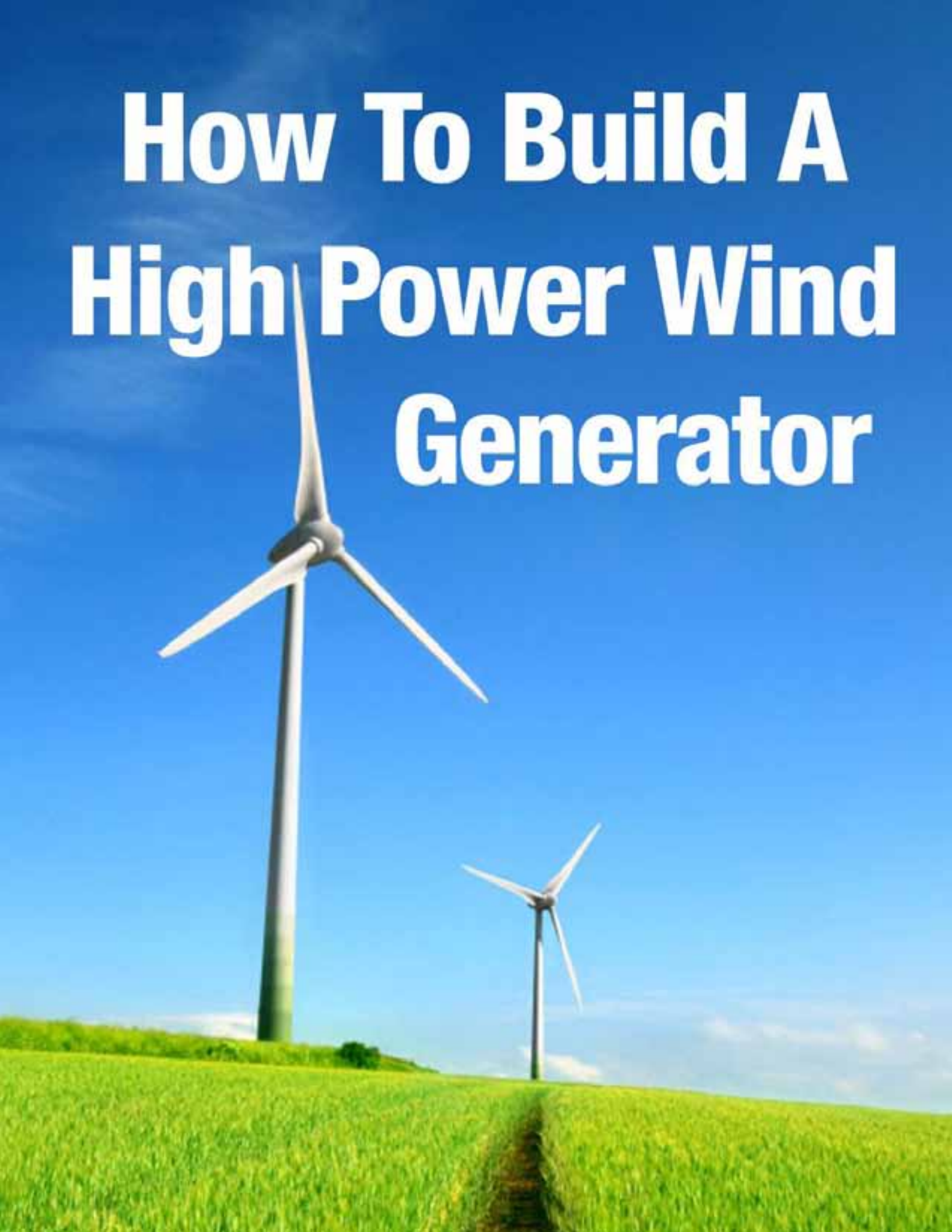
How To Build A High Power Wind Generator



Wind Power

This Manual covers:

Wind Power Dynamics

The Power4Home Wind Generator

Custom Build Guide

Building Tips

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This or any other form of home alteration maybe illegal in your town, city, state / province or country. It is your responsibility to inquire with your local government office about how to proceed if restrictions apply. Although we have not encountered a problem, you still must consult with you local government.

Power4Home.com will NOT BE RESPONSIBLE for any mishaps that occur during the build, test and application phases of your construction. We are also not responsible for a partial or complete system that has problems or causes injury. You have all the information included in this manual to safely manage and handle solar and wind generators. Common sense goes a long way. Please, if your knowledge of household electrical is not par with a certified & licensed Electrician, call your local Electrician to wire your system into the electrical breaker panel and please inform your utility company of your new system.

PLEASE READ THE ENTIRE MANUAL & ALL THE EBOOKS BEFORE DOING ANYTHING. THERE ARE TASKS AND TESTS TO BE DONE THROUGH OUT THIS BOOK

Contents

WIND POWER

Wind power is the conversion of wind energy into a useful form, such as electricity, by using wind turbines. At the end of 2007, worldwide capacity of wind-powered generators was 94.1 gigawatts.

Although wind produces about 1% of world-wide electricity use, it accounts for approximately 19% of electricity production in Denmark, 9% in Spain and Portugal, and 6% in Germany and the Republic of Ireland (2007 data).

Globally, wind power generation increased more than fivefold between 2000 and 2007.

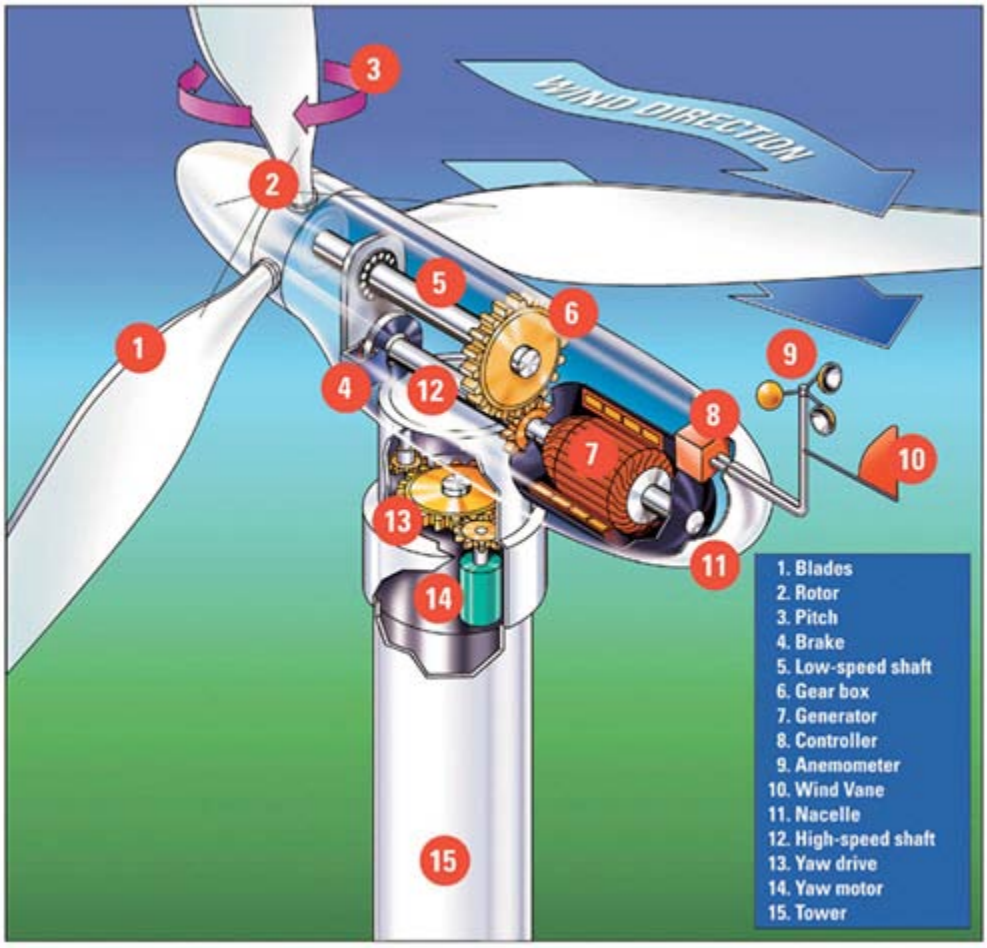
Wind energy has historically been used directly to propel sailing ships or converted into mechanical energy for pumping water or grinding grain, but the principal application of wind power today is the generation of electricity.

Large scale wind farms are typically connected to the local electric power transmission network, with smaller turbines being used to provide electricity to isolated locations. However, utility companies are currently being encouraged to buy back surplus electricity produced by small domestic turbines.

Wind energy as a power source is favored by many environmentalists as an alternative to fossil fuels, as it is plentiful, renewable, widely distributed, clean, and produces lower greenhouse gas emissions, although the construction of wind farms is not universally welcomed due to their visual impact and other effects on the environment.

The intermittency of wind seldom creates problems when using wind power to supply a low source of electrical draw like your home. Where wind is to be used for a moderate fraction of demand, additional costs for compensation of intermittency are considered to be modest.

Parts of a Wind Generator



People all over North America are asking the question: how can I lower or eliminate my home energy bills? Businesses across the nation are looking to alternative energy sources to lower their operating costs. Often, these home and business owners are finding wind power to be their solution.

"But why Wind over Solar power?"

Like most of the good alternatives to the power company, it's free to use. Unlike solar electric however, it's much lower-cost to set up initially and in many areas is more productive.

There are three basic types of wind systems:

- **Grid-tie Connection**
- **Multi-Source**
- **Off-the-grid (Stand Alone)**

A Utility Grid-Active Connection system is a wind turbine that is connected to the utility grid or to a building or home that is already connected to the power utility's grid. So if your home already has electricity from the local utility and you're wishing to supplement that with a wind turbine, then you're planning a **"grid-tie"** system. **This is recommended to all on the grid.**

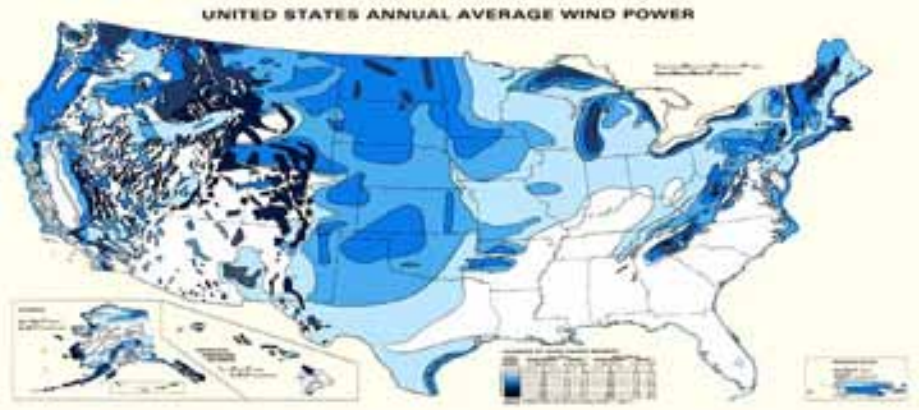
A Multi-Source System is one in which wind would be a part of the whole electricity generating system. In this case, another electrical generation option is also included, such as solar PV or a backup generator. This setup is common in cabins, recreational vehicles, job sites, remote farms, and so forth. In this scenario, the wind turbine is part of a larger electrical generation system and may or may not be the main component of that system.

An Off-The-Grid (stand-alone) system is one in which the wind turbine is the only means of generating electricity for the application. Often that turbine is coupled with a battery storage bank for power storage. This is a very common setup for water pumps, small appliance applications, and for recharging systems on a machine or battery series. It's not uncommon for remote houses and cabins to use this and a battery bank as their only electrical generation system.

The costs associated with wind versus photovoltaic (solar) make wind the lower-cost choice. In this guide, we're going to explore wind turbines for converting wind energy into electricity from top to bottom.

We'll look at whether wind is the right solution for you, how you can best harness its power, and how to keep your wind turbine maintained and functioning in peak condition. So let's get started and look at whether wind is the right resource for you to harness for your energy needs.

FACT: It takes roughly 2 years to pay off the build expense after you system is connected to your power grid.



Will a Wind Turbine Work For Me?

Whether you plan to power your home, farm, ranch, or business using wind energy, you'll need to know if this solution is the right one for you before you invest any time and money into utilizing it.

Like any sound business decision, you need to research how well it will work and whether it will pay off if you invest in wind power. With that in mind, let's look at what you need to already have available to you in order for wind to be cost-effective:

What You Need To Have To Harness Wind On Your Property

- First of all, you need enough wind to make the turbine worthwhile. Unless you live in an area that VERY RARELY sees wind, it's still worthwhile.
- Space is also important: if you live in an urban or densely suburban area, you have to be careful of function and your neighbors.
- It needs to be economically viable for you to set up a wind turbine system for electricity generation. We'll explore this in more detail later.

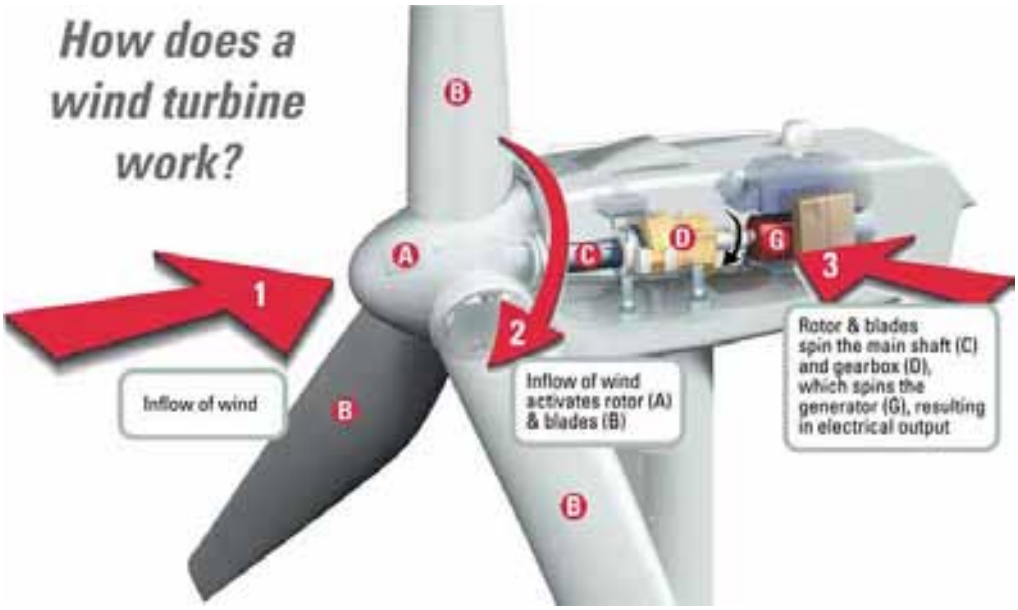
Wind Speeds In Your Area

In most parts of the United States, there is enough wind to generate at least 400 or more kilowatts of electricity per year per square meter of turbine propeller.

Check with the National Renewable Energy Laboratory or the National Weather Service to find out what the average wind speeds in your area, on a daily basis, are. If the average daily wind speed is at least four (4) miles per hour, you should be good to go.

In many parts, there is enough average daily wind to generate almost 1,000 kilowatts of electricity per year with just a small one meter squared turbine. That's a lot of energy!

If you live in the deep south, such as Florida, Mississippi, and east Texas, you'll likely want to look at another solution as wind will not likely pay off for you. Consider solar instead, since those areas that are not good for wind-generated electricity are usually prime for solar power.



Space For Your Wind Generator

You need to have enough space for your wind turbine to operate. Usually, the space required depends on how big you build. The reason I give you specific plans to build a ¼ horsepower motor is because it fits well with the average home.

Most of our population lives in the suburbs with neighbors which live only meters away. This is who I "geared" this system for originally. Businesses, farmers, and those who already own a vast amount of land have most likely explored the option of wind and solar and has ether done it or not.

If there are buildings, large trees and tall hills changing the air flow, then you will have to mount your generator in a smart place. If the turbine is one of the smaller variety meant to attach to a building, you will have a less of a problem.

The mounting section of the build should give you good ideas of how to mount your system but you need to decide if your system needs to swing freely or not. The last thing you need is children or pets running into your wind generator. **You should fence-in your system so the kids don't get hurt.**

The Power4Home wind generator needs about 2 meter radius from the center.

The top of your house is the best choice for both your Solar and Wind generators. You utilize maximum wind velocity and you get the best sunlight coverage but you don't have too. All of my generators are on 12 foot polls in my backyard and the solar panels are on top of the tool shed (10 feet high) for easy maintenance and repair.

City and county ordinances often prohibit wind turbines in areas of dense population, so check your local laws as well. Often, it is worthwhile to purchase a simple wind anemometer to make measurements of the average wind speeds and gusts in the location you plan to put the turbine. These little gadgets are meant to be mounted in a location as close to your turbine's planned location as possible (on a pole, your house, etc. in approximately the place the turbine will be) so that you can get measurements of the averages and maximums and plan accordingly.

How Economical Is It?

Wind turbines are generally cheaper per watt produced to purchase and install than solar panels and many other alternative renewable energy sources are. Generators, such as propane, gas, or diesel fueled models, are even lower-cost to set up. Of course, this low setup comes with a higher maintenance price tag. Here's a short list of popular setups of different electric generator systems and their initial costs and maintenance requirements:

1. **Solar power** (photovoltaic, PV, or solar-electric) is one of the most expensive options to set up. Its high startup cost and relatively limited generation time per day make it a lower watt-per-day generator, thus making it a higher investment per watt to set up. With no moving parts and very light maintenance requirements, solar is also one of the most reliable and maintenance-free alternatives.

2. **Wind turbines** (wind power, or wind-electric) is mid-priced in initial costs and setup requirements, but is relatively stable and reliable with a near 24/7/365 potential for power generation in many areas. It does, however, have moving parts and mechanical pieces so some maintenance is required. My generators have been running for 9 years with without one breakdown!

3. **Fuel generators**, which run on gasoline, diesel fuel, propane, etc. are the lowest in initial setup cost per watt produced and are very reliable and stable power generation units. They are, however, full of mechanical parts and are loud, polluting, and require expensive fuels to operate. Because of this, these are usually used only as backups to another system.

Is Wind Right For You?

Other considerations will involve your neighborhood, city and county governments, and similar issues. The average wind turbine produces about 50-60 decibels of ambient noise, though they get quieter every year as new technologies emerge.

This isn't a big deal most of the time, as you don't notice the turbine's noise unless you really listen for it, but nosey neighbors could use this as a reason to object. Many cities and counties will have building restrictions on structures higher than 35 feet. If your tower is to be 50-70 feet, as is average, then you'll likely have to get permits under the zoning laws to build it. This makes your turbine a potential “eyesore” for neighbors who might object. With the newer, home-mounted units, this is no longer an issue.

Finally, the issue of finances needs to be considered. Harnessing the wind, like any alternative energy plan, is not a short-term investment. The costs associated with purchasing, installing, and maintaining a wind turbine electrical system will not be reimbursed in the first few months of installation. If you aren't interested in or are not comfortable with long-term investments, then wind is not for you. Depending

on the costs of your utilities and the amount of wind energy you can afford to harness, you can expect to cut your electrical bill by up to fifty percent on a currently grid connected system. Many farms, small businesses, warehouses, and other large electrical consumers have cut their costs considerably by utilizing wind.

With new technology and setups, many home owners are now finding that they can lower their costs and raise the value of their homes with the simple addition of a wind turbine as well. Using the information in this chapter, you should be able to at least verify whether wind is an option for you to utilize or not. In almost most cases it is and you're ready to get started setting it up!

The Power4Home Wind Generator

The Power4Home wind generator was designed with only one person in mind… YOU! The only reason why you haven't purchased an "Off the shelf" pre-made kit is because it was too expensive in the first place and it doesn't include installation. Also, you purchased these books to learn about wind power and to build solar and wind generators so you can save money.

Use the parts list to source your parts so that you can build a wind generation system at 20% of is retail value. Now, there are a couple of items that don't have to be exact. For instance, the blades and motor housing can be different then the items shown in the photos.

- **The blades** can come from ether a ceiling fan or you can cut a piece of 6 to 8 inch pvc or abs plastic pipe. Ceiling fan blades are easier to mount and offer you precise mounting points for drilling.

- **The housing** was simply a recycling bin. You can use any square container that is 10 inches high, over 8 inches long and 6 inches wide. I had this just sitting in the basement for years collecting dust.

Again, this is a 400 watt generation system designed to handle the elements of hot and cold weather, rain and snow, and high wind conditions. For most of you, 1 of these wind generators will do. Let's go over the build steps and start construction.

The Power4Home Wind Generator

Parts for the Power4Home Wind Generator

Here, you will find all the parts you will need to complete your wind generator. You will notice that I do not add a price to each item. That is because you will get a different price then what I had to pay. The more expensive items can change in price depending on the source (ebay or kijiji) so do your homework on the big ticket items.

Keep In Mind: Google, Ebay, Kijiji and Craig's List are your friends

Fasteners, Metals, Plastics, Containers & Paint Materials:

Home Depot or Lowe's carry all of the items listed above. You should still see if you can get a good deal online. You may even have some at home.

Wood:

You or a friend may have the pieces that you will need. If not, Try construction sites or wood workshops and take some scrap pieces. Wood is cheap anyways.

Motor (Alternator):

I was able to pick this item up for free as my buddy had one just sitting in his garage. You can go to your local auto wreckers and grab one for $30 bucks or do your online searches. The alternator is out of a 1984 Buick Regal and was standard issue on many GM vehicles at the time - **GM 1984 Buick Regal 5.0 Liter Alternator - No A/C**

Rotor:

Check industrial stores for your rotor. Make sure it has a locking bolt in the center shaft in case you need to center the rotor on the mounting bolt to the motor shaft.

Blades:

Check online for replacement parts for ceiling fans. I got my blades from a garage sale so that's always good. If you go to the "Making a Custom Wind Generator" chapter, you can also make blades out of PVC or ABS plastic pipe.

Basketball Stand:

This item was purchased from kijiji for $20. Some lady's kid out grew the net (Child's net size) and sold it. You can find lots of people in your neighborhood that no longer want the darn thing on their driveway.

Refer To Your Parts List for Part Descriptions & Quantities

How to Build the Power4Home Wind Generator

At this point, you should have gathered all the necessary parts to build the Power4Home wind generator. Before cutting, grinding, drilling or assembling, make sure you check that all your parts work with each other to avoid frustration and extra expense.

"No returns on damaged goods" is what your retailer will say if you tamper with an item that's the wrong size. Even if you get a part for next to nothing, if you have almost completed the build and find out that you have the wrong part, and you have to disassemble the whole thing; you will only aggravate yourself. ***It happened to me***.

Here are some helpful hints:

- Check the outer yaw bearing diameter versus the inner diameter of the mounting pole
- Check the inner diameter of the yaw bearing versus the outer diameter of the ¾ by 6 inch yaw tube
- Check the fan blade rotors inner shaft diameter and compare it to the motor shaft's outer diameter
- Make sure the blades are 1 & ½ to 2 feet long

Let's Begin!

There are 7 Phases to Complete:

1. **The Mounting Base & Yaw System**
2. **The Motor Mount, Bracket & Plate Assembly**
3. **Wiring Feed & Connection**
4. **The Motor Housing Assembly**
5. **The Rotor & Blade Assembly**
6. **The Tail Assembly**

Perform each phase in the order stated above. Each phase has a step by step process with full illustrations in case you are a little confused. You can print out only the pages you need so you can build in your garage with a manual right beside you as oppose to having to go inside the house every 15 minutes.

All the parts needed to build the wind generator

Phase 1: The Mounting Base & Yaw System

Mounting Base

You will need to decide if you are going to mount the generator off of a pole that's mounted to a **fence**, **roof** or **ground**. If you are going to use one of these as a base that consider this:

- **Ground** – You will have to dig a 3 to 4 foot deep hole and fill with cement. Problem is, if you just mount the pole bare, you will have to assemble the whole system however high the poll extends. In other words; build it first and then stick it in the hole and fill with concrete.

- **Fence** – Use U-bolts if you wish to mount on a fence. Even if you have to drill a wooden fence, the U-bolts will handle some heavy work.

- **Roof** – If the roof is to your liking, use a metal pipe vent and mount it to the roof. It has a flat plate base with the vent angled for the roof. Drill a hole at the bottom to feed the wire. Then, slide the base poll over it, drill holes and secure it with bolts, washers, lock washers and nuts. Be sure to have the yaw system in place when installed. Then bring up the motor assembly & blade & rotor assembly separately. Screw the motor plate to the yaw pipe thread using silicone and tighten. Then add the blade.

The basketball net works so well.

I picked up a brand new 8 foot tall kids portable basketball net for 15 bucks off of ebay. This is what I will be covering.

Step 1

If your base is not already assembled, go ahead and build it but do not install the top pole yet. We need this pole to build the yaw system. You should have the build instructions inside the box.

Here is the base fully assembled minus the top pole. Once that's completed, move to step 2.

Step 2

The Yaw System – In order for your wind generator to swing freely around in circles, it must use a bearing that is mounted horizontally between the motor assembly and the mounting pole itself.

That side-to-side spinning motion is called "Yaw"

Important: You must have the mounting pole first so you can measure the inner diameter of the pole. This measurement is used to find the right bearing. Try to find a bearing with a ¾ inch inner diameter but either way, measure and confirm.

Here are the 3 items needed to build the yaw system:

- The top mounting poll
- The 6” by 1” inch metal water pipe
- The Yaw bearing (#6205RS)
- Lay the bearing flat on a hard floor (concrete) and gently butt 1 end of the yaw pipe to the center of the bearing. You will notice that this pipe is tapered at the end and will slightly slip-into the center.

Begin to lightly tap the pipe into the center of the bearing.

Once the yaw pipe is seated in straight, drive the pipe as far in as it goes. The treads will crush into the bearing creating a seal.

Fully seated

Place the bottom end of the top pole on a piece of wood and line up the bearing on the top

Lightly hammer the bearing into the pole till it lines up straight, and then drive the bearing in all the way till its flush.

A fully assembled Yaw System

Phase 1 Completed

Phase 2: The Motor Mount, Bracket & Plate Assembly

In this phase, you are going to build the entire motor and mount assembly. This is the most involved part of the build. Take your time and ensure that all drill points are even and square.

Here's a tip: If you get frustrated with something or a particular part is not assembling correctly, take a 5 minute break and rethink the problem.

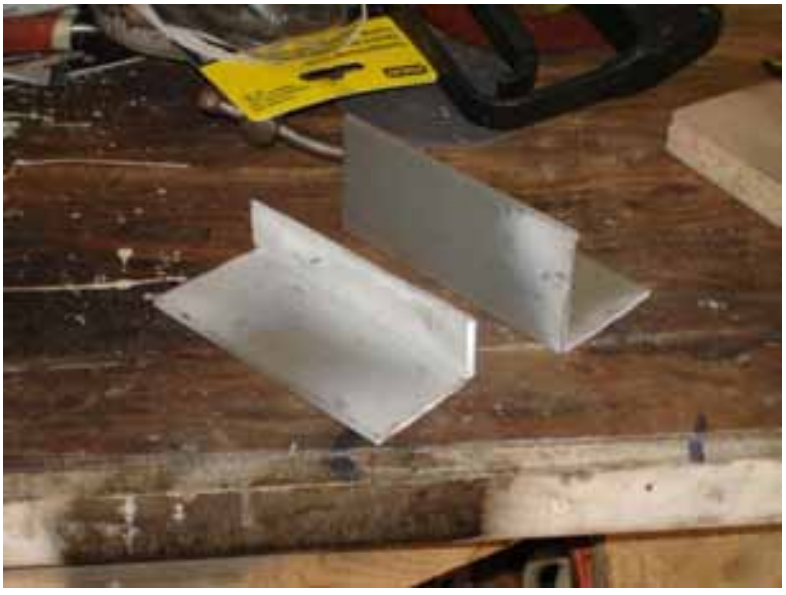
Step 1

Cut a 4 by 6 inch piece of wood (3/4 inch thick)

Step 2

Take a piece of 2 by 2 inch (1/8 inch thick) aluminum angle bar and cut two 4 inch long pieces

Take one of the 2 piece and cut off 1 inch along one of the tabs



Step 3

Measure 2 inches along the 6 inch side of the wooden mount plate starting from the end inwards, make a few marks and draw a line

Step 4

Place the non cut angle bar at the end of the plate and drill mounting hole like the photo below

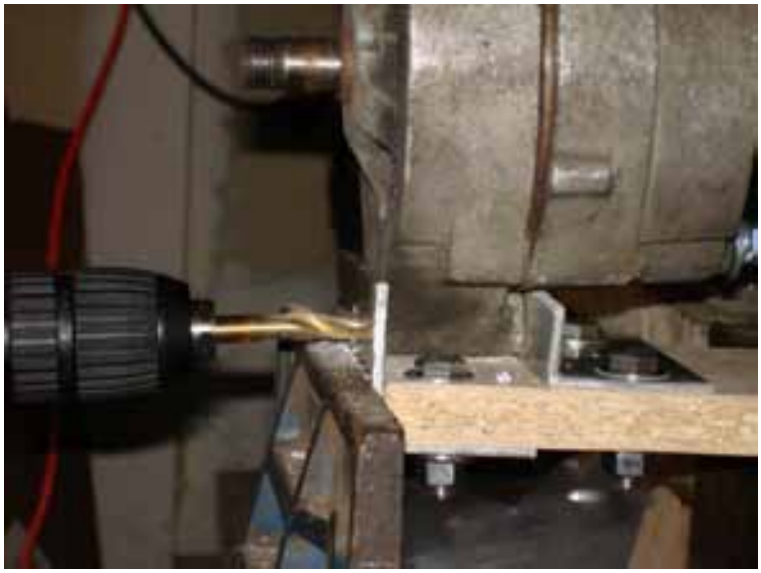
Take the second angle bar and line the cut side up to the two inch line and drill your mounting holes

Bolt both bars to the plate and secure tightly

Step 5

Place the motor (the thicker mount end) in between the 2 angle bars

With the motor sitting on the plate, measure up the mount hole and drill a hole through the first plate. Once that is done, use the motor mount hole to guide the drill bit into cutting a mount hole into the back angle bar. Secure with fasteners



Step 6

Drill a hole at the other end of the plate, one inch from the end at the center

Cut a 25 mm hole (for the 1 inch iron yaw pipe) into the plate between the angle bars

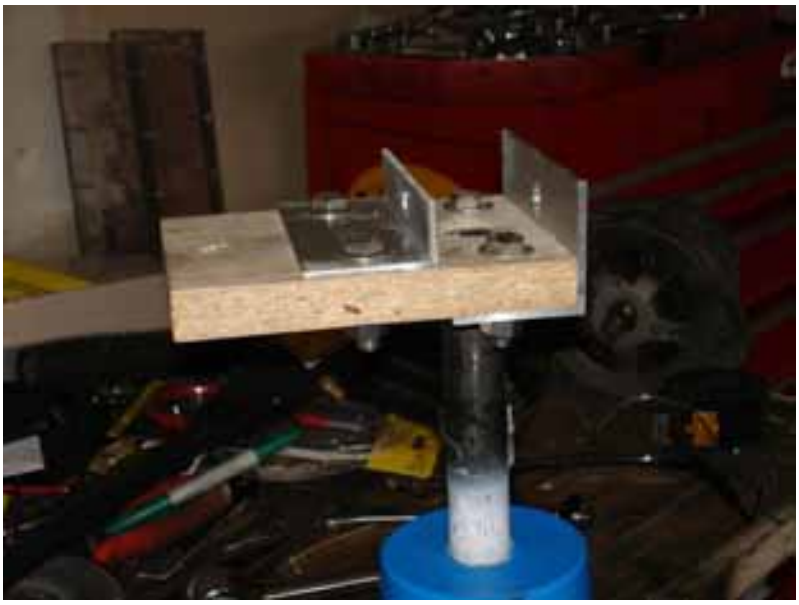
With that same bit, cut a hole in the yaw bearing cover guard in the center

Paint the bearing and shaft area of yaw system and place the yaw pipe through the guard

Step 7

Screw the 1 inch yaw pipe into the bottom of the 25 mm hole in the motor plate. Add silicone or thread sealant and crank tight

Paint entire motor plate (remove motor)



Step 8

Take a 1 inch by 2 foot metal strip and form the top motor bracket. A vice is very helpful here. Duplicate the photo

Line up the bracket to the mounting holes and mark it. Drill your holes and secure the mounts with fasteners

Phase 2 Completed

Phase 3: Wiring Feed & Motor Connection

Step 1

Take a desired length extension cable and cut off the female end

Step 2

Feed the cut end of the cable through the basketball stand to the motor

Strip the end of the cable and the white and black wires and connect the black wire to the motor body (ground) and the white wire to the positive connector stud.

Phase 3 Completed

Phase 4: The Motor Housing Assembly

Step 1

Measure the enclosed end of the container to the opening. Measure 10 inches and cut off the rest

Step 2

Place the cover over the motor and line up the motor shaft to the container. Cut out a hole for the shaft

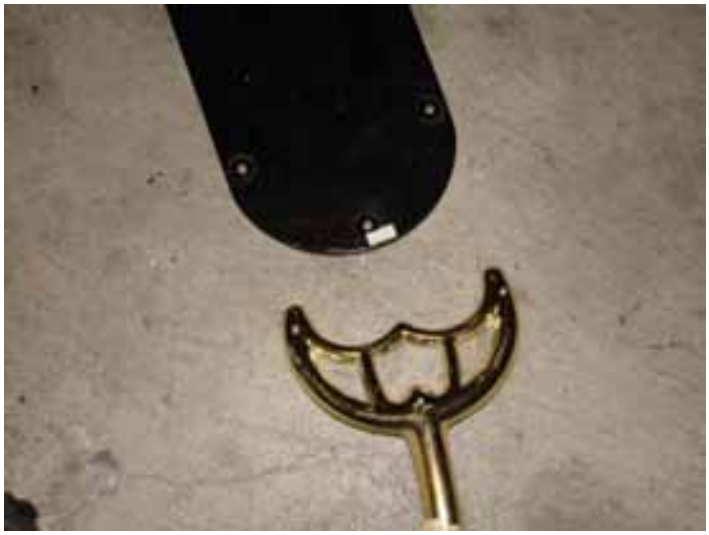
Place the container on top of the motor assembly again and use 3 self-tapping screws to mount the housing to the top motor mount

Phase 4 Completed

Phase 5: The Rotor & Blade Assembly

Step 1

Take the fan blades and remove old hardware



Drill and tap the end of the motor shaft with a 23/64 drill bit and a 3/8NC16 tap

Step 2

Remove all 3 fins off of the rotor (an exhaust fan) by drilling out the rivets. Keep 2 of the fins for the tail.

Using the blades mounting hardware, attach a blade to the rotor. Line it up evenly and drill mounting hole. Secure with fasteners

Step 3

Mount and space the completed rotor to the motor shaft and secure bolt with thread sealant.

Merge the top pole with the bottom stand

Phase 5 Completed

Phase 6: The Tail Assembly

Step 1

Cut the tail pipe to a foot and a half

Place one end cap at one end and affix both rotor fins using zip-ties to secure the top and a self-tapping screw at the bottom

Step 2

Drill 2 holes into the second end cap. Line the holes to the back of the motor housing and drill them out. Secure with fasteners

Apply silicone to the end cap and stick the tail in. Allow time to dry

Phase 6 Completed

With the Build completed, go ahead and paint it.

The rest of this book is in reference to those who wish to make a completely custom wind generator.

ESTIMATING REQUIREMENTS FOR GENERATOR SIZING

Before you can get started building, buying, or installing a wind turbine electrical generation system, you're going to need to know how much system you're going to need to do what you want it to do. There is more than one way to go about this estimation and some ways are less accurate than others.

We'll focus on the methods that are accurate enough for most people as well as simple enough to do yourself without needing a big knowledge base or expensive equipment. Just remember that the numbers you generate here will not be set in stone and could change with your situation, budget, or the availability of equipment.

Estimating Consumption for a Utility Grid-Active Connected System, we're starting with this one first as it is by far the easiest to estimate. Since you're already connected to the utility's power grid and are therefore getting billed every month, you've already got the numbers you'll need to work from to estimate your wind system's requirements. This method also works for currently grid-connected buildings or housing that you plan to disconnect from the grid.

Using your most current electric bill, you can usually get everything you need without any more research. Most electric utilities now include not only the current month's usage (usually measured in kwh or kilowatt hours), but also your average usage, per month, for the past year. If your bill doesn't include this information, you can either ask the power company to supply you with it (often this comes with a fee) or go through your files of past bills and put the information together yourself. Once you know what your average monthly power usage is, you'll want to go through those months and see what your peak, or highest-usage month was. Make a list of these numbers for handy reference. You'll need to know: your average monthly usage, your peak monthly usage, and your lowest month's usage. If you want to do cost-estimation and a Return on

Investment (ROI) crunch, you'll want to write the current cost per kilowatt and average monthly costs as well.

It wouldn't hurt to create a column next to each to write down a per-day estimate either (just take the number and divide it by thirty, so if you're average monthly kwh usage is 30, then you use 1kwh per day). Now you have an idea how much power you need to meet you're lowest, highest and your average monthly requirements.

This gives you a best-case to work from, as replacing all of your energy needs with wind would be ideal. Now, hopefully you've already got your budget range for how much you're ready to spend on your new wind system. So now you've got all the numbers you'll need to get started designing a wind turbine system that's right for your situation.

90% of you will most likely utilize the Utility Grid-Active Connection as it is the simplest and cheapest of the group. This is what I recommend for all of you that live on the power grid presently. The Power4Home system is based on this power delivery setup so that you don't need to spend hundreds or even thousands on charge controllers, system monitors and batteries.

The average American home uses about 10,000 Kwh a year, which equates to 830 kWh per month but just refer to your power bill to be accurate.

GETTING A PRE-MADE WIND TURBINE

Wind turbines can be made or purchased. Although there are many types of wind turbines, they all have blades, tower, control center, generator and some kind of mounting system.

Pre-made wind turbines are highly recommended for people who would like to use this alternative power source for most of the home's electrical needs. On average, a wind turbine for a residential property can cost $500 -$10,000.

Although this may seem expensive, it is important to keep in mind that they can cut your energy bill by 40 to 85 percent. If you do the math, this energy source can pay for itself in savings in just a few short years. Two years is the average length of time it takes to repay yourself for the expense.

When considering buying a wind turbine, it is wise to keep in mind the amount of energy necessary to power the home and the wind speed where the home is located. Just do the math as I showed you and pick a reasonable priced unit. If you live in a suburb please don't buy a huge 2000 watt generator. You will have a hard time explaining to your neighbors and your family why your wind generator is the same size as your house. Choose wisely and review the dimensions of the unit you're buying.

Here are some recommendations

www.magnet4less.com
www.wind-energy-market.com
www.abundantre.com
www.bergey.com

MAKING A CUSTOM WIND GENERATOR

For those of you who find that Building a Power4Home system is not to your specs and want to build your own custom system, then here is some info to help you. Also, we are lucky to be living in a time when making your own wind turbine is becoming easier, cheaper and more efficient.

Some of you may want to make something completely different with a higher powered generator. In this chapter, we will discuss how you can make your custom wind generator.

However, please keep in mind that although it can power all of your electrical equipment, you MUST have the wind turbine in a windy area. No wind equals No power. You will see the parts needed for this build in the next page bellow to help organize yourself.

As said before, you can upgrade your system as much as you like as long as you keep track of the power your system will supply versus the power your inverters can transfer.

Wind Turbine Materials:

a) **Nuts/bolts/screws**

b) **AC or DC power motor**

c) **Body cover assembly (Motor)**

d) **Tail assembly**

e) **Blades**

f) **Hub (connects propeller and motor)**

g) **Tower (with Yan bearings) or mounting post**

TOWER:

You will now have to decide if you are going to have a tower or mounting post. It's all about getting good wind at this point.

If you are going to mount on a fence or on a solid object like your roof, than a mounting post is what you need.

We recommend getting a cheap or free basketball net off the internet, out of someone's garbage or from a garage sale. A tower is easy to install and is safer to build seeing that you don't have to climb up on your roof.

When deciding where to mount the generator, make sure it is in an open channel of air and above the fence line if it is in the backyard. Open channel meaning an opening between large buildings

The only time you may not want to install a yaw system is when you have a consistent air stream that always follows the same direction. That is the only time you don't want the generator to swing.

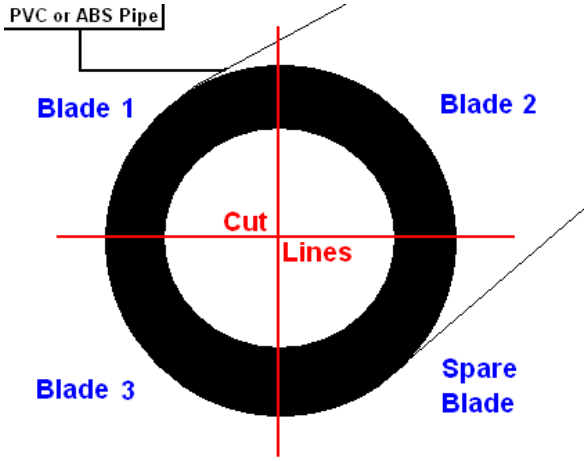
Making the Blades:

Using the jigsaw, cut the blades so that they are the right size for the application:

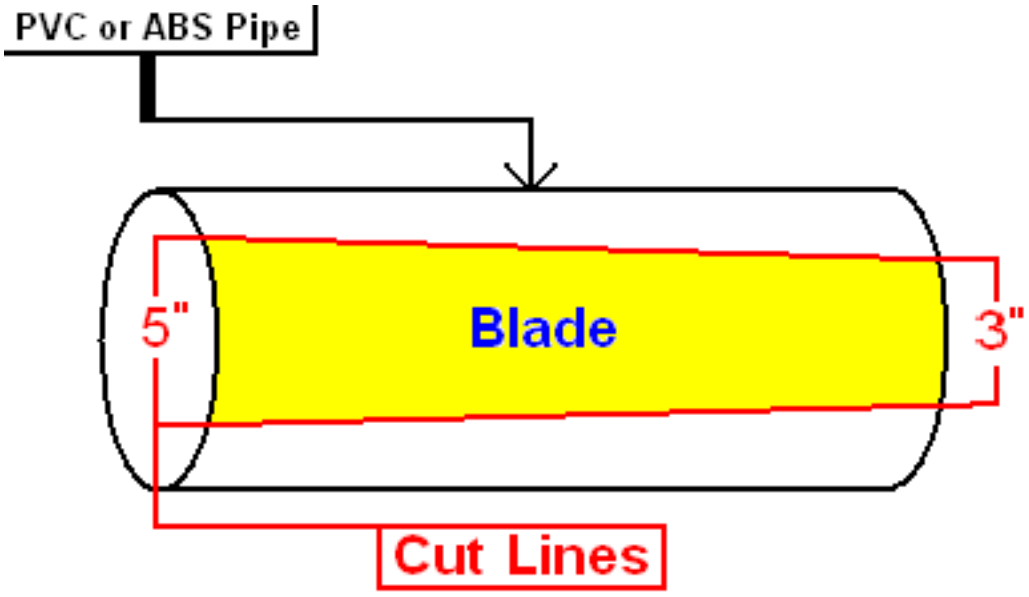
1 Foot = 100 watts or less
2 Foot = 100 to 400 watts (For this System)
3 Foot = 400 to 600 watts
4 Foot = 600 to 800 watts
6 Foot = 800 to 1200 watts
7 Foot = 1200 to 1800 watts

Please keep in mind that you will need a stronger tower the larger you go not to mention the more space you will need.

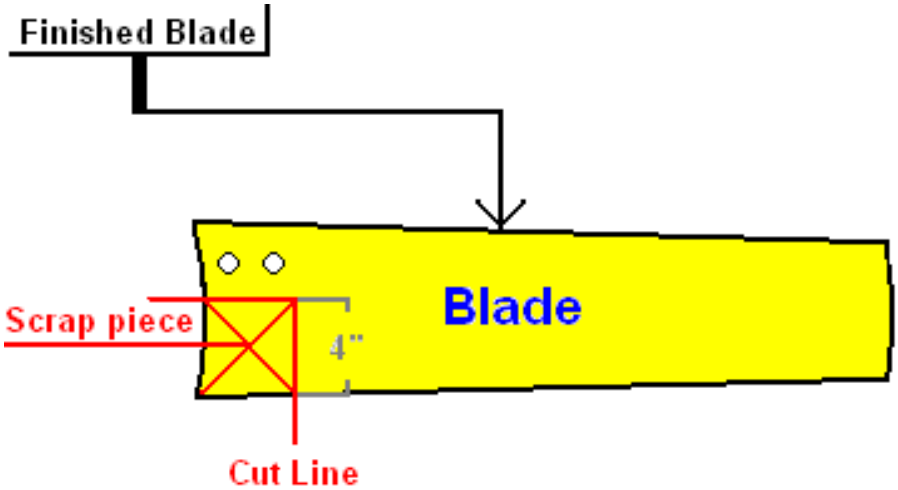
- Leave 2.5 inches of the blade on the base which will form a curved point at the edges. This changes with size
- Sand the blades to make the edges smooth. This will allow the blades to travel more efficiently through the wind increasing the speed.
- The pipe should be cut into quarters.



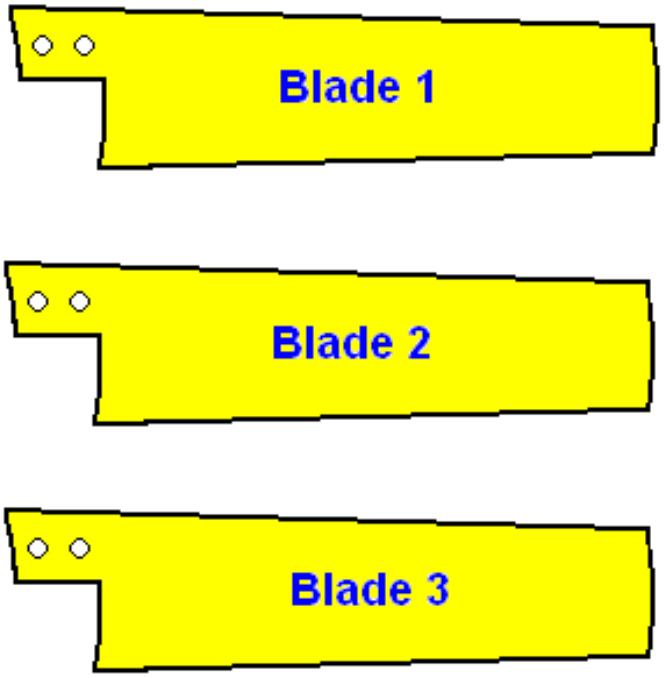
- Pipes with 6 to 8 inches diameters should be used with blades that have a hub that is 5inches wide and a point that is 3 inches wide.



- Create additional holes and cuts on the blades using the first finished blade as an example for the rest.



- In total, you should have 3 blades.



Hubs:

Although you can purchase the hub at a hardware store or on eBay, it will need to be adjusted to fit your wind turbine. The hub is used to join the blades with the generator. The hub goes on the DC motor shaft. In order to turn the DC motor shaft, it is important that the hub is secured tightly around the shaft. In order to ensure that the hub fits tightly, you have to make a hole in the center of the hub.

The size of the hole should be the same size as the shaft on the DC motor. Also, the hole must be perfectly in the center of the hub or else it will cause the wind turbine to be unstable because the blades will tremble when spun by the wind.

Once the holes are drilled you can start by putting the blades on the hub. The blades can be placed on the hub using 12 inch long flat steel strips that are 2 inches wide. By using steel strips, you are ensuring that the blades will be strong enough to work in high wind conditions. Place them over the blade; between bolt head and blade.

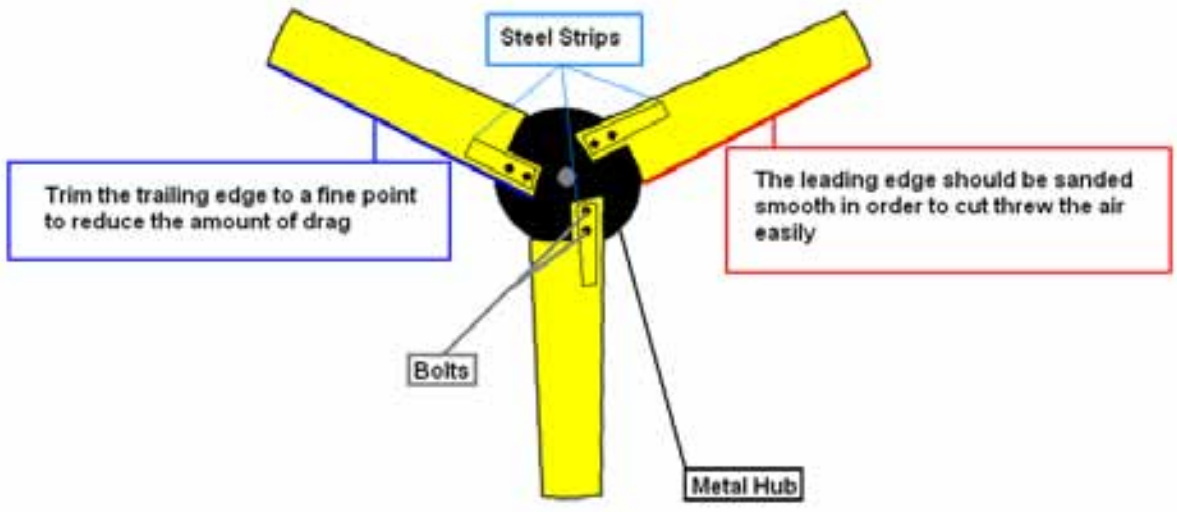
Here's a tip:

A cheap way to make a hub is by using a 6 to 12 inch saw blade. Because a saw blade's center hole is matched to most output shaft diameters used by motors of the size you will be using, all you would need to do is drill out the holes for the wind blades. Than find a rubber ball the same diameter and cut it in half; fit it over the blade. Use two or three for added strength.

Once the blades are on the hub, you can attach the hub to the DC motor shaft.

Diagram

HUB Assembly



Balance

In order to generate the amount of energy you want and also to keep the motor in excellent working condition, it is crucial to that the blades and hub are balanced.

Having an imbalanced system can cause the shaft and bearings in the DC motor to need replacing and for energy to be wasted.

Testing for Balance:

1. Using a marker, number all of the blades
2. Place the hub system on a bar or pole and turn the blades
3. After each spin record which blade is at the bottom. You should repeat this step 10 times
4. An indication that the system in imbalanced is if the same blade is always on the bottom
5. To balance the blade use a metal grinder to reduce the bars that connect the blade to the hub

Mounting the Hub:

Place the DC motor shaft into the hole that was drilled or pre-made into the hub. Use washers to space out the hub so that you have good clearance for the blades and that you can secure the end of the shaft properly.

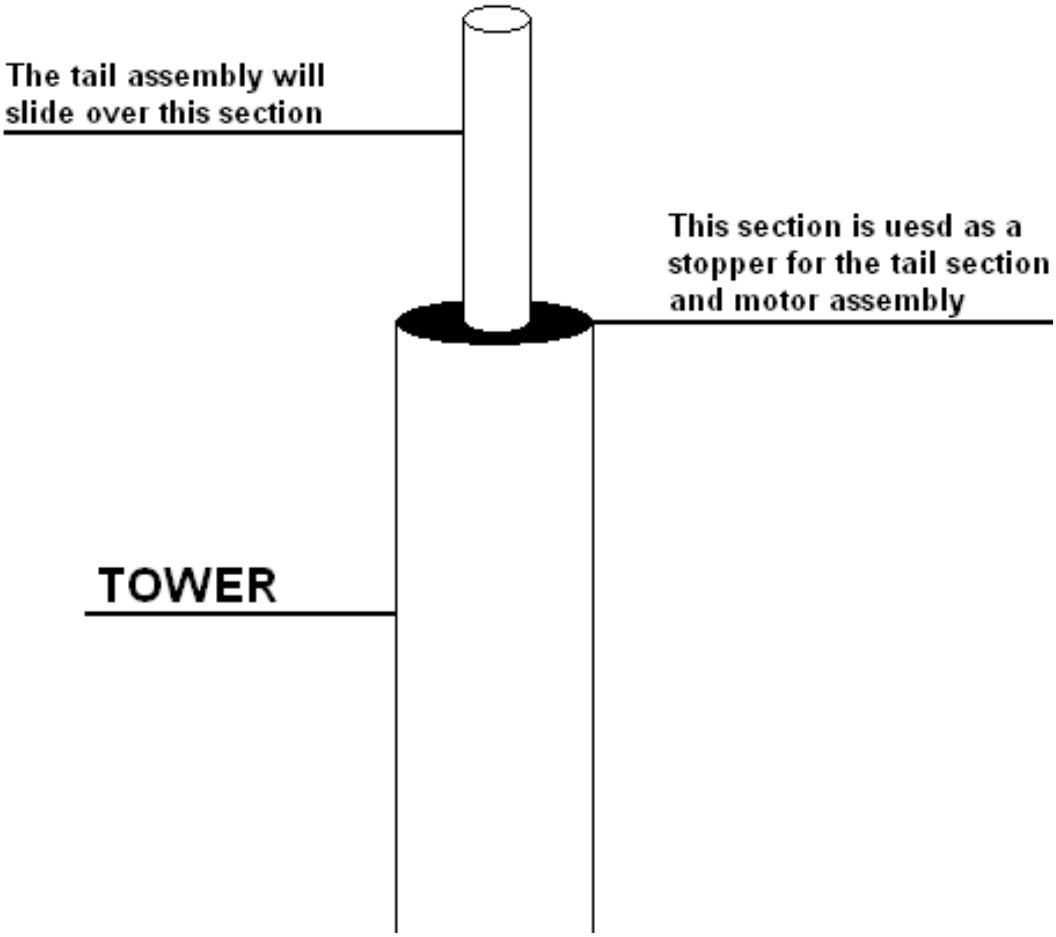
I would dye the end of the shaft (cutting bolt threads on the outer side) so you can get a nut at the end. If you don't know how to do that, just take the motor to your local machine shop and have them do it. It's only a $5 to $10 dollar job.

Make sure that the hub is on the shaft securely. A wobble in the hub at this point would be an uneven washer behind the hub.

Making the Axis:

For maximum efficiency, the blades should always be facing the wind. To make this possible, it must rotate on a horizontal axis when it is on the tower.

Diagram of Tower

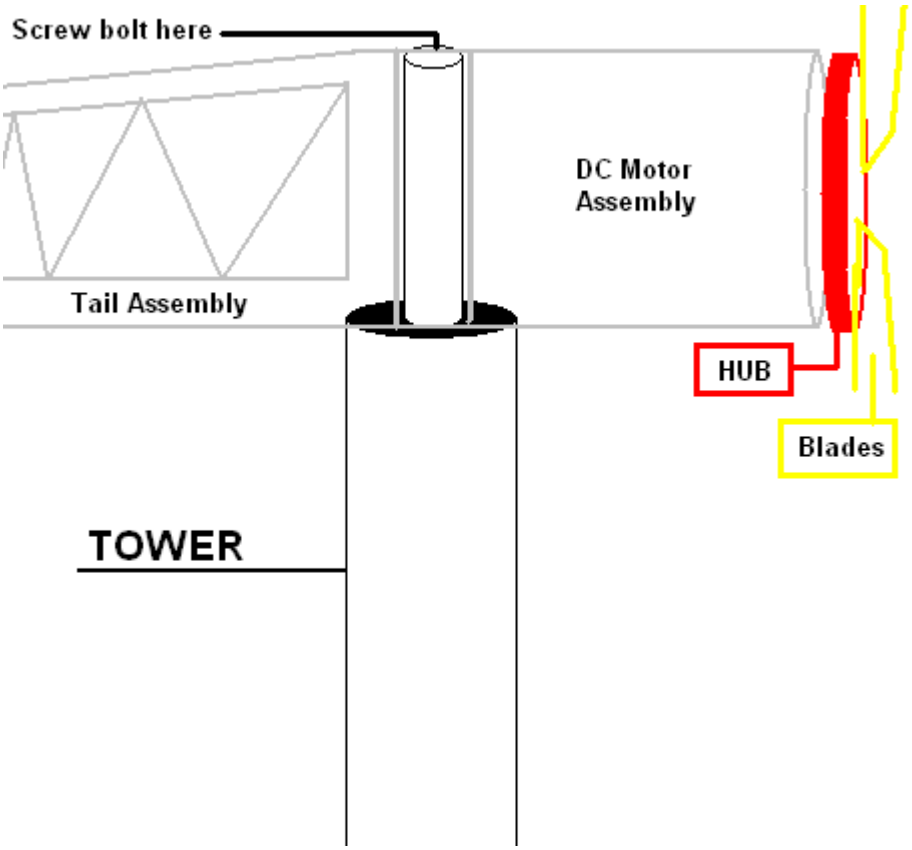


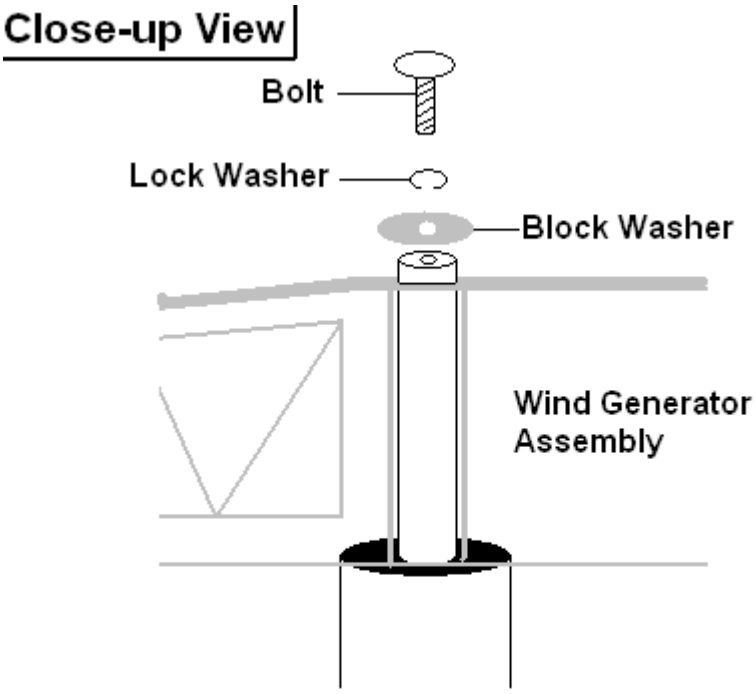
As you can see in the diagram, the top of the tower should have a narrower part.

If this part is missing from your tower, you can fix this by welding on another piece of metal or by drilling holes and mounting a smaller tube at the top.

When trying to figure out the diameter of the additional piece of metal, keep in mind that it has to be smaller than the diameter of the tail shaft. Later on in the build, a hole will be drilled in the tail shaft allowing it to slip on the top of the tower.

Diagram





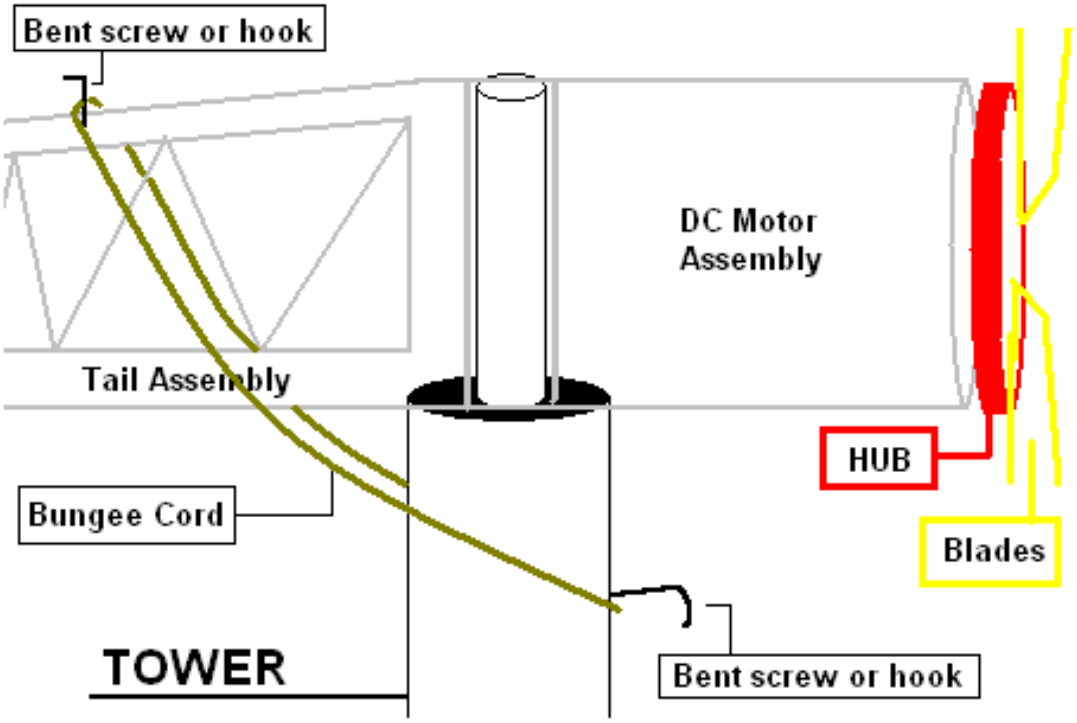
WARNING: Do not allow block washer to press down on the Wind Generator Assembly as it needs to pivot (swing) freely

Take measurements of the length of the tail shaft. You will then drill a hole near the peak tower. When deciding where to place the hole, keep in mind that once bolted together, it should be low enough on the top of the tower to firmly secure the tail shaft down.

Once in place, the windmill's tail shaft will be able to revolve around the peak of the tower unobstructed. If you feel that it is not spinning smoothly, lubricate the section of the tower where the shaft rotates.

Now that the wind turbine is rotating on a horizontal axis it will be more efficient because the blades will always be where the wind is. During times of bad weather when the wind is extremely high we must take precautions to keep the blades from spinning out of control. In order to prevent this, you can use a flexible rope such as a bungee cord to secure the wind turbine. The cord should be long enough to allow the unit to move freely in the wind without being hindered. Also, you can use bolts to keep the bungee cord from getting tangled on the tower.

Diagram



Making the Tail Piece:

This part of the wind turbine helps blades to work effectively and is responsible for sustaining balance of the overall structure. Research shows that ideally, the tail should be 3 or 4 feet. Use metal for the tail piece.

Begin by cutting out a tail shape in the metal (don't worry if you are not artistic as it can be any shape as long as it is large enough to gather wind) and then secure it to the rear of the unit. Finally, with the aid of a flat bracket secure the piece to the shaft.

ESTIMATING REQUIREMENTS FOR GENERATOR SIZING

Before you can get started building, buying, or installing a wind turbine electrical generation system, you're going to need to know how much system you're going to need to do what you want it to do. There is more than one way to go about this estimation and some ways are less accurate than others.

We'll focus on the methods that are accurate enough for most people as well as simple enough to do yourself without needing a big knowledge base or expensive equipment. Just remember that the numbers you generate here will not be set in stone and could change with your situation, budget, or the availability of equipment.

Estimating Consumption for a Utility Grid-Active Connected System, we're starting with this one first as it is by far the easiest to estimate. Since you're already connected to the utility's power grid and are therefore getting billed every month, you've already got the numbers you'll need to work from to estimate your wind system's requirements. This method also works for currently grid-connected buildings or housing that you plan to disconnect from the grid.

Using your most current electric bill, you can usually get everything you need without any more research. Most electric utilities now include not only the current month's usage (usually measured in kwh or kilowatt hours), but also your average usage, per month, for the past year. If your bill doesn't include this information, you can either ask the power company to supply you with it (often this comes with a fee) or go through your files of past bills and put the information together yourself. Once you know what your average monthly power usage is, you'll want to go through those months and see what your peak, or highest-usage month was. Make a list of these numbers for handy reference. You'll need to know: your average monthly usage, your peak monthly usage, and your lowest month's usage. If you want to do cost-estimation and a Return on

Investment (ROI) crunch, you'll want to write the current cost per kilowatt and average monthly costs as well.

It wouldn't hurt to create a column next to each to write down a per-day estimate either (just take the number and divide it by thirty, so if you're average monthly kwh usage is 30, then you use 1kwh per day). Now you have an idea how much power you need to meet you're lowest, highest and your average monthly requirements.

This gives you a best-case to work from, as replacing all of your energy needs with wind would be ideal. Now, hopefully you've already got your budget range for how much you're ready to spend on your new wind system. So now you've got all the numbers you'll need to get started designing a wind turbine system that's right for your situation.

90% of you will most likely utilize the Utility Grid-Active Connection as it is the simplest and cheapest of the group. This is what I recommend for all of you that live on the power grid presently. The Power4Home system is based on this power delivery setup so that you don't need to spend hundreds or even thousands on charge controllers, system monitors and batteries.

The average American home uses about 10,000 Kwh a year, which equates to 830 kwh per month but just refer to your power bill to be accurate.

CHOOSING THE RIGHT GENERATOR

In this chapter, we'll be looking at the various components involved in a wind turbine portfolio and how they work together to make a complete electrical generation system. We'll also look at what size of turbine, tower, etc. will best suit your needs and what options are available for both tower-mounted and rooftop-mounted turbines and accessories.

What Size Turbine Do I Need?

Turbines are measured in two different ways: average monthly or average yearly output and often have numbers representing their peak or maximum performance ratings as well, all of which are measured in kilowatts (kw). They are often grouped into categories such as micro/small (under 500kw per year), mid-sized or medium (501kw to 999kw), and large (1 megawatt and larger).

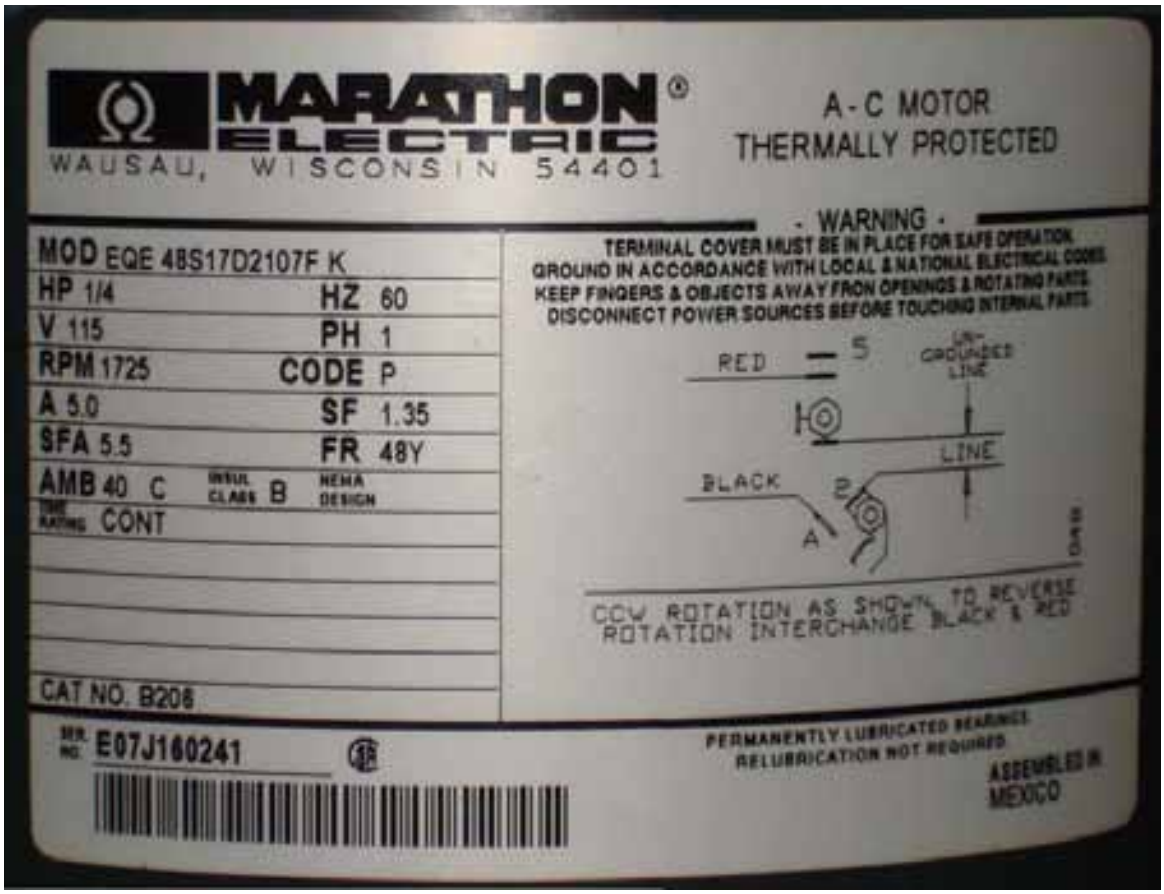
The smallest, useful turbines are usually around 20kw/month units used for very small applications such as lighted signs and electrical water pumps. The output you can expect, however, is a combination of the limitations of the turbine itself and the average wind speeds received that year. The numbers manufacturer's give are usually based on averages (about 14mph of wind) and maximums attainable. This is why they usually use two numbers to describe their turbines (both average and maximum).

For most homes and small farms, units in the micro range are usually what are used, producing up to 500 or so kilowatts per year. Most homes in the United

States use an average of about 10,000 kilowatt hours (kwh) of electricity per year, which translates to about 830kwh per month.

A kilowatt hour is one kilowatt of electricity multiplied by the number of hours as a unit of measurement. This is the unit most utility companies used to measure and charge for electrical power usage. Since there is 1 kilowatt in one kilowatt hour and there are 720 hours in a month, using only one kilowatt per hour would result in you're using only 720kwh per month.

Most households, obviously, use more than this. Reversing the math, if your turbine puts out an average of 500 kilowatts per month, you're producing 500kwh of electricity, or roughly 60% of your energy use. That could result in pretty significant savings per month! Before you order, most reputable wind turbine manufacturers and dealers will be happy to supply you with numbers specific to your chosen model and location. There are many resources on the Internet to tell you what your area's average wind speeds at various elevations are. See Appendix II to this book for recommended resources to help.



This is not the motor that I used to build the wind generator. You will notice that no wattage rating is given. However, it does state that it is good for ¼ horsepower.

1 Horsepower = 745 Watts divided by 4

= 186.25 Watts at 1725 RPM

Safety Considerations: IMPORTANT!

Several safety considerations need to be addressed before you choose a turbine and tower system to put up on your property. These includes, but obviously aren't limited to:

- **Clearance in a radius around where the tower is to be built.**
- **Turbine high-wind and rotor control mechanisms.**
- **Wiring safety and lightning protection.**
- **Cutoffs and electrical breakers for disconnecting the turbine from the electrical grid (if attached).**
- **Turbine rotor brakes or stops for safety during maintenance, installation, or removal. Choose the location for the tower carefully and be sure that nothing and no one can be hurt should the tower fall.**

Give extra added space to the movement area of the wind generator (movement of the blades and spin of the tail end).

For example:

So if you have a tail fin and blades that span and move in a one meter circumference, make sure that at least two meters of clearance is available in a radius on all sides.

Most turbines come with control and safety mechanisms that automatically function in the event of very high winds or winds that are higher than the turbine's rated safety speeds.

Turbines have automatic braking to slow the rotors, they turn into the wind to reduce “drag” and friction, fold in half to reduce their ability to spin, and utilize any number of other techniques to protect themselves and those who use them during very high wind conditions.

Most turbines are now equipped with built-in grounding connections for protection in the event of a lightning strike and have breakers and other safeguards installed to keep the energy from flowing to the grid or building they're connected to. Many turbine towers also include “break-off” or shear points where the tower will intentionally fail to safely fall into a smaller space in the event of gale-force winds or other problems.

Most qualified electricians, installers, and dealerships will also show you how to use cutoff switches to manually disconnect the unit from the grid, battery bank, etc. during maintenance and in an emergency.

Finally, most wind turbines have a brake, stop, or physical way to keep the rotors from turning that you can safely engage in order to perform maintenance, installation, etc. on your turbine safely. These are not necessary as you can simply “unplug” the system and if the turbine you're considering purchasing does not include a feature like this, it’s ok.

Getting Parts In General

DC or AC Motors:

These can be found on eBay or in power tools. Although using the motor from old power tools is inexpensive, be aware that they don't produce a lot of power. DC motors can create power instead of just using it by turning the motor in the other direction. The energy that is created travels using the wires that would be utilized if power were coming in.

When deciding what DC motor to use, there are some things to keep in mind. For starters, it must have low RPMS because when the motor is generating power as opposed to using it, it spins much quicker than what is rated.

The DC motor for your wind turbine should also have high current and voltage of at least 12v. An example of the perfect motor is one that is rated less than 400 RPM at 30 volts because when used as a generator it will create 12v at low RPM.

Another thing to keep in mind when choosing a DC motor is wind speed. The lower the wind speed, the lower the RPM rating necessary in the motor. However, the ideal conditions for the wind turbine are high wind.

Towers:

To make your tower you will need a stable structure that is between 6-12 feet tall. You can use old satellite towers or even 3inch steel pipe. The tower can be secured to the ground using cement or use a basketball net with a water base. For those of you who are handy, you might want to create your own tower by welding pipe together.

See the picture below for an example of a tower:

Old Satellite Tower

Portable Basketball Net

Blades:

It is recommended that the blades be made out of PVC or ABS pipe and be coated with UV inhibiter to increase the life span of the generator. The ideal diameter for a blade is 4 feet. Don't go over-board with the length of the blades. The bigger you go, the more stress you put on the structure.

At this size and with wind speeds of 20 miles per hour minimum you can generate the desired 200 watts of energy. However, too large of diameter can be too big for many backyards. A quick fix is to cut the blades to a size that better suits the size of your property making sure to maintain the shape of the blade.

If you know of or know someone who has an old ceiling fan that doesn't work, you can take the blades off of that and install it on your system. That is what I did.