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## Introduction

There is one disturbing fact that people are slowly beginning to realize. We can't depend on fossil fuels for our energy forever.

Oil prices are skyrocketing around the world. People are fighting and dying over oil reserves. The damage to our planet and our climate is irreversible and is becoming more and more apparent by the day.

Put shortly, chances are that if we don't do something about our energy situation now, our kids and their kids are going to have to face some extremely difficult challenges in the future.

But what can we do? It seems that most alternative energy choices are too expensive to mass market. As an individual, is there really anything you can do to make a difference?

We're going to answer those questions and a whole lot more throughout this book. We'll look at some of things you can start doing right now, today, to do your part in solving the world's energy crisis.

## Chapter 1: Before You Start





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Renewable energy is an amazing thing, but it's not easily accessible or affordable to everyone in its current state.

That doesn't mean that there aren't things that you can do right now in order to cut down on your energy expenses.

You can start by using energy efficient fluorescent light bulbs in all of your lights.

- Turn off all appliances, such as TV's and computers when they are not in use. They still consume energy, even in standby mode.
- Air dry clothes and dishes when at all possible, and only run the dishwasher or clothes washer with full loads.
- Avoid baths. Try to take short showers.
- Keep your thermostat at a comfortable but moderate temperature. Not too cool in the summer and not too warm in the winter.
- Drive sensibly and keep your car tuned up for the most fuel efficiency. Excessive speeding and rapidly accelerating and breaking can waste gas.
- Make sure that your house is well sealed around windows and doors. Warm or cool air escaping from





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homes can substantially drive up utility costs.

If you plan on using renewable energy such as wind or solar power in your home then you **MUST** act on the advice above. I didn't just put it there to look good. There is no point going to all the effort of making a wind or solar generator if you are going to leave lights and power points on when the appliances are not being used etc.

## **Chapter 2: How Solar Power Works**

Solar power is an amazing thing. The Sun blasts enough energy over the surface everyday to provide us with more than enough power to sustain ourselves.

Right now, technological limitations and financial considerations are the only reasons that we aren't using solar power for the majority of our energy needs. That won't be the case forever though.

Solar power works by collecting the energy output by the sun over a specified surface area, and then converting that energy into usable electricity.

Solar panels collect and convert that energy using photovoltaic cells. The word photovoltaic literally means "light (photo) "electricity" (voltaic).

The cells are made up of semi-conductors, with silicon





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currently the most widely used.

When the sun's rays hit the surface of a semi-conductor, a reaction takes place. The chemical makeup of the solar panel absorbs the energy, and the energy causes electrons to break free of their atoms and in the process they create electricity.

Advances in semi-conductor technology are allowing for our solar panels to absorb and retain an increasingly growing percentage of the energy output by the sun.

### **Chapter 3: Build Your Own Solar Generator**

Did you know that building your own solar generator is not only easy, but also extremely cost effective?

First off I am going to show you a few different applications a solar power system can be used with. The first solar power generator I will talk about will be my portable system that you can use to power just about anything you like. This is also a good system that you can take camping and you can create it for no more than \$200. (If you don't know what each of the parts are used for please refer to the end of this chapter.)

#### **Portable Solar Power Generator**

This solar generator can literally pay for itself within the first





few weeks that you put it into use. I have included the most basic setup below but there are some extra features you can add if you have some money left over. You can build on this system by using multiple solar panels and batteries. We will talk about wiring together multiple panels and batteries later on in the book.

Please see the below setup diagram:



1. Energy source – Solar panel(s) (12V is fine)





- 
2. Charge controller
  3. Battery
  4. Inverter
  5. Household loads (Laptop, TV, DVD player etc.)

This is a really simple solar power setup that you can create for less than \$200. You can either purchase your solar panel or make your own. We will discuss the process of building the actual solar panel later on in the book.

This type of system is great for outdoor use. A good place to store the batteries and other electrical equipment is in your garage or shed. You can then run appliances straight off your inverter. Fridges are great to run of this type of system and you will be surprised at how much power you can save just by running your fridge from this system.

### **Options:**

Batteries work better at warmer temperatures so it is a good idea to invest in a battery box. This will also keep the whole system neat and is a good idea if you have pets or children around. Another feature you can add is a system meter. This will go between the battery and the inverter. The system meter will tell you how full your battery is and how much power is being used.

### **Grid-Intertied solar power system**

This is the type of solar power system you should use if you





a still using power from the grid. This is also known as on-grid, grid-tied or a utility interactive solar electric system. If more electricity is produced by the solar system than that is used by the household loads then this will actually turn the electric meter backwards. When this happens it will credit your account and you can use this for future months power usage when less electricity may be produced (periods of cloudy weather). This arrangement is called net metering or net billing. Please consult your local electricity provider or state regulatory agency for further information. Please see the below diagram of a simple grid-intertied solar power system:



## 1. Energy source – Solar panels





- 
2. Array DC disconnect
  3. Inverter
  4. AC Breaker panel
  5. Household loads
  6. Kilowatt per hour meter
  7. Grid

### **Grid-intertied solar power system with battery backup**

Below is a grid-intertied solar power system with a battery backup. The battery backup is used for times of cloudy weather or if maintenance is needed on the system.





1. Energy source – Solar panels
2. Array DC disconnect
3. Charge Controller
4. Deep cycle battery
5. System meter
6. Main DC disconnect





- 
7. Inverter
  8. AC Breaker panel
  9. Kilowatt per hour meter
  10. Grid
  11. Household loads

### **Off-grid solar power setup**

Below is the off-grid solar power setup. In this setup a generator is needed to keep the battery charged when the sun can't. (Diagram is on next page)





1. Energy source – Solar panels
2. Array DC disconnect
3. Charge Controller
4. Deep cycle battery
5. System meter
6. Main DC disconnect
7. Inverter
8. Generator
9. AC Breaker panel
10. House





---

## 10. Household loads

### The parts and what they do

#### Solar panels



Otherwise known as PV panels they are a solar-electric system's defining component. PV panels capture the sunlight and create direct current (DC) electricity.

PV panels are rated in watts based on the maximum power they can produce when performing under ideal sun and temperature conditions. You will need to use the rated output of your PV panels to determine how many panels you will need to meet your electrical needs. You can then combine the PV panels in a series, which is called an array. We will talk about different wiring configurations later in this book.

#### Array DC disconnect





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The DC disconnect is an important part of a system for maintenance. Using a DC disconnect makes shutting off the power much easier.

### **Charge controller**



A charge controller will drastically increase the life of your battery. This unit will protect the battery from being overcharged. When the battery bank is fully charged, the charge controller will interrupt the charging process. Some charge controllers also stop the battery from discharging at night time.

### **Deep cycle battery**



This is the type of battery you should use in your system. This is what will store all of the energy produced by your PV panels. A great place to source free deep cycle batteries





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from is old golf carts or forklifts.

## System meter



A system meter is used to monitor how full your battery bank is. You can also see how much power is being used at any time. This is a great unit that can monitor your whole solar electric system.

## Main DC disconnect



This unit is placed between the battery bank and the inverter. A main DC disconnect will allow you to disconnect the inverter for maintenance.

## Inverter





The inverter is what turns the direct current (DC) into alternating current (AC). AC is what most of your household appliances use. Eg. Refrigerator, TV, VCR, Computer etc. etc. If you do not wish to use any appliances that need AC then you can simply use a DC input. A DC input costs around \$10 from any car parts store.

## **Generator**



If you are setting up a solar electric system for off-grid living you will need to use a generator. A generator is used to produce electricity for times of cloudy weather or for when you are performing maintenance on the solar electric system.

## **AC breaker panel**





This is the point where all of the homes electrical wiring meets with the provider of the electricity, whether it is the grid, a solar electric system or a wind electric system. This unit is usually found in a utility room a garage or mounted in a metal box on the outside of the building.

Each state/country has different standards for the way solar energy is connected to the AC breaker panel. For a grid inter-tied solar electric system you have to realize that in most countries it is illegal to hook up your solar energy system to the AC breaker panel unless you are a qualified electrician. **At this point we recommend you call your local power company or an electrician.**

If you do not wish to go as far as connecting your system to the breaker panel you can simply run your appliances straight from your AC inverter. Running your appliances straight from the inverter is easy and a very cheap option.

### **Kilowatt per hour meter**





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If your home is grid-tied you will have a kilowatt per hour meter. This will monitor both the electricity coming from the grid and to the grid from your solar electricity system. If you are producing more electricity than you are using, you will notice you are actually turning this meter backwards!

### **Grid (utility grid)**



The grid is the main power supply coming to your house (unless you are living off-grid of course)

### **Household loads**





The household loads consist of anything in your home that uses power from your AC breaker panel. This includes anything that you plug into the wall.

### **Obtaining free solar panels**

To save even more money I'm going to give you a neat little tip that has literally saved me thousands. I will tell you exactly how I manage to get all of my solar panels for free. Now if you prefer to simply purchase your panels that's fine. I am just offering this information as you may be able to save some money.

Now you will often see signs around construction sites that are solar powered, (which is great) from time to time these signs will get damaged from drunk drivers or rubber-neckers passing through construction areas. Look closely at the signs and you will find a sticker with the phone number of the traffic sign rental contractor. Write down this phone number!

Ask for the shop maintenance manager or head mechanic and ask him for free damaged panels. Just about all traffic rental sign contractors have free solar panels that have some





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cracks or are slightly damaged. They replace them and throw away the damaged ones. We started asking for them and they let us have them for free. Most of the panels worked fine but didn't work at 100%. When they are free, who cares!

Test and repair the damaged panels as needed, cracks can be resealed with clear silicone. Wiring can be soldered back together. Also remember to leave your details with the company that gave you the free solar panels as they may have more in the future.

Another place to get free (or massively discounted) solar panels from is actual suppliers of the panels. Many home owners who have had solar panels for years will upgrade their panels. The old panels usually get thrown away because they are not the latest and they cannot be sold. This is where you swoop in and claim them. All you need to do here is call some local solar power companies and ask if they have any old panels that will be thrown out!

If you cannot get any free panels from the above methods then do not give up hope. We have sourced MANY cheap solar panels from ebay. All you need to do is start an account at [www.ebay.com](http://www.ebay.com) and search for "solar panels". You will find listing after listing of solar panels that are much cheaper than commercial products.

### **Building your own solar panels**





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Now I am going to show you how to build solar panels for as cheap as possible! Below is a list of the parts you will need:

**Solar cells:** Obviously the most important part. The BEST place for old broken solar cells is again eBay. This time search ebay for “chipped solar cells” or “broken solar cells” etc. Below are a few listings that we have found and you can see that these are seriously cheap. All we need to do is fix them up! If you want to spend a little extra then just purchase solar cells that are not broken as it will make the project that much easier. It is a good idea to get complete cells for your first project.

Below are a few ebay auctions for chipped solar panels to give you a rough idea of the type of thing to look for:





[Back to list of items](#)

Listed in category: [Home & Garden](#) > [Tools & Home Improvement](#) > [Electrical & Solar](#) > [Alternati](#)

## Lot of Broken Chipped Transparent Solar Cell Panel Rare

Bidder or seller of this item? [Sign in](#) for your status



1 of 2

[View larger picture](#)

Current bid: **US \$26.00**

Your maximum bid: US \$  [Place Bid >](#)

(Enter US \$27.00 or more)

End time: **15 hours 16 mins** (Jul-22-08 14:28:11 PDT)

Shipping costs: [Calculate](#)

Ships to: **Worldwide**

Item location: **Duluth, MN, United States**

History: [12 bids](#)

High bidder: (13 ★)

You can also: [Watch This Item](#)

Get [SMS](#) or [IM](#) alerts | [Email to a friend](#)

Listing and payment details: [Show](#)

Get **0% APR until Jan 2009** on all your purchases made through July 31 with a new eBay MasterCard! U.S. Residents Only [See Details](#) | [Apply Now](#)





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## Chipped solar cells make solar panel over 2lbs

Bidder or seller of this item? [Sign in](#) for your status



1 of 2

[View larger picture](#)

Current bid: **US \$0.99**

Your maximum bid: US \$  [Place Bid >](#)

(Enter US \$1.04 or more)

End time: **Jul-27-08 19:56:33 PDT (5 days 20 hours)**

Shipping costs: **US \$25.00**  
US Postal Service Parcel Post®  
Service to [United States](#)

Ships to: **Worldwide**

Item location: **Phoenix, Arizona, United States**

History: [1 bid](#)

High bidder: (217 [★](#))

You can also: [Watch This Item](#)

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Listing and payment details: [Show](#)

These are chipped up fairly badly but can be repaired and will cost you peanuts.





[Back to list of items](#)

Listed in category: [Home & Garden](#) > [Tools & Home Improvement](#) > [Electrical & Solar](#) > [Alterr](#)

## 32 Chipped solar cells make solar panel

Bidder or seller of this item? [Sign in](#) for your status



1 of 2

[View larger picture](#)

Current bid: **US \$0.99**

Your maximum bid: **US \$**  **Place Bid >**

(Enter US \$1.04 or more)

End time: **Jul-27-08 20:24:50 PDT** (5 days 21 hours)

Shipping costs: **US \$25.00**  
US Postal Service Parcel Post®  
Service to [United States](#)

Ships to: **Worldwide**

Item location: **Phoenix, Arizona, United States**

History: [1 bid](#)

High bidder: (4)

You can also: [Watch This Item](#)

Get [SMS](#) or [IM](#) alerts | [Email to a friend](#)

Listing and payment details: [Show](#)

This is the winning bunch. You can see from the below picture they are not too bad and can be restored and turned into a working solar panel without too much drama.





**Strong plywood:** This will be the backing and is what will hold all of the cells. About 10 to 15mm is enough. Don't go out buy expensive hardwood as we are going to cover the wood in UV protector anyway.

**Wood:** We will need to make a wooden border around the cells. This is what we will fix the glass too.

**Glass:** This is used to go over the solar cells to make the whole unit one piece. It is best to get non reflective glass. You can buy this from any glass store. Just give them the measurements you are after. It is a good idea to get this last because then you will know exactly the size you are after.

**Copper wire:** Used to connect the cells together. Two different colors make it easier to tell what is positive and what is negative.





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**Silicone:** This is what we use to hold the cells onto the plywood and the glass to the border.

**Solder:** We need the solder to hold the copper wire onto the back of the solar cells.

**UV Protector:** The Plywood needs to be coated in UV protector so that it will last longer out in the sun.

### Let's get started

1. You need to cut your plywood to size depending on how many solar cells you have. You should use 80 solar cells because this will produce a neat 100 watts of power. For more power we need to wire multiple panels together and this will be discussed at the end of the chapter.





2. Apply 3 coats of UV protector to the plywood. Any type of deck or fence coating as show below will do the trick.





3. Now its time to join the solar cells together to form the circuitry of the solar panel. Arrange all of the cells face down on the floor. On the back of the cells you will see little tabs. You will need to drop a small about of solder onto each of these tabs. This will make it easier when it comes to soldering down the copper wire.

This is easiest when using the pencil style solder iron. Well it's what I personally use anyway.

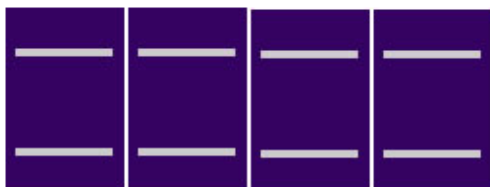


Below is an example of what your solar cells look like. Remember these cells are very fragile so take care when moving them around.





Front of cells:



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The first thing you will need to do is solder copper wire along the front of the cells. The copper wire should be twice as long as the cell and you will see why we do this soon. See the below diagram:



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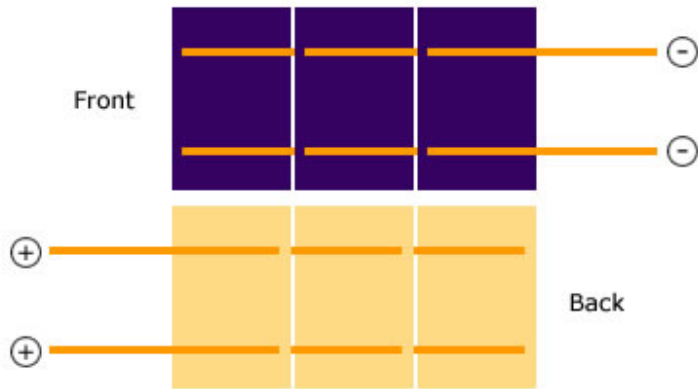
Now the extra wire is soldered to the back of the following cell like in the example below:



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In the below diagram you can see what the front and back look like after they are connected:

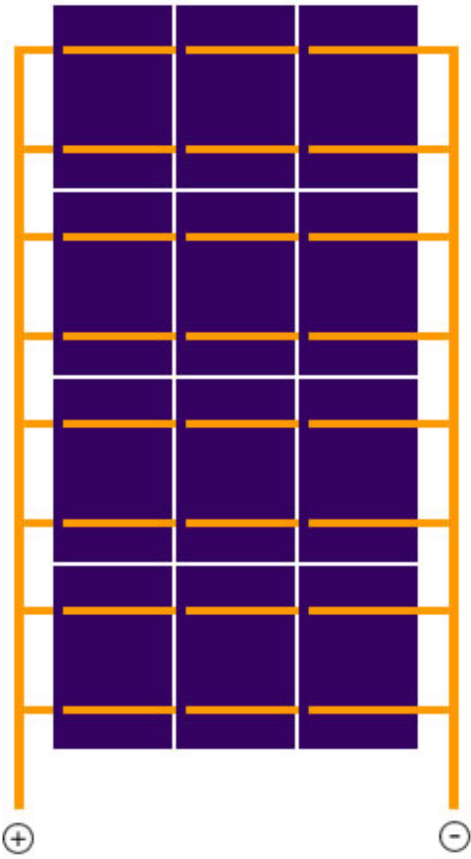




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Once you have connected your cells in rows like above. You can then connect all of the rows together. This is done using thicker wire down the sides which is known as the bus. See the below example of how this is done:





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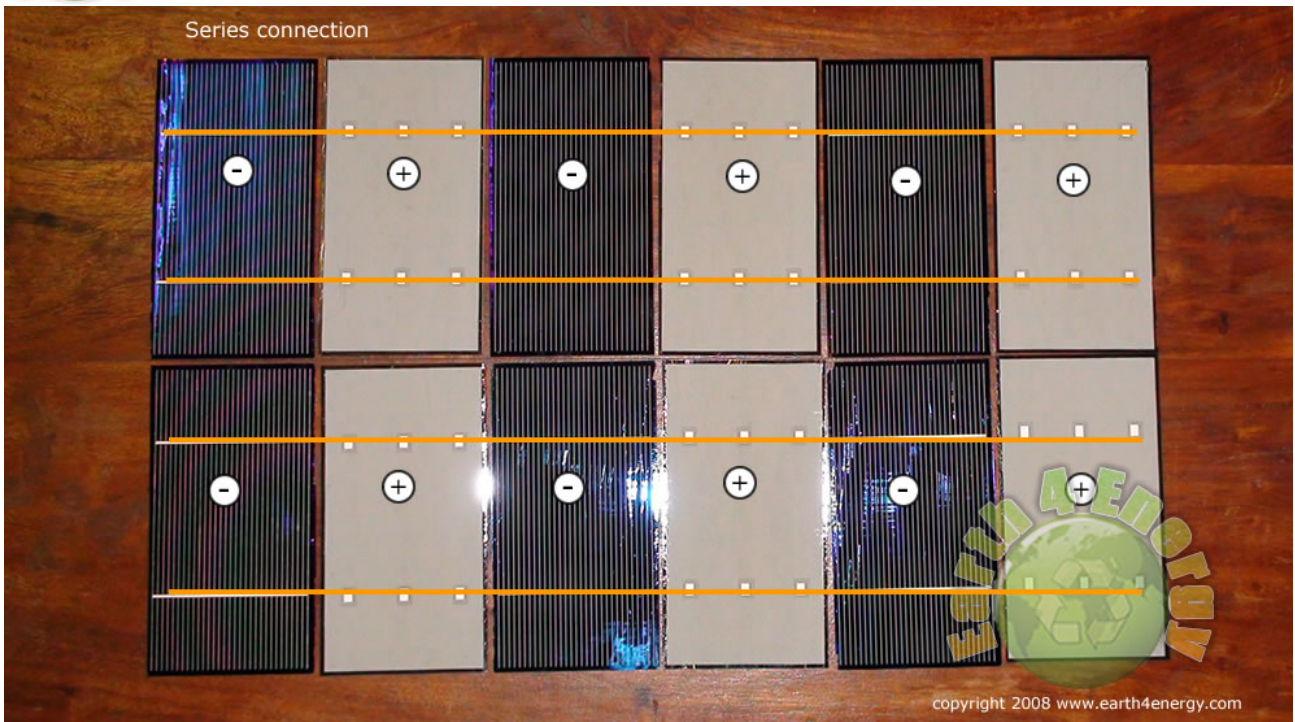
To better help you understand the wiring process please see the below picture:





This is basically how the cells are wired together. They are wired in series to increase the voltage.





Note: Before you solder the cells together you may need to scratch the surface that you solder to. The white strip on the front (-) and the little tabs on the back (+) should be slightly silver. So if they are white you can scratch them gently with a butter knife.

4. Now let's fix the cells to the plywood. For the purpose we use silicon. Just use enough to hold the cells in place. Any type of sealant will do the trick really. There is no need to cover the wires, just use enough to fix the cells to the plywood.

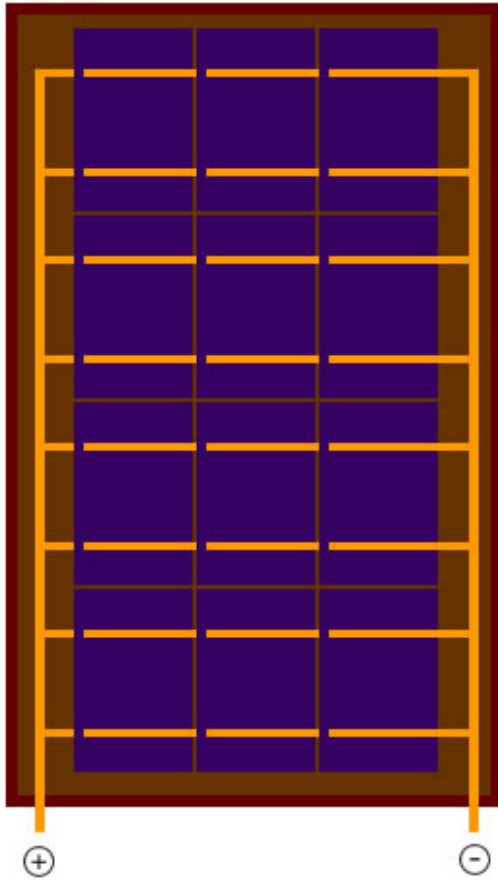




5. Now in the above diagram of the cells wired together you will notice the 2 wire ends. These wires need to go through the plywood. Drill a couple of holes where the wires end so you can feed the copper wire to the back of the plywood. Drill a hole for each wire; don't just pass them through the same hole, as you want to reduce the chances of these coming into contact with each other.

6. You will need to fix some wood to the front of the plywood as a border around the solar cells. Apply silicone to the wood and screw it down from the back. The reason why we use silicone is to prevent water from getting inside the panel. This is what we will fix the glass too. See the below diagram:



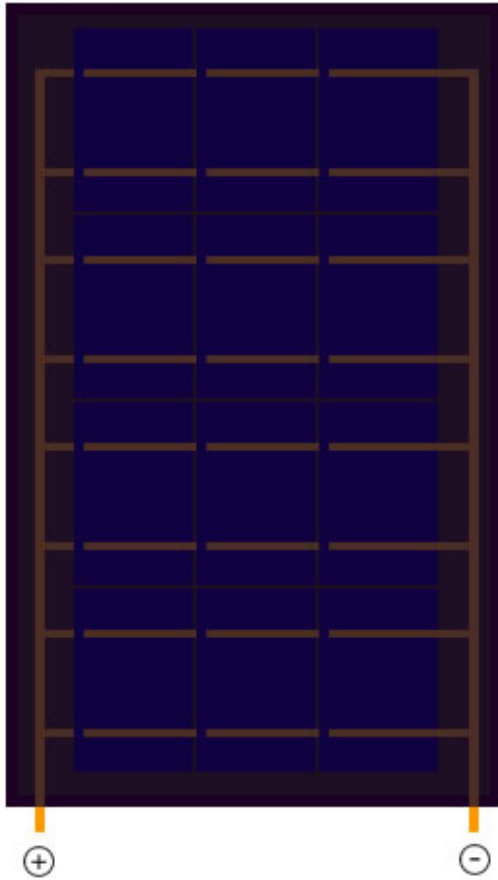


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7. Now we can fix the glass to the border and cover the cells. To do this we use the same silicon that was used to hold the cells to the plywood. If you can't get glass you can also use acrylic. This may be a cheaper option for you.

Complete solar panel:





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8. Silicon up the holes around the 2 copper wires that you have out the back of your plywood. If you notice any other gaps or holes make sure you also fill them in.

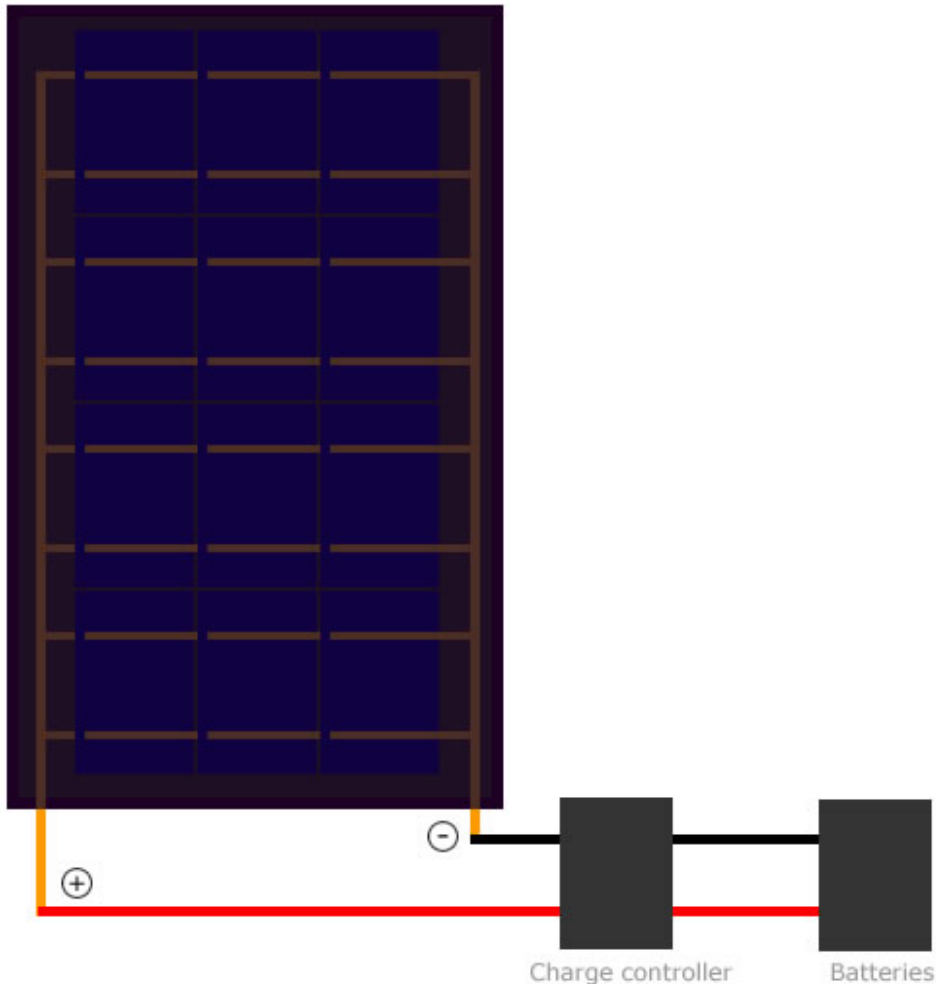
9. At the bottom of the panel away from the wires drill a "breather hole". You will do this to avoid moisture build up inside the solar panel.

9. You can now join electrical wire to the copper wires. This then connects to your charge controller or your batteries. For help on choosing the correct wire for this please visit





here: <http://www.earth4energy.com/cablesize.pdf>



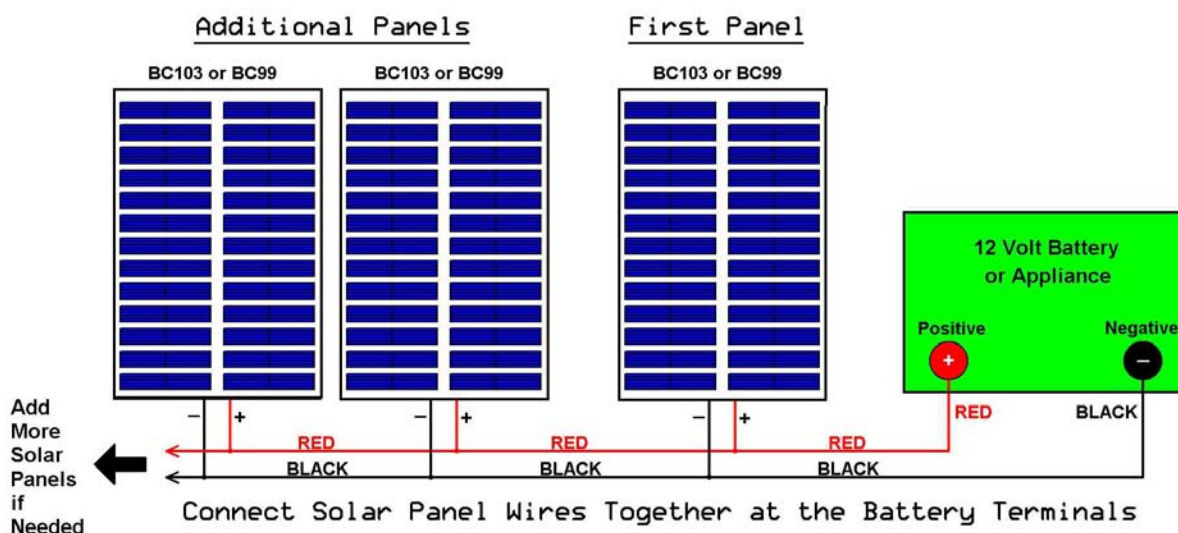
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NOTE: Before you start gluing anything down it is a good idea to put your cells in the sun and use a volt meter to check what sort of power your cells are putting out. For more power you can join multiple panels together with a simple parallel wiring configuration. Below is a diagram of multiple solar panels being used:





## Solar Panel Parallel Wiring Diagram for More Power



We will talk more about wiring configurations later on in the book.

### Maintenance of your solar panels

You should clean your solar panels at least once per year to insure maximum performance.

1. Confirm that the correct battery type has been selected.
2. Confirm that the current levels of the PV (Photovoltaic) array and load do not exceed the ratings.





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3. Tighten all terminals, inspect for loose, broken, or burnt wire connections. Be certain no loose strands of wire are touching other terminals.

4. Check that the charge controller is securely mounted in a clean environment. Inspect for dirt, insects, and corrosion.

5. Check that the air flow around the charge controller is not blocked.

6. Confirm that water is not collecting under the cover.

7. Check that the charge controller functions and LED indicators are correct for the system conditions at that time.

To clean the panels use non-abrasive cleanser and paper towels. The surrounding environment and the amount of road dust encountered determines how frequently the panels should be cleaned. One to two times a month is preferred.

A critical part of maintaining the solar powered battery charging system is keeping the panel clean. The amount of power that a panel will produce is directly related to the intensity of sunlight that reaches the internal crystals. A dirty panel will allow less light to reach the crystals resulting in reduced power output. A layer of dust or road grime can reduce power output by 15 to 25%. Combining dust with leaves and debris that cover two or three of the individual cells can reduce output power by 50 to 75%.





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Use of the basic maintenance tips, regular inspections and regular cleaning will assure maximum performance from the solar charging system.

## Chapter 4: How Wind Power Works

Wind power actually works in a very similar matter to hydroelectric power. In both cases, all you need is a driving force to create kinetic energy. In the case of hydro-electricity, that force is water. In the case of wind turbines, that force is the wind.

A wind generator consists of three basic parts.

- **Rotor blades:** Rotor blades are used to transfer energy from the wind into kinetic energy.
- **Shaft:** When the rotor blades rotate, they rotate the shaft, which transfers the mechanical energy into the generator.
- **Generator:** Generators operate on the principle of electromagnetic induction. When magnets are rotated around a conductor, they generate electricity.

It really is that simple. Electricity is created by magnets rotating around an electrical coil and generating electricity. The wind power is simply used to rotate the magnetic field





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around the coil, causing atoms and electrons to be displaced, thus creating kinetic energy that is then translated into electricity.

## **Chapter 5: Buying a Wind Turbine**

All wind turbines have 5 things in common. They all utilize a generator, blades, a mounting to keep them in the wind, a tower, and a control system.

If you're looking for a solution that provides a viable replacement for the majority of your energy needs, than you may want to look into prefabricated wind turbines.

A wind turbine large enough to provide enough energy to power an average sized home can run anywhere from \$6,000 to over \$20,000. They currently reduce utility bills by 50%-90% on average and typically pay for themselves after 8-15 years. You can also build one, or multiple windmills to obtain similar results for much cheaper then \$6,000.

In order to calculate whether or not a wind turbine can be cost effective for your home you'll need to consider energy costs and wind speed. A basic rule is that you want the average wind speed in your area to be at least 10mph and if money is a concern wind turbines start to make economic sense at about 10 cents per kilowatt hour.

Wind turbines are becoming less costly to produce, and are





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continuously becoming more and more efficient. Soon seeing wind turbines powering rural homes, more turbines running in windy areas, and even turbines on the ocean will be a common occurrence.

## **Chapter 6: Building Your Own Wind Turbine**

Most wind generators sold commercially can cost several thousand dollars and the price only rises from there.

Here we're going to show you how to build your own wind generator for as little as \$200. These windmills can be setup to power any household appliance. Even though you can build this windmill for next to nothing, you will need to be in a windy location for this to be worth the effort. There is no point building a windmill if there is no wind, right? In which case, you should look into solar power.

Here's what you'll need to get started on your windmill:

- DC Power Motor
- Body Assembly
- Tail Assembly
- Blades To Collect The Wind Energy
- A Hub To Connect The Propeller To The Motor
- A Tower
- A Battery Bank
- Nuts And Bolts
- Miscellaneous Hardware





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The majority of the materials that you'll need can be found rather inexpensively on Ebay and at your local hardware store.

As for the tools, you'll need a socket set, several screwdrivers, a grinder, a jigsaw, and some sandpaper.

Now that you are ready to get started we need to source all of the parts you are going to need. Below are the cheapest options to get these parts.

### **Finding Cheap Batteries**

You'll need a good deep cycle battery to store the power from your wind generator.

These can be purchased rather inexpensively on Ebay, but there are ways to find them for free as well.

A couple of good sources of free batteries are old golf carts and forklifts.

Companies tend to replace these batteries long before their shelf life runs out, and they just so happen to make the perfect deep cycle battery for our wind generator project.

So if you haven't got a deep cycle battery on hand then go ask your local golf club or any fork lift distributor. If you tell





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them that you are building a windmill (or solar system) then I am sure they won't mind handing you a few old batteries. If you need to recondition these batteries and don't know how then I highly recommend the "Battery Reconditioning Report". Visit the site here:

<http://d2c8s5.kevindixon.hop.clickbank.net/>

### **Finding A DC Motor**

In order to find a DC motor you can check Ebay, or look for inexpensive power tools. Drills, screwdrivers and other tools are a great way to find inexpensive DC motors although they do not generate much energy they are great for smaller projects.

### **So how do DC motors work as a power generator?**

Usually a DC motor will use power, but when we spin the motor in the opposite direction it will actually generate power. The power will go back out the same wires where the power usually comes in from. It's very simple which is why DC motors are perfect for our DIY wind generator.

### **What DC motor should you use?**

What you want to look for is a surplus permanent magnet DC motor and pay attention to the RPM, shaft size, amps and voltage. You need to look for a DC motor with a LOW RPM rating. The reason for this is because when we use a DC motor as a generator it must spin much faster than the rated RPM to produce the rated voltage. Your goal is to obtain a





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DC motor with HIGH voltage (over 12v), HIGH current and LOW RPM rating.

An ideal motor would be one rated under 400 RPM at 30 volts. When this is used as a wind generator you could expect 12v at a low RPM.

If you do not have strong winds then you need a motor with a very low RPM rating. Obviously though, strong winds are the key to high generator output.

Below is a picture of a DC motor that we found on ebay for just \$35!



A good DC motor that you can find quite easily from ebay is the 1150 RPM 38 VDC Ametek motor. These motors will produce about 13 volts at about 390 RPM. Perfect for a homemade wind generator. These motors cost about \$50 and you can see a picture of it in the below ebay ad.





## New SERVO 1150 RPM 38 VDC AMETEK motor, wind generator

Bidder or seller of this item? [Sign in](#) for your status



Current bid: **US \$49.99**

Your maximum bid: **US \$**  [Place Bid >](#)

(Enter US \$50.99 or more)

End time: **13 hours 16 mins** (Jul-30-08 19:11:42 PDT)

Shipping costs: **US \$12.50**  
US Postal Service Priority Mail®  
Service to [United States](#)  
([more services](#))

Ships to: Worldwide

Item location: midwest United States, United States

History: [1 bid](#)

High bidder: (2)

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## Finding A Tower

Old satellite TV towers work well, as well as standard steel pipe, 2-3" thick. Anything that is sturdy, roughly 8-12 feet tall, and can easily be anchored in the ground with concrete can make a great tower. Alternatively, if you know how to weld you can build your own tower. Below is a picture of a cheap satellite tower sourced from ebay. It's the perfect tower for a backyard windmill.





## **Material For The Blades**

The most efficient wind generators have a blade diameter of roughly 8 feet and a total of 3 blades. If you find that 8 feet is simply too large for your backyard then you can cut it back as needed. Just make sure the shape is the same.

Remember, our goal is to produce 1000 watts of power and to achieve this output you will need to use blades of about 8 feet in diameter with wind speeds of at least 20 miles per hour.

The best materials to use to create your blades is ABS or PVC pipe. Pipe that is between 8 and 12" in diameter works the best.

**Note:** When using pipe, keep in mind these where intended to be used underground. We recommend painting them with

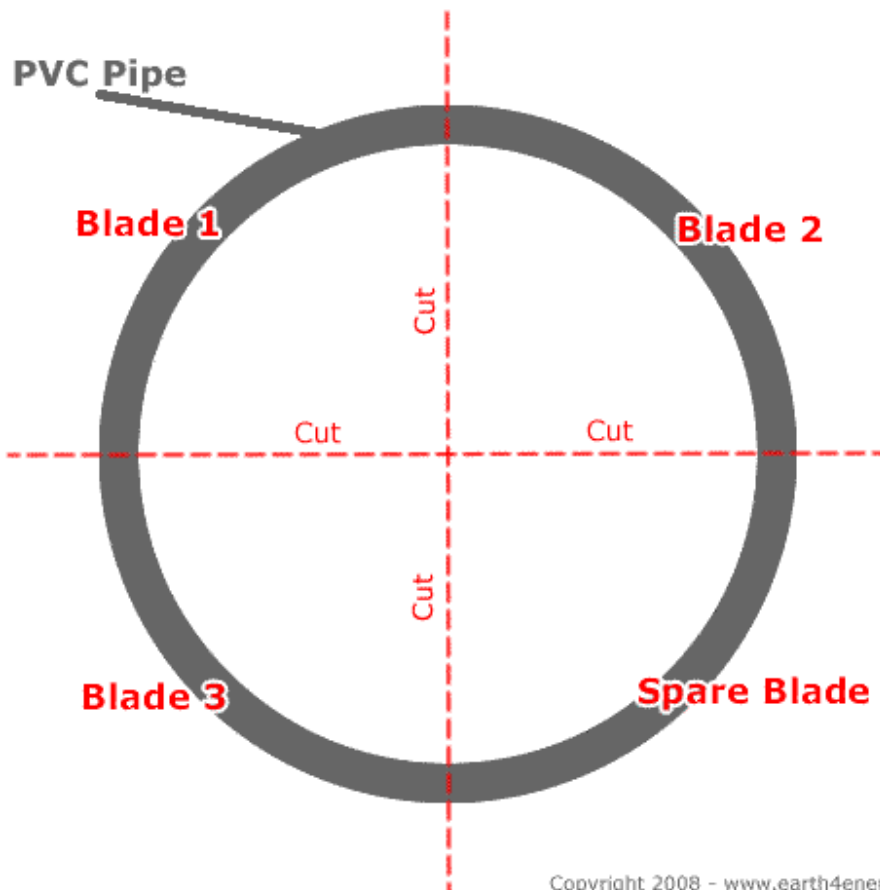




a UV inhibitor in order to prolong the life of your wind generator.

## Cutting The Blades

You can use the jigsaw for this purpose. You'll want to cut each of the blades 4-5 feet long so that the total span is about 8 feet. Cut the pipe into quarters as seen in the below diagram:



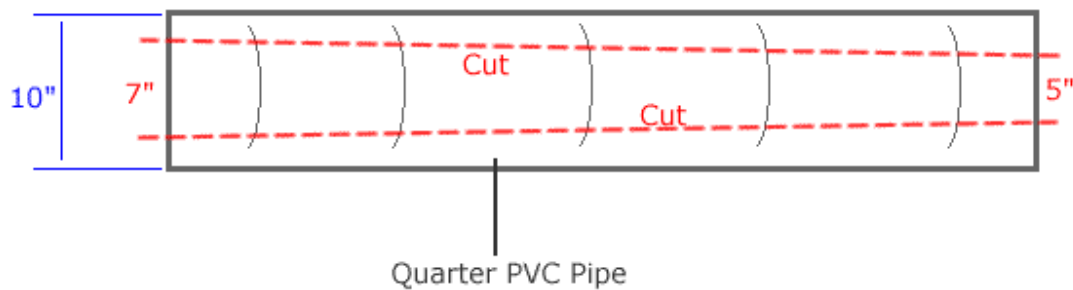
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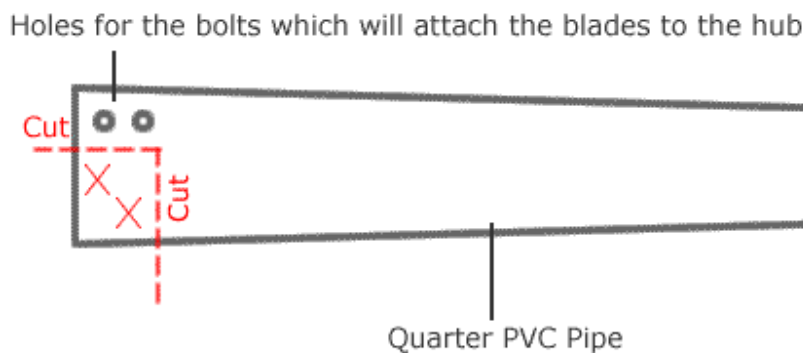
You want about half of the diameter of the blades left at the base, with the blades forming a rounded point at the outer edges.

If you are using a pipe with a 10 inch diameter the blade should be 7 inches wide at the hub and 5 inches wide at the tip. Please see the below diagram:



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You will then need to make some extra cuts and holes as shown in the below picture



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Cut one, then use it as a template for the rest. After you cut the blades feel free to sand them down in order to improve efficiency. Pay extra attention to the leading edge of the





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blades. The smoother this is the easier it will cut through the wind and pick up speed.

You should now have 3 blades that look like the shape below:



### **Building The Hub**

The hub is what connects your blades to the generator. These can easily be found at your local hardware store, on Ebay, or even your local junk yard.

The hub must fit tightly on the DC motor shaft so that when the hub turns the motor will turn. To do this we just drill a hole in the very center of the hub that is the same size as the shaft on the motor. We will attach the hub assembly to the motor later.

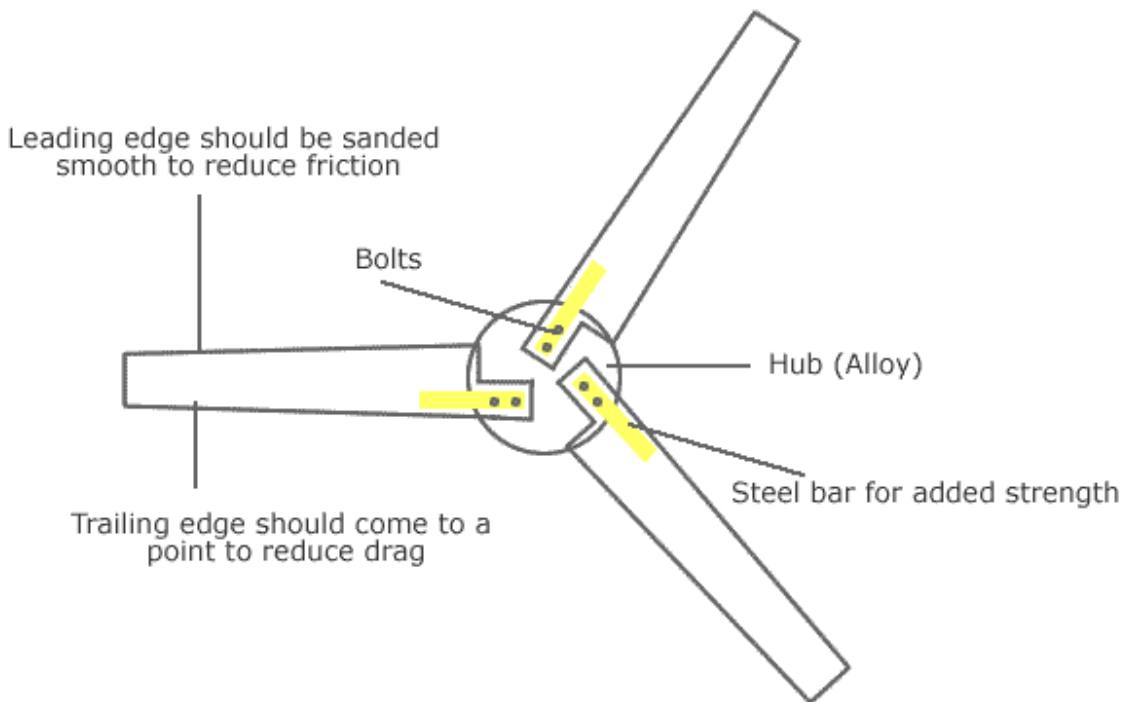
Remember: When drilling the hole in the center of the hub you must make sure it is in the dead center. If it is just a





fraction off center the whole assembly will shake wildly when the blades start spinning.

You'll want to attach the blades to the hub, and then the hub to the motor shaft. Flat steel bars, approximately a foot long and 2" wide work well to attach the blades to the hub. These bars will also add a lot of strength to the blades which will be needed for high winds. See the below diagram to see how it should look so far:



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Once you have the hub assembly put together securely, it's time to move on.

## **Balance the blades and hub**





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Making sure the whole thing is balanced is a very important part. If it's not balanced it will not produce the expected output and over time will also ruin the motor's shaft and bearings. Getting it correct right now will save you many headaches in the future.

Here is an easy at home way to test if it is balanced. First, number each of the blades with a pen. Put the hub assembly on a pole and give the blades a good spin. Do this about 10 times and take note to what number blade is at the bottom each time. If you find that the same blade ends up at the bottom every time then you will know this blade is a little heavier than the others. To fix this you can shave a bit of the metal off the bars that hold the blades to the hub. Use a metal grinder to do this.

### **Mount the hub assembly to the DC motor**

It's important that the hub assembly is tight and secure on the DC motor. Slide the shaft of the DC motor in the hole in the middle of the hub that we drilled before. To make sure the hub doesn't slide back out we can drill a hole through the end of the motor shaft and put a small bolt through it. Drill the hole in the shaft as far down as possible (when the hub is on) to insure the hub doesn't shake back and forth.

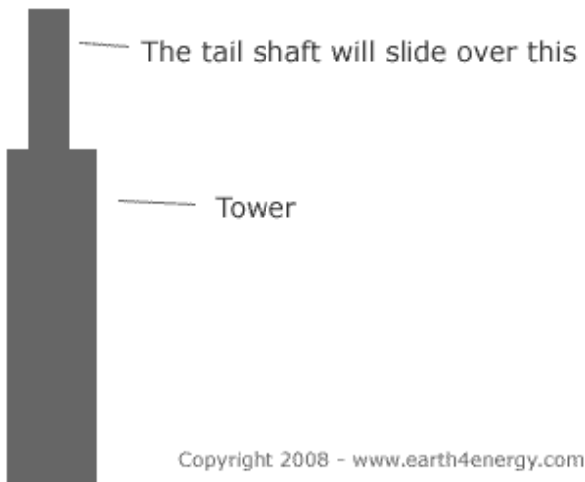
### **Building The Axis**

You want the blades on your generator facing the wind at all times. For this reason, it's important to have it rotating on a horizontal axis when mounted to the tower. First let's take a

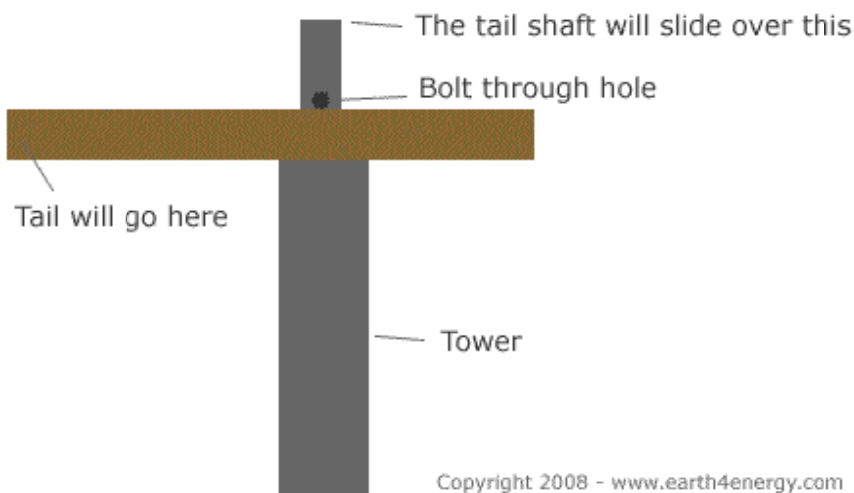




look at what the top of your tower should look like.



If your tower does not have the smaller section on the top you will need to weld this piece of metal on. Make sure that the diameter of this piece is not wider than the diameter of the windmills tail shaft. The reason for this is because we will be drilling a hole in the tail shaft and it will slide over the top of the tower. Please see the diagram below:



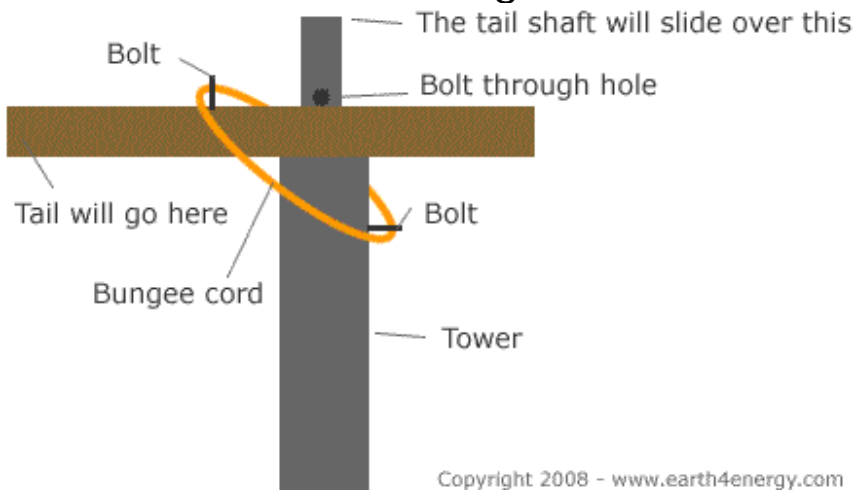
You will need to measure the height of your tail shaft and





drill a hole through the top piece of the tower as show above. Make sure to drill the hole down far enough so that when we put a bolt through it, it will hold the windmills tail shaft in place. Now the shaft should be secure and it should be able to freely spin around the top of the tower. If it is tight you may want to grease up the top of the tower where the shaft spins around.

So this will allow the windmill to spin around so that the blades are always facing the wind, but how do we stop it from rotating wildly during high winds or severe storms? This is not something we want as it could tangle the wires and damage them. The easiest home fix for this is to use a bungee cord. You may think this sounds like a cheap little fix, and you are right! It is a cheap fix and it works very well. See the below diagram:



You will need to use a couple of bolts to make sure the bungee cord doesn't slip up and tighten around the tower when it spins. The bungee cord is to be a loose fit so that the windmill can still spin 180 degrees without the bungee





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cord holding it back.

## **Building The Tail Piece**

The tailpiece is important for maintaining balance and ensuring that the blades maintain maximum efficiency.

From our tests, a tail length of between 3' and 4' works the best. Simply cut out a tail shape from the metal and attach it to the back of the assembly. You can use any shape you like, just make sure it's large enough to catch the wind. You can fix it to the shaft simply by using a flat bracket.

## **The Charge Controller**

In order to prevent your battery pack from overloading from too much energy, a charge controller is absolutely necessary.

Although it is possible to build one from scratch, it's probably more economically viable to just find a cheap one on Ebay. You can find charge controllers on ebay for about \$25. For more information about charge controllers please see the end of chapter 2 (Building a solar power generator).

Set up the controller to defer extra power to the dump load (we'll cover this in a bit).

## **The Dump Load**





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The dump load is where extra power is sent. You can use an appliance such as a hot water heater, a backup battery pack, or a simple ground wire to send excess power to.

### **AC Inverter**

If you want to use AC power instead of DC power, you'll need an AC inverter to convert the power. Once again these can be found rather cheaply on Ebay. For more information about inverters please see the end of chapter 2 (Building a solar power generator).

### **Wiring Everything Together**

The gauge of wire that you'll need to use is highly dependent on the materials used. To help select the correct electrical wire visit here: <http://www.earth4energy.com/cablesize.pdf>. You can also talk to a local electrician over the phone and they will usually help to.

You'll want to wire everything in the following order:

**DC Motor > Charge Controller > Battery Pack > AC inverter**

That's how you build your own self-sustaining wind turbine in a nutshell. You can modify any parts of the windmill to suit your needs so don't be afraid to get creative. Good luck, and remember, safety first!





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## **Chapter 7: Wiring combinations**

There are 3 different ways you can wire up your batteries/solar panels and each of them will have a different outcome. The 3 wiring set ups are series, parallel, and a combination of both which is simply called a series/parallel set up. We are going to talk about each of these in detail and how you can set up each of these by yourself.

### **Chapter 8: How much power do YOU need to make?**

Obviously this will vary from household to household but I can give you a general overview of the type of power you will need to produce so that you can reduce your power bill.

450 watts – A solar or wind power system that produces just 450 watts can have a huge impact on your electricity bill. A 450 watt system will be enough to power all of your lights, TV, DVD/Video player, microwave and a toaster. So, how do we make a 450 watt system? For this we would need to have 5 solar panels producing 24V with 4 amperes each. This would give us 480 watts of renewable power that will last for years to come.

### **Chapter 7: Reduce Your Oil Dependence**

One of the biggest problems that people as individuals face when trying to reduce personal energy consumption is overcoming the amount of fuel they consume for personal





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transportation.

There are already many cars coming to the market that greatly reduce the consumption of fossil fuels. Fuel efficient hybrid vehicles do make a significant difference.

Another alternative to fossil fuels that is already available to the public is grease powered conversion kits.

These kits allow you to take a standard diesel engine and convert it to run on filtered vegetable oil.

The benefits are that vegetable oil is a renewable form of energy, it's less costly than gasoline, and it also burns cleaner.

The downside is that the engines still need diesel to start, and they need to be warmed up before running on the vegetable oil. Therefore they aren't well suited for people who make short commutes or don't drive on a daily basis.

For the time being, beyond riding a bicycle, walking, or using public transportation, hybrid vehicles are about the best alternative currently being offered to the public on a large and affordable scale.

In the near future, we can expect to see electronic cars become more mainstream. Cars running on solar energy and alternative fuel sources such as hydrogen will be common





place.

Making the transition to electric vehicles is going to be an increasingly critical issue over the next few years. As long as we can get the cars running on electricity, then we have a wide variety of renewable options at our disposal to power the vehicles.

Batteries could be charged by solar power, wind power, hydro electric power, and many other technologies as well. With rapid advancements in technology we're getting closer by the day to finally getting over our dependence on fossil fuel use.

## **Chapter 8: The Self Powered Home Of Today**

A completely self-sufficient home that is “off the grid” so to speak is now possible. There are thousands of such homes around the world.

It's possible to build one from scratch, or to modify a traditional home to be powered by a variety of renewable energy sources.

The benefits are obvious. People spend less money on electricity over the long term. They consume less fossil fuels, have less of an impact on the environment, and the modification can drive the value of your home up.

There are multitudes of ways that a home can run off of





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renewable energy. Depending on several factors such as wind speed, the amount of sunlight, whether you live near a stream or river, and other factors can influence what types of energy sources are appropriate for your home.

Most of these self sufficient homes run off of a combination of energy sources. Sometimes solar power and gas and sometimes wind power and hydrogen. Everything really depends on your location.

The problem most people run into is that one or even a combination of alternative energy sources still don't generate enough electricity to maintain the power consumption that people have grown accustomed to.

This leads to homes still using partial power off the grid, or people cutting back on their energy consumption. Some common ways of cutting back on energy consumption would be to purchase energy efficient appliances, use a Lapp computer instead of a desktop, eliminate television or watch a smaller one, and eliminate the majority of air conditioner use.

The largest barrier for most people is the price tag associated with moving off the grid. It depends heavily on what type of power you're going to use, but it still generally costs \$100,000 or more to have enough modifications made to a home to have a significant impact. Please do remember, after converting a home to completely run "off grid" will





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increase the value of the home. So take that into account if you are considering purchasing something like this on your next home.

As technology advances the costs continues to go down, but for now it is out of reach for the majority of the world's population.

If you're interested in finding out if a self sustaining home is a good option for you, here are a few resources that you can review and find out.

<http://www.greenpowergovs.org/> - General information regarding renewable energy sources.

<http://www.akeena.net> – The world's largest installer of solar technology.

<http://www.solarenergy.org> – A non-profit organization dedicated to the education and advancement of solar power as a sustainable energy source.

## **Chapter 9: Renewable Energy On A Larger Scale**

The real changes in energy generation and consumption aren't going to drastically change until large corporations and world governments start becoming involved on a larger scale.





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Without the money and influence that these forces can provide, the advancement in technology related to alternative energy aren't going to happen fast enough to keep up with the world's energy demands.

Now, this book isn't meant to be political, and I'm going to try to keep it that way, but currently, the governments of the world, particularly the US government, aren't doing enough to help the situation.

They are spending millions of dollars on research programs for alternative energy sources such as ethanol derived from corn. They're offering tax breaks to people who drive hybrid vehicles and corporations who invest in the research of renewable energy.

But compared to the billions of dollars spent "elsewhere" every year, they aren't currently doing enough.

To be fair, just the fact that they're doing SOMETHING is a good thing, but they could and should be doing much more.

If even a fraction of the money spent on the US military every year went into the development of renewable energy sources we would see advancement in technologies and the cost of renewable energy start to go down almost immediately.

On the brighter side, public outcry has caused many large





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energy companies to start investing in the research and development of alternative energy sources.

From hybrid vehicles, large scale wind farms, energy efficient appliances, and the ongoing research of environmentally friendly technologies, the change is slow, but a good change nonetheless.

In the very near future a combination of public demand, a diminishing supply of fossil fuels, skyrocketing oil prices, and advances in technology should spark a revolution in how major corporations and world governments look at the research and development of alternative energy sources.

The cost of energy affects the cost of everything. The food you eat, the clothes you wear, everything has a transportation and manufacturing cost, and energy plays a huge factor in the price we pay for every commodity that we use.

This means that it's not just a personal problem or a regional problem. Rising energy costs affect the entire world's population. It's up to those who have the technology and the resources to invest to do so.

It's not just a problem in the developed world. Higher energy costs mean that delivering aid to impoverished nations becomes much more difficult. It means that the resources they do have will become more expensive and therefore out





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of reach to more and more people.

The emerging energy crisis is truly a problem on a global scale. It's not just up to the governments and corporations of the world. Ultimately, the responsibility lies with all of us.

## **Chapter 10: Ethanol As A Viable Energy Source**

Ethanol is an alcohol based energy source usually derived from sugar or corn.

It is already widely used in the United States and Brazil by combining ethanol and gasoline to power automobiles.

The use and production of ethanol is widespread, but there is still much controversy as to whether or not it is an economically stable and viable alternative to gasoline.

First of all, ethanol does burn cleaner than gasoline. Due to its chemical make up, it can reduce or even eliminate the output of carbon monoxide when it burns.

It's not a perfect solution however. In order to produce large quantities of ethanol you need a large supply of either sugar or corn. In the United States corn makes the most sense because it is already a large production crop.

The problem is that farmers are being paid subsidies to grow





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the corn. Since corn still has to be produced for consumption as well, the farmers are being forced to allocate more land for the cultivation of corn.

This has had an impact on corn prices and the bottom line of farmers across the country. Corn is traditionally sold for consumption, and also fed to cattle. This means that allocating more corn for ethanol production not only affects corn prices, but beef and dairy prices as well.

Other problems lie in the production costs of ethanol. Calculating the cost is extremely complicated and is hard to quantify in an exact matter once all things are considered. In order to calculate the total cost you need to figure out how much land is used, the manufacturing and transportation costs, the environmental benefits, positive by products such as alternative cattle feeds, the percentage of ethanol that is going to be used, the environmental impacts, and the added benefit that ethanol is indeed a renewable source of energy.

Despite the controversy, the fact remains that ethanol is renewable, and burns much cleaner than gasoline.

Production and distribution of ethanol is already underway on a large scale. Several states in the US already require that a mixture of at least 10% ethanol be blended in with all fuels.

As technology advances and the cost to produce ethanol





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starts to drop there will be a larger demand for it as a fuel source and in turn a larger demand for vehicles to run on higher mixtures of ethanol.

There are already cars designed to run on 100% ethanol. Ironically enough, when Henry Ford created the Ford Model T, he designed it to run on ethanol, calling it the “fuel of the future.”

He may have been right. Despite the criticism, the fact that ethanol is a renewable energy source, it burns much cleaner than gasoline, it's good for creating jobs on a regional level, and it's cheaper to produce than fossil fuels.

So, ethanol isn't really a new technology. The first car ever created was intended to run on ethanol. So what's the hold up?

The answers are murky, but it seems to be the world has been influenced by energy companies and has become accustomed to being dependent on fossil fuels.

In the early 1900's, it made more economic sense to use fossil fuels as opposed to food supplies for energy.

Today, we know better. There are already cars, trains, buses, even airplanes that run on 100% ethanol.

The fact is the technology is there. The resources are there. It's only a matter of time before we see a huge mainstream





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change from a dependence on fossil fuels to the widespread use of ethanol as a viable alternative.

## **Chapter 11: Hydro-electricity**

Hydroelectric power is by and far the most widely used form of renewable energy.

Used world wide to power entire cities, it's a much cleaner form of electricity than burning fossil fuels.

It's not without its drawbacks though. Even though hydro electric dams do create a renewable source of energy, the actual creation of the dams can have drastic environmental consequences.

The construction of a dam usually requires people to be displaced and large sections of land to be flooded, drastically changing entire ecosystems.

Large dams are not only damaging to environments and communities, but they can pose a serious threat to human life. They are bomb targets during war time, under terrorist threat, and when dams do get destroyed the results can be a catastrophe.

In 1975 the Banqiao Dam in southern China collapsed under the weight of record flood waters. This resulted in over 171,000 deaths and left millions homeless.

Despite the hazards hydroelectric energy is extremely





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important in all parts of the world. Millions upon millions of homes rely on hydroelectric power and once the dams are constructed and functioning properly they do provide a relatively clean and renewable source of energy for large populations the world over.

## **Chapter 12: What's Really Holding Us Back?**

There are some undeniable facts when you really look hard at the issues.

**Fact:** Fossil fuels are becoming increasingly expensive and are running in short supply.

**Fact:** The solutions to the energy crisis are already in place. So what's the hold up? Why aren't we all driving water powered cars and powering our homes with renewable energy?

The simple answer is that the world has taken too long to catch on. Until only recently we didn't fully understand just how low we're running on fossil fuels, and just how big of an impact their use has on our environment.

This lead to a slow down in the advancement of renewable energy technology. While energy sources such as hydroelectricity and ethanol have been in place for long periods of time, newer technologies such as solar power and





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electric cars are being forced to play catch up.

As awareness grows technology will advance and other forms of renewable energy will be less expensive to produce as well as more widespread for public consumption.

And as the prices of fossil fuels continue to rise, governments, corporations, and individuals will all be forced to turn to renewable energy sources to solve the energy crisis.

## **Chapter 13: Energy In The Future**

The future is never certain. One thing we do know is that we can't keep up our current fossil fuel consumption, it's unsustainable. We're going to be forced to turn to alternative energy sources. Here we're going to take a look at some of the concepts being discussed now that are likely to be implemented in the near future.

### **Solar Power From Space**

Scientists have been considering placing large solar panels into orbit around the Earth. This would allow the panels to escape the limitations of the planet, such as clouds, and remain in direct contact with the Sun's rays 24 hours a day 365 days a year.

Scientists have concluded that the Earth dissipates enough





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energy from the Sun in a single day to power the entire planet for a year.

The most challenging aspect of this endeavor is going to be getting the energy back down to Earth. The most logical option proposed so far is to “beam” the energy back down to the planet to a collection station.

This technology is likely years away due to technological limitations.

### **Floating Wind Farms**

There are many places in the oceans where the average wind speeds are much higher than those on land. Engineers have proposed massive wind farms, stretching miles across, to harness all of this extra energy. Testing is currently under way, and this technology may not be that far away.

### **Nanotechnology**

Advances in nanotechnology may greatly increase the efficiency of current alternative energy technologies. Some examples are increasing the strength-to-weight ratio of wind turbines or maximizing the ability of solar panels to absorb energy.

Nanotechnology may even be able to make electricity more efficient, allowing us to use less amounts of energy but outputting greater amounts of power.





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The impact of nanotechnology on renewable energy is yet to be fully understood. But the technology is rapidly advancing so we may start to see an impact much sooner than people anticipate.

### **Geo Thermal Energy**

The Earth itself contains enormous amounts of energy, which if harnessed, may be all that we'll ever need. Volcanoes, seismic activity, storm systems, even waves all contain vast amounts of energy that will more than likely be harnessed sometime in the future.

There are limitless possibilities for the future, more than we could cover in one book. Regardless, it's an exciting time. New technologies are constantly being developed, while old technologies are constantly being improved upon.

One thing we can count on is the future is wide open. Only time will tell what lengths mankind will go to in order to provide cleaner and less expensive alternative energy solutions.

### **Chapter 14: Learn more with workshops**

If you would like to learn more about renewable energy solutions you can attend a renewable energy workshop held by Solar Energy International.





Please visit the following link:

<http://www.solarenergy.org/workshops/index.html>

You will notice there are many workshops available to attend. The cost ranges from about \$950 to \$2000 but please note: If you are interested, sign up a.s.a.p. because these workshops fill up very quickly.

## **Chapter 15: Final Thoughts**

We've covered a lot of ground in this book. One thing you should take away is that although the current situation may not look too promising, we should all be optimistic about the future.

People are starting to realize that change is necessary. The technologies are in place, and we are ready to make the transition away from fossil fuels.

In the mean time, there are things you can do to save money if you're hurting. By simply being smarter and more conservative with energy and utilizing alternative forms of transportation you can greatly reduce your impact on the environment as well as your utility bills.

Probably the most important thing to take with you from this guide is the understanding that people world wide are starting to understand the significant of the problems we're all facing, and that people are taking action.





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Changes are coming, changes are happening in our world on a daily basis.

What seems like a potential crisis right now will soon be a catalyst for the changes that future generations will one day see as some of the greatest achievements ever performed by mankind.

And that's something we can all look forward to.

All the best for the future,

A handwritten signature in blue ink that reads "Michael Harvey".

Michael Harvey  
Earth4Energy.com

## **Chapter 16: Extra resources**

You may also be interested in the below websites:

Battery Reconditioning:  
<http://d2c8s5.kevindixon.hop.clickbank.net/>

CarGoH2o:  
<http://www.cargoh2o.com>





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The Worlds Best Compost:

<http://d2c8s5.turnwill2.hop.clickbank.net/>

Organic Food Gardening Beginners:

<http://d2c8s5.jhw00.hop.clickbank.net/>





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