathematics sponsored a 4-day teacher training workshop for approximately 140 Idaho K-12 teachers at College of Southern Idaho in Twin Falls. An additional 110 teachers attended a simultaneous workshop at North Idaho College in Coeur d’Alene. INL sponsored the workshops. On July 19, BSU WAC members gave a wind energy lecture and Wind for Schools introduction to about 25 teachers who signed up for the energy strand. On July 21, the BSU WAC led the same group on a tour of the nearby Cassia Gulch Windfarm.
- The American Wind Energy Association provided scholarships for several K-12 teachers throughout the nation to attend WINDPOWER 2009 in Chicago. Haynes assisted Katie Cutler, Jerome Middle School’s teacher/project champion, to prepare an application that highlighted participation in the Wind for Schools project. Cutler received a scholarship to attend the conference.
- In collaboration with INL and Skyline High, the BSU WAC participated in a teacher-training event in Idaho Falls in October 2008. The 2-day event, held in conjunction with the Idaho Science Teacher Summit, focused on energy and was open to all Idaho science teachers. The BSU WAC participated in a similar teacher-training event sponsored by INL in August 2009 in Idaho Falls. The 2009 workshop was larger than the prior year’s event, with more than 100 Idaho teachers in attendance. Haynes was part of a panel discussion to the general assembly focused on energy-related careers in Idaho and hosted a break-out session focused on Wind for Schools participation. The NEED Project was a co-sponsor and participant at both events.

4.4.4 Funding Update

According to the Idaho Wind for Schools team, funding is the biggest obstacle for interested schools. The State of Idaho and the utilities do not provide financial support for the program, and the Idaho WAC has not been able to identify parties interested in purchasing green tags.

- The WAC team tried to implement funding strategies in Idaho that were successful in other Wind for Schools project states, including applying for the U.S. Department of Agriculture's (USDA's) Rural Business Enterprise Grant program and the Department of Environmental Quality's Supplemental Environmental Project funds. So far the efforts have been unsuccessful. According to the Idaho state guidelines for use of Supplemental Environmental Project funds, the Wind for Schools project is not currently eligible.
- In FY08, the Tidwell Idaho Foundation awarded a grant of \$15,000 to the Boise State Foundation in support of the Wind for Schools project. BSU used \$4,600 of that contribution to purchase equipment at Jerome Middle School. Additional funds were used to purchase a weather station at Riverstone International School in Boise and equipment for the Richard McKenna Charter High School in Mountain Home.
- In October 2008, several schools (Rimrock, Pocatello Community Charter, Shelley, Firth) applied for a grant sponsored by Lowe's Home Improvement. Pocatello and Shelley received funds; Rimrock re-applied for the Lowes grant in the subsequent funding round in February 2009 and did not receive funding. Richard McKenna Charter High School applied for the grant in fall 2009 and did not receive funding.
- Rocky Mountain Power offers a Blue Sky Grant program to eastern Idaho schools in that service territory. Nine schools initially expressed interest in applying for that grant, but only five remained interested through the grant process. On behalf of the five schools, the BSU WAC applied for \$56,000 in funding through the Blue Sky Grant. Rocky Mountain Power awarded the WAC \$10,666 for each of three schools: Midway Middle School, Rigby High School, and Clark County Junior-Senior High.
- The WAC continues to expand externally funded wind energy research. In 2010, the WAC started a 3-year, \$300,000 grant from the Center for Advanced Energy Studies to develop a dynamic model of an innovative vertical-axis wind turbine design, the Blackhawk Turbine. The vertical-axis turbine incorporates complex helicopter concepts to overcome the self-starting issue associated with the vertical-axis design. L. Damon Woods, a mechanical engineering graduate student, will apply his thesis work to this design. WAC director Gardner is leading the effort. A grant to improve forecasting for wind integration was completed, but the WAC procured modest follow-up funding through a partnership with Idaho Power and the Center for Advanced Energy Studies.
- In May 2010, the Clark County School District superintendent informed the WAC that Clark County Junior/Senior High School would not be able to complete its planned project because 1) It could not meet its cost-share obligation, 2) The district experienced difficulty collecting donations (cash or in-kind) from the community, and 3) There was vocal opposition from the community. Rocky Mountain Power requested that the grant award be returned. Midway Middle School and Rigby High School used their awards to purchase turbines, towers, foundation kits, and balance-of-plant equipment.

- The WAC currently does not have funds to address ongoing communication issues between the turbines and INL’s Center for Advanced Energy Studies database. The WAC requires additional funding to update the software, add more schools, and maintain the database.

4.4.5 Testimonials

“We are a green school and happy to be sending that message. We really try to walk the talk here.”

Martha Martin, principal, Pocatello Community Charter School, Idaho

“Being able to participate in this project is a once in a lifetime opportunity. Hopefully today’s students will remember this as an important change in technology and that they were part of it.”

Vincent Wray, science teacher, Shelley High School, Idaho

4.5 Kansas (Round 1)

The Kansas Wind for Schools team has completed 16 installations (see Table 14 for a summary of turbine installations in the state to date). In November 2011, the WAC requested proposals for the 2011-2012 round of turbines, which is the fifth round in the state. Eleven schools submitted proposals.

Installations are planned for 2012 at Claflin High School in Claflin, which received a \$5,000 USDA grant to help with installation costs. The WAC team also plans to partner with Westar Energy on installations in Otis, Winfield, West Plains, and Circle.

WAC

Kansas State University (KSU)
www.eece.ksu.edu/psg/wac/

WAC Director

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State Facilitator

None at this time.
 Formerly Dan Nagengast, Kansas
 Rural Center

Under contract: Round 1

Number of installations: 16

Table 14. Kansas Installations Summary

Install Date	Location	Project Details
May 2012	Circle High School, Towanda	- Skystream turbine installed near the sports complex; will help supply energy to the concession stand - Area zoning was changed so that in the future the school can add a larger turbine
May 2012	Halstead High School, Halstead	- Skystream turbine - Received \$5,000 in funding from a USDA grant
October 2011	Eudora High School, Eudora	- Skystream on a 45-foot monopole - Received \$5,000 in funding from USDA Rural Development Kansas
October 2011	Jefferson West Middle/High School, Meriden	- Skystream on a 45-foot monopole - Received \$5,000 in funding from USDA Rural Development Kansas
November 2010	Solomon Schools, Solomon	- Skystream on a 45-foot monopole - The 8th-grade students who prepared the proposal to the WAC in 2009 (in 9th grade at the time of the installation) discussed wind energy careers with the WAC students - The local electric co-op, assisted by Bill Smalley of Westar, installed this turbine
May 2010	Hope Street Academy, Topeka	- Skystream on a 45-foot monopole - In 2008, the science class began to pursue a turbine installation at the school. Students researched the project and wrote a winning grant proposal. They then presented to the city planning commission and Topeka City Council for zoning and approval, learning about city government in the process - Westar and Smalley Energy installed the turbine

Install Date	Location	Project Details
May 2010	Appanoose Elementary School, Pomona	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole - The Energy Savings Store (TESS) from Kansas City installed the turbine with financial help from Kansas City Power and Light and a Green Schools grant for \$4,000. TESS did not allow Kansas City Power and Light to help with the installation, but it did provide labor at no cost to the school - About 2 weeks after the installation, Kansas City Power and Light hosted a ribbon-cutting photo opportunity for the press, and WAC Director Douglas Miller spoke to the 4th-grade classes at the school
September 2009	Pretty Prairie Junior High School, Pretty Prairie	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole - Kansas Public Television station KTWU filmed the installation, and the segment aired in December 2009
April 2009	Blue Valley Junior/Senior High School, Randolph	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole - The district's information technologies staff person, who is also a KSU employee, played a major role in installing the communications software. Blue Valley was the first Kansas turbine with live streaming data from INL - Students assembled the turbine foundation cage - Westar Energy's Green Team and Smalley Energy completed the installation
November 2008	Ell-Saline Junior/Senior High School, Brookville	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole - Tradewinds Energy provided financial support - Turbine was replaced in spring 2009 after water damage
September 2008	Greenbush Education Center, Greenbush	<ul style="list-style-type: none"> - Skystream on a 60-foot monopole
September 2008	Concordia High School, Concordia	<ul style="list-style-type: none"> - Skystream on a 60-foot monopole
September 2008	Kansas State University, Manhattan	<ul style="list-style-type: none"> - Skystream on a 60-foot non-standard monopole
June 2008	Sterling High School, Sterling	<ul style="list-style-type: none"> - Skystream on a 60-foot monopole
June 2008	Walton Rural Life Charter Elementary, Walton	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole
May 2008	Fairfield High School, Langdon	<ul style="list-style-type: none"> - Skystream on a 33-foot monopole



>> Zoom map to United States >> Kansas 1 - 16 of 16 << Prev Next >>

Project Name	City	State	Cntry	Size	Status	Type
Appanoose Elementary School	Pomona	KS	US	2.4	Operating	K-12
Blue Valley Junior/Senior High School	Randolph	KS	US	2.4	Operating	K-12
Circle High School	Towanda	KS	US	2.4	Operating	K-12
Concordia High School	Concordia	KS	US	2.4	Operating	K-12
Ell-Salina Junior/Senior High School	Brookville	KS	US	2.4	Operating	K-12
Eudora High School	Eudora	KS	US	2.4	Operating	K-12
Fairfield High School	Langdon	KS	US	2.4	Operating	K-12
Greenbush Education Center	Girard	KS	US	2.4	Operating	Educational Cent
Halstead High School	Halstead	KS	US	2.4	Operating	K-12
Hope Street Charter Academy	Topeka	KS	US	2.4	Operating	K-12
Jefferson West Middle/High School	Meriden	KS	US	2.4	Operating	K-12
Kansas Wind Application Center (Kansas State University)	Manhattan	KS	US	2.4	Operating	University
Pretty Prairie Middle-High School	Pretty Prairie	KS	US	2.4	Operating	K-12
Solomon High School	Solomon	KS	US	2.4	Operating	K-12
Sterling High School	Sterling	KS	US	2.4	Operating	K-12
Walton Rural Life Charter Elementary School	Walton	KS	US	2.4	Operating	K-12

Figure 11. Kansas Wind for Schools project locations

4.5.1 Kansas WAC Activities

Examples of Kansas WAC activities include the following:

- KSU offered the Wind and Solar Energy System Design class in fall 2010. Approximately 30 students, mostly MS engineering students, completed the course, as well as four projects on campus and an additional eight projects by off-campus students. The projects ranged from assisting individual homeowners in estimating the cost and payback of a wind or PV system to performing the initial assessment and design of a commercial wind farm. Three students worked on designing the communications system for four turbines and two PV systems to be installed at the Riley County Shops; two continued on this project with support from a county grant. Thirteen MS students in power engineering enrolled in the class through a distance education program. Six of the students helped with turbine installations and communications for the ongoing Wind for Schools projects, as well as reviewing four new applications and making site visits. Most of these students continued working with the new schools and preparing USDA Rural Business Enterprise Grant proposals.
- Five students completed two wind siting research projects in spring 2010: a school and a convent. The school also consulted with Northern Power about turbine prospects, so the students were able to compare their results to Northern's estimates.
- Two graduate students and the WAC director attended the WINDPOWER conference in Dallas and the WPA All-States Summit in 2010. The WAC team presented one poster at WINDPOWER and a second at the IEEE Power and Energy Society's Transmission and Distribution Conference in New Orleans in April 2010. Another poster presentation at the IEEE conference on modeling turbulence around trees and buildings to determine effects on wind turbines won a student award at the conference.
- KSU sealed a formal relationship with Wichita State University in spring 2010 to collaborate in wind energy research. The WAC also received a subcontract to develop the High Plains Small Wind Test Center at Colby Community College with support from Midwest Energy.
- KSU offers a 1-credit spring Wind Research class, which ensures students are available to help with Wind for Schools installations.
- The WAC also engages students outside of class activities. During 2009, three MS candidates and eight undergraduate students participated in WAC activities outside of enrolled classes. One MS student received direct funding from the WAC; one MS and two undergraduate students were funded by the Power Affiliates Program, supported by a consortium of local electric utilities; and three undergraduate students and one MS student were supported by a National Science Foundation grant to incorporate sustainability principles into the undergraduate curriculum.
- In spring 2008, Douglas Miller taught a combined wind and solar system design class to 15 students (three graduate students and 12 seniors). Eight students were involved in siting turbines at Wind for Schools project sites. During the fall 2008 semester, Douglas Miller directed eight undergraduate students in siting projects at Wind for Schools project sites, a

Kansas Department of Transportation site, and a site belonging to the Kansas 4-H Foundation. Students also visited three large wind farms nearby and one turbine refurbishing shop.



Figures 12, 13. Turbine dedication ceremony at the Hope Street Academy. Photos from Ruth Douglas Miller, Kansas State University, NREL/PIX 17338 and NREL/PIX 17340

4.5.2 Curriculum and Teacher-Training Activities

Examples of Kansas WAC activities regarding curriculum and teacher training include the following:

- The WAC hosted one KidWind challenge on the KSU campus in fall 2010 with assistance from the Multicultural Engineering Program. The Women in Engineering and Science Program helped oversee a second one in Great Bend. WAC students trained the other groups to use the KSU “wind tunnel.” More than 100 K-12 students attended the challenge in Great Bend; about 20 middle school students attended the Multicultural Engineering Program event on campus.
- In August 2010, the WAC sent teacher Dean Stramel to New York for Wind Senator training. He will co-host Wind Senator training sessions at Ft. Hays with Ft. Hays State University science department head Paul Adams.
- Approximately 20 teachers attended a NEED Project teacher-training workshop in Newton in August 2009.

4.5.3 Funding Update

Westar Energy approached the WAC with a proposal to fund Wind for Schools turbine installations as part of an agreement with the Environmental Protection Agency. The utility plans to help the Topeka Public School District install a Northwind 100 or similar turbine but also wants to increase the number of Wind for Schools turbines installed across the state by donating between \$250,000 and \$300,000 toward installations in Kansas. Approximately \$37,000 of that amount will support the WAC in this effort. At present there is no intent to apply for USDA grants in addition to the Westar

funds, but that is open to negotiation with the schools and with Westar. The Kansas WAC hopes to use the funding for two rounds of five schools each.

4.5.4 Testimonials

“Josh Cochran, a Greenbush teacher, says they have people stopping by almost daily to ask about the turbine, and they have had some 16,000 to 17,000 students working with it, one way or another, in the last year. And that’s just one installation. This program works, and it’s a tremendous draw.”

Ruth Douglas-Miller, associate professor, Department of Electrical and Computer Engineering, Kansas State University

4.6 Montana (Round 1)

Montana has installed 11 turbines to date (see Table 15). Although the Montana state facilitators continue to visit potential host schools and conduct program outreach, the program's main focus is providing support to the existing Montana host schools, troubleshooting technical problems, and identifying more ways to use the turbines in classroom curricula.

4.6.1 Montana WAC Activities

Examples of Montana WAC activities include the following:

- The MSU WAC demonstration project, which was commissioned in 2008, is used for MSU monitoring and experimental projects. The project received funding from a Department of Environmental Quality technical support grant and consists of one grid-tied Skystream 3.7 wind turbine on a 50-foot tilt-down monopole tower.
- The Montana WAC launched a new mechanical engineering senior design project for the 2011-2012 academic year, which is the fourth project like this sponsored by WAC funding and supervised by WAC Director Larson. This project utilizes the MSU Skystream turbine as a capabilities development test bed for acquiring loading spectrum data from instrumented wind turbine blades. The project can be described as the Phase 2 extension of prior work involving application of several configurations of strain sensors to turbine blade surfaces on the MSU Campus Skystream 3.7 turbine. Phase 1 of this project involved environmental surface preparation, strain sensor bonding, and sensor encapsulation with various protective over-coating treatments. Phase 2 of this project focuses on the design, installation, and test of a real-time blade strain system mounted in the hub of the MSU turbine. Goals for Phase 2 include development of expertise with practical considerations involved with logging dynamic data from turbine blades in a cost-effective manner, while providing engineering students in-depth exposure to wind energy components, data acquisition, and wireless communication.
- The MSU Wind Turbine Trainer was utilized for the first time in laboratory demonstrations in the fall 2011 ETME470 Alternative Energy Applications course. This trainer was designed and fabricated during the 2010-2011 academic term as a Montana WAC-sponsored interdisciplinary capstone senior design project. Montana WAC interns enhanced it during summer 2011 and created several new lab exercises. The Turbine Trainer uses a variable-speed DC motor to simulate wind power and to turn a three-bladed hub. A low-speed shaft connects to a gearbox, which steps up the rotational speed to the high-speed output shaft, which turns a DC generator to produce DC power proportional to rotational speed. The desktop-scale unit features variable pitch blades, yaw control, variable simulated wind speed via the DC drive motor, and numerous modes of fault simulation. All elements are controlled and monitored with a custom LabVIEW software routine, which has been designed and tailored for use in a classroom environment.

WAC

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Under contract: Round 1, June 2007

Number of installations: 11

Table 15. Montana Installations Summary

Install Date	Location
2008	Montana State University, Bozeman
2008	Cascade Middle School, Cascade High School, Cascade
2008	Fairfield High School, Fairfield
2008	Sleeping Giant Middle School; Park Senior High School, Livingston
2008	Stanford High School, Stanford
2010	Forsyth High School, Forsyth
2010	Glasgow High School, Glasgow
2010	Fergus High School, Lewiston
2010	Townsend Elementary and Middle School; Broadwater High School, Townsend
2010	Valier Elementary and Middle School; Valier High School, Valier
2010	Wolf Point High School, Wolf Point

Note: Lack of funding prevented turbine installations in 2009 and 2011.

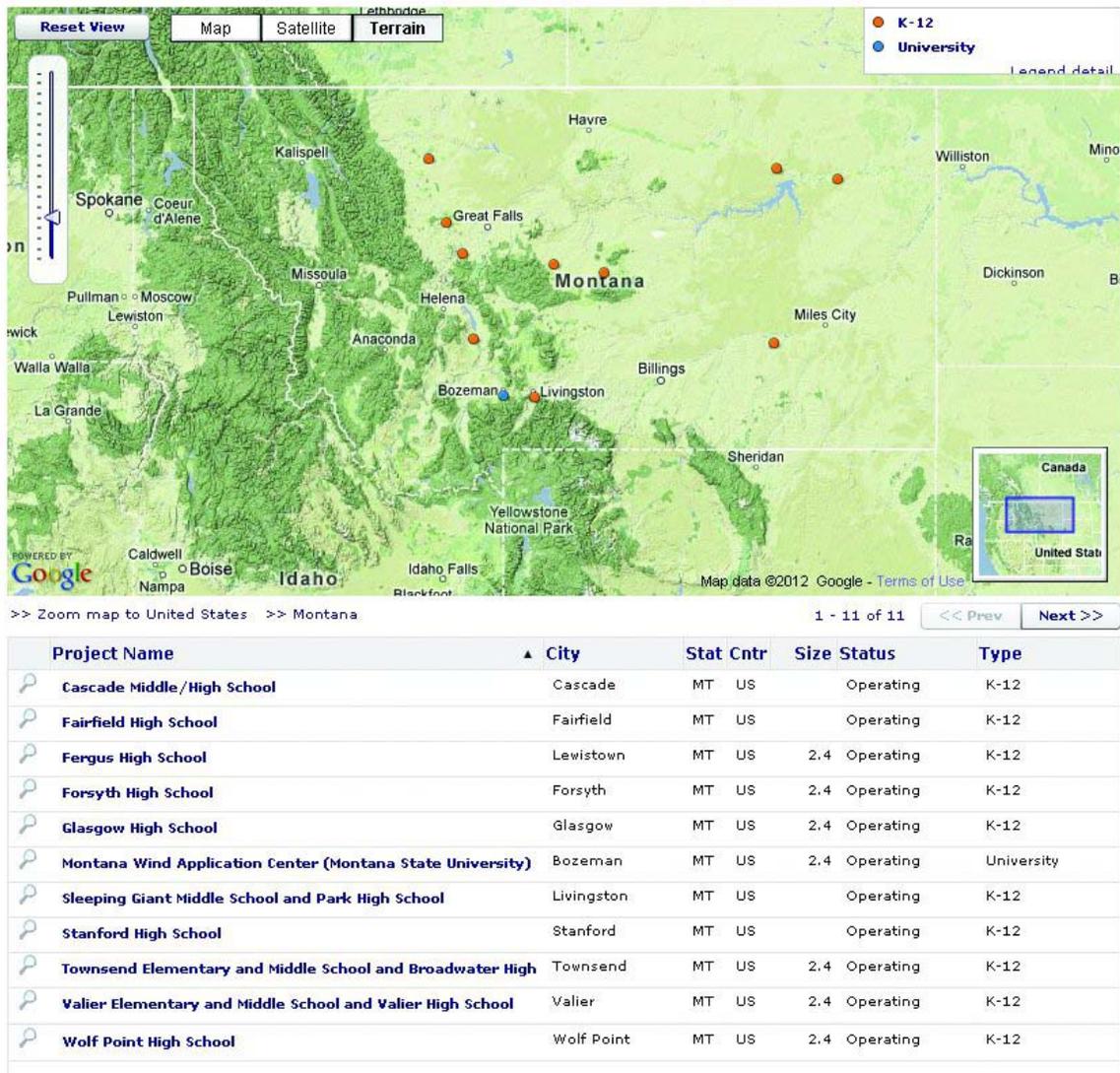


Figure 14. Montana Wind for Schools project locations

- The Montana WAC has collaborated with the Wind Montana program and created 1-year certificate and 2-year degree Sustainable Energy Technician programs at four Montana campuses. This project, the result of a \$2 million U.S. Department of Labor grant awarded in December 2008, is administered through the MSU-Great Falls College of Technology. Montana WAC Director Larson serves as a member of the academic implementation team for this project, advises administration and instructors on program content, and helps to represent the program at the national level.
- WPA's support of the Montana WAC permitted the fourth consecutive offering of ETME470 in fall 2011. All 18 enrolled students, representing several disciplines, completed the class. The first half of this professional elective class focused on wind resources, wind energy, power transmission, and the grid. The second half of the course included coverage of solar photovoltaic systems, solar hot water, fuel cell, micro hydroelectric generation systems, ground source/geothermal, and system integration topics.
- In January 2009, Montana Governor Brian Schweitzer's office presented a Governor's Clean Energy Award to Western Community Energy for the Wind for Schools project in Montana.
- Newspapers in 10 of the 11 host school communities published stories about the Montana program and projects during the installation periods in 2008 and 2010. Montana Public Radio produced a 3-minute story about the project and the Cascade installation, which it aired on National Public Radio across the state in October 2008. Governor Schweitzer participated in the installation and dedication of the Lewistown Wind for Schools project in May 2010. Several press releases and online forums published news of the Governor's participation and endorsement of the program.



Figure 15. Montana Governor Brian Schweitzer helps winch up the Lewistown turbine in Montana.
Photo from Sean Micken, NREL/PIX 17435

4.6.2 Curricula and Teacher-Training Activities

Montana WAC members have engaged in the following curricula development activities:

- In October 2008, the NEED Project hosted a wind energy curriculum workshop in Livingston. Twenty-five teachers from more than a dozen schools across the state, including all four 2008 host schools, attended the workshop. Classroom teachers interested in the Wind for Schools project learned about wind energy, wind-generated electricity, and using data produced from wind installations in their classrooms. The Montana Office of Public Instruction approved the workshop for professional development and continuing education credits.
- In January 2009, Montana Wind for Schools facilitator Sean Micken attended the School Administrators of Montana conference and presented two workshops on wind energy education and the Wind for Schools project to approximately 60 teachers, administrators, and facilities managers. Micken also attended the legislative session in Helena to lobby state policymakers to provide funding for the Wind for Schools project, but his efforts to introduce a bill proved unsuccessful.

4.6.3 Funding Update

The primary source of funding for Wind for Schools projects in Montana has been Universal System Benefits funds administered by NorthWestern Energy and Montana-Dakotas Utilities. Facilitators secured this grant funding through NorthWestern Energy's open RFP process and through direct solicitation to the Montana Department of Environmental Quality's state energy office, which administers the funds collected by Montana-Dakotas Utilities. Other funding and support was provided by the host schools (\$1,500 each), in-kind donations of labor and materials, a \$2,000 donation from wind project developer Invenergy for the Lewistown project, and a \$4,000 grant from the Livingston Educational Foundation for the Livingston project. The six projects installed in 2010 each received Treasury Department Section 1603 grants for 30% of the eligible project costs. A lack of funding prevented turbine installations in 2011.

4.6.4 Testimonials

"Montana's on the move. This important program will not only provide a small amount of wind energy for rural Montana schools but will also educate tomorrow's leaders on the value and importance of this renewable energy source."

Brian Schweitzer, Governor of Montana

"I believe that Wind for Schools Montana will be a valuable asset for our state for years to come...It is a new and unique program that reaches the heart of Montana."

Jon Tester, Montana Senator

"This broad-based collaborative project stands to enhance Montana State University's energy research efforts, support engineering education, and help to demonstrate a commitment to sustainable and renewable energy on the Bozeman campus."

Tom McCoy, V.P. for Research, Creativity, Montana State University, Bozeman, Montana

4.7 Nebraska (Round 1)

The Nebraska Wind for Schools team has completed 18 installations to date (see Table 16). Planned projects for 2012 include Laurel-Concord-Coleridge Public Schools in Laurel, Kimball Public Schools in Kimball, Norfolk Senior High School in Norfolk, Superior Public Schools in Superior, Raymond Central Public Schools in Raymond, and Meridian Public Schools in Daykin.

In addition to installed Wind for Schools projects, Nebraska is also home to higher education institutions with installed turbines and/or wind energy curriculum. Nebraska community colleges and the University of Nebraska-Lincoln (UNL) allow credits for electrical and engineering courses at the community college level to transfer to UNL. The following institutions provide wind energy education in the state:

- UNL Wind Applications Center, which includes a Skystream installed at Rogers Research Farm in August 2008 and anemometers installed at various locations
- Southeast Community College in Lincoln, which includes a Skystream installed in April 2011 (Nebraska facilitator McGuire assisted with the planning and installation)
- Central Community College in Hastings, which includes a Skystream installed on campus
- Northeast Community College in Norfolk, which offers a wind technician training course
- Western Nebraska Community College, which includes wind energy in courses.

WAC

University of Nebraska – Lincoln (UNL)
<http://engineering.unl.edu/academicunits/electricalengineering/outreach/windforschools/index.shtml>

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Under contract: Round 1. The UNL WAC will not receive any DOE funding in 2012.

Number of installations: 18



Figure 16. A billboard displays Elkhorn Valley's school pride (green is a school color). Elkhorn Valley installed its turbine in 2008. Photo from Dan McGuire, NREL/PIX 17332

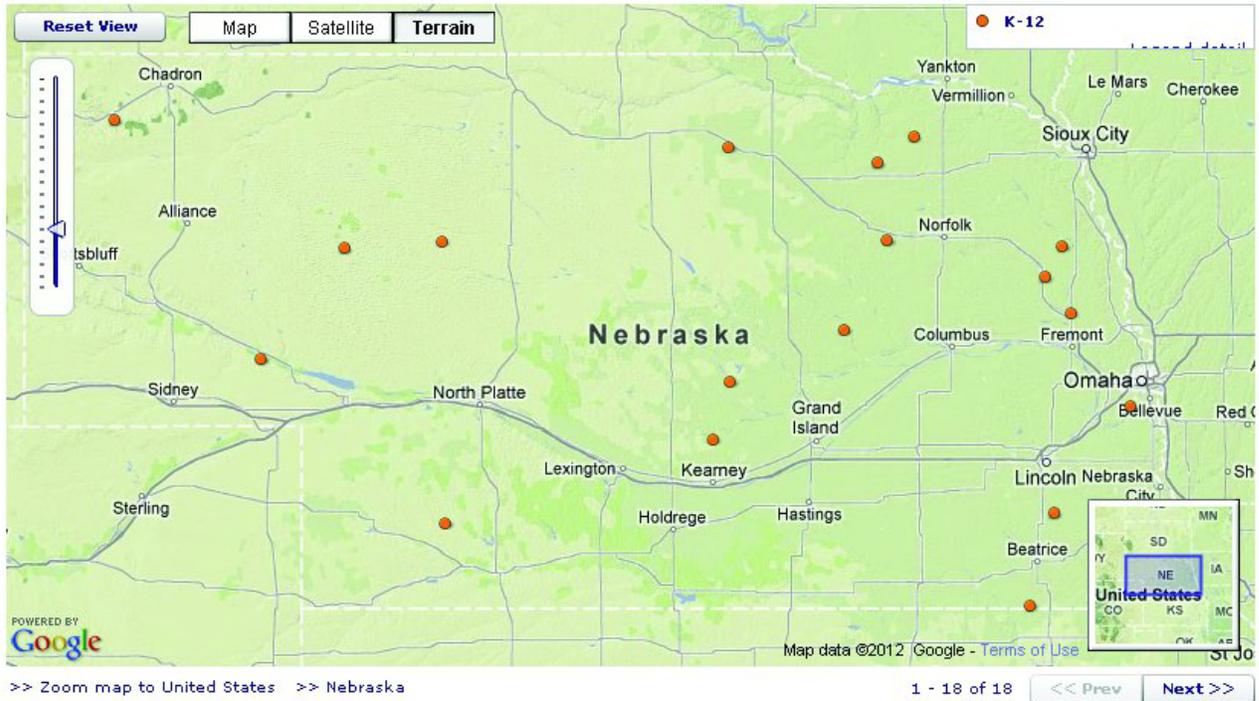
Table 16. Nebraska Installations Summary

Install Date	Location
December 2008	Elkhorn Valley School, Tilden
December 2008	Cedar Rapids Public School, Cedar Rapids
January 2009	Hayes Center Public School, Hayes Center
February 2009	Diller-Odell Public School, Odell
April 2010	Bloomfield Community Schools, Bloomfield
May 2010	Norris Public Schools, Firth
July 2010	Loup City Public Schools, Loup City
November 2010	Bancroft-Rosalie Public Schools, Bancroft
October 2010	Papillion-LaVista Public Schools, Papillion
March 2011	Logan View Public Schools, Hooper
April 2010	West Point Public Schools, West Point
September 2011	West Holt Public Schools, Atkinson
May 2011	Pleasanton Public Schools, Pleasanton
November 2010	Mullen Public Schools, Mullen
September 2011	Hyannis Public Schools, Hyannis
April 2011	Crawford Public Schools, Crawford
June 2011	Garden County Public Schools, Oshkosh
June 2011	Creighton Public Schools, Creighton

4.7.1 Nebraska WAC Activities

Examples of Nebraska WAC activities include the following:

- The WAC team has taught 75 undergraduates and 16 graduate students in the wind energy class, and more than a dozen undergraduates and more than five graduate students were involved with installations. Hundreds of high school students were exposed to wind energy topics in their schools or summer programs. More than 10 graduate students have graduated or are currently working on wind energy research projects.
- In June 2009, the WAC at the University of Nebraska - Lincoln co-hosted an international symposium on power electronics and machines in wind applications. Approximately 88 attendees from eight countries heard speakers from GE, Vestas/Aalborg University, North Wind, the National Renewable Energy Laboratory, Electric Power Research Institute, Convention of National Societies of Electrical Engineers of Europe, the University of Wisconsin, and Oregon State University.



Project Name	City	State	Cntry	Size (kW)	Status	Type
Bancroft-Rosalie Public School	Bancroft	NE	US	2.4	Operating	K-12
Bloomfield Community Schools	Bloomfield	NE	US	2.4	Operating	K-12
Cedar Rapids Public School	Cedar Rapids	NE	US	2.4	Operating	K-12
Crawford Public Schools	Crawford	NE	US	2.4	Operating	K-12
Creighton Public Schools	Creighton	NE	US	2.4	Operating	K-12
Diller-Odell Public Schools	Odell	NE	US	2.4	Operating	K-12
Elkhorn Valley Schools	Tilden	NE	US	2.4	Operating	K-12
Garden County Public Schools	Oshkosh	NE	US	2.4	Operating	K-12
Hayes Center Public Schools	Hayes Center	NE	US	2.4	Operating	K-12
Hyannis Public Schools	Hyannis	NE	US		Operating	K-12
Logan View Public Schools	Hooper	NE	US	2.4	Operating	K-12
Loup City Public Schools	Loup City	NE	US	2.4	Operating	K-12
Mullen Public Schools	Mullen	NE	US	1.8	Operating	K-12
Norris Public Schools	Firth	NE	US	2.4	Operating	K-12
Papillion-LaVista Public Schools	Papillion	NE	US	2.4	Operating	K-12
Pleasanton Public Schools	Pleasanton	NE	US	2.4	Operating	K-12
West Holt High School	Atkinson	NE	US	2.4	Operating	K-12
West Point Public Schools	West Point	NE	US	2.4	Operating	K-12

Figure 17. Nebraska Wind for Schools project locations

4.7.2 Curricula and Teacher-Training Activities

Examples of Nebraska curricula and teacher-training activities include the following:

- In February 2012, the Nebraska WAC director and associate director provided a training workshop at UNL for wind energy instructors at community colleges and trade associations. Attendees included four from Southeast Community College, two from Northeast Community College, four from the International Brotherhood of Electrical Workers in Omaha and Lincoln, and one from The Nebraska Renewable Energy Systems Co.
- The Nebraska Wind for Schools team hosted an educators' workshop in Kearney in March 2011. Facilitator McGuire mailed invitations that included NEED Project and WindWise packets to 23 Nebraska partner schools. Seventeen educators from 11 of the partner schools attended. A NEED representative led the first day of activities, including Wind for Schools 101 and NEED 101, science of energy, using Wind for Schools data acquisition, hands-on wind activities (making anemometers, testing wind speed, electricity basics, blade testing and blade design), interdisciplinary wind energy activities, and kit evaluations.

4.7.3 Funding Update

- The USDA awarded Nebraska \$147,800 to start or expand rural businesses and to fund employment-related education programs under the American Recovery and Reinvestment Act.
- State Facilitator McGuire has worked closely with the Nebraska Attorney General's office to obtain grant funds from the Supplemental Environmental Program for a number of Wind for Schools partners,⁹ obtaining \$185,162 for 12 schools. Key benefits of the Supplemental Environmental Program grant funding are the streamlined process and the fact that schools were able to apply for the full project cost. However, near the end of 2010, officials informed the Nebraska Wind for Schools team that the program had provided all the grant funds it had allocated for the Wind for Schools project, so the team will revert to its previous strategy of helping interested new schools apply for USDA grants, Nebraska Energy Office grants, and other sources of grant funding. The Nebraska media covered the Supplemental Environmental Program grants and the related announcements, and the Wind for Schools project has received statewide coverage during the past 3 years as a result of the assertive outreach.
- Another source of Nebraska project funding has been Nebraska Public Power District (NPPD). NPPD provided funding for Elkhorn Valley School (\$3,000), Cedar Rapids Public School (\$1,500), Hayes Center Public School (\$1,500), Diller-Odell Public School (\$1,500), Bancroft-Rosalie Public Schools (\$1,500), Bloomfield Community Schools (\$3,000), Loup City Public School (\$3,000), Norris Public Schools (\$1,500), Crawford Public Schools (\$3,000), Mullen Public Schools (\$1,500), and Creighton Public Schools (\$3,000). In the future, NPPD will not provide similar grants but will instead invest in a new wind energy educational center in Norfolk that will include school tours.

⁹ Further information about this funding is available on the Wind Powering America website at www.windpoweringamerica.gov/filter_detail.asp?itemid=3522

- The WAC at UNL will not receive any DOE funding in 2012. The Nebraska Energy Office has only \$25,000 available (\$5,000 per school), so additional sources of project funding must be found.
- The current annual cost of the Wind for Schools operation in Nebraska is \$60,000 per year, exclusive of the rural school project costs (which are funded through a variety of school, state, federal, private, and cost-shared sources detailed above). A new model under consideration involves forming a 501(c)(3) corporation focused on Nebraska wind education. Its role will be to transform the Nebraska Wind for Schools programs to a state-based public-private collaboration while maintaining its non-funding relationship with the existing Wind for Schools project and the American Wind Energy Association’s education program. UNL will contribute \$10,000 as a cost-sharing contribution.
- If successful, the Nebraska program will expand the current 24 rural school projects by three to five schools per year, educating children (and their communities) in K-12 rural schools and 100-200 college students by 2016.

4.7.4 Testimonials

“I would just like to expose my kids to all the possible alternative energies that are out there, and what better way than this? It’s just too good of a project to turn down.”

Amy Malander, superintendent, Cedar Rapids, Nebraska

“These projects will get people back on the job now and will set the stage for growth by educating future generations.”

Ben Nelson, Nebraska Senator (announcing American Recovery and Reinvestment Act funding that included three Wind for Schools projects)

“It’s a new job market opportunity for some of our vocational kids.”

Dave Owen, principal, Burwell Schools, Nebraska

4.8 North Carolina (Round 2)

The North Carolina Wind for Schools project team applied for several large grants after receiving DOE funding in 2010 and, while waiting for the funding, the team members concentrated on siting, identifying host schools, and talking to teachers. After the grants were awarded in 2011, the team had to move quickly because they had a deadline of 6 months in which to spend the money.

The short timeline resulted in limited time for the planning, zoning, and construction process for the nine planned school turbines. To complete all installations prior to December 2011, the group contracted them to Sundance Energy Systems, a local company with renewable energy project experience. All nine projects were installed¹⁰ within a short timeframe at the end of 2011.

The WAC is recruiting schools for 2012 turbine installations and has received four applications to date.

WAC

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Under contract: Round 2, funded in 2010

Number of installations: 9

Table 17. North Carolina Installations Summary

Install Date	Location	Project Details
December 2011	Watauga High School, Boone	<ul style="list-style-type: none"> - Skystream 3.7 turbine on a 45-foot tower - Funded by the North Carolina Green Business Fund Grant and GEAR UP program - Installed by Sundance Power Systems with assistance from the ASU WAC and host school students
2011	North Wilkes Middle School, North Wilkesboro	<ul style="list-style-type: none"> - Skystream 3.7 turbine on a 30-foot tower - Funded by the North Carolina Green Business Fund Grant and GEAR UP program - Installed by Sundance Power Systems with assistance from the ASU WAC and host school students
2011	Alleghany High School, Sparta	<ul style="list-style-type: none"> - Skystream 3.7 turbine on a 30-foot tower - Blue Ridge Electric Co-op donated approximately \$500 to cover metering and permit costs - The Alleghany School Board offered \$1,500 toward the project - Additional funding provided by the North Carolina Green Business Fund Grant and GEAR UP program - Installed by Sundance Power Systems with assistance from the ASU WAC and host school students

¹⁰ More information about the nine installations is available on the Wind Powering America website at www.windpoweringamerica.gov/filter_detail.asp?itemid=3454

Install Date	Location	Project Details
2011	Avery County High School, Newland	<ul style="list-style-type: none"> - Skystream 3.7 turbine on a 45-foot tower - Funded by the North Carolina Green Business Fund Grant and GEAR UP program - Installed by Sundance Power Systems with assistance from the ASU WAC and host school students
2011	First Flight Middle School, Kill Devil Hills	<ul style="list-style-type: none"> - Skystream 3.7 turbine - Funded as part of a Rural Center for Economics grant and a partnership among the ASU WAC, Baker Renewables, and the Albemarle Resource Conservation and Development Council - The ASU WAC provided technical assistance via teleconferences and mapping software during the preliminary site assessment - The installation was contracted to Baker Renewables and the Albemarle Resource Conservation and Development Council
2011	Cape Hatteras Secondary School of Coastal Studies, Buxton	<ul style="list-style-type: none"> - Skystream 3.7 turbine - Funded as part of a Rural Center for Economics grant and a partnership among the ASU WAC, Baker Renewables, and the Albemarle Resource Conservation and Development Council - The ASU WAC provided technical assistance via teleconferences and mapping software during the preliminary site assessment - The installation was contracted to Baker Renewables and the Albemarle Resource Conservation and Development Council
2011	JP Knapp High School, Currituck	<ul style="list-style-type: none"> - Skystream 3.7 turbine - Funded as part of a Rural Center for Economics grant and a partnership among the ASU WAC, Baker Renewables, and the Albemarle Resource Conservation and Development Council - The ASU WAC provided technical assistance via teleconferences and mapping software during the preliminary site assessment - The installation was contracted to Baker Renewables and the Albemarle Resource Conservation and Development Council
2011	College of Albemarle - Dare Campus, Manteo	<ul style="list-style-type: none"> - Windspire turbine - Funded as part of a Rural Center for Economics grant and a partnership among the ASU WAC, Baker Renewables, and the Albemarle Resource Conservation and Development Council - The ASU WAC provided technical assistance via teleconferences and mapping software during the preliminary site assessment - The installation was contracted to Baker Renewables and the Albemarle Resource Conservation and Development Council
2011	College of Albemarle - Edenton Campus, Edenton	<ul style="list-style-type: none"> - Bergey XL hybrid system installed as part of a workshop hosted by the ASU WAC staff - In October 2011, a 20-meter met tower was also installed here as part of a wind resource assessment workshop that was conducted by the ASU WAC staff

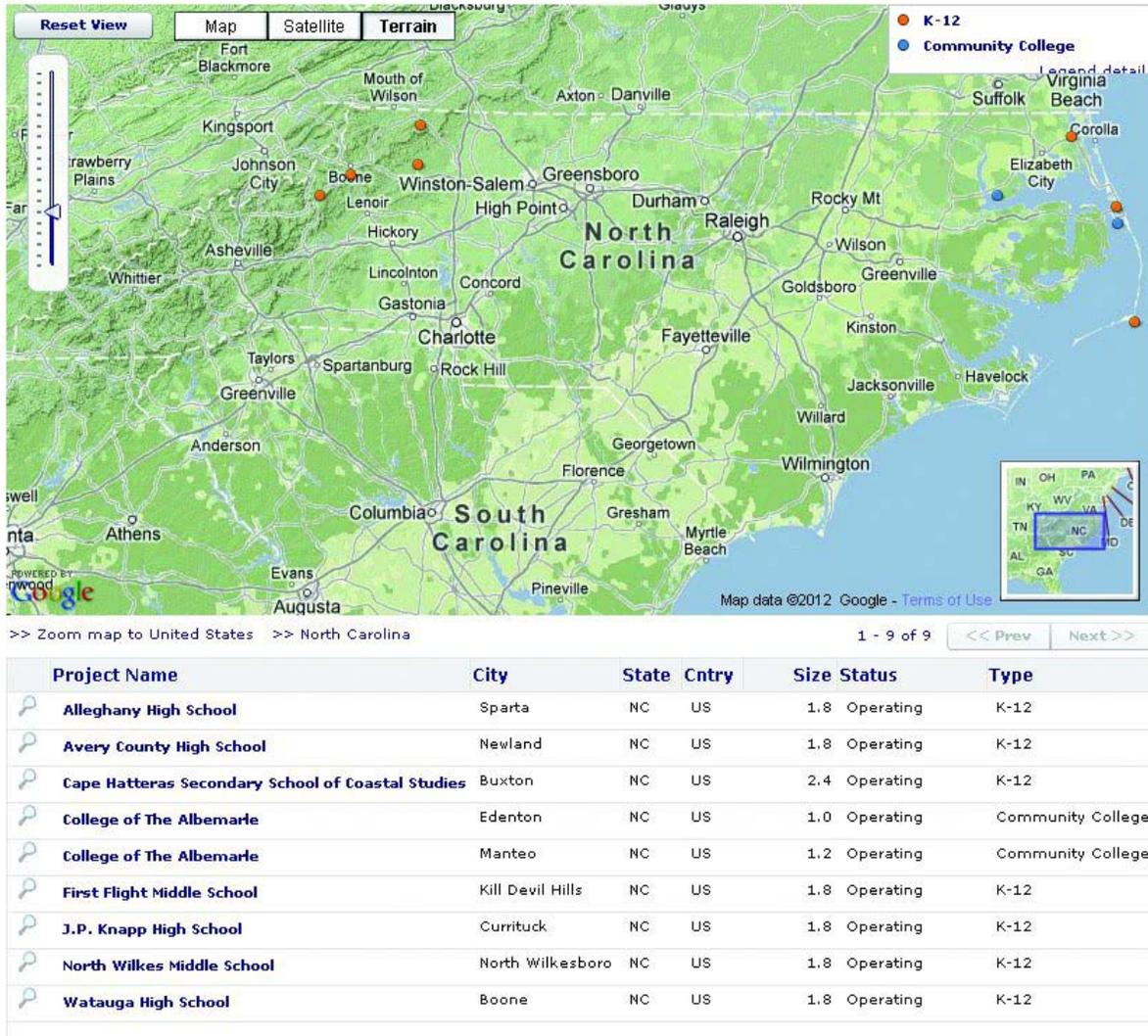


Figure 18. North Carolina Wind for Schools project locations

4.8.1 North Carolina WAC Activities

Examples of North Carolina WAC activities include the following:

- As of spring 2012, 250 Appalachian students (200 undergraduates and 50 graduate students) are studying renewable energy.
- Approximately 100 students per year are involved in the WAC's Wind for Schools projects. All students receive hands-on experience from these projects.
- Four graduates are currently working in the wind industry, while several others work for renewable energy companies involved with small wind/PV/micro-hydro projects.

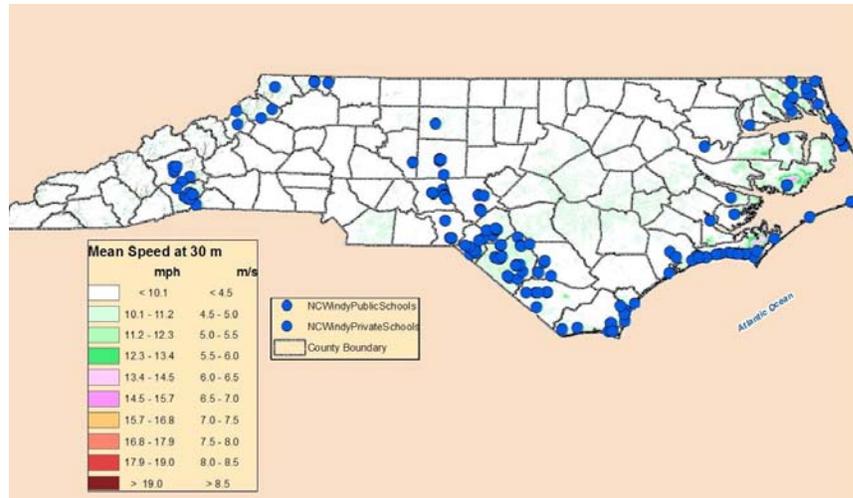


Figure 19. North Carolina school locations with >10-mph average annual wind speed @ 30 meters (based on AWS Truepower's North Carolina wind resource map)

The North Carolina WAC is staffed by six graduate students. In addition to Wind for Schools activities, the group:

- Participates in the North Carolina Wind Working Group
- Offers community outreach, education, and consultation (providing wind mapping service and workshops open to the public)
- Administers an anemometer loan program
- Manages the Beech Mountain Small Wind Turbine Research & Demonstration Facility in western North Carolina. The group recently installed three new turbines and two met towers at the site and also purchased a new Campbell Scientific datalogger and new transducers and sensors for the work
- Provides education at the university level (currently two undergraduate wind and hydro technology classes and one graduate wind and hydro class)
- Conducts outreach, including a recent appearance by WAC members on a public radio program discussing Wind for Schools (www.oursoutherncommunity.org/showarchives.htm)
- Prepares a project description document to aid the local champion teacher in pitching the idea to others. This document includes specifics on the Skystream turbine, a tentative price breakdown, a satellite photo of the proposed installation area, and photo simulations of the turbine in its proposed location. This serves as a tool to promote local acceptance for the project and address concerns.



Figure 20. North Carolina WAC research assistant Christopher Guttenberg learns about the KidWind model kit. Photo from Appalachian State University, NREL/PIX 18604

4.8.2 Curricula and Teacher-Training Activities

Examples of North Carolina curricula and teacher-training activities include the following:

- WAC members participated in a regional technology education program, distributed NEED Project and other wind curriculum materials, and demonstrated KidWind Project kits.
- The group maintains www.wind.appstate.edu as an information center for teachers and administrators interested in the program. WAC staff members have updated the site to include a list of frequently asked Wind for Schools questions that addresses curriculum integration, how the installations are funded, and specifics on the Skystream model. They've also added links to curriculum development resources.
- The WAC sends e-mails to North Carolina science and technology education contacts and to the principals included in its "windy schools" database. Since fall 2010, the group has offered informational webinars to interested teachers and administrators. The group also administers a listserv.
- On May 14, 2011, the WAC sponsored a wind workshop for teachers. NEED Project staff led the workshop, which was attended by 27 teachers from across the state. Most of the teachers were from schools with average annual wind speeds of 10 mph or higher at 30 meters. Also, most of the participating teachers had followed up on a letter of intent and an application signed by the principal of the school and superintendent of the county school system.
- Appalachian graduate students working in the WAC office participated in several other wind-related educational activities, including a half-day Earth Day workshop in Caldwell County for a group of 24 students selected for their academic excellence and strong interest in engineering, math, and science. The group also set up displays at two regional technology education events: a technology educational student organization and conference of technology educators. More than 100 people attended each of these events. The group distributed Wind for Schools project literature and wind energy curriculum materials and demonstrated KidWind Project kits.



Figure 21. North Carolina Wind for Schools project logo

- The ASU WAC facilitated a 3-hour Catawba County Green Commission Wind Energy workshop in November 2011. Forty honors students from the western North Carolina area attended and learned about wind energy basics. Activities included presentations, met tower instrument wiring, turbine technology and components, and a KidWind kit introduction.
- Modeled after the KidWind Challenge, WAC staff member Chris Guttenberg is leading a pilot group of North Carolina Technology teachers to develop and conduct wind energy competition events for potential long-term adoption by the North Carolina Technology Student Association.

4.8.3 Funding Update

- The group secured a commitment from Gearup and Upward Bound for \$10,000 to support projects in Alleghany and Avery Counties.
- A North Carolina Green Business Fund Grant resulted in \$100,000 to fund four projects in the mountain region.
- The Albermarle Resource Conservation & Development Council included the Wind for Schools project in a grant it submitted to the North Carolina Rural Center to support coastal projects. A \$200,000 grant award was recently announced pending appropriation of funding from the state general assembly.
- Sudie Hargis, a Coast Guard member who worked with the Alaska Wind for Schools project, is now working with the North Carolina WAC. Personnel at Base Fort Macon in Atlantic Beach are planning to install a Skystream 600. They want to provide most of the funding for the project and site the turbine on their property but also allow Carteret County Public Schools to use the turbine as a learning aid and post the data on the school's website.
- Invenergy has promised \$3,000 to support a project in Currituck, Beaufort, or Tyrell Counties.

- The WAC team will engage in fundraising efforts with the Global Institute for Sustainable Technologies director and the Reading, Riding, and Retrofit: Schools Leading the Way to Sustainability director for a project in Buncombe County.
- Mountain Valleys RC&D has applied for grants to fund turbine installations in 2012. During the first quarter, the team applied for an \$85,000 Wells Fargo grant and a \$10,000 Appalachian Regional Commission grant.
- Also during the first quarter of 2012, WAC staff member and Appropriate Technology graduate student Sebastian Brundage applied for a \$5,000 ASU GEAR UP grant. GEAP UP provided funding for several of the 2011 turbine installations. The recent grant was written to fund the relocation of the Skystream turbine installed at Brushy Creek Middle School in Buncombe County. The turbine was installed at a poor wind site and school personnel requested that it be relocated. The WAC is trying to relocate the turbine to Glade Creek Elementary School in Alleghany County.

4.9 Pennsylvania (Round 2)

In January 2011, the Pennsylvania team released its first request for applications from schools. The application period ended in March with a pool of 11 applicant schools from across the state (see map below). Seventy students in WAC Director Susan Stewart's junior-level wind and hydropower course at Penn State conducted the feasibility studies.



Figure 22. Locations of 2011 Pennsylvania Wind for Schools applicants

These reports will be provided to each school. The team used results of the feasibility studies to rate each school on the expected energy production for the site, the ease of permitting, and on the funding probability for the projects. The resulting ratings were used to determine the top three schools from this candidate pool that the WAC will work with to raise funding for a turbine and customize wind energy curricula. The selected schools were Hazelton Area High School, Greater Johnstown Career & Technology Center, and Northwestern High School. The WAC will also work with the Mount Nittany Elementary School, continuing work that began before DOE funding.

4.9.1 Pennsylvania WAC Activities

Examples of Pennsylvania WAC activities include the following:

- Course proposals for three new graduate-level wind energy engineering courses were drafted as part of a separate DOE-funded wind workforce development effort. This course series will lead to a graduate certificate in wind energy engineering, beginning in fall 2012. This sequence of courses will also constitute an option in Penn State's online Intercollege Professional Master's degree program in Renewable Energy and Sustainability Systems.
- As of November 2011, the Pennsylvania WAC team reported that 125 students were enrolled in wind energy courses, 70 university students were involved in the feasibility study for Wind for Schools projects in the state, two students had summer internships that offered hands-on experience with turbine installations, and five students landed jobs in the wind industry.

WAC

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Dina Taucher, Wind Senator

Under contract: Round 2, December 2010

Number of installations: 1

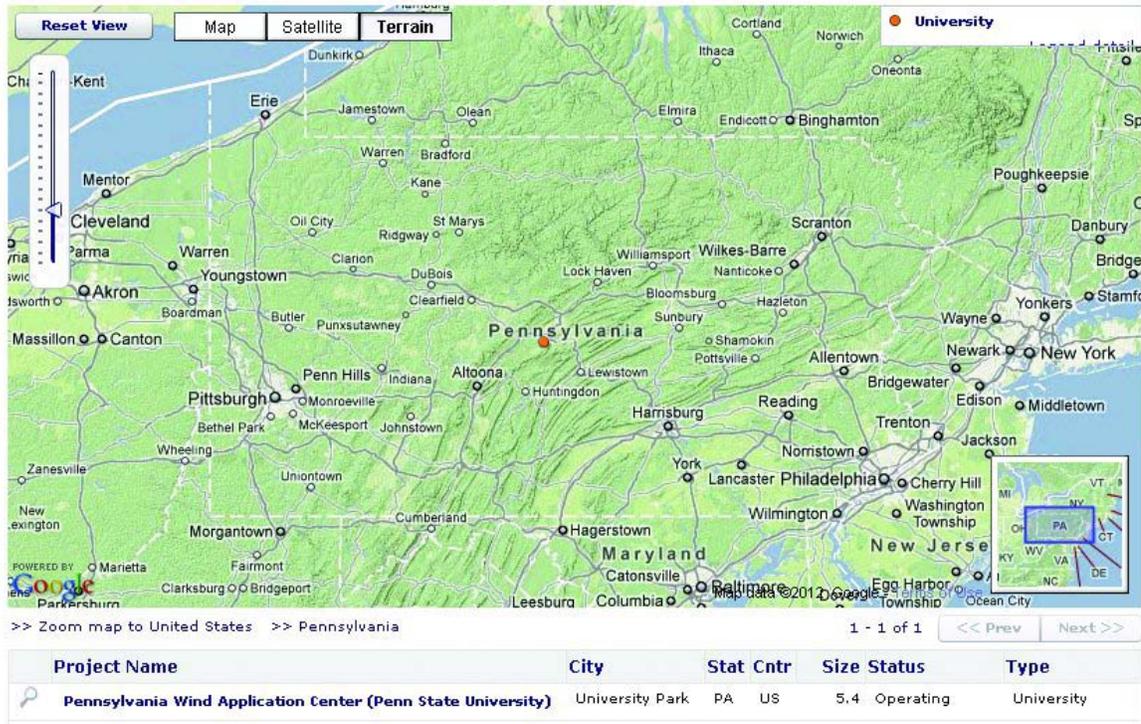


Figure 23. Pennsylvania Wind for Schools project locations

- Prior to the DOE contract, the group worked with Mt. Nittany Elementary School, a local school in State College, to raise funds for a turbine at the site. The school recently received a Lowe’s Education Toolbox grant for \$5,000 and is expecting \$5,000 from Citizen Power. The school district agreed to fund “everything from the ground down.” One of the faculty members involved with this process is also building turbines with his students at the Park Forest Middle School.
- Aerospace engineering faculty member Professor Schmitz taught a graduate course on wind farm modeling in fall 2012. This course will transition into one of three online wind energy courses leading to a graduate certificate in wind energy engineering beginning in fall 2012. This sequence of courses will also constitute an option in Penn State’s online Intercollegiate Professional Master’s degree program in Renewable Energy and Sustainability Systems, which is also scheduled to kick off in the fall.
- During the spring 2011 semester, 70 students in EGEE 438: Wind & Hydropower conducted wind turbine feasibility studies for the 11 applicant schools previously mentioned and provided reports to each school. The project team also rated the applications for the educational plans presented. The results of the feasibility studies will lead to ratings for each school on the expected energy production for the site, the ease of permitting, and the funding probability. The resulting ratings determined the three schools that the WAC will work with to raise funding for a turbine.
- In addition to the 70 students enrolled in Stewart’s course in spring 2011, 30 undergrad and graduate students also enrolled in an aerospace engineering course focused on the analysis and modeling of wind turbine aerodynamics using available NREL tools and codes developed in student projects.

- On February 8-9, 2011, Penn State hosted the third Windustry Community Wind across America conference. The Pennsylvania Wind for Schools project, KidWind, and Southwest Windpower were represented in the exhibition. One conference session focused on education and community engagement.

4.9.2 Curricula and Teacher-Training Activities

Examples of Pennsylvania curricula and teacher-training activities include the following:

- In July 2011, a Skystream turbine was installed on the Penn State campus to support a hybrid renewable energy residence laboratory. The turbine will introduce host school teachers and administrators to the system and how the resulting data can be used in their classrooms. In September, training was also provided on the PI software system, which will integrate the data from the various renewable energy systems at this research facility.
- The WAC hosted its first Saturday Science Workshop in March 2011 for selected host schools.

4.9.3 Funding Update

- Pennsylvania is a deregulated utility market, and the group was encouraged to apply for \$25,000 from one of the Sustainable Energy Funds that resulted from deregulation in the late '90s. Funding was received, and this will partially support approximately five installations in Allegheny Power territory by providing \$5,000 each. The group hopes to receive similar support from the other utility regions in the state.
- The WAC submitted funding requests to the TE Connectivity Foundation and the Pennsylvania Space Grant Consortium, and both requests were granted. The TE Foundation is providing \$20,000 in support of Wind for Schools installations and activities in the central Pennsylvania region. The Pennsylvania Space Grant provided \$6,281 to support a teacher-training event in October 2011 to train teachers from the selected host schools and the remaining applicant schools in the KidWind Project curricula, led by Wind Senator Taucher.
- The WAC is teaming up with North Carolina and Virginia to pursue funding from the Appalachian Regional Commission for turbine installations in these states.
- The West Penn Power Sustainable Energy Fund provided a \$5,000 grant to the Mount Nittany Elementary School.
- The team has contacted Johnson Controls about supporting a wind turbine project as part of the company's Guaranteed Energy Service Contracts.

4.10 South Dakota (Round 1)

South Dakota has installed 12 turbines. Planned projects at Elk Mountains School in Dewey and Sturgis School District in Sturgis are on hold due to lack of funding.



Figure 24. Sanborn Central School in Forestburg was the first South Dakota school to install a Wind for Schools project turbine. Photo from East River Electric Power Cooperative, NREL/PIX 16030

WAC

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Under contract: Round 1

Number of installations: 12

Table 18. South Dakota Installations Summary

Install Date	Location	Project Details
2011	Brookings School District, Brookings	- Air-X wind turbine
2011	Lake Andes School District, Lake Andes	- Skystream on a 45-foot monopole tower - D & Z Energy Products installed the turbine under WAC supervision - Lake Andes School District funded the installation
June 2010	Yankton School District, Yankton	- Skystream on a 45-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with the support of D & Z Energy Products, Bon Homme Yankton Electric, and East River Energy Cooperative - Funding sources: Utility contribution (\$5,000), school contribution (\$10,000)
2010	Wessington Springs School District, Wessington Springs	- Skystream on a 45-foot monopole tower - Students from Mitchell Technical School installed the turbine, supervised by the WAC director, with support from Miller City Electric Department - Wessington Springs School District and Heartland Power Consumer District funded the installation

Install Date	Location	Project Details
2010	Miller School District, Miller	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole tower - Students from Mitchell Technical School installed the turbine, supervised by the WAC director, with support from Miller City Electric Department - Miller School District and BP Wind funded the installation
November 2009	Faith School District, Faith	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with the support of GenPro and Missouri River Energy Services - Funding sources: Industry sponsor grant (\$3,500), alumni grant (\$2,800), utility contribution (\$3,672), school contribution (\$5,229)
November 2009	Memorial Middle School, Sioux Falls	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with the support of Green Energy Products LLC and Xcel Energy - Funding sources: NREL grant (\$3,500), utility contribution (\$7,500), school contribution (\$4,850)
October 2009	Selby School District, Selby	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with the support of Green Energy Products LLC and Montana-Dakota Utilities - Funding sources: Industry sponsor grant (\$3,300), utility contribution (\$3,500), school contribution (\$5,212)
September 2009	Dakota Valley School District, North Sioux City	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with the support of Green Energy Products LLC, Union County Electric Cooperative, and East River Energy Cooperative - Funding source: School contribution (\$4,026)
June 2009	Elkton School District, Elkton	<ul style="list-style-type: none"> - Skystream on a 60-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with support from Green Energy Products LLC - Funding sources: Utility contribution (\$3,000), school contribution: \$7,750
January 2009	Douglas School District, Box Elder	<ul style="list-style-type: none"> - Skystream on a 60-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with support from GenPro and Black Hills Power - Funding sources: Industry sponsor grant (\$3,500), utility contribution (\$3,300), school contribution (\$11,274)
May 2008	Sanborn Central School District, Forestburg	<ul style="list-style-type: none"> - Skystream on a 45-foot monopole tower - WAC students installed the turbine, supervised by the WAC director, with the support of Green Energy Products LLC and East River Energy Cooperative, which supplied linemen and a pole truck for the installation - Funding sources: Industry sponsor grant (\$3,500), utility contribution (\$5,720), school contribution (\$4,027)

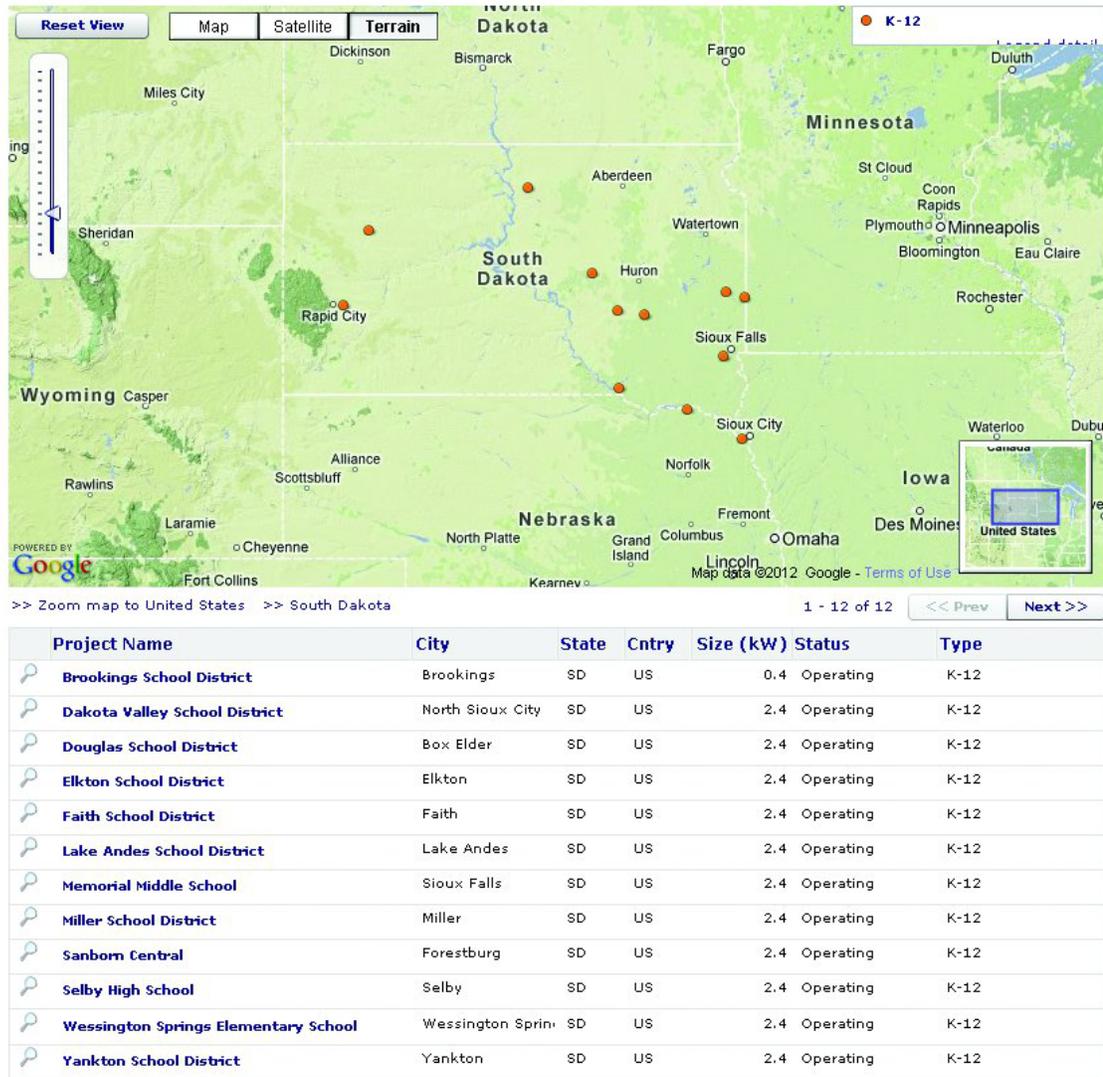


Figure 25. South Dakota Wind for Schools project locations

4.10.1 South Dakota WAC Activities

- As of December 2011, 23 university students have attended renewable energy classes, 25 students were involved in the WAC's Wind for Schools projects, and 12 students have graduated with some hands-on wind experience from these projects.
- The 2010 Youth Engineering Activities camp was a huge success for the South Dakota WAC as students discovered wind energy. Students learned through an interactive presentation with a finale involving their own blade designs. Students tested their best blade designs for performance and durability in a simulated environment.
- The WAC installed a 34-meter NRG anemometer tower in June 2010. Contributors were Sioux Valley Energy, Mitchell Technical Institute, SDSU's mechanical engineering department, and the SDSU Sheep Unit (donating a pasture for the tower installation). Sioux Valley Energy Co-op donated the time of two linemen and a derrick truck.

- State Facilitator Wegman has made numerous presentations on Wind for Schools in South Dakota to groups such as the South Dakota Wind Energy Association, Corson County Landowner Association, Cheyenne Sioux Tribe, Edmunds County Commissioners, and the Pierre Central Planning District.
- WAC students also participated in a special project focused on conducting a review of data communications options for use in the program.

4.10.2 Curricula and Teacher-Training Activities

- In April 2010, BP Energy sponsored a NEED/KidWind workshop in Miller with representatives from state communities interested in wind. NEED Project wind kits were made available to schools for use in classroom sessions focused on wind energy.
- In June 2009, Mitchell Technical Institute hosted a NEED Project education workshop for representatives from all the project affiliates, Lake Area Technical, and the WAC. More than 40 South Dakota Wind for Schools teachers attended.
- It should be noted that school administrators, teachers, and students find educational materials to be the most valuable component of the Wind for Schools program but are hesitant about spending the time to adapt curriculum resources from KidWind, NEED, 4H, or others to their classrooms because they may not exactly align with required topics. The WAC team has found that workshops and supplemental educational snippets provide high value to the students with minimal effort to the teachers.

4.10.3 Funding Update

Finding project funding is increasingly difficult. Wegman has conducted discussions with Black Hills Power and Light, BP Wind, Acciona, ITC, NextEra, the U.S. Department of Agriculture, and others regarding funding part of the expansion of the Wind for Schools project in South Dakota.

Wind energy developers FPL Energy, Babcock & Brown, and Iberdrola Renewables have each pledged \$10,000 to help support the South Dakota Wind for Schools project. The funds will be used to defray construction expenses associated with installing the turbines. FPL Energy is the developer of South Dakota's first utility-scale wind farm near Highmore. Babcock & Brown is the developer of the Wessington Springs Wind Farm. Iberdrola Renewables is the developer of the MinnDakota Wind Farm and the Buffalo Ridge I Wind Farm, both in Brookings County.

4.10.4 Testimonials

“I believe the Wind for Schools Project provides an excellent opportunity for our students and staff to study renewable energy. Having a wind turbine on our campus provides our staff and students an opportunity to study firsthand what renewable energy can do for this country.”

Loren Scheer, superintendent, Douglas School District, South Dakota

“This Wind for Schools Project is such a great opportunity for students at Douglas. As the wind industry expands, particularly in South Dakota, we realize how important it is to equip students with an understanding of wind energy. In a few years these students will be the ones installing

and maintaining wind turbines. I hope this project is the beginning of an exciting time for Douglas.”

Dusty Johnson, chairman, South Dakota Public Utilities Commission

“The Wind for Schools Project will give the students and teachers at Douglas a great hands-on learning experience in the growing field of wind energy. They will play a vital role in bringing renewable energy to a grassroots level in Box Elder. This is a project and energy source both the school and community can embrace.”

Don Martinez, energy services engineer, Black Hills Power, South Dakota

“The students notice the wind turbine when they come in. They talk specifically about how windy it is, and they’ve asked to see the output on the windier days.”

Tracy Moody, science teacher, Sanborn Central School District, South Dakota

“I strongly support continued local, state, and federal cooperation in putting this nation’s wind energy resources to work for all Americans. The Wind for Schools program is an important step in achieving this goal, and I thank you for your continued administration of this program.”

South Dakota Senator John Thune

4.11 Virginia (Round 2)

The Virginia WAC developed a process for selecting host schools; beginning in March 2011, schools must submit a simple proposal that includes information on campus location, intended use of the wind turbine in the classroom, school support, community awareness, and more.

The Virginia WAC received nine applications for host schools for the 2011 school year and completed two installations (see Table 19 below). Planned 2012 installations include Thomas Harrison Middle School in Harrisonburg and Central High School in Woodstock.



Figure 26. Northumberland Middle/High School installed the first Wind for Schools project in Virginia in February 2011. Photo from Remy Luerssen, James Madison University, NREL/PIX 18543

WAC

Virginia Center for Wind Energy (VCWE) at James Madison University (JMU)

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Under contract: Round 2

Number of installations: 2

Table 19. Virginia Installations Summary

Location	Install Date	Project Details
Henley Middle School, Crozet	December 2011	<ul style="list-style-type: none"> - The Virginia Department of Mines, Minerals, and Energy funded a wind and solar project at the school in 2010 - The WAC team assisted with siting and finding an installer - The school presented to the Board of Supervisors and the zoning board of Albemarle County and were successful at gaining a variance to the current 35-foot height restriction

Location	Install Date	Project Details
Northumberland Middle/High School, Heathsville	February 2011	<ul style="list-style-type: none"> - In November 2009, the school applied for a \$20,000 stimulus grant from the Virginia Department of Mines, Minerals, and Energy to fund the turbine project. The grant funding originated from the American Recovery and Reinvestment Act. Almost a year after submitting the grant application, funding was approved, allowing for construction to begin - A success story about this installation is posted on the Wind Powering America website at www.windpoweringamerica.gov/filter_detail.asp?itemid=3042

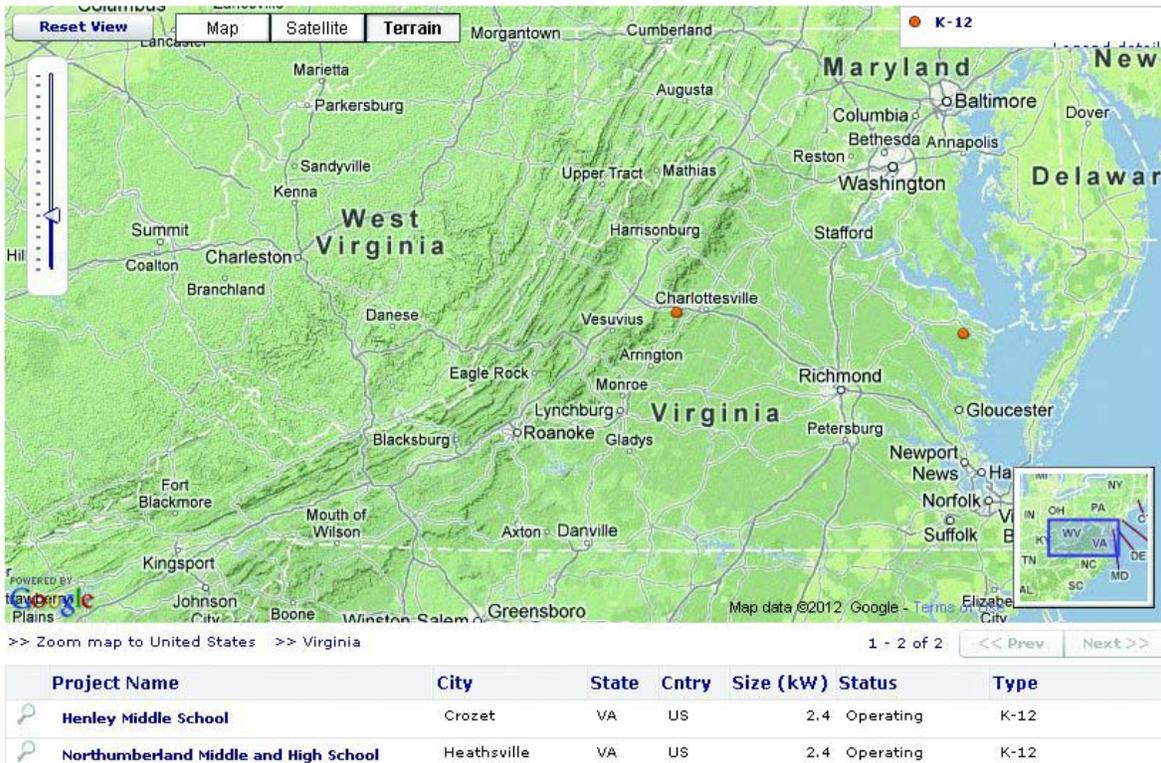


Figure 27. Virginia Wind for Schools project locations

4.11.1 Affiliates

The WAC identified five schools in Virginia with turbines. Of these, Spotsylvania Career and Technical Center and Gereau Center have agreed to become affiliates, and the team is acquiring their turbine information to connect them to INL’s database. Virginia Beach Public Schools (which has four Skystreams at the bus maintenance building) and William Fleming High School in Roanoke (which has four Skystreams to power stadium lights) have expressed interest but have not officially signed on as affiliates. A fifth school appears to be uninterested.

In addition, many military bases around the state are interested in installing turbines to help meet renewable portfolio standards goals. On Earth Day 2011, Ft. Story in Virginia Beach installed three SkyStreams, and the WAC contacted them to discuss the possibility of partnering with a

local school to use the installation as an educational project for that school. WAC members are also working with the Coast Guard, planning a Wind for Schools installation at the base in Cape Charles. They have engaged a local middle and high school that are interested in partnering on the project and using it as an educational tool in their classrooms. They are planning to install a Bergey 10-kW system and are in the process of collecting bids. Finally, the WAC contacted Wallops Flight Facility on the eastern shore of Virginia to discuss linking a SkyStream installation to local schools. A summer undergraduate intern has been working on these projects and is incorporating these interactions with the military projects into his senior thesis project.

4.11.2 Virginia WAC Activities

Recent WAC activities include the following:

- In 2011, two James Madison University (JMU) student teams (total of five students) worked on school projects through the WAC. In addition, one team of students from the University of Virginia is working with a school (total of four students). The WAC worked with a student from JMU's education department to assist with curricula. Presentations were made about the Wind for Schools project and the opportunities for pre-service educators to become involved in education classes at JMU.
- JMU currently offers courses that include wind energy at all four undergraduate levels and in graduate courses. Twenty-four students enrolled in the Instrumentation and Measurement in Energy course during the fall semester, which included several wind lab modules. Thirty-one students are enrolled in Sustainable Energy Development during the spring semester, which includes a 5-week wind module plus a wind energy term project.
- There is an effort underway at JMU to develop a minor that addresses wind energy, technologies, policy, and industry in a holistic fashion with several departments and programs served. Also, the JMU Small Wind Training and Testing Facility should be completed and operating during 2012.
- The WAC also has five other JMU students working on wind-related senior thesis projects on topics such as SODAR wind data analysis, siting a turbine at Tangier Island, and planning a small wind testing and training facility at JMU.
- A student in the joint master's program with the University of Malta did a dissertation on the needs of the industry in a small wind testing facility.
- In total, with summer student interns, student volunteers, and student project work, the WAC engaged 19 students in education, geographic science, and engineering and sustainable environmental resource management.
- JMU students installed several anemometers in 2011. The WAC has an inventory of old 20-meter systems and expects delivery of two 34-meter systems. The university approved the loan agreement with language outlining safety plans and installation inspection by a building inspector.
- In 2011, the Shenandoah Valley Technology Council nominated the Virginia Wind for Schools team for an award in the Innovation in K-12 Education category.

4.11.3 Curricula and Teacher-Training Activities

- The WAC is planning a KidWind Challenge in 2012 at the Science Museum of Virginia in Richmond. The event will follow a daylong Wind for Schools Summit in which all schools in the networks will come together to share successes and discuss hurdles. The goal is for 20 school teams to compete in the high school or middle school division. A JMU student who is working on her master's degree in education is leading the planning effort. She is also working with another JMU student who volunteered at the KidWind Challenge at the WINDPOWER Conference in Anaheim to learn more about the event.
- The WAC engaged informal science institutions around the state to help educate students and the public about wind energy and to serve as possible hosts for regional teacher training workshops. The group is currently working with the Science Museum of Virginia (which has a Bergey XL.1 turbine), the Science Museum of Western Virginia, Nauticus, and the Virginia Aquarium. The WAC will seek funding to create a teacher-training network using these museum partners, with the goal of training an educator from each institution as a NEED facilitator and a Wind Senator.
- The WAC hosted a NEED teacher training in June 2010 in coordination with the state wind symposium and hosted a NEED workshop for Wind for Schools teachers in summer 2011. Other trainings will be offered at schools throughout the state.

4.11.4 Funding Update

- The VCWE receives funding to support wind-related efforts such as community outreach and siting evaluations (including one at Tangier Island near a prospective host school). In addition, the funding received to manage small wind projects through the state rebate and grant programs helps with projects at the two host schools this year. The WAC continues to conduct outreach as requested, but these efforts are constrained by funding limitations.
- The Virginia state energy office provided full funding for two schools to install Skystreams. Woodstock applied for a \$50,000 grant from the county and was not successful, so the WAC team is working on creative fundraising ideas and green certificates. Harrisonburg is investigating climate education funding from the Virginia Space Grant Consortium (NASA). The WAC team convinced the state energy office to allot \$10,000 for the two schools struggling with funding. The group also received funds for wind-related projects from the 25x'25 initiative and may make these available to these schools to help expedite the turbine installations. Finally, JMU education department faculty members are working on a National Science Foundation proposal to determine whether a virtual simulation lesson would have potential for rural students in high school science courses. In the future, the WAC team will pursue funding from the Appalachian Regional Commission in partnership with North Carolina and Pennsylvania..

5 Appendix I: Wind for Schools Partner Organizations and Contacts

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