Wind for Schools Project Power System Brief

Wind Powering America Fact Sheet Series

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This fact sheet provides an overview of the system components of a Wind Powering America Wind for Schools project.

Wind Powering America's (WPA's) Wind for Schools project uses a basic system configuration for each school project. The system incorporates a single SkyStream™ wind turbine, a 70-ft guyed tower, disconnect boxes at the base of the turbine and at the school, and an interconnection to the school's electrical system. A detailed description of each system component is provided in this document.

The local power cooperative or utility should be an integral part of the Wind for Schools project and 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.

The Wind for Schools package includes all of the disconnects and tower hardware associated with the project. Depending on the specific installation requirements, foundation and guy wire anchors must be installed, as well as fencing around the base of the wind turbine.

System Description

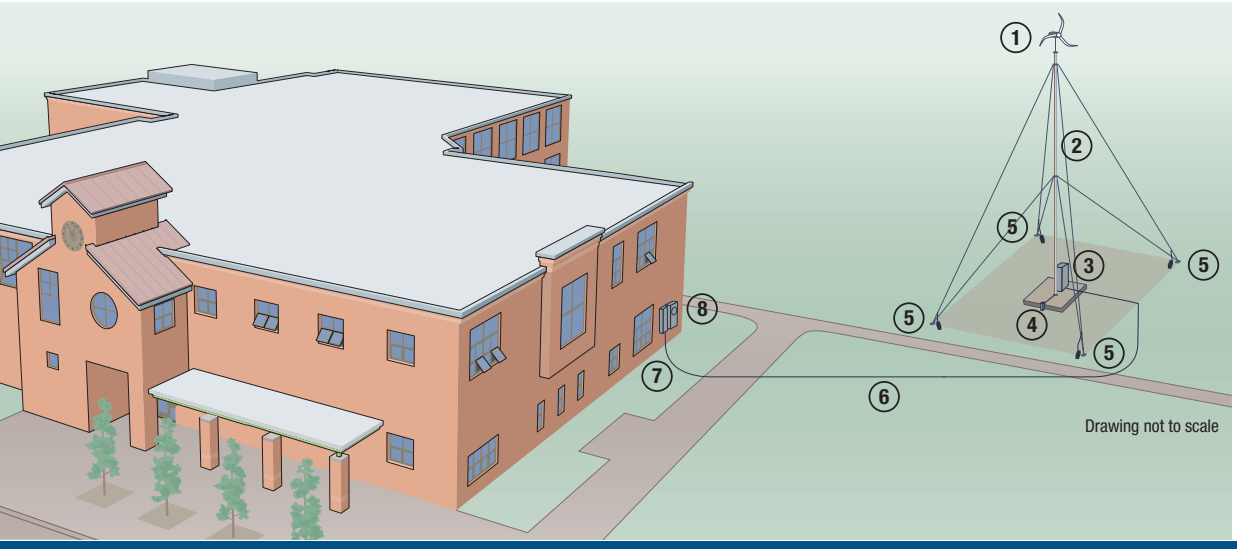
The following components are part of a standard WPA Wind for Schools project. Note that all descriptions are explanatory; please consult local building and electrical codes.

1) **SkyStream™ 3.7, 1.8-kW wind turbine.** Two versions are available: a 120/240V split-phase or a 120/208 three-phase. Depending on service level to the school, either version can be used. The 120/240V split-phase is preferred if the turbine is to be installed a large distance from the school (see item 6).

2) **A standard 70-ft guyed tower (supplied by Southwest Windpower)**. An electrical connection (with three strands of AWG 10 wire) must be made between the turbine and the junction box. Guy wires should be marked with streamers and other anti-avian devices. The tower and areas immediately surrounding the guy wires may require fencing. Monopole towers (45' or 60') are also available for additional cost.

3) **Tower/turbine base fused disconnect and junction box.** The fused disconnect and junction box allows an electrical separation between the wind turbine and the electrical wires connecting the power system to the school. It allows the isolation of the buried electrical lines and a way to safely disconnect the turbine from the electrical lines at the turbine site. The junction box also allows different wire sizes to be used from the turbine to the disconnect and from the disconnect to the school. The electrical connection is fused to provide further electrical safety.

4) **The main foundation for the turbine and tower, including tower base electrical grounding.** The tower foundation for a lattice tower is a 36"-diameter steel-reinforced concrete cylinder that extends 42" into the ground. The tower foundation is also electrically grounded using a standard grounding rod to protect the tower and turbine from lightning and static electricity buildup. The base of the turbine will likely be fenced to restrict access and limit liability. The concrete pad should be installed at least 28 days before the turbine is



Wind for Schools Project Parts List — Additional Items (to be purchased new)

5" Schedule 40 Steel Pipe, 21' (6.4m) length	5		comprises the tower; purchased at local farm supply
0.75" Tie Rods	4		foundation rods
¾" x 12 inch galvanized forged eyebolt	2		for two of the guy wire anchors
¾" x 8 inch galvanized forged eyebolt	2		for two of the guy wire anchors
Copper ground rod	1(6)		electrical grounding rods; number depends on local grounding requirements
Grounding Wire	10(70ft)		connection of grounding rods to towers and guy wires
Concrete (2500 psi rating)	4.5 cubic yds		0.9 cubic yards per anchor (main and 4 guy wires)
Rebar –various sizes and lengths			see specific tower foundation design
Tower base fused disconnect box	1	SQUARE D #DU221RB	2-POLE, 30A, 240VAC. Tower base fused disconnect
School disconnect box	1	SQUARE D #DU221RB	2-POLE, 30A, 240VAC. School disconnect box
AWG 10 turbine electrical wire (80-ft length)	3 at 80 ft		connects the turbine generator to the tower base disconnect box
Steel exterior grade electrical conduit	Varies	Depends on distance	connects the turbine to the school - may be supplied by supporting utility
Turbine interconnection electrical wire	Varies	Depends on distance	connects the turbine to the school - may be supplied by supporting utility

installed. Several foundation designs are available for the monopole tower, and these designs will vary according to height and soil type. The SMarT™ foundation provides significantly reduced implementation costs over standard foundation designs.

5) **Tower guy wire foundations and electrical grounding**. Each turbine has four guy wires that maintain the turbine stability. A 36"-diameter steel reinforced concrete anchor is required at each guy wire location, depending on specific soil conditions. In areas prone to lightning strikes, each of the guy wires will be grounded with standard grounding rods and will potentially be interconnected using buried copper cable. The area around the guy wires may require fencing. Monopole foundations do not require guy wires.

6) **School electrical connection**. The interconnection between the turbine and the school will be completed with a buried electrical cable. The cable size will depend on the distance between the wind turbine site and school and the specific turbine (see chart), although wires larger than 4 AWG can be used. In nearly all instances, the wires should be buried within a grounded steel electrical conduit (typically 1-inch schedule 40). PVC may be used, but a grounding wire must also be added. Electrical wire and trenching may be obtained from the local utility or power cooperative. Check local building codes, which typically require direct cables to be buried to a minimum depth of 24 inches (61 cm), while cables in conduit may be buried at a depth of 18 inches (46 cm).

7) **School disconnect and junction box.** This junction box is typically located where the wind turbine electrical wires enter the school building. It allows the isolation of the buried electrical lines and a way to safely disconnect the school from the wind turbine. The junction box also allows different wire sizes to be used from the turbine to the school and within the school's electrical systems. In areas prone to lightning strikes, a grounding rod may be installed at this location or simply tied into the school's electrical grounding system. Check with local building codes to ensure proper location of the disconnect box (in some cases it may need to be located next to the school's electrical meter).

8) **School's electrical power meter or interconnection point, where the turbine is electrically connected to the school's 240-V or 208-V electrical system**. This should be connected on the school's side of the electrical meter (connection to the main or primary node electrical panels is recommended). Check local building and electrical codes. Depending on local electrical requirements, this will require a certified electrician and may require that parts of the school's electrical system be disconnected for a short period of time. If interconnection is made at the school's primary circuit panel, only 20A breakers should be used.

Wire Size	Maximum Distance			
	120 V	120/208 V	230 V	120/240 V
4 AWG (21.2 mm^2)	646 ft (197 m)	885 ft (270 m)	934 ft (285 m)	1017 ft (310 m)
6 AWG (13.3 mm^2)	407 ft (124 m)	557 ft (170 m)	588 ft (179 m)	640 ft (195 m)
8 AWG (8.4 V mm^2)	256 ft (78 m)	351 ft (93.3 m)	371 ft (113 m)	403 ft (123 m)
10 AWG (5.3 mm^2)	161 ft (41 m)	220 ft (67 m)	232 ft (70.7 m)	253 ft (77 m)
12 AWG (3.3 mm^2)	101 ft (31 m)	139 ft (42.4 m)	146 ft (44.5 m)	159 ft (48.5 m)
14 AWG (2.1 mm^2)	64 ft (20 m)	87 ft (26.5 m)	92 ft (28 m)	100 ft (30.5 m)

Use copper conductors only. Minimum wire temperature rating is 167°F (75°C). Distances and wire sizes are based on 1,800-W power production and maximum 2% voltage line loss. Distances for 120-V system based on 3,000 W power production and 8% voltage line loss.

Project Costs

An installed Wind for Schools system costs between $15,000 and $20,000, depending on the tower type selected. Equipment and system-specific hardware such as the turbine, tower, and connection boxes cost between $7,000 and $10,000. An additional $3,000 to cover expenses for electrical wire, conduit, concrete, and other consumables can likely be obtained from donations from local companies and the power utility or local electrical cooperative. Remaining expenses for installation of the foundation and turbine can also be met through in-kind or donated support to the school project. The school will provide 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 in-kind support for the turbine installation. The Wind for Schools program does not provide funds through NREL for turbine hardware, although it may contribute to the cost of data-monitoring systems and other educational materials.

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