Power from the Wind

Wind farms are large multiple installations of commercial wind turbines, usually exceeding 100 ft. in height, that convert wind energy into electricity. Wind farms are being installed by utility companies around the globe harness this source of renewable energy.

Now, new technology is making wind power generation feasible at the residential scale. A homeowner who lives in an area with sufficient wind can install a wind turbine that feeds electricity directly into the home augmenting or replacing the electricity that comes from the local power company.

How can a wind turbine convert wind power into electricity?

In areas of sufficient sustained wind, the rotor is turned in the same manner as a windmill. The rotating center pole (as seen here, can be either on vertical or horizontal axis) is attached to a generator which contains strong magnets and coils inside. As the magnets rotate around the coils of copper wire a magnetic field is created which induces an electric current. The current is converted to useful AC current or DC current for battery charging.

"How much electricity does a residential scale wind turbine produce?"

A wind turbine produces different amounts of electricity at different wind speeds. At higher sustained wind speeds, more energy is produced (for reasons of safety, residential turbines are limited to a maximum velocity). The energy generated from a wind turbine depends on the "windiness" of your site as measured by both the sustained wind speed and annual seasonal variability of wind. With this information, it is possible to calculate an estimate of the amount of energy you will generate over a year.

"Will a residential wind turbine be feasible for me?"

Although the most accurate way to know is to install an anemometer and monitor wind speeds over at least a year, estimates for your location can be found on wind maps. Your site may be appropriate for a residential wind turbine if:

- you have about 11 mph average wind speed
- your property is at least ½ acre and has unobstructed access to wind
- your local zoning allows structures 30 or more feet in height
- your local utility has an existing interconnection agreement for home owners.

DEPARTMENT OF ENERGY

For more information go to **www.eere.energy.gov/windandhydro**, **www.nrel.gov**, or **www.awea.org/smallwind/**.

Mariah Power

You are looking at a Windspire, a vertical axis wind turbine that generates electricity from wind power. This model produces about 1800 kWh of electricity a year in an area with average wind speeds of 12 mph (about 1/4 the needs of the average house). It can be used on-grid to power homes, businesses, even large commercial buildings, and off-grid to charge batteries, golf carts, remote lighting, water pumps, etc. The model you are viewing is a “giromill” style, which uses vertical airfoils that, just like airplane wings, use the concept of “lift”. Lift enables the rotor to spin around a little faster than the speed of the wind.

How is Windspire different from a traditional propeller-style turbine?

Since it spins around a vertical axis, Windspire can catch the wind from any direction to turn the rotor without re-orienting itself. The airfoils also spin more slowly than the tips of propeller-style blades, rendering it virtually silent. Windspire was specially designed with aesthetics and minimal cost in mind.

The Department of Energy’s Office of Energy Efficiency and Renewable Energy and The National renewable energy laboratory’s National Wind Technology Center thanks Mariah Power for making this exhibit possible.

Southwest Windpower

Renewable Energy Made Simple

This Skystream 3.7™ residential turbine is a new generation of wind generator that hooks directly to your home to reduce or eliminate your monthly electrical bill. It's the first all-inclusive wind generator (with controls and inverter built in) designed to provide quiet, clean electricity in very low winds. This wind generator is ideal for residential homes and small businesses.

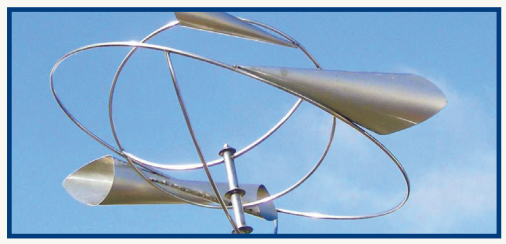
As the wind is blowing, your home is powered and when it's not, your home is seamlessly powered by your utility as usual. During periods of strong winds, this turbine can actually produce excess electricity. Depending on your utility, your meter could spin backwards—giving you credit for a later date.

The Department of Energy's Office of Energy Efficiency and Renewable Energy and the National Renewable Energy Laboratory's National Wind Technology Center thank Southwest Windpower for making this exhibit possible.

Wind Sculptures

BY SUSAN PASCAL BERAN

Partnering with Mariah Power to create sculptural wind generators culminates a lifelong dream for Susan Pascal Beran, whose purpose is to harmonize people with their environments. She has done that for four decades through her art, evolving into a unique and powerful style. This style derives from a love of nature and the wondrous interplay of form and function. As a result, the kinetics are fluid and balletic, choreographing surprising palettes of color and elegant archetypal shapes. The ever-changing yet harmonious compositions evoke the animation of our living world: birds, fish, water, trees, and, of course, the way of wind. She creates her art to help people enjoy and celebrate their environments. It has been called Abalancing™, Ameditative™, Aenlivening™, and was featured in PBS's "Healing and the Mind." Beran has received awards and recognition, and her audacious, visionary life has inspired movies. And now, working with Mariah Power, she will help create art for a whole new world—one where the art will not only inspire, but truly energize and empower us all!

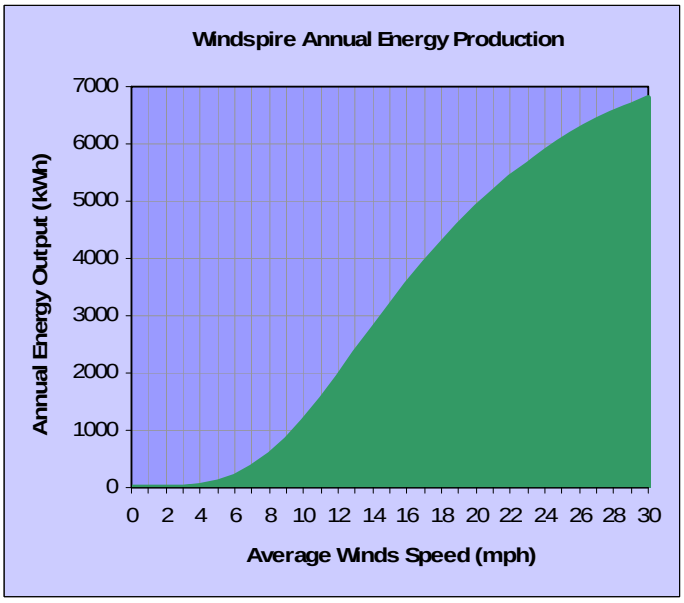


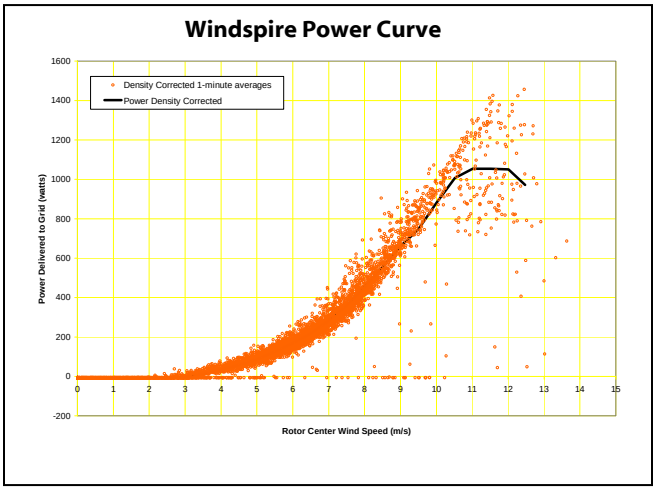
To learn more please visit **www.pascalberan.com**.

Windspire® Specifications

		Standard Specification	Options
General	Annual Energy Production (AEP)	2000 kWh*	
	Instantaneous Power Rating (IPR)	1.2 kW*	
	Standard Unit Height	30 ft | 9.1 m	35, 40, or 50 ft | 10.5, 12, or 15 m
	Total Weight	600 lb | 273 kg	
	Color	Soft Silver	Custom Color
	Sound	20 decibels @ 40 ft | 12 m	
	Warranty	5 year limited warranty	
Rotor	Rotor Type	Vertical Axis - Low Speed Giromill	
	Rotor Height; Radius	20 ft | 6.1m; 2 ft radius | 1.2 m	
	Swept Area	80 ft^2 | 7.43 m^2	
	Max Rotor Speed	500 RPM*	
	Peak Tip Speed Ratio	2.8	
	Speed Control	Dual Redundant: passive aerodynamic; electronic	
	Wind Tracking	Instantaneous	
Electronics	Generator	High Efficiency Brushless Permanent Magnet	
	Inverter	Custom Integrated Grid Tie 120 VAC 60 Hz	International Autotransformer Kit
	Inverter Certification	ETL: Meets IEEE 1547.1; UL 1741	
	Performance Monitor	Integrated Wireless Zigbee Modem	Performance Monitoring Kit
Wind	Cut-in Wind Speed	9 mph | 4 m/s	
	AEP Average Wind Speed	12 mph | 5.4 m/s	
	IPR Rated Wind Speed	25 mph | 11 m/s	
	Survival Wind Speed	100 mph | 45 m/s	
Construction	Foundation	Poured Concrete	
	Foundation Size	2 ft diameter by 6 ft base*	Custom for certain soil conditions
	Rotor Material	Aircraft Grade Extruded Aluminum	
	Monopole/Structure Material	Recycled High Grade Steel	
	Coatings	Corrosion-resistant industrial grade paint	Snow & Ice Shedding Coating

*Notes: Performance data is based on initial test data and expected final test results. Final testing is currently underway. AEP is based on assumptions, including a Rayleigh wind speed distribution and sea level air density. Foundation size may vary for non-standard soil conditions or non-standard heights.





Note: This initial data was provided by Windward Engineering, an independent test facility, using an in-ground installation in real world wind conditions, and scientific 1-minute average binned data. Final data will be released once all electronic settings have been calibrated for optimal performance. We expect final data to be even more impressive.

Windspire® FAQs

How does Windspire turn wind energy into electric power I can use in a home or building?

As the wind pushes the *rotor* around, the rotor turns a *generator*. The generator is basically a set of magnets that spin close to copper coils. The moving magnetic field from the magnets induces an electric current in the copper wire. This DC current then needs to be conditioned into an AC current by an *inverter* so that it is compatible with standard grid electricity. The generator and inverter are housed in the disc just below the rotor. The electricity then flows down a wire through the pole, and under the ground to connect with your home or building.

Why does Windspire appear to turn more slowly than a propeller turbine?

The Windspire's airfoils are at a constant and small radius from the axis, so every part of the airfoils moves at the same speed, about 2 times the speed of the wind. In contrast, the blades of a propeller are rigid, so the area near the hub moves slowly, while the tips move really fast (about 7 times the speed of the wind) around a larger circumference. In fact, the hub of the Windspire rotates *faster* than some propeller-style wind turbines.

What affects power output?

Power output is related to rotor size, air density, wind speed, and the efficiency of the wind turbine. Windspire has a comparable efficiency to most small propeller turbines.

How much wind do I need for Windspire to make sense?

In general, an average of 12 mph (5.5 m/s) or more, although in some circumstances it may make sense in lower wind regimes. Doubling the wind speed gives you eight times as much power from the wind. Wind turbines get most of their power when the wind is really blowing.

To what extent will a Windspire power my home?

This is difficult to answer, because electricity use varies *widely* by home size, age, construction, climate, and the occupant's habits. Furthermore, the power you can expect depends entirely on your wind regime. The best place to start is with your electricity bill and a wind map of your area. In a true generalization, a Windspire can power about 1/3 to 1/5 of the average US home, about ½ the average European home, and several homes in developing countries.

What's the difference between a kW (kilowatt) and a kWh (kilowatt-hour)?

A kilowatt is an instantaneous measure of power. At any moment, the power that is produced by a small wind turbine is measured in watts or kilowatts (1000 watts). A kilowatt-hour is a measure of energy production: how much energy is produced over one hour. For example, if you turn on a 60W (.06 kW) light bulb for one hour, you draw .06 kWh. If you keep it on for a full year, you will use .06 kW x 8766 hours = 526 kWh. Of course, you should never do this!

Is Windspire safe for birds and bats?

Since Windspire does not have fast-moving tips, it is easily visible and avoidable by flying creatures, so we expect that it will be safe for birds and bats. You should also be aware that collisions with wind turbines in general are very rare – overall they account for less than 0.003% of human-caused bird death - although the media has tended to hype them. To put it in perspective, cats, windows, and automobiles kill over a billion birds a year in the USA.

For more information please visit our website, www.mariahpower.com

SMALL WIND

Small Wind Toolbox

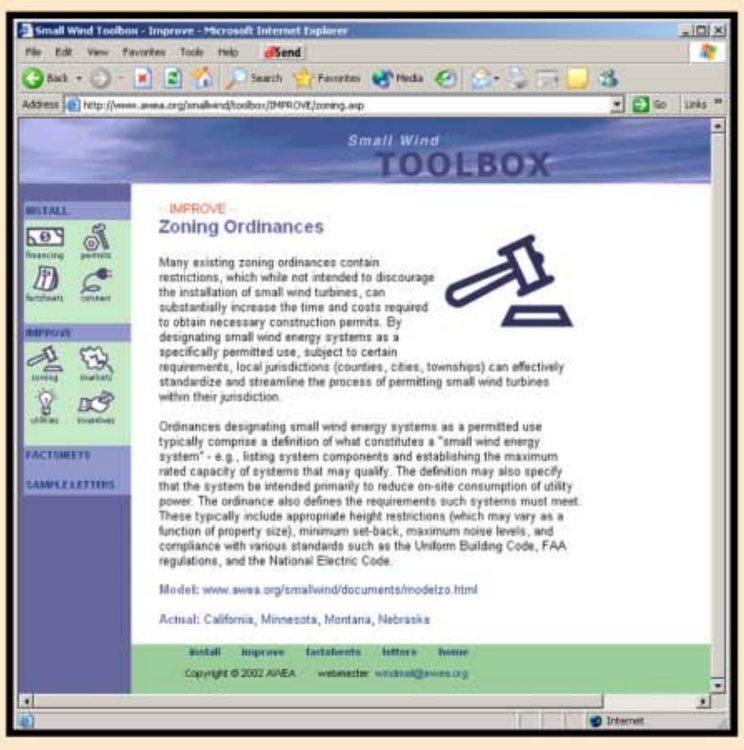
The Small Wind Toolbox on the AWEA web site is a concise tutorial that will quickly get you up to speed on wind turbine installation and policy initiatives that encourage further wind power development. It's a resource both for individuals seeking to install small wind energy systems and for advocates, policy makers, and others interested in improving opportunities for small wind energy use.

DRAWER 1

If you already have a small wind energy project in mind, Drawer 1 can help guide you through the process of getting your project approved for installation/operation.

DRAWER 2

If you are interested in improving conditions for small wind energy in your community, Drawer 2 explains the critical elements of zoning, net metering, interconnection agreements, and financial incentives - including examples of existing laws and policies and model language.



www.awea.org/smallwind/toolbox/default.asp

Inside the Toolbox

SMALL WIND FACTSHEETS

- What is Small Wind?
- How Much Noise Do Small Wind Systems Make?
- Do Small Wind Systems Kill Birds?
- What About Visual Impact?
- Small Wind and Public Safety
- How Do Small Wind Systems Affect Property Values
- Zoning Ordinances
- The Economics of Small Wind

MODEL LAWS & POLICIES

- Zoning Ordinances
- Net Metering
- Interconnection Agreements
- Line Extension
- Financial Incentives

and much more...

INSTALLATION:

Financing, Getting a Permit and Connecting to the Grid

SAMPLE LETTERS

- Introductory Letter to Neighbors
- Letter to Local Official or Legislative Representative
- Letter of Support / Letter to the Editor