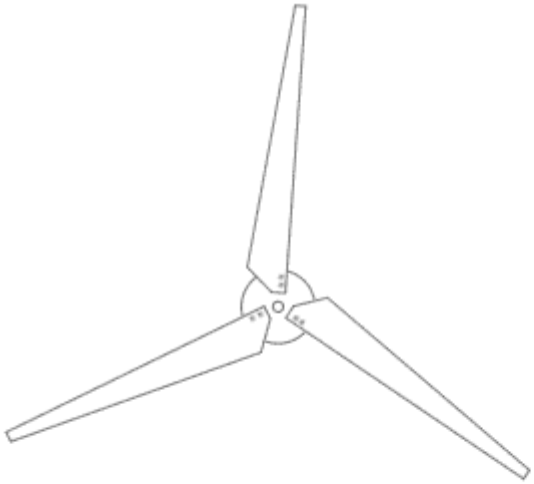
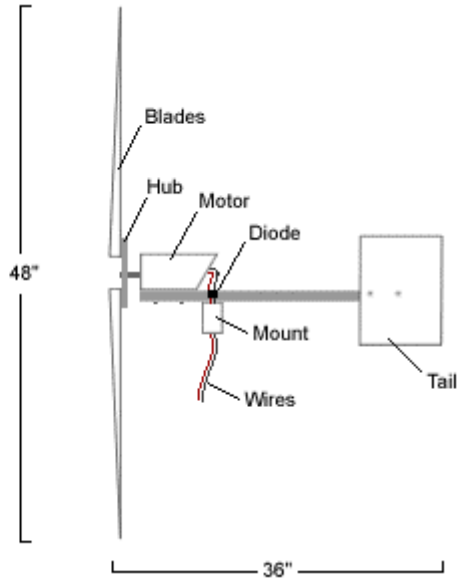
HOW TO BUILD A CHISPITO WINDMILL





INTRODUCTION

Wind power is abundant, clean, inexpensive and easy to do. It is our belief that anyone can be in control of where his or her electricity comes from. There is nothing more rewarding and empowering than making a wind powered generator from scrap materials. Most of the tools and materials in this manual can be found in your local hardware shop or junk pile. We highly recommend you search your local dump and/or junkyards for the materials required. If you live in a city, do a search on freecycle.org for salvaged parts.

WARNING: Safety should be our highest priority. Human life is more important than electricity, so please follow any and every safety guideline you come across. Wind generators can be very dangerous, with fast moving parts, electrical sparks, and violent weather conditions.

The Chispito Wind Generator was designed to be simple and efficient with fast and easy construction. There are no limits to what you can do with wind power.

Step 1. Building the generator

SUPPLIES

This manual is based on using a 260 VDC, 5 A continuous duty Treadmill Motor with a 6 inch threaded hub. These motors are available for under $50 from most motor surplus stores. We are getting about 7 amps in a 30 mph wind. In other words, it is a simple, cheap little machine to get you started.

You may use any other simple permanent magnet DC motor that returns at least 1 V for every 25 rpm and can handle upwards of 10 amps. If you do, there will be certain changes to this supply list (for example, you will have to find a hub - a circular saw blade with a 5/8" shaft adaptor will work).

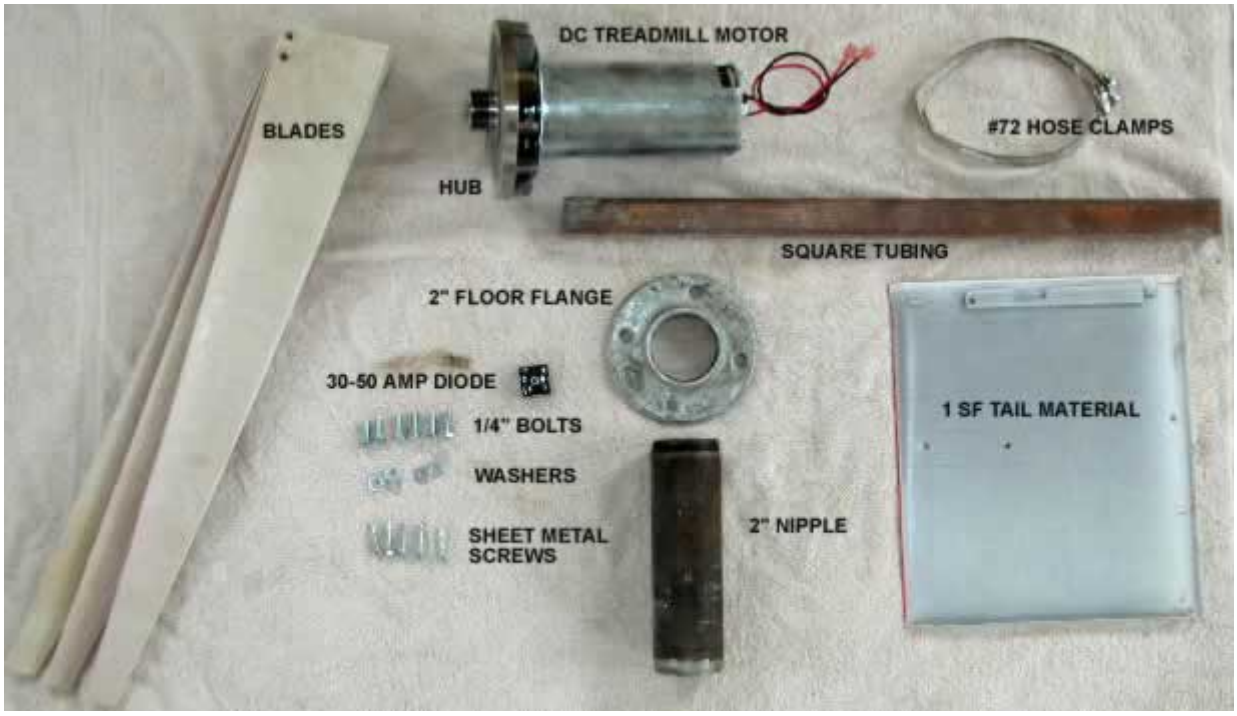
Tools



- Drill

- Drill Bits (7/32", ¼", 5/16")
- Jigsaw with a metal blade
- Pipe Wrench
- Flat Head Screwdriver
- Crescent Wrench
- Vise and/or Clamp
- Wire Strippers
- Tape Measure
- Marker Pen
- Compass + protractor
- ¼" #20 Thread Tapping Set
- An extra person helps a lot!

Materials



Mount

- 36" of 1" Square Tubing
- 2" Floor Flange
- 2" X 4" Nipple
- 3 X 3/4" Self-tapping Screws

NOTE: if you have access to a welder, you can weld a 4” section of 2” pipe onto your square tubing instead of using the flange, nipple and sheet metal screws.

Motor

- 260 VDC, 5 A continuous duty Treadmill Motor with a 6 inch threaded hub
- 30 - 50 Amp Blocking Diode (one-way)
- 2 x 5/16” x ¾” Motor Bolts
- 3" X 11" PVC Pipe

Tail

- 1 sqft (approx) lightweight material (metal)
- 2 X ¾" Self-tapping Screws

Blades

- 24" length of 8" PVC Pipe (if it is UV resistant, you will not need to paint it)
- 6 X ¼" X 20 Bolts
- 9 x ¼" washers
- 3 sheets A4 paper and tape

Preparation

Cutting Blades - makes 9 blades (or 3 blade sets) and a thin waste strip.

1. Place the 24" Length of PVC pipe and square tubing (or other straight edge) side by side on a flat surface. Push the pipe tight against the tubing and mark the line where they touch. This is Line A.
2. Make a mark near each end of Line A, 23" apart.
3. Tape 3 sheets of A4 paper together, so that they form a long, completely straight piece of paper. Wrap this around the section of pipe at each of the two the marks you just made, one then the other. Make sure the short side of the paper is straight along Line A and the paper is straight against itself where it overlaps. Mark a line along the edge of the paper at each end. Call one Line B and the other Line C.
4. Start where Line A intersects Line B. Going left around Line B, make a mark at every 145 mm. The last section should be about 115 mm.
5. Start where Line A intersects Line C. Going right around Line C, make a mark at every 145 mm. The last section should be about 115 mm.
6. Mark each line using a straight edge.
7. Cut along these lines, using the jigsaw, so that you have 4 strips of 145 mm and one strip about 115 mm.
8. Take each strip and place them with the inside of the pipe facing down.

9. Make a mark at one end of each strip 115 mm from the left edge.
10. Make a mark at the other end of each strip 30 mm from the left edge.
11. Mark and cut these lines, using the jigsaw.
12. Place each blade with the inside of the pipe facing down.
13. Make a mark along the angled line of the blade, 3" from the wide end.
14. Make another mark on the wide end of the blade, 1" from the straight edge.
15. Connect these two marks and cut along the line. This prevents the blades interfering with the others' wind.



Sanding the Blades

You should sand the blades to achieve the desired airfoil. This will increase the efficiency of the blades, as well as making them quieter.

The angled (leading) edge wants to be rounded, while the straight (tailing) edge wants to be pointed.

Any sharp corners should be slightly rounded to cut down on noise.

Cutting Tail

The exact dimensions of the tail are not important. You want about one square foot of lightweight material, preferably metal. You can make the tail any shape you want, so long as the end result is stiff rather than floppy.

Drilling Holes in Square Tubing - using the 5/16” drill bit

1. Place the motor on the front end of the square tubing, so that the hub part hangs over the edge and the bolt holes of the motor face down.
2. Roll the motor back so you can see the bolt holes, and mark their position on the

square tubing.
3. Drill a 5/16” hole at each mark all the way through the square tubing.

Floor Flange Holes

This will be dealt with in the assembly section of this manual, as these holes are what determine the balance.

Drilling Holes in Blades - using the ¼" drill bit

1. Mark two holes at the wide end and along the straight edge of each of the three blades. The first hole should be 3/8 " from the straight edge and ½ " from the bottom. The second hole should be 3/8 " from the straight edge and 1 ¼" from the bottom.
2. Drill these 6 holes.

Drilling and Tapping Holes in Hub - using the 7/32" drill bit and ¼" tap

1. The Treadmill motor comes with the hub attached. To take it off, hold the end of the shaft (which comes through the hub) firmly with pliers, and turn the hub clockwise. This hub unscrews clockwise, which is why the blades turn counter-clockwise.
2. Make a template of the hub on a piece of paper, using a compass and protractor.
3. Mark 3 holes, each of which is 2 3/8" from the center of the circle and equidistant from each other.
4. Place this template over the hub and punch a starter hole through the paper and onto the hub at each hole.
5. Drill these holes with the 7/32" drill bit.
6. Tap the holes with the ¼" x 20 tap.
7. Bolt the blades onto the hub using the ¼" bolts. At this point, the outer holes have not been drilled.
8. Measure the distance between the straight edges of the tips of each blade. Adjust them so that they are all equidistant. Mark and punch each hole on the hub through the empty hole in each blade.
9. Label the blades and hub so that you can match which blade goes where at a later stage.
10. Remove the blades and then drill and tap these outer three holes.

Making a Protective Sleeve for the Motor

1. Draw two straight lines, about ¾” apart, along the length of the 3” x 11” PVC Pipe. Cut along these lines.
2. Make a 45º cut at the end of the pipe.
3. Place needle nose pliers inside the strip that has been cut out, and pry the pipe apart.
4. Making sure the bolt holes of the motor are centered in the middle of the missing

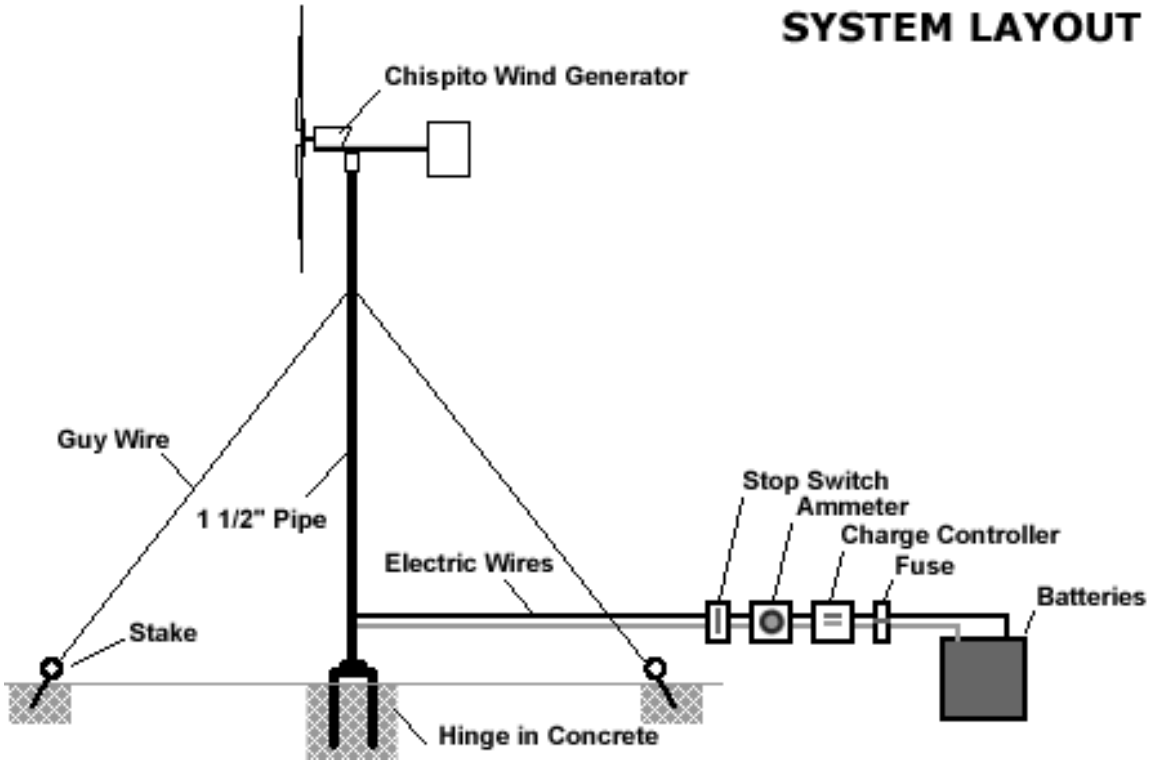
strip of PVC pipe, push the motor into the pipe. An extra person will make this a lot easier.

ASSEMBLY

1. Place the motor on top of the square tubing and bolt it in, using the two 5/16” x ¾” bolts.
2. Place the diode on the square tubing, about 2” behind the motor, and screw it into position using the self-tapping metal screw.
3. Connect the black wire coming out of the motor to the positive incoming terminal of the diode (Labeled AC on the positive side).
4. Connect the red wire coming out of the motor to the negative incoming terminal of the diode (Labeled AC on the negative side).
5. Center the tail over the square tubing, at the back end. Clamp your tail onto the side of the square tubing.
6. Using 2 self-tapping screws, screw the tail in place.
7. Place each blade on the hub so that all the holes line up. Using the ¼" bolts and washers, bolt the blades to the hub. For the inner three holes, use two washers per bolt, one on each side of the blade. For the outer three holes, just use one washer next to the head of the bolt. Tighten.
8. Hold the end of the shaft of the motor (which comes through the hub) firmly with pliers, and turn the hub counterclockwise until it tightens and stops.
9. Screw the nipple tightly into the floor flange using a pipe wrench.
10. Clamp the nipple in a vice so that the floor flange is facing up and level.
11. Place the square tubing (and everything that is on it) on top of the floor flange and move it so that it is perfectly balanced.
12. Through the holes of the floor flange, mark the square tubing at the point of balance.
13. Drill these two holes using a 5/32" drill bit. You will probably have to take off the hub and tail to do this).
14. Attach the square tubing to the floor flange with two sheet metal screws.

For a longer life span of your wind generator, you should paint the blades, motor sleeve, mount and tail.

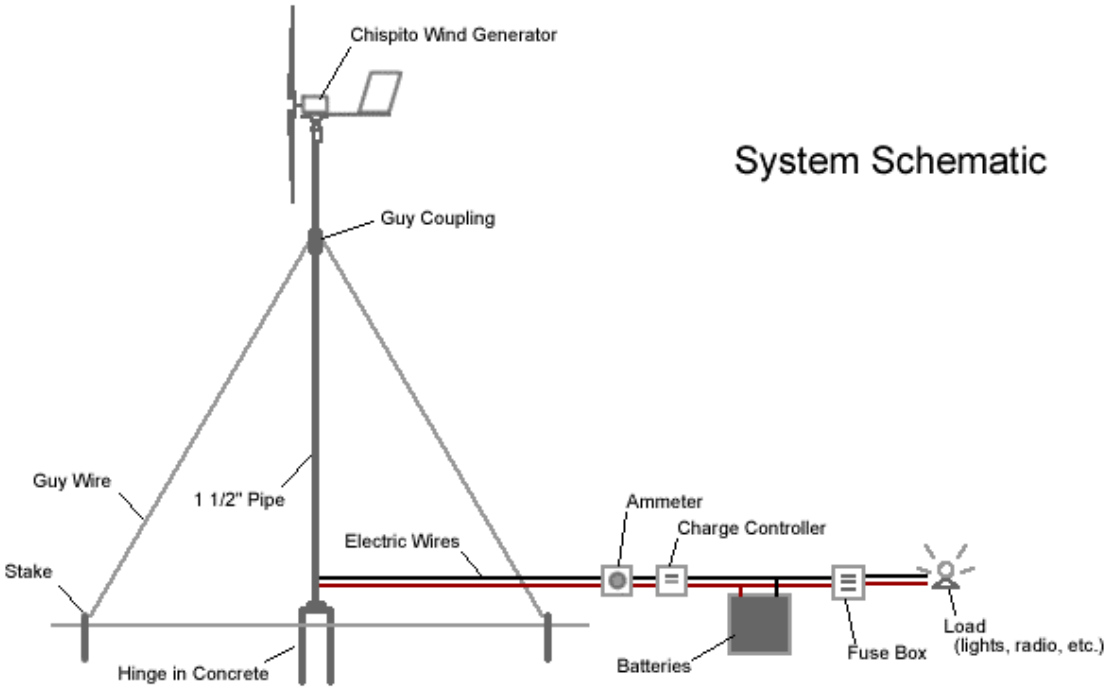
ADDITIONAL INFORMATION



Use of Chispito Wind Generator

You will need a tower, wire, ammeter, charge controller/regulator, and a battery bank for your Chispito Wind Generator.

Step 2. How to Build a Tower for a Chispito Wind Generator



Building the Tower

The tower is one of the most important components in your wind generator system. It must be strong, stable, easily raised and lowered, and well anchored. The higher your tower is, the more wind your generator will be exposed to. Guy wires must be placed at least every 18 feet of tower height. Guy wires must be anchored to the ground at least 50% of the height away from the base.

SUPPLIES

Tools

- Pipe Wrench
- Vise
- Shovel
- Wheel Barrow (mix concrete)
- Wire Strippers

- Drill and Drill Bit

Materials
Base

- 2 X 2' X 1 ¼" Steel Pipe Nipple
- 6" X 1 ¼" Steel Pipe Nipple
- 2 X 1 ¼" 90 elbow
- 1 ½" Steel Pipe T

Pole

- 10 - 30 ft piece of 1 ½" Steel Pipe
- 2 pieces #8 Copper Stranded Wire (must be long enough to go through the pole to the batteries)

Guy System

- 1 ½" U-bolt
- 4 X Guy Wires, at least 25ft long (must be long enough to go from pole to stakes)
- 4 X Stakes
- 4 X Turnbuckles

ASSEMBLY

Base

1. Dig a hole about 1 ft in diameter and 2 ft deep.
2. Feed the 6" X 1 ¼" Steel Pipe Nipple through the horizontal part of the 1 ½" Steel Pipe T
3. Screw the elbows onto each end of the 6" X 1 ¼" Nipple.
4. Screw the 2 ft X 1 ¼" Steel Pipe Nipples into the elbows.
5. Set the hinge base in the hole, so that the T clears the ground. The horizontal part of the T should be level.
6. When the base is plumb and level in the hole, pour concrete into the hole.

Pole

1. Drill a large hole about one foot from the bottom of the 10 - 30 ft 1 ½" Steel Pipe for the wire to exit.
2. Screw the pipe into the vertical part of the T.
3. Make 4 loops of wire, each loop consisting of several turns of wire.
4. Place the 1 ½" U-Bolt round the pipe, 3 feet from the top of the pipe, threading it through the four loops you just made.

5. Move the loops so that they are equally spaced.
6. Tighten the nuts of the U-Bolt.
7. Secure a guy wire to each of the loops on the U-Bolt.

Guys

1. Put the four stakes (spaced evenly apart) about 12 feet from the base.
2. Drive each stake firmly into the ground, slightly angling them away from the base.
3. Wire a turnbuckle to each stake, using several strands of wire.
4. Raise the pole upright and level.
5. Attach the guys to the turnbuckles.
6. Hold the pole level and tighten all turnbuckles to ensure a secure fit.
7. Mark the front turnbuckle for future reference.

Wiring

1. Release the front guy and lower the pole to the ground.
2. Feed the #8 wires down through the pole an out through the hole in the bottom of the pipe.
3. Wrap the bottom ends of the wires together to provide a closed circuit.

Mounting the Chispito Wind Generator

1. Slide Chispito over the top of the pole.
2. Pull the wires up through Chispito.
3. Wrap the positive (red) wire from Chispito to the positive (red) wire going through the pole. Secure the connection, and use either wire nuts or heat-shrink connectors. Do the same for the negative wires.
4. Raise the pole by pulling the front guy into place. Tighten the front guy to the mark made earlier.
5. Unwrap the ends of the wires and connect them to the positive and negative terminals of your battery bank. If you have a charge controller and/or ammeter, please refer to manufactures instructions for system wiring.

Step 3. Charge controller/Regulator

It is important to include electronic controls for your home energy system. Electricity coming from the source should be regulated against overcharging your batteries, and your appliances should be guarded from overuse.

Regulating your sources can be done in several ways, most commonly, using a charge controller. The **charge controller** can read when your batteries are full, and

subsequently shorts out the source, so that no more power comes in. Then, when the level of the batteries drops a little, the charge controller will switch the source back on. Of course, if the charge controller cuts out the source, there is effectively a bunch of power that is being wasted (not being used). To counteract this, you can use a **diversion, or dump, load**, which uses up the excess energy when your batteries are full, to power something like a hot water heater or air compressor.

Manual cut-off switches are essential for safety purposes. If you need to work on any part of the system, it helps to have a way to easily shut off any electricity coming in.

Your system should always be fused between the source and the battery, and also between the battery and the appliance. That way, if something should happen, the **fuse** will blow, interrupting the circuit, and your components will remain unharmed. Fuse your system as close to the batteries as possible.

You will also want a **voltage meter** to check the state of your batteries, and an **ammeter** on each source to show how many amps your source is generating. Proper system health can be achieved with the proper controls, regulators, and metering.

Step 4. Banks of Batteries

Storing the electrical energy that has been converted by your source is the hardest part of the home-energy process. Most systems use lead-acid batteries, which cannot be constructed very easily in your average home workshop. Still, they are efficient compared to the cost, and along with conservative energy use, deep cycle batteries can play a very important role. Lead-Acid battery systems can be any voltage, but most people use either 12 or 24 volts.

So, what is a battery? A battery converts the electrical energy from your generator or solar panel into chemical energy by means of a specific chemical reaction. When you need to use electricity, the battery reverses the chemical reaction and releases electricity. Batteries come in all shapes and sizes, but for most small home systems, deep cycle lead acid batteries are used. These batteries can be found in most cities, and have many applications including golf-carts, forklifts, and telephone lines. Lead-Acid Batteries are rated in Amp-Hours, which means they contain a certain amount of time at a particular electrical draw. A 200 amp-hour battery with a 20-amp draw will be discharged in 10 hours of use. So, if you had a lamp that pulled 2 amps, you could light a room for 100 hours.

Most batteries in this class come in 6-volt sizes, but most appliances are at least 12

volt. To get around this, we use two 6-volt batteries, wired in series, to get one 12-volt battery. Then, our 12-volt batteries are wired in parallel to give us more amp hours.

Because batteries are expensive, you will want to make them last as long as possible. Checking the water level regularly is vital, and should be part of your general maintenance schedule. Another key factor in the lifespan of your batteries is not leaving them drained too low for too long. We have learned the hard way, and it has cost us dearly. Now, we try not to drain our system below 12.0 volts (a battery is full at 12.6 volts), and so far we have been very pleased with the performance of our battery bank.

One thing to note, when reading the level of your batteries, is that you will only get a true voltage reading when there is no power coming in. For example, if there is no wind or sun, and hasn't been for a while, your voltage reading will tell you exactly what your batteries are sitting at, 12.6 volts being the maximum. However, when the wind is blowing, your voltmeter might read anywhere up to 14.6 volts. This is because you are reading an average of what your batteries are sitting at and what is coming in. The closer the batteries are to full, the less they act as a voltage buffer, and the voltage rises faster.

I wish you all the success in your project. The steps above are laid out so that ANYONE can build they're own windmill. Good luck and enjoy.

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HC 65 276G Alpine TX. 79830
206-333-0321
antiquebahia@yahoo.com
www.antiquebahia.com