HomeMadePowerPlant

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Why HomeMadePowerPlant?

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.

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Today is the day for change. This is your action plan for change. In this book you will not find dry, boring scientific claims that global warming and climate change will be the end of us all.

In this book you will find interesting and easy to follow plans to build your own homemade solar panels, find free or inexpensive solar panels, and find free batteries too. Many problems plague the modern World right now- whether your concern is pollution, rising gas and oil prices in the future, or you fear blackouts and higher energy costs in the future.

The solution to our everyday energy and lifestyle problems really lies in our own backyard. The actions we take and the decisions we make everyday can affect change. How do I know this?

No, I don't have a fancy science degree from a famous university, and I don't support fancy name brand societies that line their own pockets in the name of marketing 'Green' choices.

My family has simply made the choice to implement a lifestyle that would no longer contribute to global warming and climate change. The truth is that we have been doing this for 21 years and we see it working.

That's the important part in all of this. We all have to take personal responsibility for our own part in global warming or there will be no change. Back in the 1960's when I grew up I thought we could keep consuming the Earth's resources without any consequences.

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I was wrong.

Chapter 1. Useful tips before starting

What you must now on energy saving

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 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. Electricity 101

For some of you it may be instructional to start at a basic level in understanding how electricity works in everyday life.

Unless you work everyday in the electronics field or are a licensed Electrician you may want to get back to the basics first. Right now we will explain the terms used in this discussion of electricity as it pertains to your off grid home.

Watts

We started our discussion earlier asking you how many watts your appliances use everyday and your weekly wattage (power) consumption.

Most people are fairly familiar with the term ***watt***, but most don't know what it describes. A ***watt*** is the power produced by current (amps) flowing through a wire multiplied by the pressure (voltage) at which it flows.

Volts

Like water pressure in a pipe, voltage is the pressure of electricity flowing through the wire.

Amps

This is the amount of electricity flowing through the wire.

Power Rates

We are most familiar with the term KWH (or Kilowatt Hour) as it appears on our monthly power bills. This is the rate of power flowing through a wire.

As an example, if a 100 watt light bulb is turned on for ten hours the power rate would be 100 x 10 = 1,000 watt-hours or 1 Kilowatt hour (kilo means 1000)

Direct Current (DC)

We will be discussing both ***Direct Current (DC)*** power and ***Alternating Current (AC)*** in the planning of your renewable energy system. AC current is what you presently use in your home.

The most important difference between AC and DC power is that DC current can be stored in a battery while AC power cannot.

In the Renewable Energy system that you are designing to run your home DC power produced by your solar panels or wind generator (for example) will be converted to AC power by using an inverter. Inverters will be discussed later in depth.

In this way you can still use many of the same appliances that you currently depend on. Because of the blessings of capitalism, AC appliances are cheaper since there are so

many units produced. All you shoppers, I know that I promised you would be able to buy new appliances, but for now you should know that you will be able to continue using some of the appliances you now own.

Common DC voltages are 12, 24 and 48. The advantages of DC appliances are many, but most important is that DC motors are more efficient than AC motors. There are many applications for DC power and the benefit is that we can use this form of energy in our off grid home, while in your present tied to the grid home you cannot.

AC Current

Alternating current is called this because the current changes direction constantly. AC is the most common form of electricity usage today mostly because it is easier to work with than common DC current.

Chapter 3. Your Own Personal Solar Generator

How exactly does it work?

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).

What Is PV?

The term "photovoltaic," commonly referred to as PV, is derived from a combination of the Greek word for light "photo", and "Volta," the name of the Italian physicist, Alessandro Volta, who invented the battery in 1800.

The PV effect is the direct conversion of solar energy into electricity. This process does not generate much heat like solar domestic hot water or solar pool heating systems do. It also differs from the process used in solar thermal, where concentrated solar energy is used to produce steam that activates a turbine connected to a generator.

PV power systems do not have any moving parts. They are reliable, require little maintenance and generate no noise or pollutants. PV systems are great in that they are modular - the building blocks or cells come in a wide range of power capabilities, from a fraction of a watt to more that 300 W. Modules can be connected to achieve the power that your application requires.

Some large PV power plants have several megawatts of power, although most installed PV systems are much smaller.

Unfortunately, there is a lot of the sun's energy lost in this transfer of energy from light to electricity. Everyday larger and more efficient panels are manufactured it seems.

Even though they are not that efficient at converting light to electricity solar panels remain a very good choice in the renewable energy system because of their low maintenance and long life.

Properly installed your solar panel array should last around 50 years. Not a bad long term investment for most people.

The Advantages of PV Power Systems

Users of PV power systems appreciate their quiet, low-maintenance, pollution-free, safe and reliable operation, as well as the degree of independence they provide.

Why else should you consider a PV system?

If you are some distance from an electrical grid, it may be cheaper to generate your own power rather than pay to extend transmission lines from the grid.

Fossil fuel- Diesel, gasoline or propane generators are the main alternatives, but many people find them noisy, polluting and costly to run and maintain.

It also makes little sense to turn on a 5-kW generator to power a few 100-W light bulbs or the TV. PV systems reduce the negative aspects of generators by using them only as a backup.

When capital cost is an issue, or when photovoltaics alone are not enough to replace an existing generator, you can use a wind generator as part of a hybrid PV system. It works great and reduces the use of the generator.

This kind of charging system is more efficient than a generator running continuously at low load.

In addition to saving fuel and lowering maintenance costs, you will increase the generator's life span.

Also, since the PV panels and battery banks are modular, you can expand the PV system gradually as your budget or needs increase. That, we think is the best part.

The Limitations of PV Power Systems

It is important to realize that PV power systems are expensive when compared with the low price of utility power in North America for the most part.

You should reserve the electric power produced by PV modules, an inverter and a storage system for your most energy-efficient appliances, tools, lights, etc.

Although it is technically possible, heating with photovoltaic is generally not recommended. You can easily and more efficiently collect heat with a solar thermal system.

A solar water heater or pool heater mentioned earlier generates more hot water with less initial cost than any PV-powered heater.

Also, for cooking, it is generally more cost-effective and convenient to use a stove that operates on propane or natural gas rather than solar electricity.

Stand alone PV-powered homes and cottages often rely on wood cook stoves for cooking and space heating.

Refrigerators are becoming more energy efficient, so the cost of operating them with PV power is now feasible. They make some great ones now.

What type of Solar Panels should I choose?

A PV System to Suit Your Particular Power Requirements

Right now you can choose from three main types of panels:

-***Monocrystalline***;
-***Polycrystalline***;
-***ThinFilm*** (or Amorphous);

Tried and True Monocrystalline Solar Panels…

For many years monocrystalline solar modules have been the workhorses of the solar market. Those iridescent blue faced panels you have been seeing on rooftops are probably of this type of panels.

For most of you this is the type of solar panels you will build because these types of cells are readily available.

They have distinct rounded individual solar cells visible from all angles stacked in very uniform rows.

This type of solar panel is produced from a single silicon ingot or crystal. Manufacturing costs are very high because of this process making them the most expensive solar modules on the market.

They are, however the most efficient type of solar panel making them the correct choice when space is at a premium.

Monocrystalline cells have a life expectancy far exceeding 25 years, probably over 50 years. The only real problem with this type of cell is it's fragile nature making it a requirement that it be mounted in a very rigid frame.

Polycrystalline Solar Panels…

Polycrystalline modules are manufactured from a block of multi-crystalline silicon. They are usually square and have a varied, almost mosaic-like appearance.

Only slightly less efficient than ***monocrystalline*** modules they are cheaper to manufacture and thus cost less money. You can expect the same great lifespan as ***monocrystalline*** cells too.

Thin Film Solar Panels…

Recently a new product was introduced into the market that could provide some much needed answers for solar power users. Amorphous silicon PV or thin film technology could make rigid solar panels obsolete if some better research is done.

Thin film solar panels are produced by applying silicon material on glass or stainless steel, or more commonly between two pieces of flexible laminate material.

Solid or rigid thin film panels are in use but flexible laminated thin film panels are more popular. The flexible panels can be applied to any surface and sometimes used as roofing material.

Most customers like the almost seamless blending of solar panels right into their roof top. Saving you the cost of regular shingles or steel roofing, thin film solar panels are a good choice.

These panels are not nearly as efficient at converting light to electricity when compared to mono or polycrystalline

solar panels- not nearly by half. You would need twice the space to accommodate their installation.

From a manufacturing standpoint they do absorb light more efficiently though, allowing for a thinner design and less material being used in their manufacture.

The real benefit, because less material is needed, is in the simplified manufacturing process resulting in lowered costs to build. The lower price pushed thin film panels to the lead in price per watt of output.

The panels may have to be slightly larger, but it costs less for the homeowner for every watt of power production. They are flexible, light and rarely break during shipping. Add in the great price and this makes thin film panels a great choice where space is not a consideration.

They jury is still out on the lifespan of these panels though. Some say they will last just as long as monocrystalline panels, others point to their decreased efficiencies only a couple of years after purchase.

As mentioned earlier, with increased research this could be the answer. We have a couple smaller panels and they seem to work fine, but we like our monocrystalline solar panels and are going to stick with them. Your choice.

New Technologies...

There are many new forms of solar panels out there, from spheral solar to liquid paint on solar panels. All very revolutionary, but all need some time to be properly tested before we would recommend them.

From an economic point of view, first consider investing in energy-efficient electric AC appliances, and then size your PV system based on actual consumption.

For example, using compact fluorescent lights will reduce your electrical consumption for lighting by 80 percent or more.

The cells are made up of semi-conductors, with silicon currently the most widely used.

When the suns 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.

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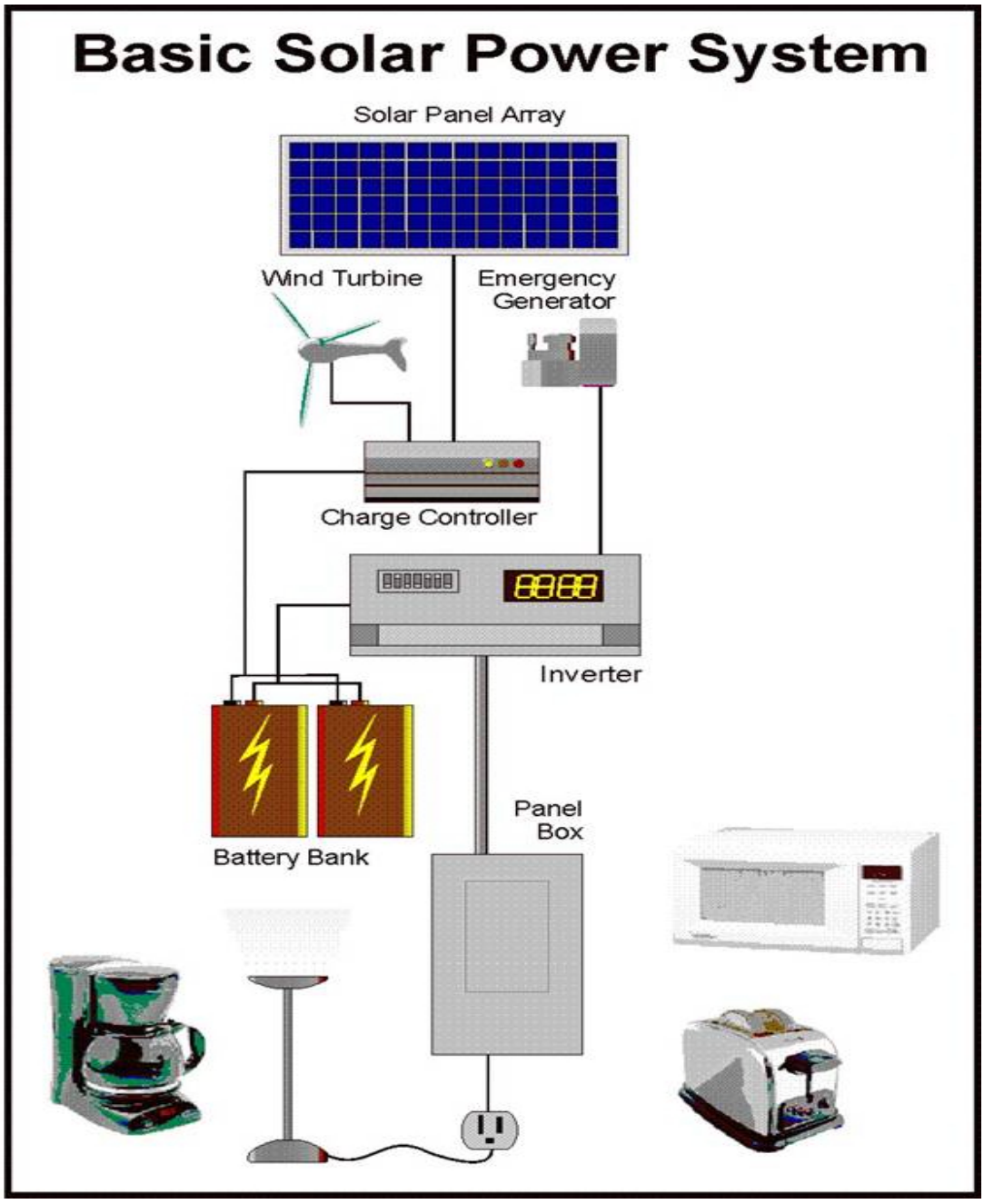
Various types of usage for your solar generators



Basic diagram of solar power system

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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 then $200. (If you don't know what each of the parts are used for please refer to the end of this chapter.)

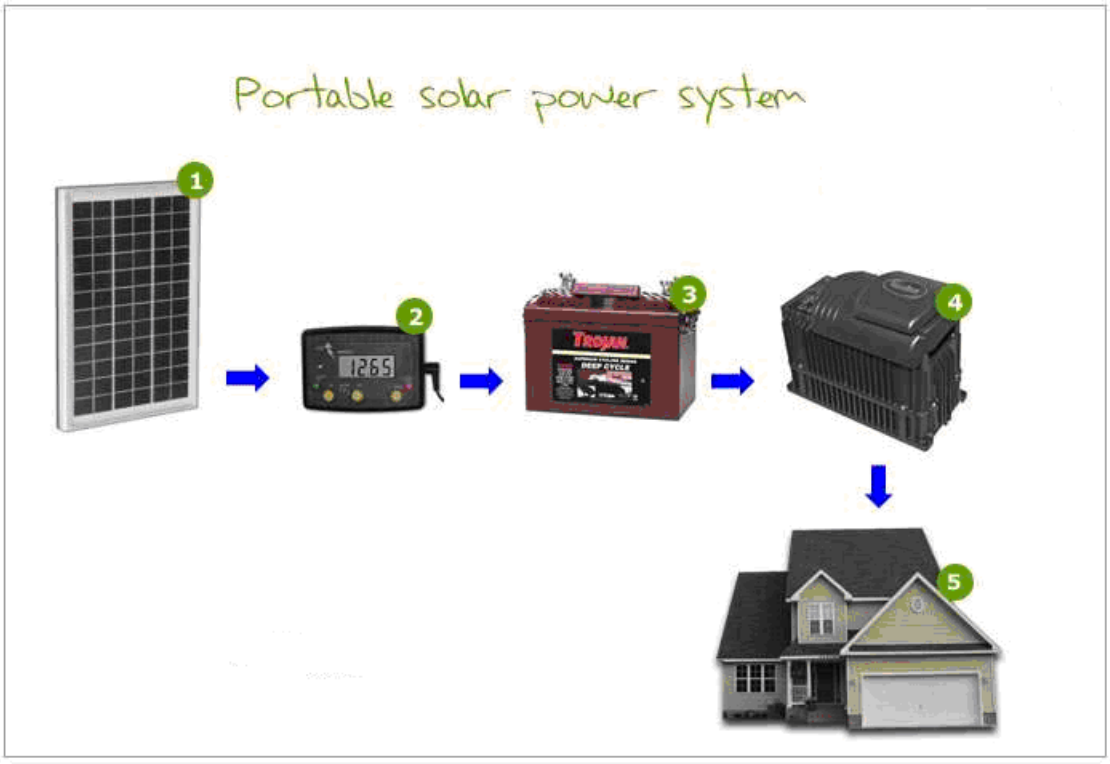
Portable Solar Power Generator

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 then $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.

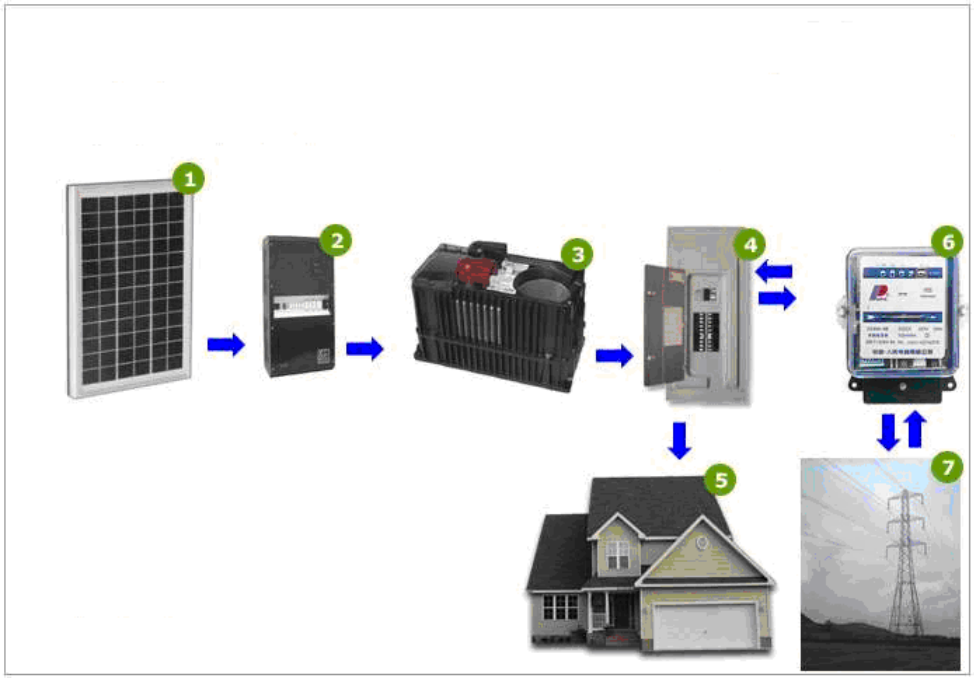
Grid-Intertied solar power system

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 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 stats regulatory agency for further information.

Please see the below diagram of a simple grid-intertied solar power system (next page):



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 batter charged when the sun can't.

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 batter 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.

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 your 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)

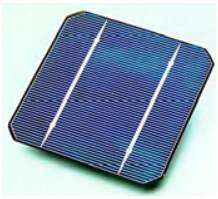
The grid is the main power supply coming to your house (unless you are living off-grid of coarse)

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.

Parts and tools needed for your energy saving science project

Let's Get Started



Material Needed	**Cost**
Wood	Free
Glass	Free
Solar Cells	$160
Caulking	$3
Solder	$2
2 sided tape	$6
Electrical Box	$4
Screws and fasteners	$7
UV varnish	$13
Total	$195

Prices may vary in your location but the most expensive item on the list, the Solar Cells are available pretty reasonably on ebay at the time of writing. There is a predicted shortage in silicon so all that could change but you will still save a ton by building your own.

***Not familiar with EBay*?**

Basically, this is an auction website, where buyer's and seller's meet. Prices are usually very decent, although we have seen some seller's who were way out in left field on their pricing.

When you set up your free eBay account, they will offer you all of the advice and instructions necessary to make your purchase. Just follow the instructions carefully and you will soon have a very good condition solar cells for your solar panel construction project.

Take your time, you will see that prices vary wildly depending on condition and the size of the equipment you are looking for. Shop wisely.

Setting Up Shop

Your first order of business will be to find those solar cells and gather together the materials mentioned in the material list above. Once that s accomplished you should set up a comfortable work area for you and your helper

Once you have your shop set up and you have all the material you need including your solar cells it s time to begin building your very first solar panel.

Step by step guide on how to build your solar personal solar generator

The Base

First you will need a base to set the solar cells on to make a panel. Hopefully you ordered enough solar cells (about 80) to layout a fairly large surface area. You will notice that there are two distinct sides to a solar cell.

The front looks kind of a blue color while the back looks very much like the back of a mirror. It is essential that you set up the cells with the blue or upper surface facing toward the sun.

Each solar cell will create not much more than one half a volt DC usually. The voltage remains the same. As the size of the cells increase, depending on what you get, the current or amperage will increase.

We like to lay the solar cells out on the floor before we begin sort of like a deck of cards. Leave a space between each cell of about one quarter inch. Arrange the cells in rows until you have a shape that is pleasing to you. We like to make the finished panels slightly narrower in the width so they are easier to handle, but you can do as you like.

Once you have the cells laid out in the pattern you want measure the outside dimensions of the rows. You need to know how big to make the backing board. You will attach the solar panels to this board so you need to know how big it is.

With 80 cells you should end up with a panel that produces approximately 100 watts of power.

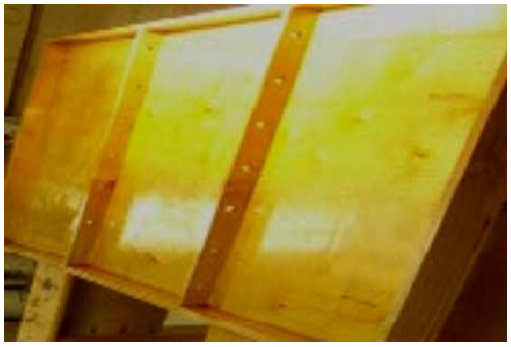
We usually use our own lumber that we cut here but for this project we had some plywood that a local contractor gave to us from some window crates. Any kind of strong lumber will work. The nice thing about the plywood was that we didn't have to join it together.

After we get the outside measurements we assess what glass we will have to cover the upper portion of the panel. We usually put 2 inch spacers on top with a ventilation space around the panels as well.

The glass will usually need a support in the middle too so leave room for that as well. Let's say that the layout of the cells added up to a size of 24inches wide and 40 inches high including the spaces between the cells.

If we wanted a 2 inch spacer in the middle and all the way around the outside to support the glass then our plywood should be cut to 30 inches by 46 inches. In this way we could fit the cells on the plywood and still have support for the glass.

Before we begin to put the cells down on the plywood we first treat it with an epoxy sealer that is designed for UV protection as well. It sinks right into the wood and protects it long term from the weather.



You will notice the holes in the dividers that will have the wires from the cells meeting and joining to form the circuitry of the panel. The holes also allow a certain amount of ventilation too.

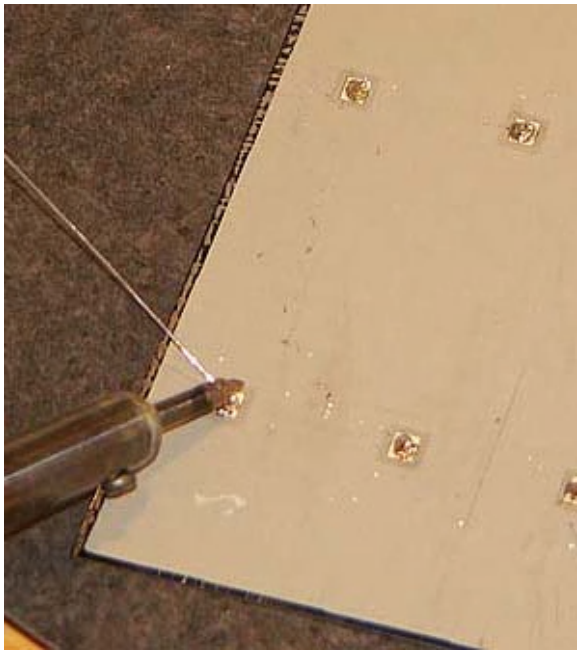
Make sure you put at least 3 coats of the epoxy on everything as it will be exposed to some rough weather at times.

It's now time to get out that soldering gun and clean it up with a rag. You can use either the gun model shown or our personal favorite the pen model below.

There are even portable models without a cord now, just get one that is comfortable for you to use. Look for a model that is about 25 watts (at least) and use silver bearing solder for this work.

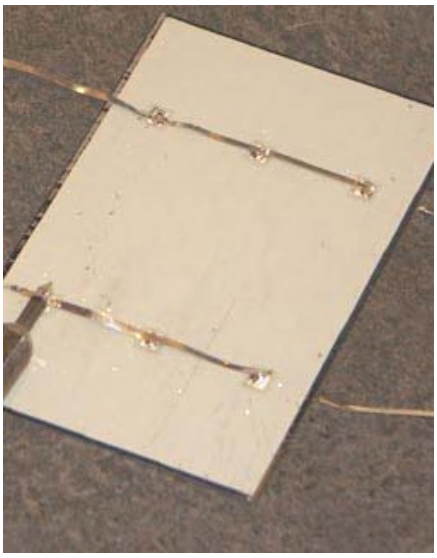
Connecting the Solar Cells Together

You will find little tabs on the back of the cells. Take your soldering iron and heat it up. Touch the tip to the tab and gently feed some solder onto the heated surface of the iron. Just one drop will do. Make sure you do all 4 or 6 of the tabs that you find.



The tabs on the backs of the cells will form a line, one on top and one on bottom. The top tabs are negative and the bottom tabs are the positive leads. With the drop of solder on the backs of the tabs gently place a copper wire lead onto the tab and heat it up. The wire will bond to the tab and connect the negative tabs together. Do the same for the other tabs.

Use different color wire for negative and positive leads to avoid confusion.

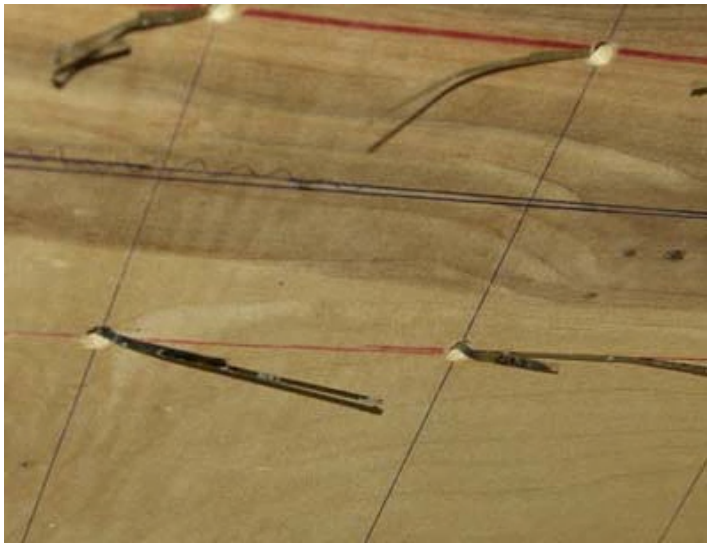


The cells are now stuck down to the plywood base in the pattern that you made before and the wires are gently fed through the back of the plywood.

Use just enough caulking to secure the cell to the backing. We usually use some sort of silicone because it is pliable and lasts a long time too.

Use each hole for 2 cells, one facing left and one facing right so the lead wires will easily thread through the holes. Be careful to not press too hard on the cells when you are attaching them. We usually use a small piece of wood to place on the cell to press evenly with, thereby avoiding any breakage.

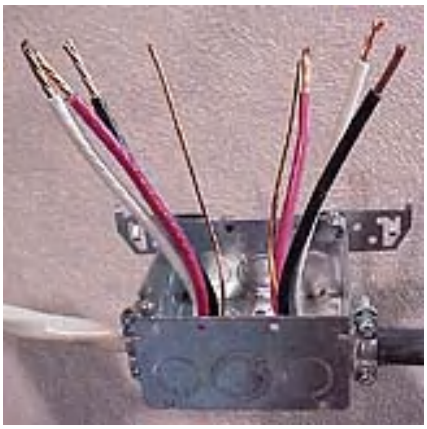
When you have all of the solar cells stuck down on the backing you will need to wire all of the same color (negative) wires together.



It is a good idea to make the leads long enough to join the ends later. Test fit a couple of cells before you begin.

Remember to connect all of the positive leads together and all of the negative leads together or your panel will not function properly.

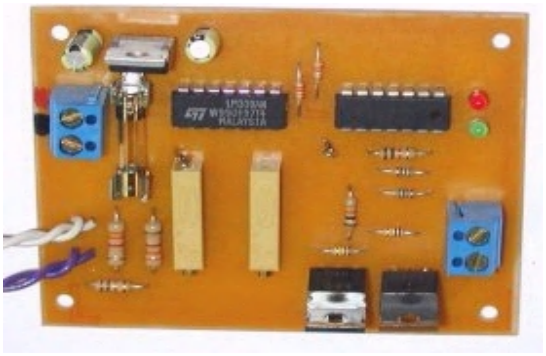
This spaghetti of wire will get connected to a junction box outside of the panel. We have started to put another piece of plywood on the back of this backer piece just to keep out the weather. Remember to coat it with 3 coats of epoxy too.



All of the same colored leads will be joined together and the positive and
negative leads will be connected to just one wire leading to your batteries.

Use the glass to cover the front. You can either use aluminum sealer strips that you can screw the glass down with or make your own from wood. Seal up all the edges and leave a drain hole in the bottom of the panel to let any accumulate moisture drain out.

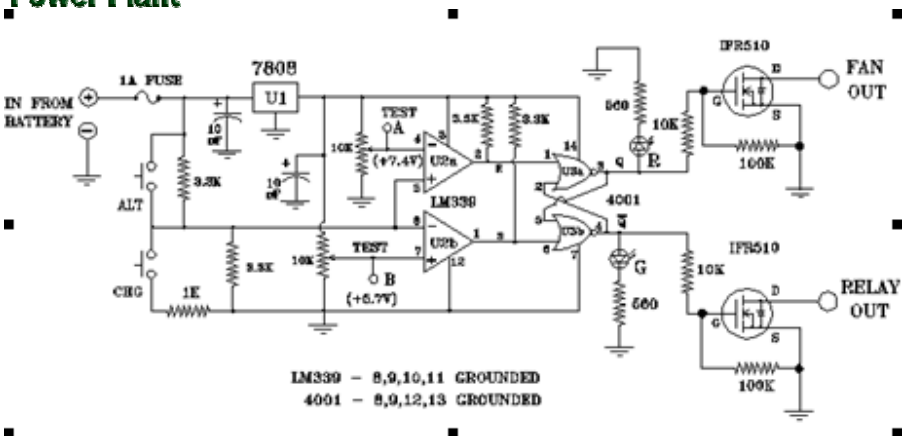
Charge Controller



Once your solar panels are up and running, the next obvious requirement is some sort of charge controller, since continuous overcharging will ruin the expensive battery bank.

Charge controllers intended for solar panels work by monitoring the battery voltage, and once it reaches full charge, the controller simply shorts the solar panel leads together. This doesn't harm the solar panels, but it does waste whatever power they're generating. The energy ends up heating the transistors in the controller instead.

Simple Charge Controller Circuit

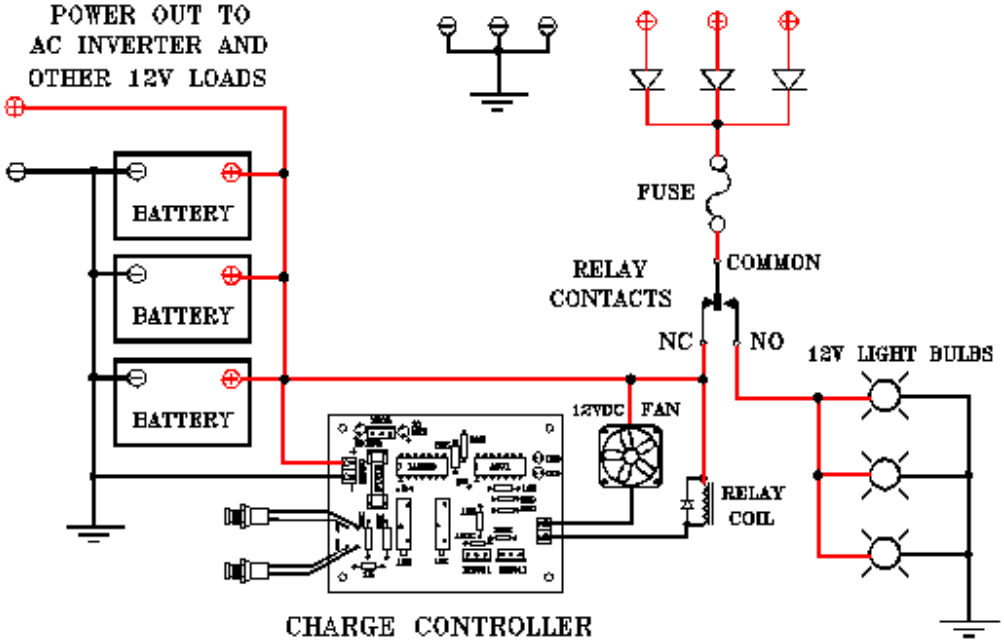


The above diagram shows the simple charge controller circuit. The incoming battery voltage is divided in half by a pair of 3.3K resistors, so the trip points are adjusted to one-half the desired levels. Start at 14 volts for the trip points.

The actual trip points will depend on your particular batteries, but a good starting point is 14.5 volts for full charge, and 11.8 volts for discharged. In this case, the trimpots should be adjusted to read 7.25 volts at TP-A and 5.9 volts at TP-B. You will probably need to monitor your battery voltage through several charge cycles to determine the perfect trip points for your system.

Simple Wiring Diagram Showing the Charge Controller and Batteries.

Home Made
Power Plant

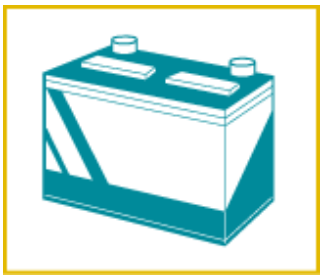


Batteries

How about those free batteries too!

Your battery bank is truly the heart of your renewable energy system. Batteries are used to store DC electricity during your daily charging cycle for use at a future time.

Housing your Batteries...



Your choice of battery location should comply with the Electrical Code, whether you install the batteries inside or outside.

The location should also be designed to keep the batteries warm (25°C is best), because their capacity decreases at temperatures below 25°C. This means that if you choose to locate your batteries in an unheated space, you will need to insulate the area properly.

You will also need greater battery capacity to compensate for the losses at lower temperatures. Make sure that your supplier knows about the planned location of your batteries.

The batteries and other equipment should be accessible for maintenance and inspection, but safety must also be considered.

Batteries may give off hydrogen gas during charging and can be a source of electric shock, so the room or area where they are housed should be properly vented to the outside and kept locked.

In addition, other electrical components, which can also be a source of spark, should be kept separately from the battery housing.

Do not locate batteries near sources of heat or possible sources of open flame or spark. Finally, read all of the manufacturer's recommendations and warnings about the safe and proper use and handling of batteries.

Batteries...

Inside Locations

Batteries located inside the living space should be properly vented to the outside. For small cottage systems with as an example, two 12-VDC (volt direct current) batteries, you need a vent that is at least 1 inch in diameter.

Keep batteries separate from the living space by housing them in special battery cases and should be properly ventilated to the outside.

For summer cottages, keep batteries full of charge to prevent freezing in the off-season.

Outside Locations

Batteries located outside of the living space should be housed in a box or shed. In a very cold location, you can house the batteries in a buried container for better temperature control.

In all cases, batteries should be well protected from the elements and be well vented to the outside. Battery maintenance varies with the type used.

Basic maintenance includes visually checking the electrolyte levels and regularly verifying the specific gravity of your batteries with a hydrometer. Add distilled water as necessary, and clean and tighten battery.

Also, check for any leaks or physical damage to batteries. Follow battery and charge regulator instructions.

SELECTING YOUR SYSTEM VOLTAGE

Now that you know the different basic components that will make up your renewable energy system it's time to make your first decision. It is very important to decide what voltage your system will run at, in order to design an efficient setup for long term use.

It can be very costly to change system voltage later if you decide to expand the size of your power generating setup.

Your choice will basically depend on the size of your renewable energy system and your peak demand for power.

YOUR CHOICES…

12 volts

We would recommend a 12 volt system for only the smallest systems like weekend cottages in remote areas, or small backup power systems could be run on 12 volts. With this sized system there is very little room for further expansion.

It can be set up rather inexpensively though. Your charging sources must be within 40 feet of your battery bank in order to charge efficiently. The maximum for upper limit power is about 3000 watts. There is also the fact that heavier more expensive wire must be used to carry 12 volt current. Here's how it works: Remembere Electricity 101 ?

With a low voltage system (12 volts) your amperage current increases. With higher amps comes higher resistance to flow. Thin of water flowing through a pipe. As more water flows, a bigger pipe is needed to carry that flow.

Basically Low Voltage = Larger Wire = Higher Cost

24 Volts

This is our recommendation for home scale renewable energy production. 24 Volts is very common and most companies sell components in this voltage.

There is also lots of room for expansion of your system later on. You would be able to run a 4000 watt inverter with a 24 volt system which allows more usage of AC equipment in the household.

As mentioned earlier when voltage increases, amperage or current decreases.

With a 24 volt system smaller wire can be used resulting in lower costs of installation of the system.

You also have the option of setting up your power generating system farther from the house. This is a good choice for wind towers, or micro hydro setups which are very site specific.

You can't change where the highest elevation is on your property for wind tower placement. You also can't change where that stream flows to suit where you have placed your home.

Maximizing power output usually means running a higher voltage system to accommodate greater distances to your power source and

24 volts fits very well.

48 Volts

If your power output source is a great distance from your home you might want to consider a 48 volt system. It is more efficient and would also allow you to run a 6000 watt inverter setup for your home.

Although not as common as 24 volts, larger manufacturers now carry higher voltage systems for special large scale or high performance systems. Special projects such as grid intertie or deep well water pumping can be set up very efficiently with higher voltages. We know of several setups (micro- hydro) where the power generating system (water flow) is over two miles from the households that it powers. But it is still more economical to install this system than to run power lines to the site.

The size and application of the system you are designing will usually determine your system voltage. Take a few minutes right now to digest this information and make the voltage decision. Please take into account your maximum daily power needs and the size of inverter you think you will need based on these numbers.

Lastly the distance to your power source will prompt the right decision in most cases.

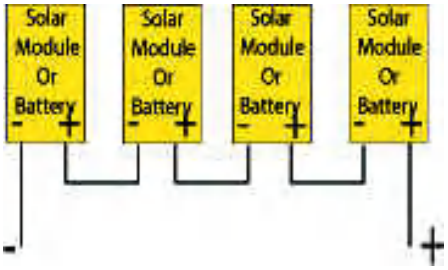
Wiring Your Solar Panels to your Batteries

There are three types of wiring configurations that are relatively easy to learn. Once mastered, the job of wiring batteries or solar modules becomes easy as pie. The three configurations are: Series , Parallel wiring, and a combination of the two known simply as series/parallel wiring.

In any DC generating device such as a battery or solar module, you will always have a negative (-) terminal and a positive (+). Electrons or (current) flows from the negative terminal through a load to the positive terminal.

Series Wiring

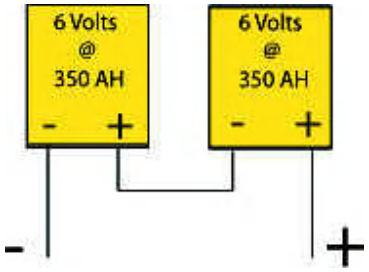
To wire any device in series you must connect the positive terminal of one device to the negative terminal of the next device (battery)



When you wire them in series the individual voltages of each one is additive. In other words if each battery or solar panel in the above example had the potential of producing 12 volts, then 12 + 12 + 12 + 12 = 48 volts.

The second important rule to remember about series circuits is that the current stays the same. If these batteries had a rating of 12 Volts @ 220 Amp hours then the total value of this series circuit would be 48 Volts @ 220 Amp hours.

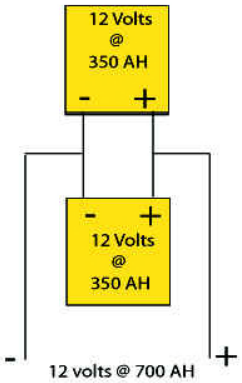
In the example below two 6 Volt 350 Amp hour batteries were wired in series which yields 6 Volts + 6 Volts = 12 Volts @ 350 Amp hours.



Remember the Voltage in a series circuit is additive and the Current stays the same.

Parallel Circuits

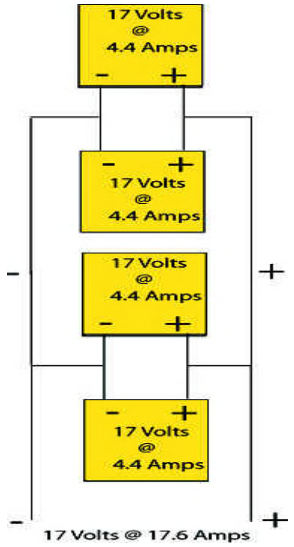
To wire any device in parallel you must connect the positive terminal of the first device to the positive terminal of the next device and negative terminal of the first device to the negative terminal of the next device.



When you wire devices in parallel the resulting Voltage and Current is opposite of a series circuit - instead the Voltage in a parallel circuit stays the same and the Current is additive.

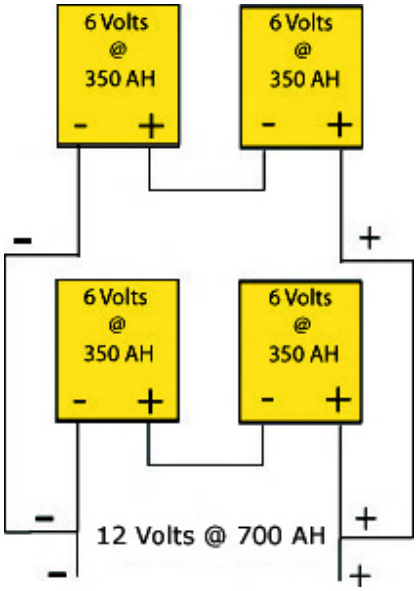
If each device in the above example had the potential of producing 350 Amp hours then 350 + 350 = 700 Amp hours, the Voltage would stay the same.

In the example below four 17 Volt @ 4.4 Amp solar panels were wired in parallel which yields 4.4 Amps + 4.4 Amps + 4.4 Amps + 4.4 Amps = 16.6 amps total @ 17 volts



Series/Parallel Circuits

A Series/parallel circuit is simply two or more series circuits that are wired together in parallel.



In the above example two separate pairs of 6 Volt batteries have been wired in series and each of these series pairs have been wired together in parallel.

Why in the world would someone want to do this ? Lets say that you want to increase the Amp hour rating of a battery pack so that you could run your appliances longer but you needed to wire the pack in such a way as to keep the battery pack at 12 volts. This is a good way to accomplish that.

What if you want to increase the charging capacity of your solar array but you needed to wire the solar modules in such a way as to keep the solar array at 24 volts, series/parallel is the way to do that.

A good place to start would be to start by wiring the batteries in individual sets that will give you the voltage that you need. For instance if you need 24 volts but have six volt batteries on hand. First wire four of the batteries in series to get 24 volts.

Tips on how to lower the cost of your generator

Find Free Solar Panels

Solar Panels are expensive! At $800usd for a 170 watt panel it would take over $10,000 to power the normal off grid home with solar energy.

That is a lot of money for our family, a lot of money for any family in fact…

We had it in the back of our heads that there must be a source of inexpensive (preferably free) solar panels. We just had to find out where that source was?

In our search for sources of free or inexpensive solar panels we have found two sources of free solar panels! And one source of very, very inexpensive solar panels.

Free Solar Panels Found

Finding our first source of free solar panels happened quite by accident… a car accident that is. Here' s how it went.

We were driving down the 401 highway (one of Canada's largest divided highways). Our family was going to visit the folks where we grew up.

Driving west just before dark we noticed up ahead the dreaded 'trail of brake lights', indicating a traffic jam. Traffic slowed down to a crawl.

Twenty minutes, forty minutes, fifty minutes, bumper to bumper until we finally got to the scene of the crash that had caused the traffic jam. Police and tow trucks were still on the scene.

What had happened was immediately obvious. It was the beginning of a construction zone with a lane change indicated. One driver hadn't seen the flashing mobile sign and piled right into it.

The twisted wreck of the orange mobile sign told the story. There was metal and tires and solar panels on the highway.

Wait a minute! Solar Panels?

That's right, and the light went on in my head. Here was our source of free solar panels. I asked Jane to quickly write down the name and phone number of the company written down on the sign. It was obviously a rental company.

On Monday morning we called them up to inquire about the solar panels. The company receptionist said that 'Yes, the signs get hit all the time, and yes, we could probably have the cracked solar panels after the insurance company looked at them."

It turns out that this company installs 5- 65 watt solar panels on each unit. After getting the company approval we totaled away 13 slightly damaged solar panels.

The workman that we talked to at the equipment yard said that "because the panels are mounted on the top of the mobile signs, they

rarely take a direct hit, and are frequently only cracked or shattered." He didn't know if they still worked.

After getting the panels home we wanted to know just that. Do they still work? We put them in full sunlight at noon and measured the current to see if they still produced power.

Only two of the units were ruined beyond fixing. The remaining eleven panels produced about 20 to 24 watts of power apiece in full sunshine.

That meant we had over 200 watts of solar panels, about $1000 worth for the cost of going to get them!

That is about as close to free solar panels as you will ever find. Just find out the name of the company who rent signs to the highway maintenance company and give them a call.

Free Solar Panels Found- Source #2

We have to give credit for this one to our good friend Bill who shared this one with us.

Here's what he found…

Solar panels are getting better and better everyday. New manufacturing process is making them more efficient and cheaper everyday too.

Now homeowners who have had solar panels on their home, some for over 20 years are upgrading. It's just like buying a new care every few years. Installers and dealers are now getting frequent calls from homeowners wanting to put up a new solar panel array.

What happens to the ones they replace? They go to the dump!

Call your local dealer or installer, better yet, call a bunch of them and see if they will save out old solar panels that are being replaced. It's that easy.

Inexpensive Solar Panels

Ask your dealer one more thing.

Solar panels are very fragile and frequently get broken during shipping and occasionally during installation.

What do they do with these solar panels? You guessed it. To the dump, or in some cases they go back to the manufacturer.

These panels you will not get for free usually. Most of the solar panels can be bought for one quarter of their wholesale price though.

Be sure to test the solar panels to see how many watts they are producing before you buy them though. Usually the relative amount of watts produced compared to the actual amount they were supposed to produce when new will determine the price you will pay.

There will be no warranty in any case, so make sure of what you are buying. We have also found one more source of inexpensive solar panels.

Used solar panels are available on e-bay. Yes, get an account, it's pretty simple and start shopping. Usually some pretty good deals here.

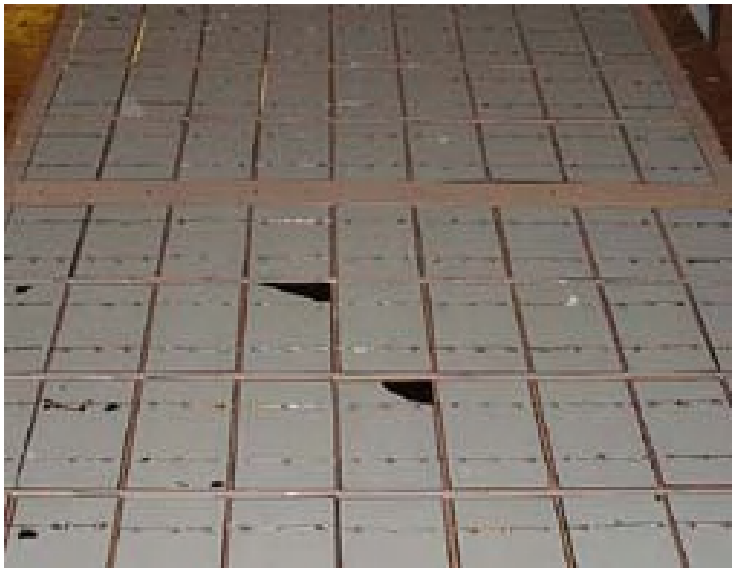
Again, it's buyer beware and make sure the shipping is included in the price, which can get expensive. Have the seller guarantee their condition for 30 days. If the panels are any good they will do this for you, to make the sale.

Build Your Own Homemade Solar Panels

First you will need a few tools and as we mentioned earlier a comfortable work space. You will be doing some wood work as well as electronic work so a nice comfortable workbench and chair are ideal.

Things you'll need-

Cordless drill, soldering iron (small pen type), pliers, hammer, caulking gun and miscellaneous nuts and screws



This is a picture of the back of a solar cell, the building blocks of solar panels.

Several of these small cells which are about the size of your hand go into the making of a solar panel. Mostly we use monocrystalline solar cells.

This picture is a good one to show you the component parts of a solar cell.

They are small and very fragile until they are mounted.

We will begin by getting you accustomed to different forms of solar power and a bit of electrical terms to make sure you understand all of the processes involved.

Home Made
Power Plant

Batteries

How about those free batteries too!

Finding Free Batteries

Free is where you find it - Most of the time the goods and materials you need can be found with a little persistence and the simple direct method of just asking.

Such is the case with free batteries. So far, we have found two great sources of free batteries for Renewable Energy systems.

Free batteries in your own backyard

For a few years our oldest son worked at a golf course for his summer job.

One of his jobs was regular cleaning and maintenance of the golf carts, some gas powered, some electric.

He usually rode his bike to work, but upon occasion he would ask me to drive him to work if it was raining or if his bike was in need of repairs. One particular morning that I dropped him off for work I spied one of the electric golf carts in the shop with the body taken off for repairs. They were going to replace the batteries.

I looked at the large batteries that had 'Deep Cycle' written on the sides of them and they looked to be in good shape. I came away with an idea.

After a bit of research I discovered that golf cart batteries are used and recommended for use with Renewable Energy systems, perhaps not the best batteries for the job, but certainly usable.

So I asked for the old batteries from the golf carts. Mike, the owner of the golf course said that he had to pay to have the old batteries taken away and
that I could have them.

Ok, so we had a source of free 'old' deep cycle batteries. Most of them didn't work though.

I had heard that batteries could be brought back to life by using a device called a desulfator.

A battery expert we met through our work installing renewable energy systems explained the process of reviving these batteries thoroughly so we set to work to do just that.

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. Protect from direct sun and rain. 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.

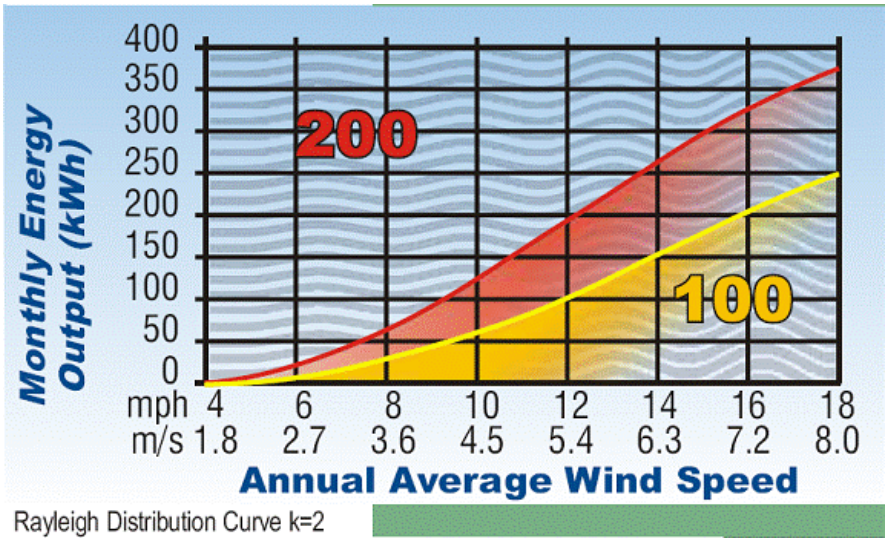
A critical part of maintaining the solar powered battery charging system is keeping the panel clean. The amount of power that a panel will produce is directly related to the intensity of sunlight that reaches the internal crystals. A dirty panel will allow less light to reach the crystals resulting in 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%.

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

Chapter 4. The Power of Wind – The Wind Generator

How does it work?

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.

Why build your own and not buy one?

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 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.

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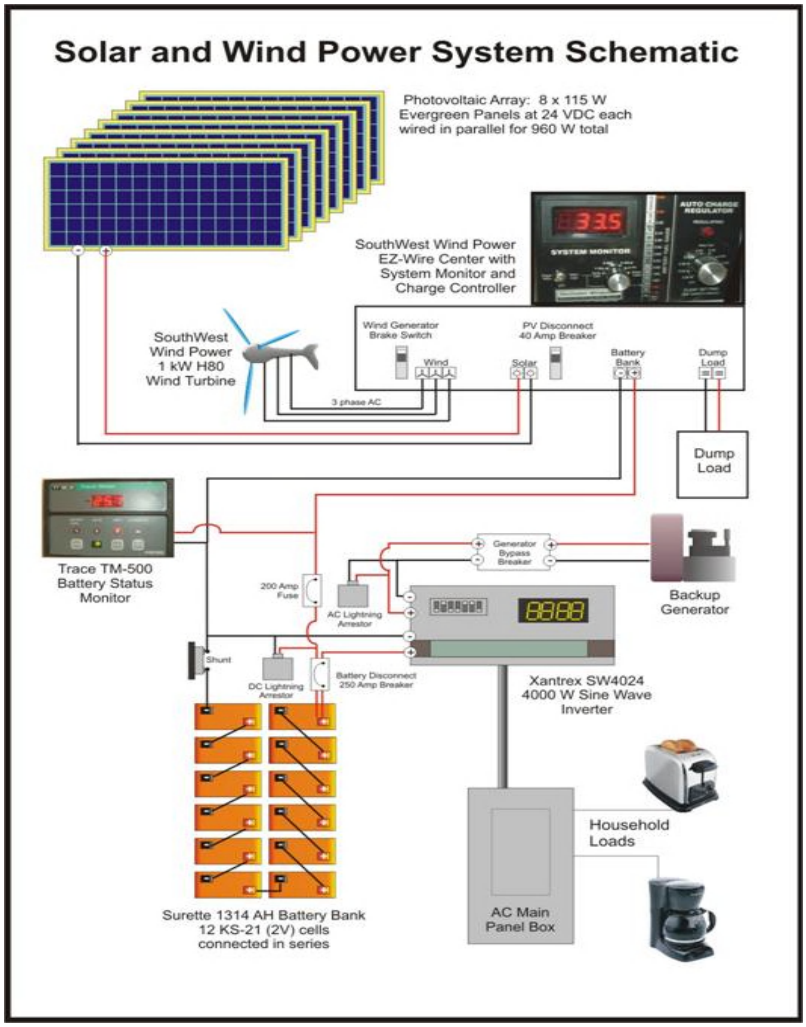


Wiring diagram of the wind generator

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
☐ 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 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.

Step by step guide on how to build your wind powered generator

Tips on how to lower the cost of your generator

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 them that you

are building a windmill (or solar system) then I am sure they won't mind handing you a few old batteries.

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 then 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 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.

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.

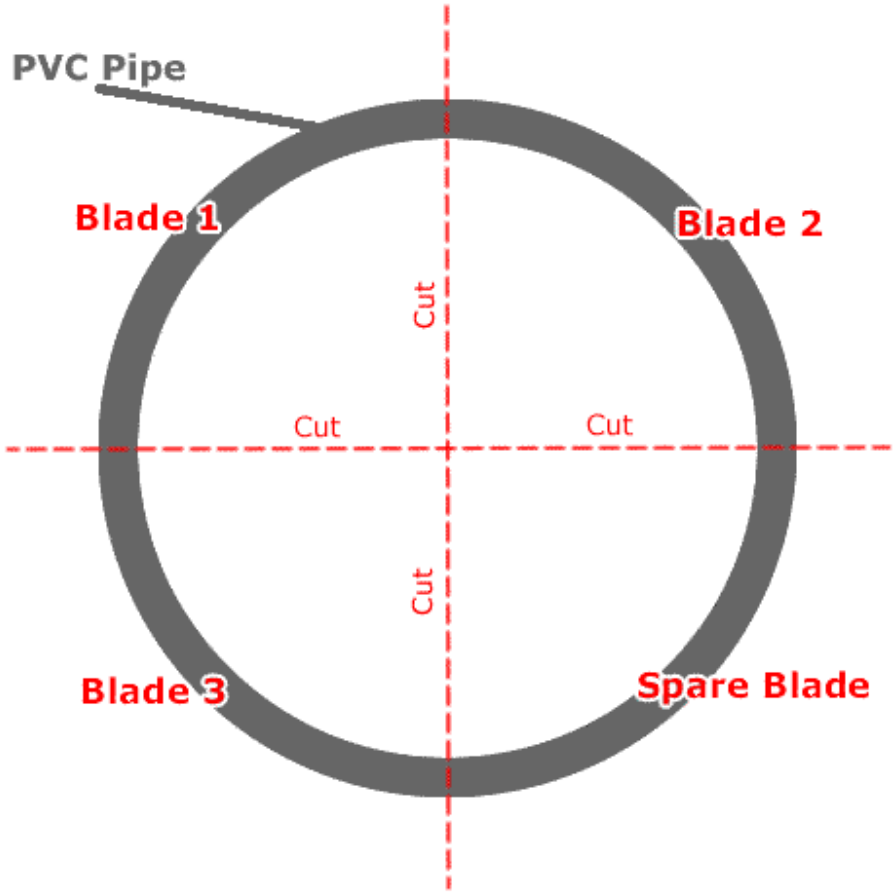
Remember, our goal is to produce 1000 watts of power and to achieve this output you will need to use blades of about 8 feet in diameter with wind speeds of at least 20 miles per hour.

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

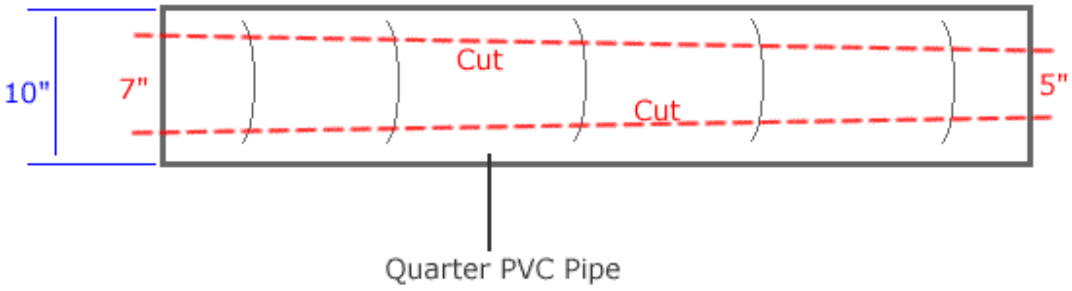
Cutting The Blades

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:

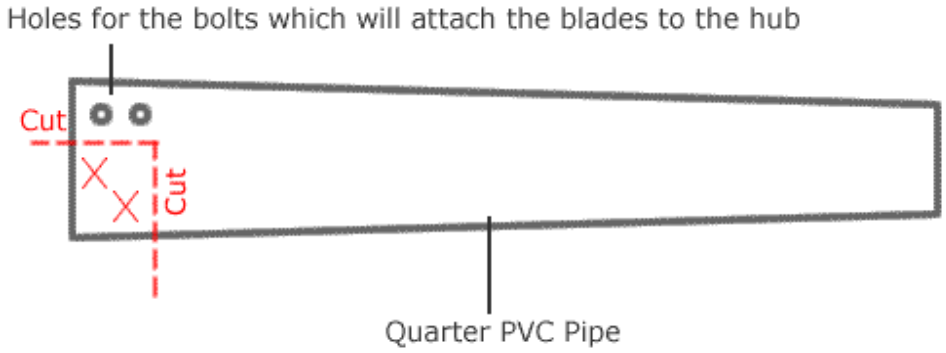


You want about half of the diameter of the blades left at the base, with the blades forming a rounded point at the outer edges.

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:

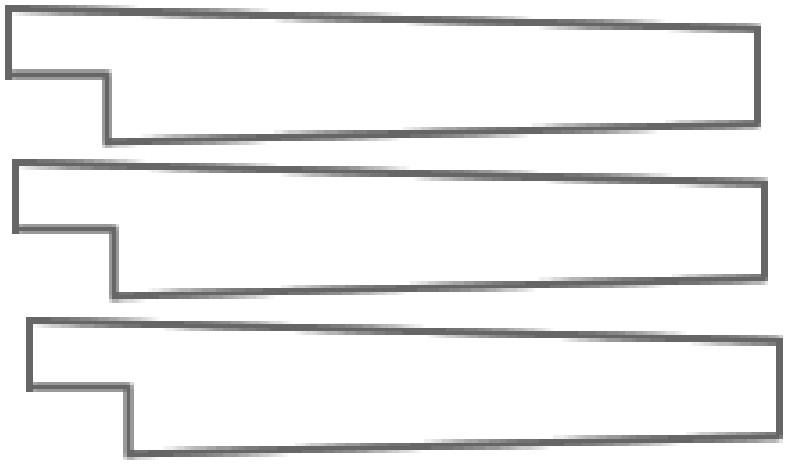


You will then need to make some extra cuts and holes as shown in the below picture



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 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:



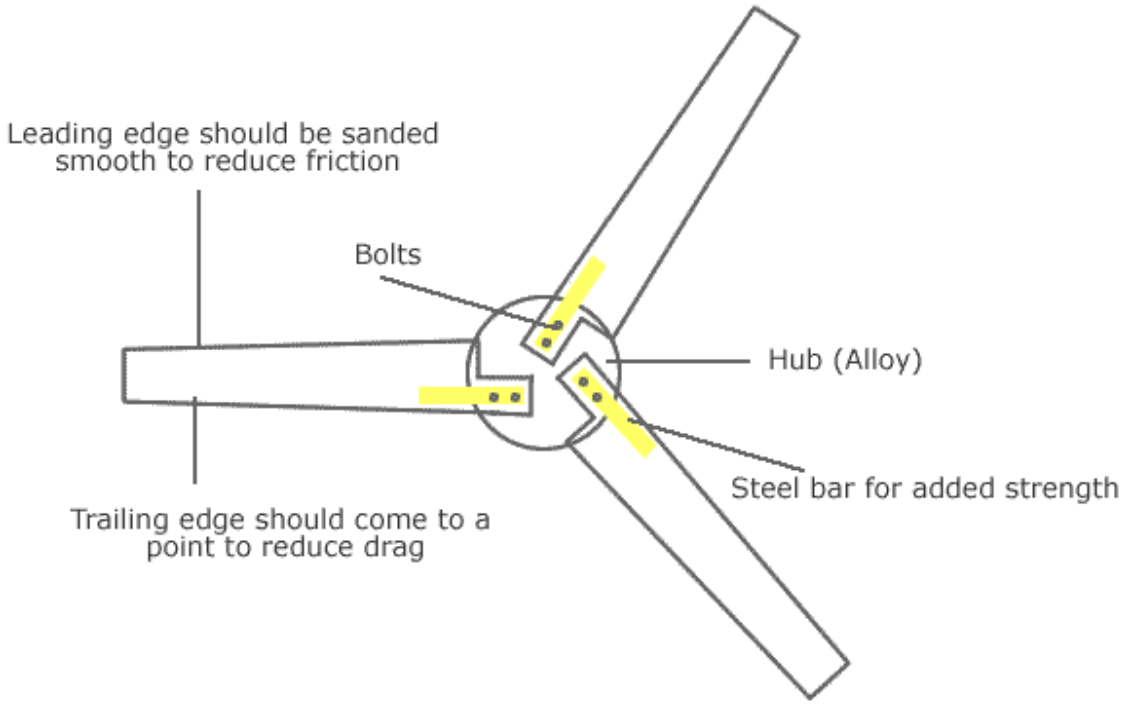
Building The Hub

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:



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.

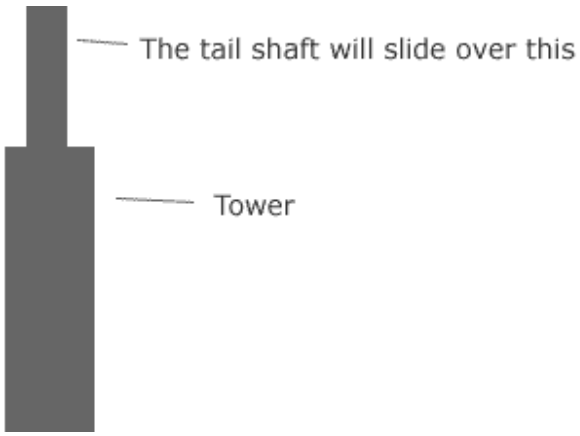
Here is an easy at home way to test if it is balanced. First, number each of the blades with a pen. Put the hub assembly on a pole and give the blades a good spin. Do this about 10 times and take note to what number blade is at the bottom each time. If you find that the same blade ends up at the bottom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

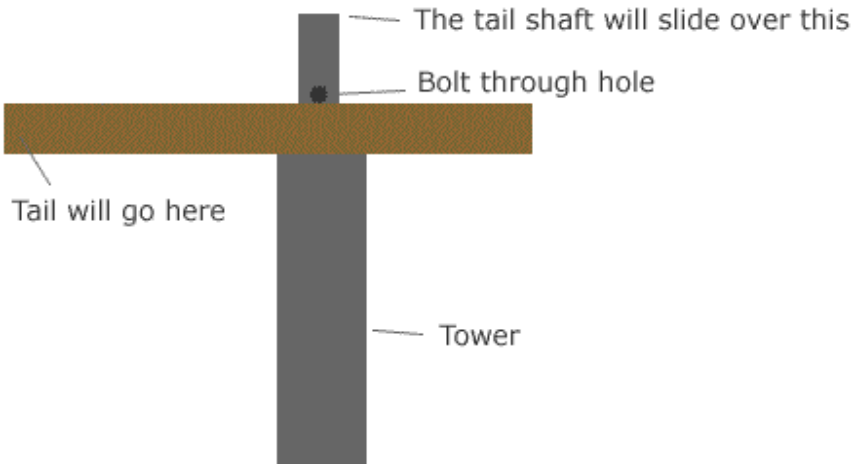
Building The Axis

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 then 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:



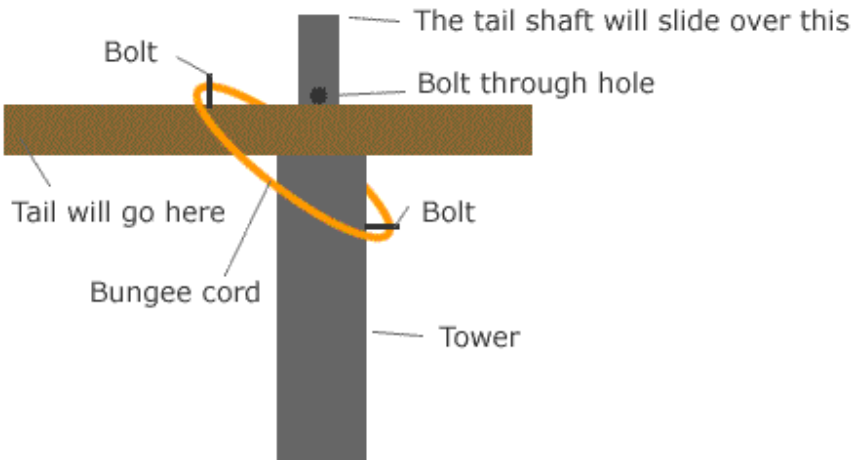
You will need to measure the height of your tail shaft and drill a hole through the top piece of the tower as show above. Make sure to drill the hole down far enough so that when we put a bolt through it, it will hold the windmills tail shaft in place.

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.

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 charges controllers on ebay for about $25.

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

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.

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. 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 5. So how much energy do you want?

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.

Some examples of energy consumption and household appliances

Appliance	Watts
Toaster Oven	1500
VCR	35
Well Pump	800
Sewing Machine	87
Satellite TV	50
Refrigerator/freezer	460
Vacuum	1125
Circular Saw	1500
Hair Dryer	1500
Jigsaw	300
Computer	100
Laptop	60
Monitor	60
27" TV	200

DVD	**14**
Drill	**800**
Microwave oven	**1245**
Compact fluorescent	**13**
Battery Charger	**25**
Blender/mixer	**350**
Belt Sander	**800**

Chapter 6. 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 7. The self sustained home of tomorrow, 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.

http://www.HalfWaterHalfGas.com – The world largest distributor of vehicle alternative fuel solutions

Chapter 8. Think big

Imagine 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 9. Ethanol as an energy source

Energy from sugar and corn

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 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 10. 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 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 11. Why not today

Find out why these easy to make and use devices are not widely used

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 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 12. Future energy

Today's fantasies, tomorrow's reality

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 Suns 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 13. Frequently Asked Questions

1.Why does my solar panel doesn't make the energy I expect?

Make sure that the glass on top of the panel is clear, remember the energy the solar panel produces is proportionally to the energy of the sun rays that reach the solar cells.

2.How do I get more ? I need more amps or more volts?

See again the chapter on how to connect the batteries series or parallel. That will solve your problem.

3.The device works but the energy doesn't reach my house or it is very little.

The answer is simple. Verify the thickness of the wire you use.

Remember the lower the voltage the thicker the wire.

4.My wind mill generator makes a lot of noise.

The reason is because the blades are not centered. You should try to rebuild the blades and place them at equal distances.

5. I live in a small home what energy do I need?

You can easily add the appliances you have using the table contained in this book and see. Usually it is around 450 watts.

6.Can I use the grid and the devices too?

Of course, as long as you tell the electrical company in your area and they agree there is absolutely no problem. And if you produce more than you consume the electrical company will be in debt to you not the other way around.

7. Do I need electrical expertise?
No. Anybody can build these devices, the only need of an electrician is when you connect the devices to the grid. It is more cautious to be around an electrician when you do that.