



Wind for Schools: A Wind Powering America Project



What is the Wind for Schools Project?

Energy is largely taken for granted within our society, but that perception is changing as the economic and environmental impacts of our current energy structure are more widely understood. The U.S. Department of Energy's (DOE's) Wind Powering America program sponsors the Wind for Schools Project to raise awareness in rural America about the benefits of wind energy while simultaneously developing a wind energy knowledge base in the United States to educate future leaders of our communities, states, and nation about the importance of renewable energy.

The three primary project goals of the Wind for Schools Project are to:

- Engage rural school teachers and students in wind energy education
- Equip college students in wind energy applications and education to provide interested and equipped engineers for the growing U.S. wind industry
- Introduce wind energy to rural communities, initiating a discussion of wind energy's benefits and challenges.

The Wind for Schools Project approach is to implement a wind energy training center at state-based universities or colleges. As part of the wind energy curriculum activities, college students assist with installing small wind turbines at primary and secondary schools.



Sanborn Central School in Forestburg, South Dakota, installed a Skystream 3.7 wind turbine as part of Wind Powering America's Wind for Schools project.

The wind turbine located at a school, when combined with science-based curricula, provides students and teachers with a physical example of how communities can take part in providing for the economic and environmental security of the nation while allowing exciting, hands-on educational opportunities for the students. The project implementation also provides solid experience for the college students that, when combined with wind energy coursework, prepares them to enter the wind energy workforce. It is expected that through this project, small wind turbines will be installed at five to eight new schools while graduating 10 to 15 university engineering students with wind energy experience in each targeted state each year.

How does Wind for Schools address the need for wind workforce development?

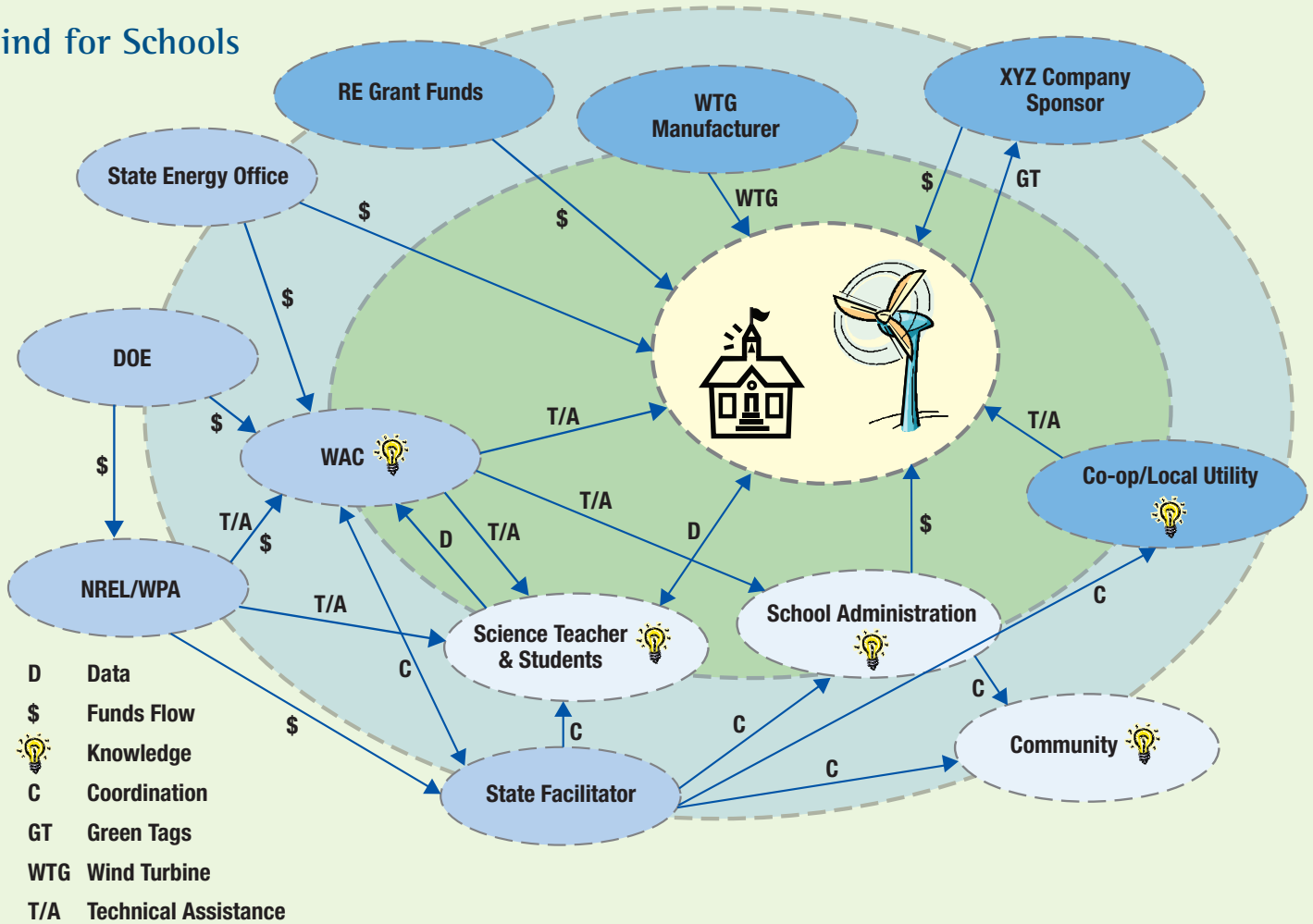
In 2006, President Bush emphasized the nation's need for greater energy efficiency and a more diversified energy portfolio. This led to a collaborative effort of more than 70 organizations (led by the U.S. Department of Energy Wind and Hydropower Technologies Program, the American Wind Energy Association, and the national laboratories) to explore a modeled energy scenario in which wind provides 20% of U.S. electricity. The purpose of the 20% Wind Energy by 2030 report, released in July 2008, is to begin a dialogue about issues, costs, and potential outcomes associated with the 20% wind scenario. Although the report clearly indicates that this ambitious 20% wind scenario is achievable, it also highlights the challenges to overcome.

One of the challenges of providing 20% of U.S. electricity from wind by 2030 is a lack of skilled workers. The report estimates a direct U.S. wind workforce of approximately 180,000 by 2030 to support the implementation of approximately 16 gigawatts (GW) of new capacity per year. The development of a national educational infrastructure will be a cornerstone to the successful creation of a green energy economy in the United States. President Obama has expanded on this theme from the early days of his administration, describing the hundreds of thousands of jobs that will result from a transition to a green energy economy, many of which will result from the expansion of the wind industry.

Within the educational infrastructure, three primary focus areas stand out: primary and secondary education, community college and lifetime learning programs, and graduate and post-graduate education systems. Although there is a clear need for development of each of these areas in addition to apprentice and skill-focused education programs, Wind for Schools Project efforts are directed at the K-12 and university sectors.

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Wind for Schools



Who participates in the Wind for Schools Projects?

The main focus of the Wind for Schools Project is to develop a Wind Application Center (WAC) in identified states and, through these organizations, to support the installation of Wind for Schools systems as part of a larger education package. Eight entities are involved in the implementation of each Wind for Schools system: the host school (which includes a science teacher, the school administration, and the community); a WAC; a facilitator; Wind Powering America/NREL/DOE; a green-energy-sponsoring company; a wind turbine manufacturer; the local utility or electric cooperative; and the state

The success of the Wind Application Centers is one of the long-term goals of the Wind for Schools Project. The 20% Wind Energy by 2030 Scenario estimates that 3 million new positions will be created if the wind industry expands to provide 20% of the nation's electrical energy; therefore, there is an urgent need for colleges and universities to train future wind energy practitioners.

energy office. The following section describes the roles and responsibilities of each entity in greater detail. The diagram above depicts the Wind for Schools program structure.

Host school, science teacher, school administration, and community: In order for a Wind for Schools project to succeed, people at all levels must support the concept: the science teacher, the school principal and administration, the district superintendent and administration, and the school board. The school provides land for the project, support for the interconnection of the wind turbine to the school electrical system, facilities support, financial support, and support for the project in community meetings or other organizational events. After the installation, the science teacher uses the wind turbine as a teaching aid in energy-related curricula and possibly as a source for science fair concepts. Although project financial structures will vary from state to state, the host schools own and are responsible for the wind turbine system. The schools will save a small amount of money by offsetting power generation but will have access to wind energy curricula, teacher training workshops, and data from other wind turbines around the country.



Tyson Sherwood, a student at Milford High School in Milford, Utah, affixes an anemometer to a Skystream tower for a comparison on wind speed to power output. Tyson was in the eighth grade when the first 20-meter tower was installed on teacher Andy Swapp's farm for a school project. Now Tyson is a senior who hopes to work in the renewable energy field.

Wind Application Center (WAC): A WAC will be implemented at a state university or college under the leadership of an interested university professor. The WAC will implement a wind energy curriculum and will graduate engineers and systems analysts interested in pursuing wind energy as a career. Roughly fashioned after the Industrial Applications Centers and working with the state facilitator, the WACs will also provide technical assistance to rural schools (analyzing the wind resource, energy usage, siting, permitting, land use, and financials, as well as overseeing the installation of the power system and analyzing system performance data). After

the first year, new K-12 candidate schools will be identified in the early fall. The WAC will conduct analysis and permitting during the fall academic semester and will install the turbine in the spring, allowing the project to be developed as a junior or senior academic project.

After the 3-year implementation period, the WAC will assume the responsibilities of the state facilitator and will become the primary repository of wind energy applications knowledge and expertise. Schools, small business owners, residential users, state policy-makers, regulators, and other stakeholders will view the WAC as the source of impartial information regarding

wind energy applications. Although Wind Powering America/NREL will provide technical and financial support to develop the WAC, it is anticipated that after 3 years the WAC will develop additional funding sources and be self-sustaining.

State facilitator: This individual or organization assists Wind Powering America in developing a Wind for Schools project in each state. The facilitator's primary responsibility is to identify candidate K-12 schools and science teachers and support the project's development by working with the local communities and school administrations and the WAC. The state facilitator is also responsible for working with Wind Powering America and the WAC to line up funding and implement each project. The facilitator's role is designed to last about 3 years, at which point the WAC assumes the facilitator responsibilities.

Wind Powering America/NREL/DOE: In each state, Wind Powering America will provide technical and financial assistance to the WAC and state facilitator over the first few years of the project, including:

- Conducting an annual wind energy applications training program
- Assisting in the analysis of Wind for School projects
- Providing analysis models and other tools to support project development
- Providing turbine installation and commissioning procedures training
- Assisting in curricula development for the K-12 schools and the WAC
- Providing wind measurement towers to support student learning and host school wind resource assessment
- Hosting students, professors, and teachers with summer projects at NREL.

Company that sponsors Green Energy Certificates: The energy from the wind turbines will offset a modest amount of energy usage at the school. Although not formally green tags, the green attributes for the energy produced by the Wind for Schools Project turbines will be sold to defray the turbine costs. A sponsoring company will pre-purchase the environmental attributes associated with the first 10 years of the wind turbine's operation.

Wind turbine manufacturer: Southwest Windpower (www.windenergy.com) has joined the Wind for Schools Project as the initial supplier of all Wind for Schools systems. The standard system will incorporate a SkyStream 3.7 wind turbine on a 70-ft guyed tower. This 2.4-kW wind turbine will produce about 3,600-4,000 kWh/year, depending on the wind resource at the school. Several tower options will also be available (including a monopole tower, or self-supporting tower without guy wires), although these tower options will incur an

Basic Timetable for Wind for Schools Projects

Summer	Identify nine to ten candidate host schools; narrow selection to four to six for analysis
Summer	Convene training week at National Wind Technology Center
Early fall	Implement initial Web-based analytical training of WACs and host schools as needed
Fall	Perform analysis of candidate schools (WACs)
Fall	Secure financing for projects (including green tags transaction)
Winter	Permits and planning the installation of projects at host schools
Spring	Install systems at host schools
Spring/Fall	Institute host school K-12 curriculum

additional cost. Other wind turbines or configurations will not be considered part of the Wind for Schools Project initial offering, although after a few years of operation this program may include other turbine options.

Local utility or electric cooperative: To ensure the success of a Wind for Schools project, the local electricity provider should be involved. The utility or cooperative should provide technical expertise (both in terms of installation and education) and assist in the installation of the wind turbine and associated hardware. The school and state facilitator (or the WAC after the initial years) will be expected to secure the support and assistance from the local provider.

Community education is one of the goals of the Wind for Schools Project, and the local electricity provider is a critical project partner. In most rural areas, the local utility or energy cooperative is one of the key community members, an entity that supplies the services that have expanded development and the quality of life. The Wind Powering America program supports a more environmentally sustainable energy economy, including the expanded use of wind energy, as one of the ways to bring prosperity to rural communities. The local electricity providers play a special role in assisting this development opportunity, although many are hesitant because of lack of experience with wind technologies. The Wind for Schools Project hopes to help bridge this experience gap.

Also, partnering with the local schools and the Wind for Schools Project provides an opportunity for local energy organizations to highlight the importance of energy in our society.



Dave Parsons/PIX00555



The Greenbush Science Center in Greenbush, Kansas, installed a Skystream 3.7 wind turbine as part of Wind Powering America's Wind for Schools project.

State energy office: The state energy or development office provides technical, financial, and managerial support for the project as appropriate, generally through the WAC and state facilitator. The state energy office will also identify grants and other funding opportunities for Wind for Schools projects.

What school curricula is included as part of the Wind for Schools Project?

Through the Wind for Schools program activity, curricula is developed and implemented at both the university and K-12 level. The program currently does not work directly with community colleges or other vocational programs.

The primary responsibilities of a WAC are to provide technical assistance to schools and develop and implement wind energy curricula as one step toward graduating engineers, systems analysts, and other majors who are knowledgeable in the wind application process and motivated to pursue wind energy as a career. Curricula is developed and shared among the WACs, each typically focusing on specific technical areas that are the strengths of the respective professors and institutions. The Wind for Schools systems installed at the primary and secondary schools play a key role in the development of this experience. Through the implementation of the schools projects, students from the WACs gain valuable experience in wind project implementation. Although these activities involve a small

project, they mirror experiences that are applied on a much bigger scale with large projects. The WACs also address the need to stimulate further interest in the renewable sector by engaging with and fostering relationships between universities and K-12 schools and recognizing the mutual benefits gained as university students learn not only through classroom instruction but also by participating as “consultants-in-training.” Likewise, the relationship between the university and K-12 school provides young students and their teachers the opportunity to mine university resources, assistance, and to apply context to principles of mathematics, science, and other subjects that are applicable and of growing interest at all levels. It is also clear that early positive experiences with science and engineering are more likely to lead to students entering these work areas and that positive role model experiences support this process.

Providing educational opportunities at the primary and secondary level is also crucial to the project's aim of developing a workforce for the future. This aspect is completed by implementing age-appropriate curricula produced by the American Wind Energy Association, the NEED project (www.need.org), and the KidWind Project (www.kidwind.org). These hands-on, interactive curricula are implemented through teacher-training workshops in each of the states sponsored by the Wind for Schools Project. The program also provides teacher-training science kits for use in the classroom.

Following further development to implement data systems at each of the host school projects, data from each of the turbines will be uploaded to a central Wind for Schools data repository, allowing free access of the data to all schools. As part of the development of this data-sharing capability, further curricula are being developed to allow expanded science-based educational opportunities, such as comparing turbine output at different locations and in different wind resource areas. It is expected that the availability of data from across the Wind for Schools Project will lead to expanded curricula developed at individual schools or through dedicated science projects, all shared throughout the Wind for Schools network.

Who funds the Wind for Schools system?

NREL, DOE, and state energy offices provide support, especially during the initial project periods, but they generally do not provide funding for specific turbine or hardware purchases. An installed Wind for Schools system costs between \$15,000 and \$20,000 to commercially install, depending primarily on the tower type selected. Between \$7,000 and \$10,000 of this amount is for equipment and other system-specific hardware. The host school typically provides between \$1,500 and \$2,500; the sale of the turbine's environmental benefits will provide approximately \$2,500; and state-based grants, local donations, or equipment buy-down will provide the remaining funds. Many project participants donate their time, and the local utility or co-op is strongly encouraged to provide material and in-kind support for the turbine installation. More information on the wind for school system can be found in the separate Wind for Schools Project document, Wind for Schools Project Power System Brief (available at <http://www.nrel.gov/docs/fy09osti/45685.pdf>).

A separate document, Wind for Schools Project Power System Brief, describes the specifications of the Wind for Schools Project system in greater detail. A PDF is available at www.windpoweringamerica.gov/pdfs/wpa/schools_wind_brief.pdf.

What is the basic system configuration for a Wind for Schools Project?

The Wind for Schools Project basic system configuration incorporates a single SkyStream wind turbine, a 70-ft guyed or monopole tower, disconnect boxes at the base of the turbine and at the school, and an interconnection to the school's electrical system. The Wind for Schools system includes all of the disconnects and tower hardware associated with the project. For simplicity, the WACs will only install this basic power system configuration. If schools are interested in larger or

different turbines, the state team may assist in the technical (but not financial) portions of the project and if applicable, can be included in data sharing and curricula activities of the Wind for School Program.

Depending on the requirements of a specific project, a foundation and guy wire anchors must be installed prior to turbine installation. Turbine foundations must be installed 1 month prior to the turbine installation. In some cases, fencing around the base of the wind turbine should be installed.

Early discussion with the local power cooperative or utility is essential because the wind turbine is a power generation device. The local power cooperative or utility should be an integral part of the Wind for Schools Project and should assist in the turbine installation and associated electrical interconnections. However, special electrical permits are not required because the turbine is not expected to produce enough energy to supply a large portion of the school's power needs, even at low-load periods during the summer or at night.

How do I become involved in the Wind for Schools Project?

Although the Wind for Schools Project is currently active in only a handful of states, many states and communities wish to become involved in wind energy education. For this reason, the Wind for Schools Project implemented an affiliates activity to allow individual K-12 schools or states to initiate educational programs that are modeled after the Wind for Schools Project activities (but without financial support from the formal DOE Wind for Schools Project). By becoming an official program affiliate, an institution will receive access to program support functions, Web sites, and information. The program is organized to support individual schools that wish to implement wind-related educational curricula and install a Wind for Schools system, or states that intend to implement a full statewide program.

In all cases, DOE and WPA will not provide funding to directly support the activities of a Wind for Schools Affiliate but would provide an appropriate level of technical assistance and make available all program resources and documentation. State programs and individual school projects would be responsible for all organizational responsibilities associated with the implementation of an Affiliates Program.

How do I learn more?

The Wind Powering America Web site offers a section devoted exclusively to wind energy and schools, including updates on the Wind for Schools Project: www.windpoweringamerica.gov/schools.asp.

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Summary

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Resources

U.S. Department of Energy
Wind Energy Program
Forrestal Building
1000 Independence Ave., S.W.
Washington, D.C. 20585
(202) 586-5348
www.eere.energy.gov/windandhydro
www.windpoweringamerica.gov/schools.asp

National Renewable Energy Laboratory
National Wind Technology Center
1617 Cole Blvd.
Golden, CO 80401
(303) 384-6979
www.nrel.gov/wind

American Wind Energy Association
1101 14th St. NW, 12th Floor
Washington, D.C. 20005
(202) 383-2500
www.awea.org



www.windpoweringamerica.gov
U.S. Department of Energy