BUYER'S GUIDE TO WIND TURBINES

Green Home Gnome

www.greenhomegnome.com

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1.0 BUYING A WIND TURBINE

1.1 An overview

With wind turbine technology growing so rapidly in recent years, wind energy has grown into a viable, cost-competitive energy resource that has attracted consumer interest like never before. Wind farms are now seen both onshore and offshore as companies realize the profit that can be made in selling wind-generated power. Governments and utilities are turning to them to satisfy the demands of their energy hungry citizens and some home owners are even going off the grid thanks in part to wind energy.

Wind turbines are classified according to how they apply mechanical energy. Windmills and wind pumps harness wind energy to pump water

or grind grain whereas wind generators and wind chargers use wind to generate electricity. Most of those considering a wind turbine for their home are looking at a wind generator. Wind turbines can be used for a variety of applications—for the home, farm or boat to charge batteries or to provide electricity directly to the grid. Small wind turbines come in two basic varieties, the horizontal axis and vertical axis.

So you've decided that you want to use wind energy to generate your home's electricity, or at least a part of it. The first thing you have to ask yourself is whether you want to purchase wind energy from a green energy provider or generate it yourself with your own wind turbine? For a complete analysis of these two options have a look at Section 1.3.

Next comes the obvious question of whether there actually is enough wind to warrant buying a turbine for your home. If you live in a really wind-poor or wind-rich part of the world the decision will be a simple one to make, but if you're borderline it will require measuring the wind with an anemometer to make that assessment (see Section 2).

1.2 Considerations

Then you have to consult your local government to find out the rules and regulations governing wind turbine installation:

What siting requirements and restrictions exist for your area?

At your local government office ask what the smallest property size and the minimum setback from property lines is to install a wind turbine. You also need to find out if there are any height restrictions and noise ordinances. The answers to these questions will determine whether you are allowed to install a wind turbine and if so, how large and how loud it can be.

Do you need special approvals or permits to get your installation approved?

Contact your local utility and municipal permitting office to find out what documents they need. Will the documentation from the turbine manufacturer or dealer satisfy their requirements or will you need to hire an engineer to give them what they need?

Consider what your neighbors' reaction will be — will they put up resistance?

The NIMBY (not in my backyard) factor for wind power is huge. Don't underestimate your neighbors' ability to obstruct your plans, but at the same time don't let the potential threat of resistance hold you back. You can avoid potential problems by writing up a letter outlining your intention to install a wind turbine, including the type of turbine, how large it is, how far it will be setback, and how loud it is. In most cases, respecting neighbors by informing them in this way will alleviate potential problems and answer any questions they may have.

Can you connect your turbine to the grid? If so, what are the requirements?

Contact your local government and utility to find out what the requirements are to connect to the grid. When speaking to the utility also ask whether they offer net-metering — an arrangement in which the utility pays the consumer for energy they feed back to them.

If you are lucky enough have adequate wind and have worked your way through the previous questions, it's time to get on to the fun part — buying your turbine! A wind turbine is a long-term purchase, so you'll need to put a lot of thought into your decision. The first step is to determine your energy needs to size your turbine (see Section 3). Finally, choosing the turbine itself (see Section 4).

1.3 Generate your own energy or use a provider?

If you can't put up a wind turbine without pissing off the neighbors or you figured that buying or leasing a wind turbine is just too costly, alternatives exist to power your home with green energy. Green energy providers such as Bullfrog Power buy up electricity from wind farms and other renewable energy sources, then resell that electricity to you. You continue purchasing energy from your local utility and the provider uses your funds to add green energy to the grid. It's a simple setup that doesn't require much work at all on your part. Here are the pros and cons to going with a provider.

1.3.1 Pros

Backing the right cause – By supporting green energy producers you not only increase their sales, which leads to more wind farms, but you avoid putting money into the pockets of coal, nuclear, and other dirty energy providers.

Easy - Making the switch is as simple as filling out a form that you can cancel at any time. If you cannot install a wind turbine on your property or if you just don't like the idea of having one, this avoids the hassle.

No NIMBYs – Wind turbines have sadly been stigmatized as noisy eyesores. The not in my backyard factor stops many a wind turbine from ever spinning a blade. Going this route allows you to use wind energy without the headaches associated with putting up a turbine.

1.3.2 Cons

Cost – Purchasing power from a green energy provider means that you're still paying your regular energy bill as well as a premium to the green energy provider on top of that.

Invisible - People won't know you're powering your home by wind unless you tell them. Do you enjoy advocating on behalf of renewable energy? If so — and you don't like openly advertising that you buy green energy — this may not be the choice for you. If, on the other hand, you like to stand on the soapbox and spin soliloquies about the benefits of green power, here's your chance!

No sight to see – To some people, staring into a wind turbines' spinning blades until they enter a trance is quite a thrill. Going this route means you won't have your own turbine to look at, but you would be contributing to the building of turbines at a wind farm somewhere nearby.

2.0 How to measure wind speed

For the purchase of a wind turbine to be economically feasible, a minimum wind speed of 4 m/s (9 km/h) is necessary. Though advances in wind turbine technology have created exceptions to the rule (see Top 5 Wind Turbines for Low Speed Wind Conditions) the fact remains that wind turbine output is based on the cube of wind speed, which means that if wind speed doubles, a turbine can produce eight times more power. Even a slight increase of 1 mph—from 11 to 12 mph—can yield a 33% increase in power. So before spending your hard-earned dollars on a funky monument for your backyard, know how much wind Mother Nature blessed you with before making the decision to buy.

2.1 Research wind speeds

Have a look at a wind atlas to determine your area's average wind speed. Links to a few countries' wind atlases are listed under Resources. If your country is not listed, search wind energy resource atlas, plus the name of your country, on your favorite search engine.

Locate your specific region on the atlas to find out its average annual wind speed. Some atlases provide the speed in m/s or km/h whereas others provide a wind power class. On this 1 to 7 scale, class 3 and above is considered suitable for most wind turbines to generate power. Class 2 is marginal—wind power feasibility will depend on your turbine.

Though searching online for wind speed in your area is fast and simple, it is not overly accurate. These assessments are usually made at heights greater than a small wind turbine will be located at, meaning it will be able to access the stronger wind that comes with height and avoids the pitfalls of being sited close to the ground such as turbulence caused by trees and buildings and roughness of land (tall grass vs. water).

2.2 Test wind speeds

To accurately measure wind speeds for your specific site, use an anemometer, an instrument designed for testing wind speeds, that has an accuracy of at least 1% or +/- 0.2 m/s.

Set up your anemometer where you plan on siting your wind turbine (hopefully away from obstacles such as trees and buildings). Try to position it as high as possible to more accurately gauge what wind speed will be at the level of the turbine. Take readings regularly over the course of a few months or, if you have the time, an entire year to get as accurate data as possible.

Once you have collected all your wind speed data, add up all the numbers you have recorded and divide that figure by the number of readings you have taken to calculate the average annual wind speed for your location.

Taking the time and effort to conduct a full wind speed assessment will provide you with the most accurate gauge of wind speed for your location and will give you the peace of mind knowing how much wind you can expect to get from your site.

Resources:

- National Renewal Energy Laboratory: Wind Energy Resource Atlas of the United States
- Environment Canada: Canadian Wind Energy Atlas
- UK Department of Energy & Climate Change: Windspeed Database
- Wind Atlases of the World: European Wind Atlas

3.0 Choose the right size turbine for your energy needs

Wind turbines come in all shapes and sizes. Whether you want to power your entire home or just a few appliances, you can find the right model to suit your individual needs. Before making the decision to purchase a turbine you'll need to assess your home's energy requirements and decide how much of that energy you plan on generating from wind.

3.1 Calculate your home's electricity usage

1. Collect your electricity bills for the past year so you can calculate your average monthly electricity usage. Calculating an average is essential because electricity use peaks in the hottest months due to the high air conditioning demand.

2. Add up the kWhs for all 12 months and divide that number by 12 to determine your average monthly energy consumption.

OPTIONAL: To more accurately assess your home's electricity needs, make a list of all your appliances, listing the power consumption for each in wattage and whether it is AC or DC power. Track how many hours you use each of those appliances per week, then for each appliance, multiply the watts by the hours/week to determine the number of watt-hours per week you use each appliance. Alternatively, you can figure out the energy usage for particular appliances by installing an electricity usage monitor between the appliance and outlet. Leaving the monitor in place for a week will give you the appliance's watt-hours per week. Enter the data you have collected into a load sizing worksheet (see Resources). Work through the worksheet's remaining calculations to determine the total number of Amp hours per day that your appliances use.

3.2 Calculate energy needs

1. Browse wind turbine dealers' brochures and websites, noting the rotor diameter in meters and annual average wind speed in m/s for the models you're interested in.

2. Plug the numbers from the previous step into the following equation:

AEO (Annual energy output) = 1.64 D2 (rotor diameter in meters) V3 (annual average wind speed, m/s)

3. Divide AEO from the previous step by 12 to calculate monthly energy output.

4. Compare the figure from 3.1, Step 2 "Monthly kWh" to the monthly AEO from the previous step to determine how many kW you need to generate every month in order to power your home.

Wind turbines can't be added on to as with solar PV systems, so it's best to buy a larger model than you need if you foresee increased energy usage in your future. To help lower the cost, have a look into government incentives (see Resources). But most importantly, before going ahead and buying a big turbine, focus on ways to make your home more energy efficient. Doing so means you'll need a smaller turbine and therefore, less money out of your pocket.

Resources:

- Residential Load Calculation Worksheet
- DSIRE: Database of State Incentives for Renewables & Efficiency

4.0 Selecting the right wind turbine

As wind turbine efficiency made great strides in recent years, a whack of models have flooded the market. With all that choice, the purchasing decision can seem somewhat daunting, especially since most of the names in the industry don't have the same brand recognition as car or appliance manufacturer. Nevertheless, as with any major purchase, a thorough analysis of your various options should be undertaken to give yourself the peace of mind to know that you've made an informed decision. After getting an idea how much energy your home requires you're now ready to pick a turbine to suit your needs.

4.1 Wind speed

Rotor diameter defines swept area, which is the major determining factor in how much power the turbine will generate. The larger the diameter, the more power will be generated. Small wind turbines generally run in the 8 to 56' range.

When analyzing different models' specs do not dwell on peak output as it is not a reliable gauge since different manufacturers use different wind speeds to make their assessment. Instead, focus on monthly energy output in kWh to estimate how much electricity you can expect a model to produce in a month.

4.2 Cut-in / Cut-out

Once you know the average wind speed for the site you have chosen, use that information to find a turbine that is right for you. If your site gets minimal wind, have a look at models designed to operate in low wind speeds and with a low cut-in (the wind speed in which the turbine starts generating power). If you're blessed with lots of wind, pay particular attention to cut-out, (the maximum wind speed a turbine can handle — any additional increases in wind speed won't yield higher power).

4.3 Upwind or downwind

Most models on the market are upwind machines (blades on the windward side). There is no clear advantage between the two designs.

Look at the specs of each individual model to accurately assess its performance.

4.4 Noise

Remember the NIMBY (not in my backyard) factor. You don't want to install your turbine to have an irate neighbor come knocking at your door the next day demanding you to turn the volume down on your new wind turbine. Avoid the problem before it becomes one. If you are siting the turbine close to neighbors have a look at the many models on the market that claim low noise operation.

4.5 Vibration

If you're mounting your turbine on your roof, consider the vibration factor. This is especially a concern if anyone in your home is a light sleeper. Once it's up, it's up. If you plan on selling your home and leaving the turbine behind, think about the impact of a vibrating turbine on your sales price.

4.6 Warranty

Think about how long you plan on owning your turbine. Do you plan on moving at some point or will you settle in your home for years to come? Are you handy with repairs should the need arise? Do some research on the Internet and by asking the dealer how often the model

breaks down or if it has a high return rate. Is it parts and labor, does it include crane costs, if that is necessary? How much do you feel like gambling that your model won't break down?

4.7 Installation and maintenance

Is this a DIY installation or would you need a professional installer to put it up? Flip through the operating manual to see how easily understandable it is. Will you be able to repair this on your own? Ask how easy you'll be able to obtain spare parts now as well as years from now. Ask if they offer installation, maintenance, and tech support help to customers?

4.8 Foreign or domestic?

Plenty of choice exists for the North American consumer. If you find a foreign model that you like, consider the long-term implications of the purchase as you may not get support from North American importers years down the road. Though you may never have a problem, another possible alternative is that you may have problems communicating with the foreign manufacturer or wait around a long time for parts to when repairing your turbine.

4.9 Other considerations

Reliability: How long has this manufacturer been in operation? How long has this model been on the market? Are there many returns or repairs? Does the model perform up to spec?

Safety and protection: Does the turbine have a shutdown mechanism in the event of a severe storm? How about lightning protection?

Grid connection: Find out whether the model can be connected to the grid, if that is a concern to you.

4.10 Other components

Ask the dealer if the following come as part of the package or if you need to buy them separately. Assess each component according to your individual needs:

Tower: the higher the tower, the stronger wind your turbine can capture. A turbine raised high in the sky is also more likely to avoid turbulence caused by buildings and trees as well as the friction from rough land.

Batteries: only necessary for storing electricity in off-grid or battery backup systems. If you just want electricity when the wind is blowing, batteries are not a concern.

Inverter: essential component to convert the variable DC output from a turbine to useable AC.

Wiring and conduit: transports the electricity from the turbine for conversion.

Controller / electronics: controls battery charging or input to inverter.

Meter: provides system management.

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