Table of Contents

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http://www.earth4energy.com/cd.php

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 the things you can start doing right now, today, to do your part in solving the world's energy crisis.

Chapter 1: Before You Start

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, rapidly accelerating and breaking can waste.
- Make sure that your house is well sealed around

windows and doors. Warm or cool air escaping from 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 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 ad 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 then 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 month's 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 stats 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. Household loads

The parts and what they do

Solar panels

Otherwise known as PV panels they 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 then 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

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 from is old golf carts of 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.

You can also purchase inverters that plug into your homes power socket. These inverters will actually feed electricity back into your home through a normal power socket.

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 of 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

If you 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 then 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 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 http://www.earth4energy.com/recommends/ebay.php and visit the following link for a list of solar panels for sale: http://www.earth4energy.com/recommends/ebay-solarpanels.php. Buying these online are much cheaper than buying from large companies.

Chapter 4: Build Your Own Solar Panels

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 than 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:

These are transparent cells and are a little more expensive.

Back to list of items Listed in category: Home & Garden > Tools & Home Improvement > Electrical & Solar > Alterna

Chipped solar cells make solar panel over 2lbs

Bidder or seller of this item? Sign in for your status

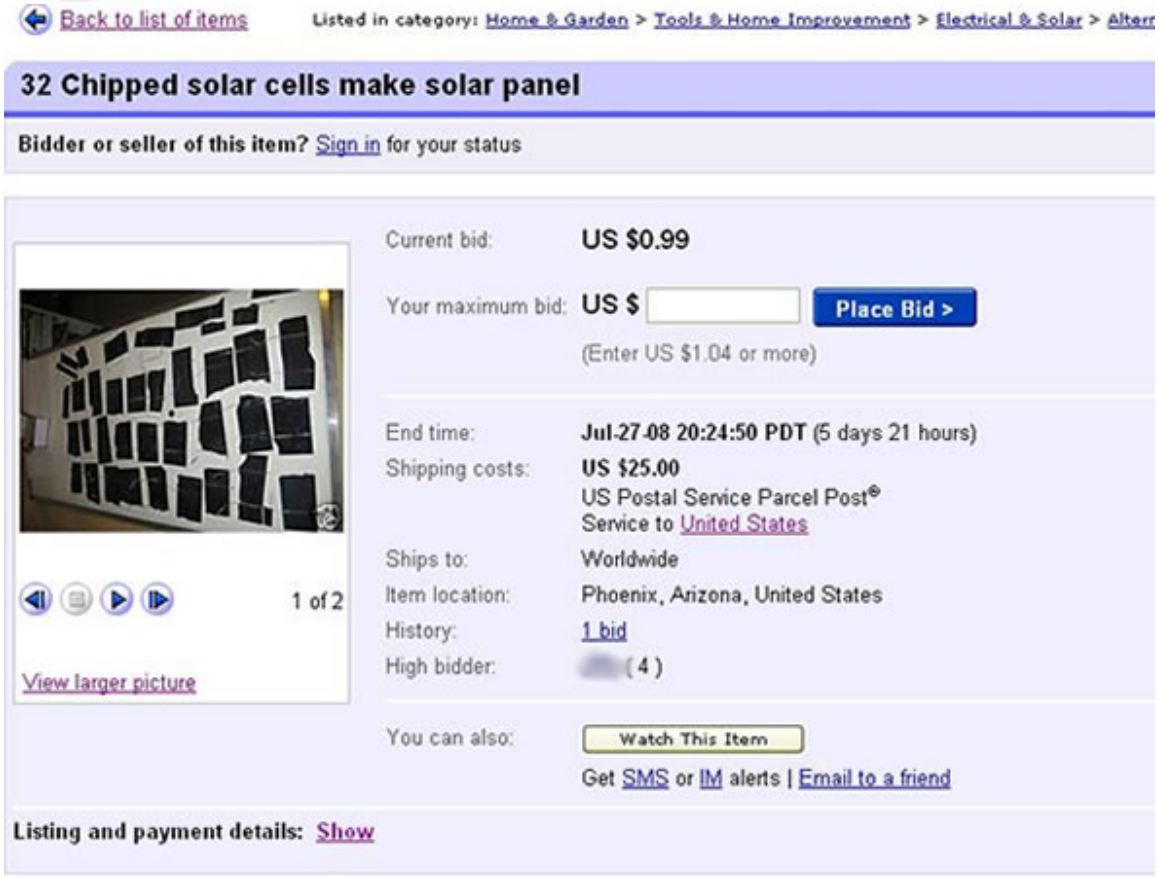
1 of 2

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:	[redacted] (217 ☆)
You can also:	Watch This Item
	Get SMS or IM alerts | Email to a friend

Listing and payment details: Show

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



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.

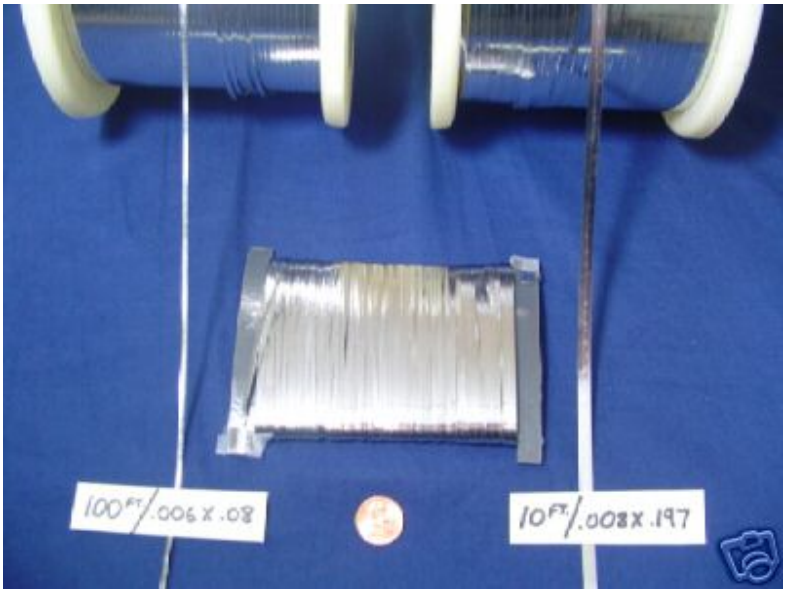
You can also use complete/unbroken cells. In my videos I used full cells produced by Evergreen solar. They put out 1.98 watts per cell. Visit the following link to view all of the new solar cells that are currently available:
http://www.earth4energy.com/recommends/ebay-solarcells.php

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 flexi-glass too. This can be picked up from your local hardware store. Make sure it is not too thin because it will split when screwing it to the plywood backing and border.

Flexi-Glass: This is used to go over the solar cells to make the whole unit one piece. The flexi-glass should be about ½ an inch think. You can buy this from your local hardware store. Just give them the measurements you are after and they will cut it for you. It is a good idea to get this last so you will know the exact measurements.

Tin coated tabbing wire: Used to connect the cells together. This looks like a shiny silver flat wire. When the solder iron heats it the solder will melt and bond with the cell. Please see below picture.



http://www.earth4energy.com/recommends/ebay-tabbingwire.php

The thin wire is used to connect each cell together and the thicker wire is to join each string of cells together.

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

Solder: We need the solder to hold the copper wire onto the back of the solar cells. The tin coated tabbing wire will usually hold itself down but if it doesn't you will need extra solder to do the job.

Rosin flux pen: This is used to help the wire stick to the cells. Watch the videos to see how it is used.

http://www.earth4energy.com/recommends/ebay-rosinfluxpen.php

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

Volt meter: This is used to test the cells power output. As you connect each cell together you can check the volts. They should increase with each new cell connected.

http://www.earth4energy.com/recommends/ebay-voltmeter.php

You can get these from your hardware store for around $10. You can also buy them online for about $8 delivered.

Let's get started

1. You need to cut your plywood/plastic backing to size depending on how many solar cells you have. This is what the individual solar cells will be glued too. The average cell produces about 2 watts so you should use 50 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.

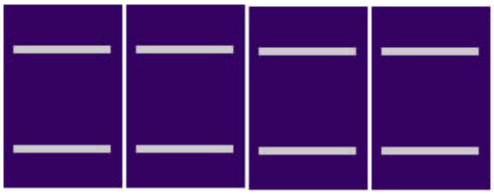
2. Apply 3 coats of UV protector to the plywood. Any type of deck or fence coating as show below will do the trick.

3. Now it's 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.

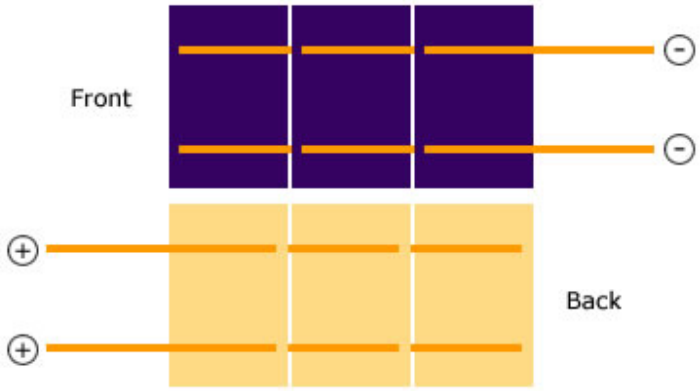
Front of cells:



The first thing you will need to do is solder wire along the front of the cells. The wire should be twice as long as the cell and you will see why we do this soon. You should use the flat solder coated wire that is specifically made for joining solar cells. See the below diagram:

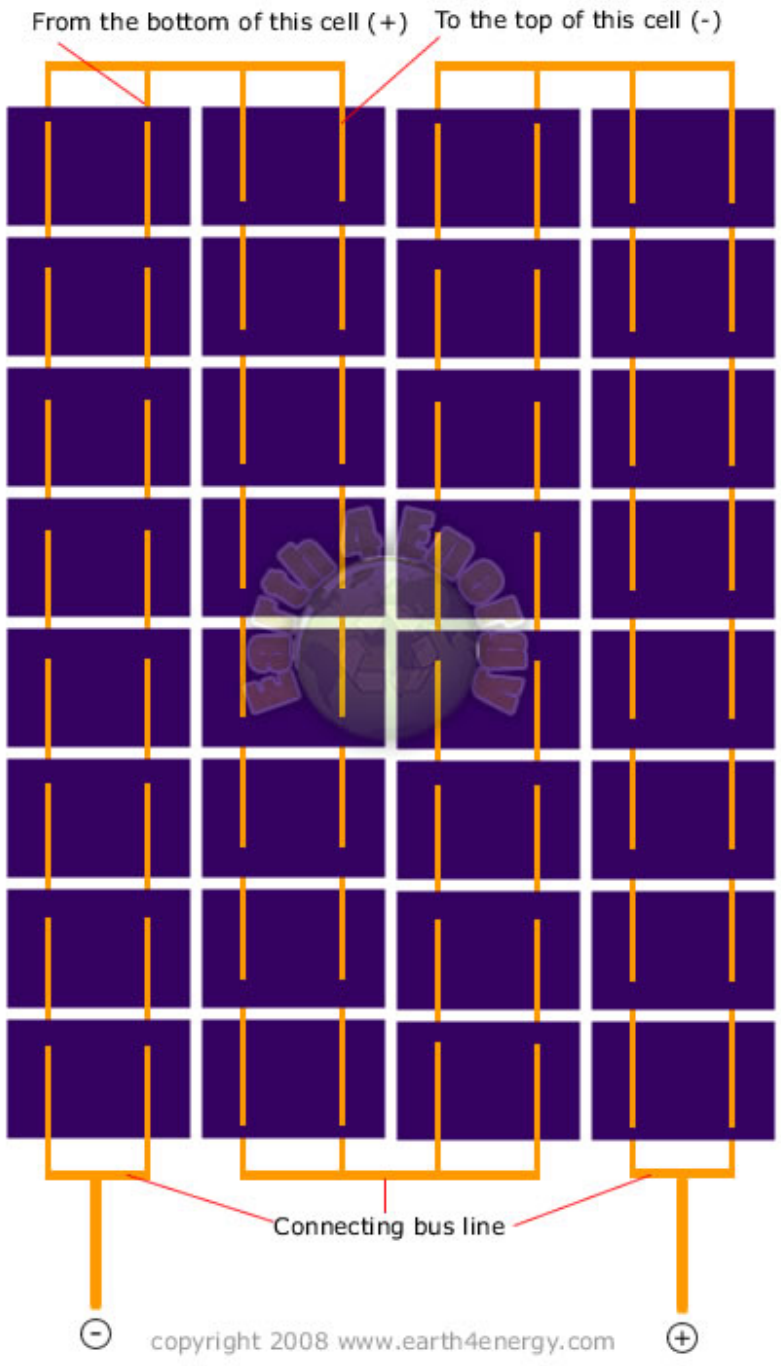
When you have the cells like this they are known as tabbed cells. Now the overhanging wire is soldered to the back of the following cell like in the example below:

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



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:

Wire the cells togethor in Series



Series connection means the wires go from negative to positive to negative to positive etc. This type of connection will increase the total voltage of the solar panel. If each cell produces .5 volts and there are 32 connected in series, this complete circuit will produce 16 volts. So the above panel with 32 cells would produce about 64 watts of power at 16 volts and about 4 amps. For further understanding on how the string of cells are wired together please watch the videos in the Earth4Energy member's area.

Note: Before you solder the cells together remember to drag the flux pen along the solder points. This will help the wire to stick down. If the tabbing wire still does not stick you can add some extra solder as necessary.

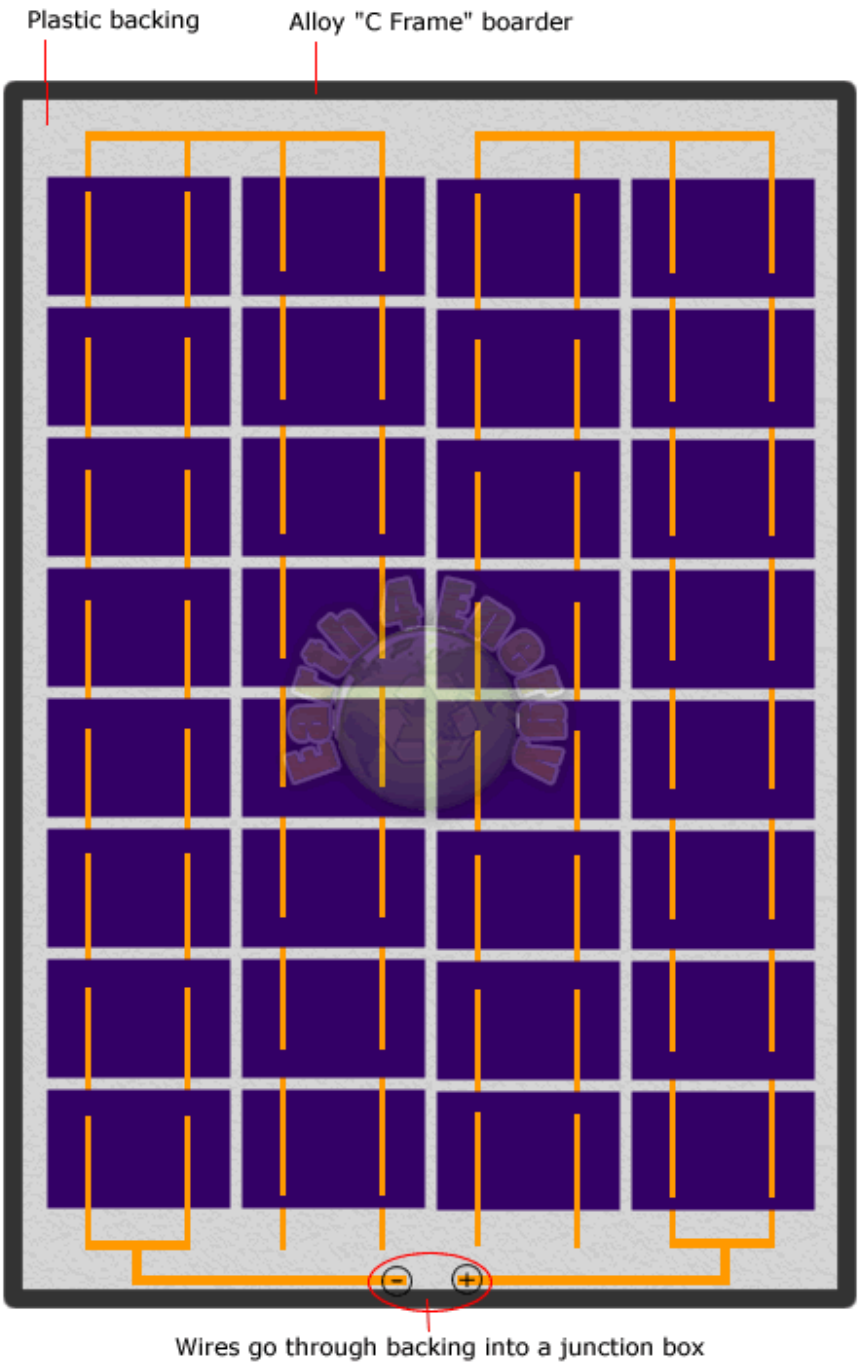
4. Now let's fix the cells to the plywood or plastic backing. For the purpose we use silicon. You really do not need to use much silicon at all, just use enough to hold the cells in place. Any type of sealant that you have lying around will do the trick. There is no need to cover the wires, just use 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 or plastic backing and into a junction box. Drill a couple of holes where the wires end so you can feed the copper wire to the backing. 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.

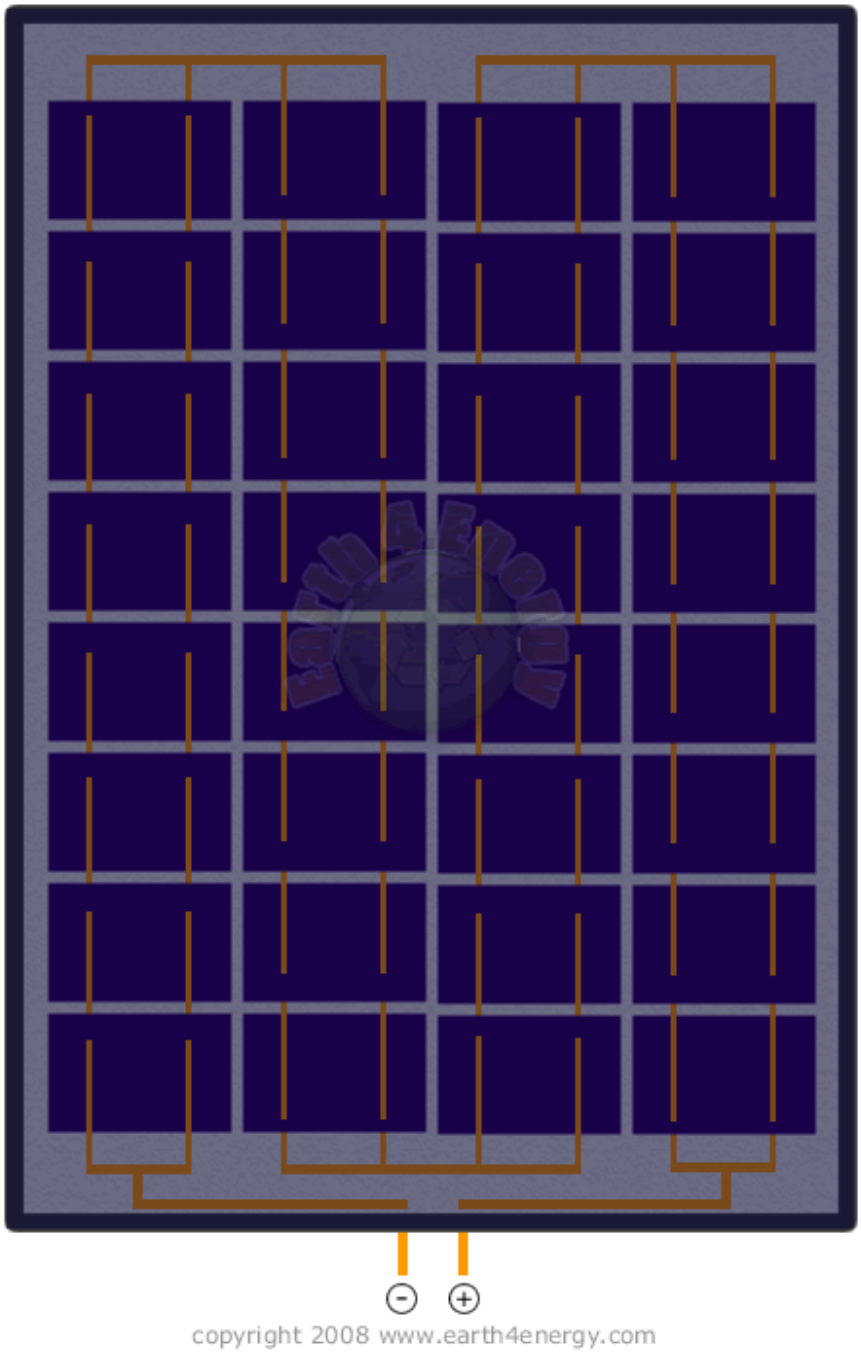
If you are using a plastic or acrilyic backing you can use alloy "C frame" as a frame around the panel. This is lighter than a wooden frame and looks more professional.

This border is what we will fix the flexi-glass too. See the below diagram:



7. Now we can fix the flexi-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 backing. You should also screw the flexi-glass down. Do not just screw through the flexi-glass as this will crack it. You need to drill a hole that is just smaller than the diameter of the screws you are using. Then screw into the holes.

Complete solar panel (on next page):



8. Silicon up the holes around the negative and positive wires that you have out the back of your panel and into the

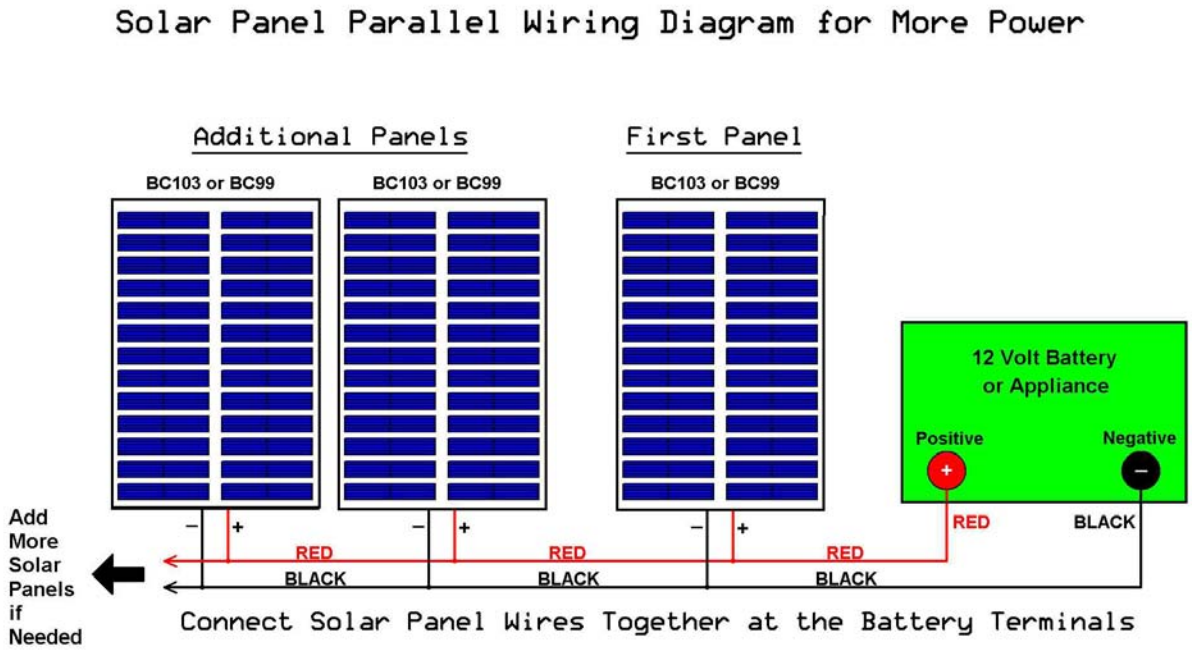
junction box. If you notice any other gaps or holes make sure you also fill them in.

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. Make sure this is going to be the bottom of the panel otherwise it will just fill up with water when it rains.

9. You can now join electrical wire to the panels junction box. This will then connect to your charge controller, then your batteries. The 64 watt panel in my above diagrams produces 16 volts at 4 amps (64/16 = 4). So if I were using just one panel in my system I would only need 4 amp wiring (6 amp to be safe). If I wanted to join 5 of these panels together I would need 20+ amp wiring (4x5=20amp).

You can purchase this wire (and the junction box) from any electronics store.

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 your can join multiple panels together with a simple parallel wiring configuration. Below is a diagram of multiple solar panels being used:



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.

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 panel 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 determine how frequently the panels should be cleaned. 4 times per year 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%.

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

Chapter 5: 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 around the coil, causing atoms and electrons to be displaced,

thus creating kinetic energy that is then translated into electricity.

Chapter 6: 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 than $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 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 7: Building Your Own Wind Generator

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 (Ametek 30vdc)
- 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

The majority of the materials that you'll need can be found rather inexpensively on online 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 online, 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 them that you are building a windmill (or solar system) I’m

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://www.earth4energy.com/recommends/batteryreconditioning.php

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. A great DC motor/generator is the Ametek 38VDC as pictured below.

http://www.earth4energy.com/recommends/ebay-ametekwindgenerators.php

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 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 line 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. If you have lower winds than you should go for the Ametek 30 VDC as they do not need to spin as fast to produce 12 volts. 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

View larger picture

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)

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 online. It’s the perfect tower for a backyard windmill.

Material for the Blades

The most efficient wind generators have a blade diameter of roughly 6 ft. and a total of 3 blades. If you find that 6 ft. is simply too large for your backyard than you can cut it back as needed. Don't go much smaller than 4 ft. diameter otherwise it will be too hard for it to start spinning. Just make sure the shape and weight of each blade is the same.

A backyard windmill will easily produce 300 watts of power and to do this output you will need to use a blade span of about 6 ft. with wind speeds of at least 20 miles per hour.

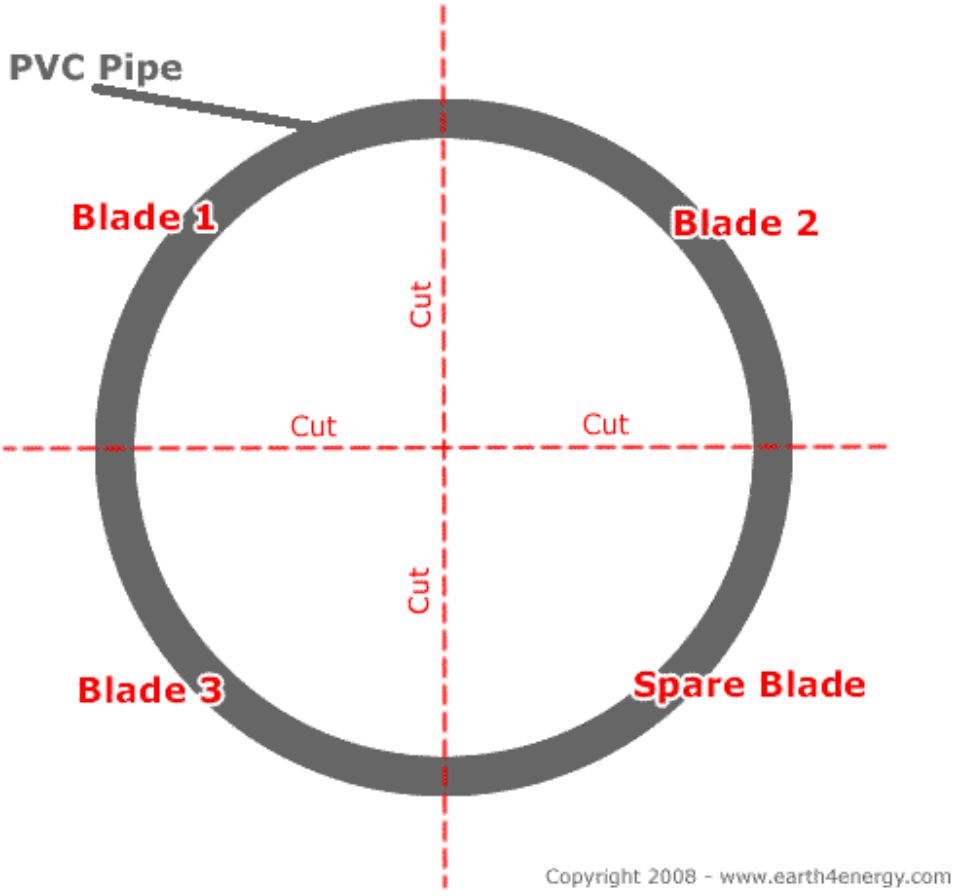
The best material to use to create your blade is ABS or PVC pipe. Pipe that is between 8 and 12" in diameter works the best.

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 blades.

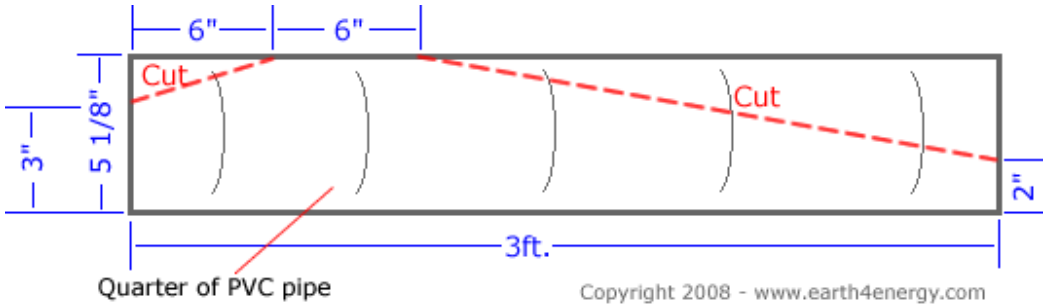
Cutting the Blades

You can use a jigsaw or angel grinder for this purpose. You'll want to cut the PVC pipe into a 3 ft length. Then cut the pipe into quarters as seen in the below diagram:



After you have cut the pipe into quarters you need to shape

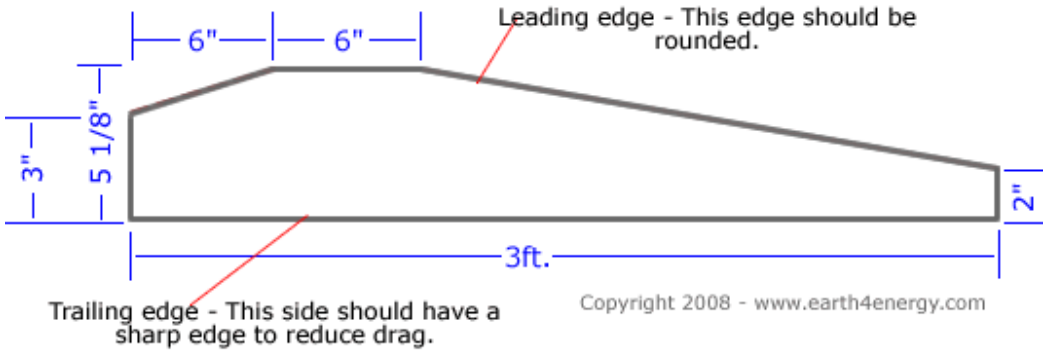
the blades. Please see the below diagram for measurements.



The wide part of the blade is what will help the windmill start spinning. The blade comes down to a narrow 2” tip as this will allow the windmill to spin at high speeds.

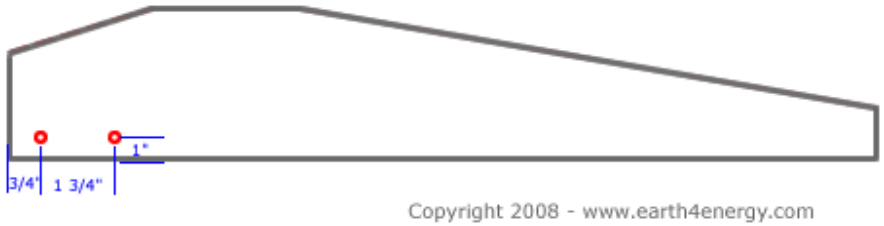
After the shape is cut you need to do some sanding/grinding. Make the leading edge rounded and smooth. This will allow the wind to flow over the top of it easier. You need to angel the trailing edge until it is sharp. This will reduce the drag from the blades as it spins around. To angle the edge you can use an angel grinder then a sander to remove any rough parts.

The below diagram shows what parts of the blade need to be shaped and grinded.



Now we need to drill a couple of holes. Bolts will go through the holes and attached the blade to the hub. The below diagram shows the placement of the holes when our hub design is used. If you plan to use your own hub from scrap metal than simply mark out the holes to suit your hub.

Note: It's a good idea to have the hub ready before drilling the holes in the blades. This way you can confirm the holes on the hub match the holes on the blade.



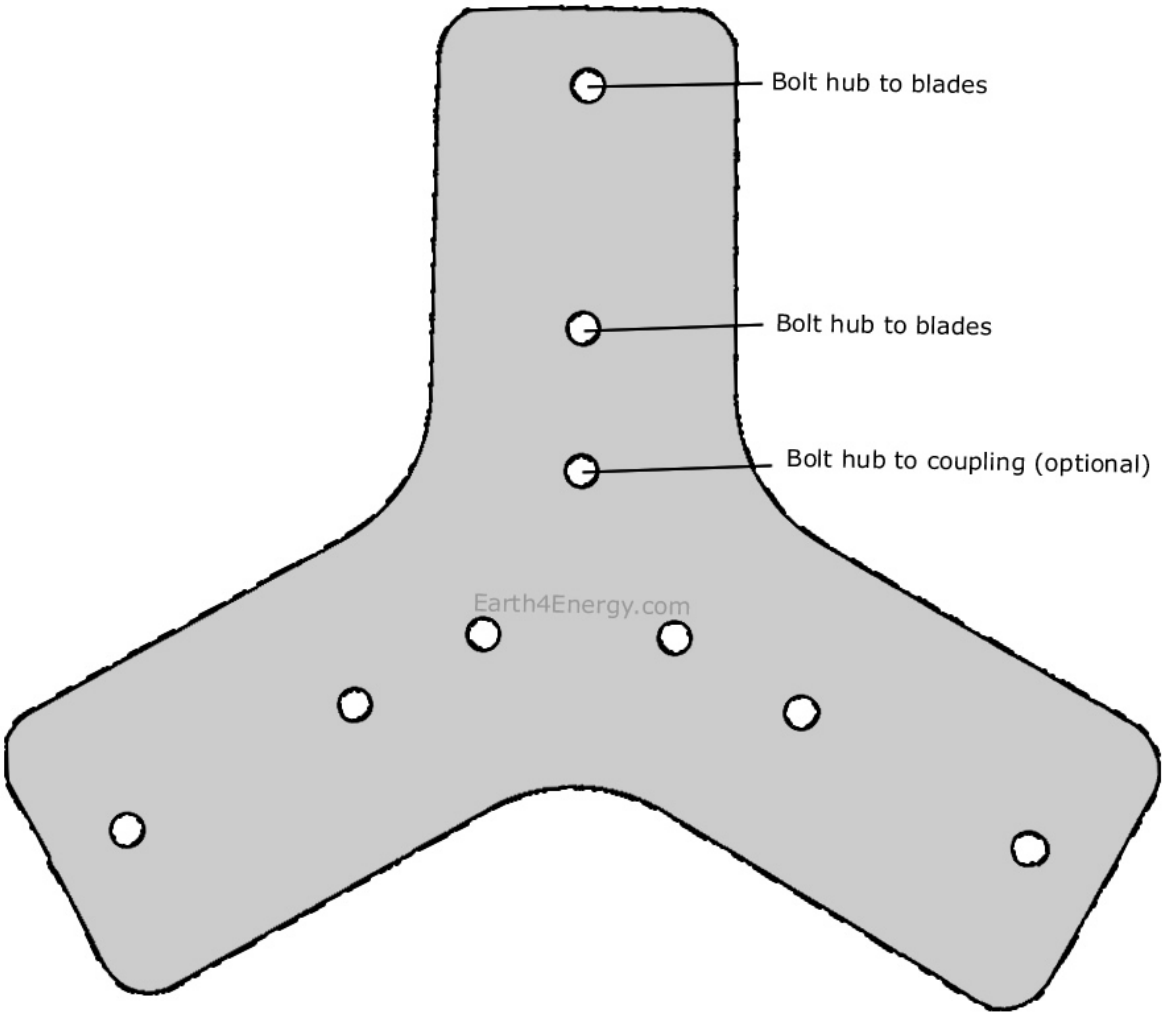
After you have finished one blade simply use the same above steps for the next 2 blades. You can use the extra piece of pipe and make a spare blade if you like too.

When your blades are all shaped you should give them a sanding. This will help the paint stick to the pipe. Now that the blades are made its time to work on the hub.

Building the Hub

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

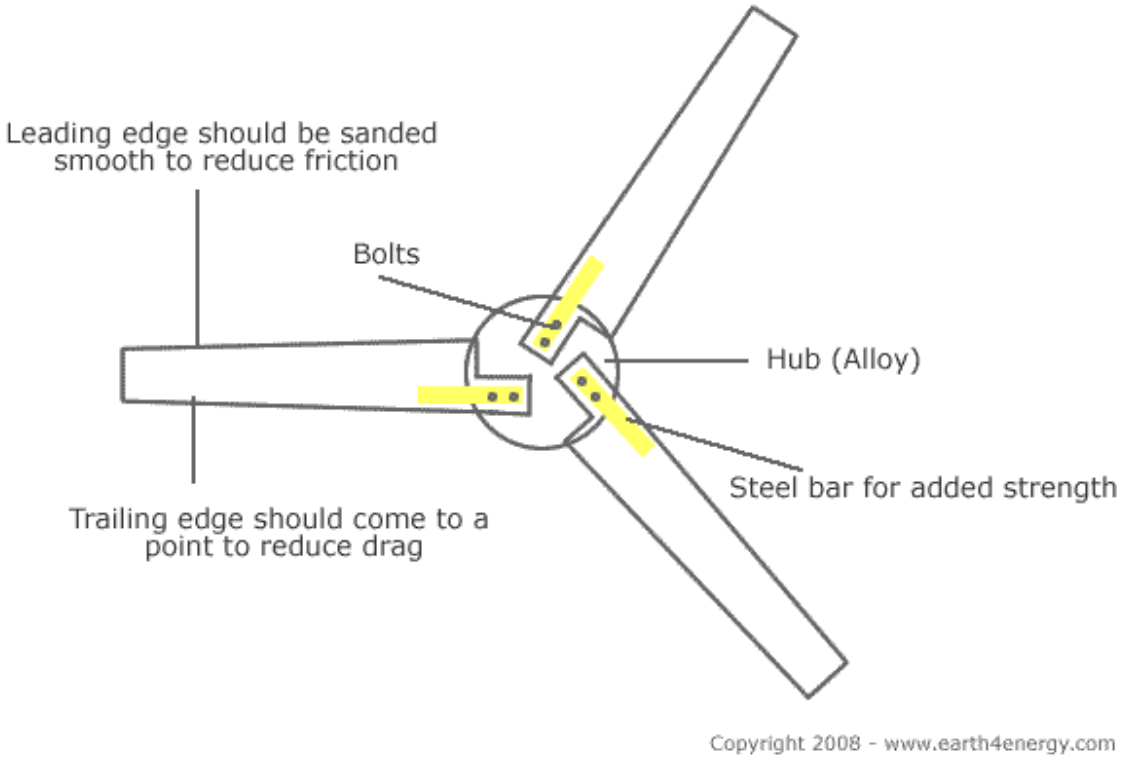
The hub must fit tightly on the DC motor shaft so that when the hub turns the motor will turn. To do this we just drill a hole in the very center of the hub that is the same size as the shaft on the motor. We will attach the hub assembly to the motor later. The hub can be any old circular piece of metal or alloy and it should be quite strong. You can use old pullys, cogs, saw blades (make sure to grind the edges smooth), etc. If you want to make your own hub than below is a real size template you can use. Mark this template out onto a piece of steel that is about ¼ of an inch thick.



You will then need to weld or bolt a coupling to the center of the hub. This is what the motor shaft will slide into and the coupling will hold the hub in place.

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:



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

Balance the blades and hub

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 motors shaft and bearings. Getting it correct right now will save you many

headaches in the future.

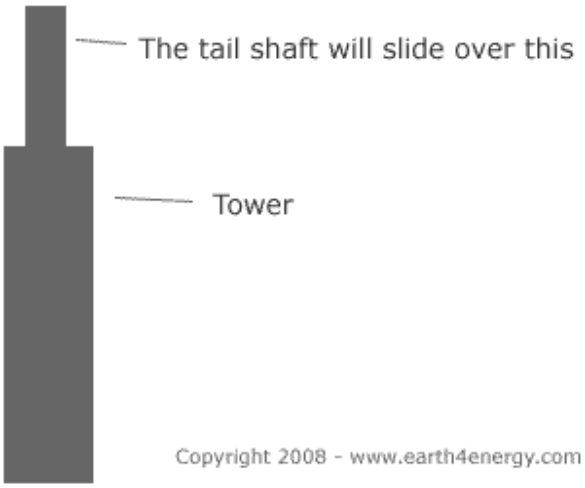
Here is an easy at home way to test if it is balanced. First, number each of the blades with a pen. Put the hub assembly on a pole and give the blades a good spin. Do this about 10 times and take note to what number blade is at the bottom each time. If you find that the same blade ends up at the bottom 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

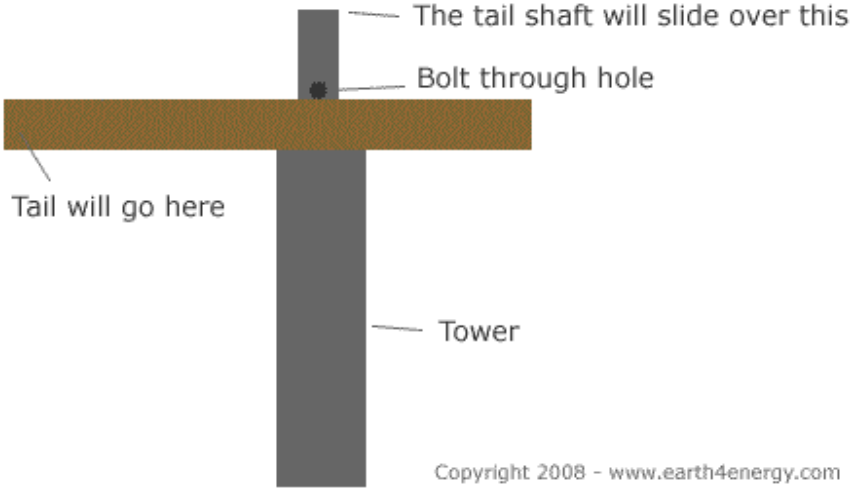
It's important that the hub assembly is tight and secure on the DC motor. Slide the shaft of the DC motor in the hole in the middle of the hub that we drilled before. To make sure the hub doesn't slide back out we can drill a hole through the end of the motor shaft and put a small bolt through it. Drill 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.



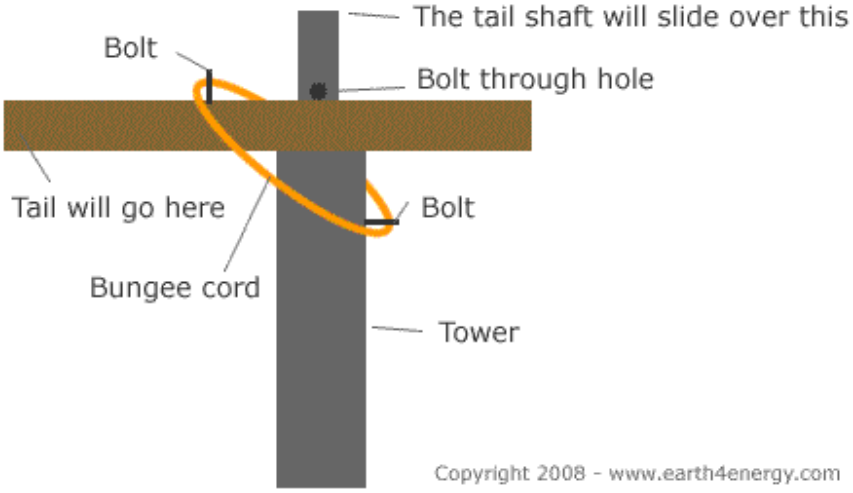
If your tower does not have the smaller section on the top you will need to weld this piece of metal on. Make sure that the diameter of this piece is not wider than the diameter of the windmills tail shaft. The reason for this is because we will be drilling a hole in the tail shaft and it will slide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

Another easy DIY rotating point is to use an old office chair (the ones that spin around). You can easily take apart these chairs and use the swivel section. This swivel can be welded to the top of your tower.

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 tail can also be made from plywood. Just make sure it is properly coated in UV paint to protect it from the sun.

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 line. You can find charges 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.

The Dump Load

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. Anything that has a heating element is great for a dump load as they can take a lot of power.

AC Inverter

If you want to use AC power instead of DC power, you'll need an AC inverter to convert the power. These can be found online and vary in price depending on how many watts you want to use. You can get a 1500 watt inverter for around $75.

If you are making a portable solar/wind system that will be used only for lighting/TV and other small wattage appliances then you can use a 350 watt or smaller inverter and these cost around $45. 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!

Chapter 8: 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 with 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.

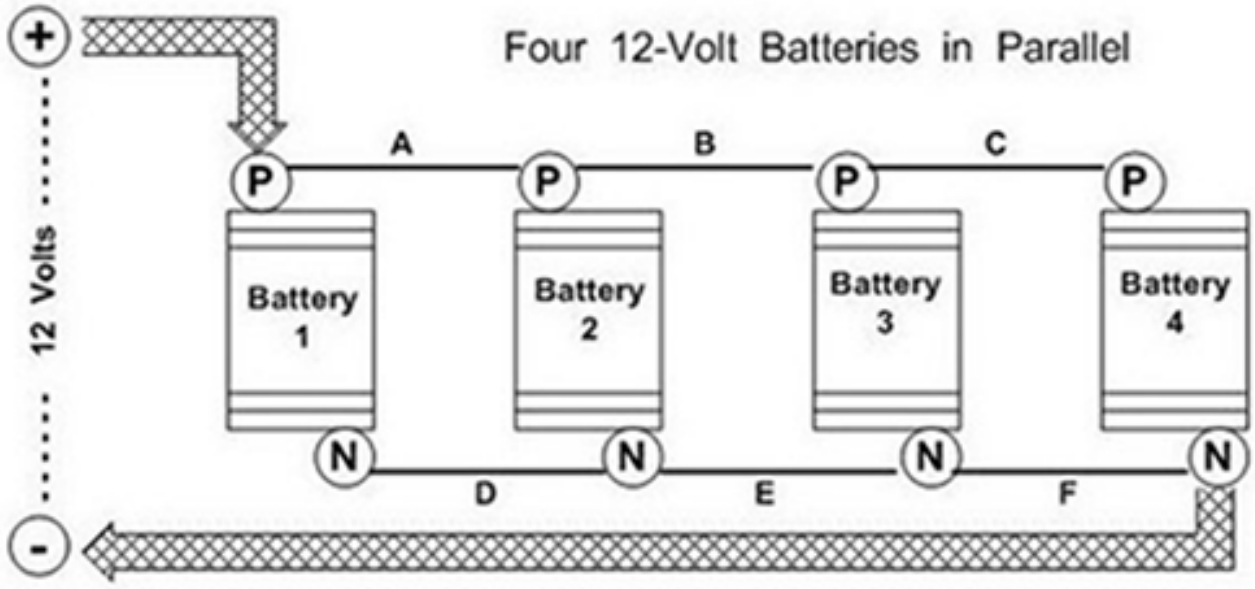
The different ways to connect the panels will wither increase the voltage, amps, or both.

Series wiring - This will increase the overall voltage of the joined solar panels. You join the negative from one panel to the positive of the next panel and so on. When you have

finished joining all of the panels you are left with a negative at one end and positive at the next. You need to increase the voltage to at least 15V+ to charge a 12v battery bank. So if you have 2 panels producing only ~8V, they should be joined in series to charge a 12 volt battery.

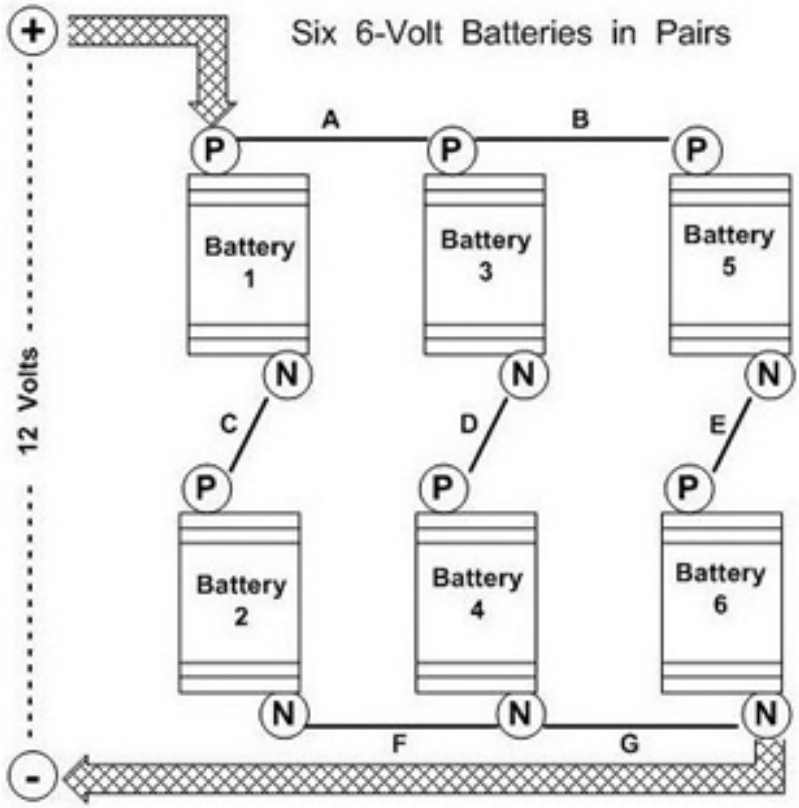
However if you were charging a 6 volt battery then the 2 panels can be wired in parallel.

Parallel wiring - This is simply joining the positive of one panel to the positive of the next panel and the negative to negative. This setup will increase the amps. This would be fine if both of the panels are producing 15V+ each when charging 12 volts.



Series/parallel wiring - this is just a combination of both. You need to have at least 4 panels for this setup. You would

join 2 panels as series, than the other 2 panels in series. Then these 2 sets of panels get joined together in parallel.



Chapter 9: 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.

1 KW (1000 watts) – A solar or wind power system that produces just 1 KW can have a huge impact on your electricity bill. A 1 KW system will be enough to power all of your lights, TV, DVD/Video player, microwave and a toaster.

The solar/wind system will trickle feed to the battery bank and will provide sufficient power for your home.

So, how do we make a 1 KW system? For this we would need to have 10 solar panels producing 100 watts each. This would give us 1 KW of renewable power that will last for years to come.

Chapter 10: 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 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 11: 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 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 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 12: 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.

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

Chapter 14: Hydro-electricity

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

Used worldwide 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 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 15: 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 slowdown 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 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 16: 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 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.

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 17: 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 18: 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 importance of the problems we're all facing, and that people are taking action.

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,

Michael Harvey
Earth4Energy.com

Chapter 19: Extra resources

These are some of my favorite books. I have read the below guides and personally recommend them to you.

The Battery Reconditioning Report
http://www.earth4energy.com/recommends/batteryreconditioning.php

CarGoH2o
http://www.cargoh2o.com

The World's Best Compost
http://www.earth4energy.com/recommends/worldsbestcompost.php

Organic Food Gardening Beginners
http://www.earth4energy.com/recommends/organicfoodgardening.php

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http://www.earth4energy.com/recommends/ebay-tabbingwire.php

View rosin flux pens for sale
http://www.earth4energy.com/recommends/ebay-rosinfluxpen.php

View wind generators for sale (Ametek)
http://www.earth4energy.com/recommends/ebay-ametekwindgenerators.php

If you would like a copy of this ebook and our instruction videos on CD please visit the following link:

http://www.earth4energy.com/cd.php