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Foreword

Our heavy, perhaps even irrational, dependence on fossil fuel casts a shadow over the world in the Twenty-first century. Some see impending environmental problems of a global nature looming around the corner, but, that aside, no one can deny the very real impact our demand for fossil fuel has in human cost when people fight over these resources and are willing to kill and die in order to take possession of them.

In pointing this out I do not mean to say things can – or even should – be changed by force or by pointing fingers at guilty parties. No, the right way forward, I believe, is to convince users around the world, both in the home as well as in the plants and factories, to put aside their sole reliance on fossil fuels, and switch to renewable energy. A switch that not only lessens pollution but also makes good financial sense in the long run.

Governments and people in general work harder on solving their economic issues, and if this also benefits the environment then so much the better. And, of course, future generations will benefit both financially and in terms of resources and the environment if we learn to switch to alternative solutions for our energy needs.

Oil prices are now sharply rising and the overall energy demand at a global level is anticipated to grow in the near future due to developing parts of the world reaching the same level of energy need as the already powerfully industrialized countries, as well as projected significant increases in world population. Although impossible to estimate our remaining fossil-energy resources, it seems wise to explore renewable energy as a solution for all the reasons thus far mentioned.

This manual, then, has been written to provide some answers related to the most efficient ways we can save energy and, eventually, resources. It also suggests complementary solutions, solutions we can apply as simple users who don't have the power to change the face of the earth by a single gesture, but who can make a difference in our own homes and communities.

You may be thinking that you do not have enough money to adopt some or all of the solutions in this book. Let me assure you that things need not be as expensive as you may now think. In this manual I will guide you to the best options for your circumstances.

Although alternative-energy technologies were once only the province of affluent private investors, changing attitudes along with economic uncertainties have sped up the process of such materials breaching the market thus making them available to all. And that's good news for you!

Small Tips for Big Changes

Alternative energy solutions and technologies remain, for the moment at least, way beyond mass marketing, despite embodying the extremely appealing and sensible ideal of renewable energy.

However, you and other small end-users need not be dismayed by this. You can still employ low-cost alternative-energy methods to reduce energy consumption and, consequently, energy bills.

This manual will introduce you to two systems that are affordable and, with the instructions contained herein, simple to implement. But before I get into that let's look at some ways you can save energy right now with little effort. These tips will not only help lower your expenses but they will also help you to optimize the use of renewable energy.

TIP#1 Fluorescent light bulbs are much more energy-efficient than standard bulbs

Replacing regular light bulbs with fluorescent bulbs will save you money, even if at first sight this change seems too minor to mean very much. Keep an eye on your bills and you'll see the difference.

TIP#2 Avoid negligence

Negligence is perhaps the largest source of waste. Most people may be unaware, for example, that appliances can consume energy when switched off if they are still plugged into the mains. So unplug them when not in use and prevent pointless energy consumption.

TIP #3 Change domestic habits

You can save both energy and water (not to mention detergent and money) if dishwashers and washing machines are put to use when full. This may, like many of these tips, seem like common sense, but common sense and common practice are often not the same. We all need reminding.

On a related matter, using an electric clothes dryer, even if a big timesaver, is also a big energy waster. When, and if, possible, clothes (and dishes) can be easily – and freely! - air dried.

Are you guilty of over using the heating in your house, or keeping the air coolers (if you have them) on a little longer than need be? It's an easy habit to fall into. However, medium temperatures are preferable in both cases and avoiding the, albeit comfortable, extremes makes for a smaller bill and often a more healthy environment.

Of course, trying to regulate the temperature in your home is somewhat hampered when air circulation and insulation are poor. Windows and doors should be checked to see that they are air tight, and roofs and walls can be insulated to prevent leakage of heat. Attending to these will prevent a lot of waste over the years.

TIP #4 Driving habits

Saving on gas for your car is yet another solution for lowering expenses. Perhaps not as powerful as the tips above, but every little helps especially if you're struggling financially. By not accelerating or breaking too suddenly, fuel can be used more efficiently and will last a little longer. Your car might last longer too…

Solar Power Explained

The sun is an extremely precious source of energy, and the only reasons why people don't use solar power to the same extent as fossil fuel are related to technological and financial issues. Once these issues are solved, solar power will be used to meet our demands and, at the same time, the implications of consuming fossil fuel, or at least so much of it, will no longer be a concern. We've come a long way since the days when solar panels were only used on satellites back in the 1950s and 60s. And the industry has grown greatly since the 1990s. This is wonderful news for you, the Twenty-first-century reader. It means solar technology is now more available and far cheaper.

Let's look at a little bit of the science and other details behind solar energy before we go any further.

In order to make electricity from the energy released by the sun, panels designed to collect such energy are required. These solar panels work on the basis of some integrated photovoltaic cells meant to – as the name itself suggests – turn the light ("photo") into electricity ("voltaic"). You will often see this word abbreviated to PV.

Solar cells represent the basic unit responsible for creating energy within a solar-power generating system. Although materials used to make solar panels differ, silicon is the most common. Silicon solar cells are semiconductors in solid state and able to generate direct current if stimulated by photons.

These silicon solar cells can be divided into four types: single-crystal (or monocrystalline) cells, polycrystalline cells (sometimes known as multicrystalline or thick-film cells), amorphous cells (also referred to as thin-film or vapor-deposition cells) and, finally, hybrids of the monocrystalline and amorphous technologies). They all have their place but single-crystal cells, with the exception of more expensive hybrids, are the most efficient when it comes to producing energy. The other two types have their own kind of efficiency but they do not match the productivity of single-crystal cells.

The semi-conductors, of which these cells are made, comprise the crucial “active ingredient” which make solar panels work. A chemical reaction is triggered when the sun’s rays hit the surface of these semi-conductors which sets electrons free from their atoms thus generating electricity. It’s important to note that even cloudy days will excite some electricity from your PV cells, though a lot less than a cloudless one.

Progress continues in optimizing solar panels (such as with the hybrid technologies mentioned above) to extend their capacity to collect an increasing amount of energy; with research and development, solar power may well come to represent an increasingly reliable source of energy in the near future.

But relying on photovoltaic cells to harness solar power is not the only solution by which we can turn the sun into a source of energy and exploit it for necessities. There is also passive solar heating.

It’s true that this concept is applicable only when it comes to heating, and it is not valid with respect to our complete needs for energy. Yet, passive solar heating is not something we should disregard. It can have its place in our energy-efficient home.

So what is passive solar heating? It is simply the natural heat generated inside of buildings. It is facilitated by large windows strategically positioned on the south side of a building so that they are able to transmit shortwave infrared radiation to furniture, walls and floors which, in turn, absorb this radiation and produce heat. Dark-colored furniture and décor absorb this radiation more readily.

Of course, in order to obtain this kind of heating, you will have to live in an appropriate climate. But this doesn't mean a warm climate is needed – if it were so, than the whole purpose of heating our homes would be superfluous. Passive solar heating is just as reliable in cold climates as is its corollary, "Daylighting", which simply means that natural light can be relied upon more and for longer during the day thus requiring less need for artificial light. The only aspect that should be taken into consideration when we speak of climate is cloudy weather. Clouds hinder passive solar heating, since they block the direct sunlight needed.

Although free and of some benefit, it is of course highly defective when it comes to storing heat or having any control over the same, either in its generation or use. Blinds and curtains will allow some retention of the heat during the nighttime as they act as a barrier to the windows which become cold after dark. By the way, it is also possible to make use of this radiation during the winter as snow reflects sunlight and sends it straight to our windows.

It should also be noted that objects constantly exposed to infrared in our homes will fade in time, and of course our home may just not be set up for passive solar heating even if we do live in a clime relatively free from prolonged cloudy periods. Our windows may not be placed southwards, walls may not be built from a material able to maintain a constant temperature, and so on.

Add to this the fact that we have to make sure walls, roofs, ceilings, doors, and windows are perfectly insulated, because it's only reasonable to presume we don't waste what we have contrived so hard to gather.

Passive solar heating in the form presented above is not sufficient by itself. In order to optimize it, other means of enabling passive solar heating are required. Thermal mass is an excellent way to improve the efficiency of this process. The idea here is to use high-density materials, such as concrete, brick, stone or adobe, to improve the structure of a building; such materials are extremely sensitive to light and shortwave infrared radiation, absorbing it and releasing heat instead – a process known as Direct Gain. In addition, high-density materials are able to produce heat in the absence of light and shortwave infrared radiation, since they are able to release long-wave infrared radiation.

Sunspaces can be used to facilitate passive solar heating. This is a greenhouse-like structure attached to the south side of the home which heats up during the day and, with the correct ventilation, circulates the heat into the house during the night. Another supporting design feature is the trombe wall which is a thick, dark-colored wall built to face south and constructed of heat-absorbing material. A sheet of glass or plastic covers the sunward-side of the wall, with a gap between the two, which facilitates the wall to slowly absorb heat during the day which the tombre then releases slowly during the night. Modern designs of the trombe wall minimize the loss of heat to the environment during the night, securing most of it for the interior where it is needed.

Daylighting can also be greatly magnified by the use of a clerestory or windows in the roof, as commonly seen in the familiar design of factory roofs.

However, the sun can do more for us than passively heating our homes. Solar energy can be used to power out fridges, out TVs, air conditioners and virtually all appliances commonly found in any home. But the best way to harness solar power for this purpose is to use solar panels.

Such devices can literally replace the grid or, at least, significantly cut down your electricity bills and thus reduce your reliance on the grid. The next section of this manual will tell you about low-budget solar-power systems for your home and how to implement them.

Home-made Solar Generators – a Fact

As advanced as it may sound, the technology used in building solar generators at a professional level can be reproduced in the average home for around $200. Anyone can build their own solar generators with minimal resources and with maximum efficiency

But before we get into that we need to mention an important fact. A little earlier we mentioned about solar cells. Each one of these cells, regardless of its size, is able to generate .5 volts or less, depending on the type of cell used in manufacturing the panel.

If we split a 5” by 5” solar cell rated at .5 volts and 4 amperes into 4 smaller units, each unit would still be able to generate .5 volts.

Although we end up with the same voltage per unit, the current output will only be 1 ampere (quarter of the initial undivided unit). This should be kept in mind when building a solar panel. It’s much more productive to use larger cells since that will save us time, tab and connection elements for the panel.

How to Build a Portable Solar-Power System

Portable solar-power generators produce energy able to supply any appliance commonly found in the home. Building such a system is simple and rewarding, as the results will begin to show no later than a few weeks after manufacturing it.

All you need, as shown on the previous page, is:

(1) a solar panel (or more if necessary, but these need not exceed 12V)
(2) a charge controller
(3) a battery
(4) an inverter
(5) an appliance.

This is the most basic structure, but if money's not so tight then you can add some extra elements. Solar panels can be bought of course but there are also ways to make them yourself. We'll be covering this topic a little later in the book.

Batteries are much more efficient in operating in warmer temperatures, which is why they are best stored in a battery box. The battery box may add a little to the initial budget, but it is also useful in deterring children and pets from interfering with it and possibly hurting themselves and the battery.

A system meter is another option. These devices "read" how full the battery is and how much power is being consumed at any given moment. System meters, if used, should be placed between the battery and the inverter.

As previously mentioned, any appliance can be supplied with energy from this system. Fridges, for example, run extremely smoothly if connected to this system, and the results will show in the monthly electricity bill. Appliances can be connected directly to the inverter in order to receive electricity – the garage is generally the best place to keep the various electrical elements of the system in this case.

How to Build a Grid-Tied Solar Power System

The parts necessary to this kind of system are the following:

(1) solar panel(s)
(2) an array DC disconnect
(3) an inverter
(4) an AC breaker panel
(5) appliance(s)
(6) a kilowatt-per-hour meter
(7) a grid.

This system is also referred to as interactive solar-electric system or on-grid system. It is, in fact, a conjoint system, since it entails the partial use of the local power grid.

If the energy produced exceeds the energy consumed, you can benefit from this and save money. This is how it works: you make an agreement with the local electricity provider called net metering or billing and the meter measures the system’s energy consumption.

How to Build a Grid-Tied System with Battery Backup

This system requires the following elements: (1) solar panels as energy sources, (2) an array DC disconnect, (3) a charge controller, (4) a deep-cycle battery, (5) a system meter, (6) a main DC disconnect, (7) an inverter, (8) an AC break panel, (9) a kilowatt-per-hour meter, (10) a grid and (11) appliances.

The difference between this system and the previous is that this one uses a battery backup as a solution in case the energy production is interrupted for various reasons, such as improper weather or maintenance interventions.

How to Build an Off-Grid Solar-Power System

(1) Solar panels as energy source, (2) an array DC disconnect, (3) a charge controller, (4) a deep-cycle battery, (5) a system meter, (6) a main DC disconnect, (7) an inverter, (8) a generator, (9) an AC breaker panel, (10) and appliances – all these are necessary for building an off-grid solar-power system.

In this system the generator undertakes the function of the sun (i.e. the source of energy) whenever it's not available, such as during cloudy weather.

On the Parts Necessary to the System

The Solar Panel

Solar panels are, of course, the defining element of a solar-power system. Their role is to collect solar energy (sunlight) and turn it into electricity.

The energy generated by the panels is measured in watts. In order to see how many panels are necessary to provide the amount of energy required for your needs, you will need to review the measured output in the PV panel. If more solar panels are needed, then they will be connected in a series.

While, or before, building the system you will need to know that the output of the current will be highly influenced by factors independent of the elements of the system itself. The amount of light that hits the cell in order to produce direct current can vary due to weather conditions (moisture, clouds, and other attributes of the air) and, of course, from the period of the day and from season to season. The position of the sun at any given time of day, or season, will create variations in the angle at which the sunlight hits the PV cells. Cells can also heat greatly and this can diminish the current (panels on roofs should always have a gap between them and the surface of the roof so as to increase air flow around the panel).

The DC Disconnect

This part is extremely important for efficient disabling of power in such cases as maintenance work and so forth.

The Charge Regulator

This is a part I highly recommend, even if it may seem unnecessary at first. It monitors and controls the charging of the battery, preventing it from being overcharged and monitoring the discharge during the night. The charge regulator, by doing these things, extends the life span of the battery and will thus save you having to replace your batteries quite so often as would otherwise be the case.

The Deep-Cycle Battery

Deep-cycle batteries are preferable to regular batteries because they store all power produced by the solar panels, preventing waste.

The Main DC Disconnect

A main DC disconnect is essential for the maintenance needs of the inverter. As the name suggests, it helps disconnect the inverter.

The System measuring device

Should you be interested in how much energy your system is producing, and how much is consumed, you will need a system- measuring device. This device will thus help you monitor your system to make sure you are getting the most efficiency, and the most savings, from it.

The Inverter

Most of the appliances we commonly use run on alternating current (AC). But the solar panels only generate direct current (DC). An inverter converts direct current into alternating current. If you do not use AC appliances (such as TVs, refrigerators, and computers) then a DC output will suffice and you will not require the inverter.

The Generator

Any solar-power system that is not grid-tied needs an alternative source of energy for those times when the system is down or disabled (such as during periods of maintenance or improper weather). In order to make sure the energy supply is not cut off in such moments, you should employ a generator to temporarily cover the energy production.

The AC Breaker Panel

The appliances in any home can be directly connected to the inverter in order to run them on the energy produced by the solar-energy system. However, this is not usual because most energy sources are connected to the electrical wiring in a home by an AC breaker panel.

This device acts as a kind of intersection point between the actual energy source and the various appliances that source feeds. AC breaker panels are usually installed outside the house or in a utility room or garage. The difficulty with them is that you cannot tamper with them unless you are an authorized person – an electrician or similar. Also, you will need to contact your local energy provider and tell them you want to connect your solar-energy system to the panel. Each country has it sown regulations in this regard and you will need to find out about those.

The Kilowatt-per-Hour Indicator

This unit is necessary for grid-tied systems. The purpose of it is to determine the energy which is both received from and delivered to the grid. The meter will turn backwards if the energy consumption is smaller than the energy produced.

The Grid

It goes without saying that this element is essential in a grid-tied system. The grid, of course, and in the absence of alternative sources, provides all the energy to our homes.

The Appliances

Any device that needs electricity in order to run is an appliance. Our energy needs are defined by these appliances.

Solar Panels – How to Get Them for Free

If you have a very low budget then here's a way you might find solar panels either for free or very cheaply. You'll need to find the telephone number of a maintenance shop. Such phone numbers are usually found near construction sites, on signs that are solar powered. Calling that number will put you through to a head mechanic or to a person in charge. Ask them whether they have any damaged panels. They usually give these away for free.

Damaged solar panels don't work at full capacity. However, they can be repaired quite easily. Soldering wires is not hard and replacing cracked or scratched silicon is not difficult either.

You might also keep an eye out for second-hand solar panels. eBay is a good example of where you might find low-priced solar panels. Just type in a keyword such as "solar panel" and see what it throws out. Generally prices here will be much cheaper than the professional market.

Solar Panels – How to Build Them

Home-made solar panels are a possibility you may wish to explore as it will save you a good part of the money needed for your entire renewable-energy solution in your home. The parts necessary for building a solar panel are as it follows: solar cells, plywood, glass, copper wire, silicone, solder, and a UV protector.

On the Parts Necessary for Building the System

Photovoltaic cells are of course the heart of a solar panel. These come in shapes that vary between round and square but the type rather than the shape is what's important. Cells are typically low cost. As mentioned above there are various types but the monocrystalline ones are fine, as are some polycrystalline, and count as the most popular. You'll see others around such as ribbon cells but the single-crystal cells are perfectly adequate for our use.

Again, eBay is your friend. Here you can find even more expensive cells at a greatly reduced price. You may also find damaged ones to bid on, which should again lower the cost.

Spoiled cells can be of two types. They can be either cosmetically flawed or cells that are off-specification. Cosmetically flawed cells are cheaper even if they work at full capacity. However, sellers choose to cut down prices because cells have chipped corners or sides, show discoloration or lack reflective coating. But some cosmetically damaged cells can also be flawed with respect to their efficiency. For example, if some essential parts of the cell are not covered with reflective coating this can have a serious impact on the output of the cell, since the cell will reflect more light than it takes in.

Off-specification cells are the ones that failed the test before marketing. That is, they do not comply with the output standard imposed to them, which means they do not produce the current and the voltage that would make them up to scratch for commercial panels. Should you choose to purchase these, you should keep in mind that low-efficiency cells will render a low efficiency of the entire system, despite the fact that such cells are more appealing due to the purchase price. So spend your money wisely.

To keep things simple, and assuming you can afford the cost, it is best to get unspoiled PV cells to start you off on your first construction of a solar panel.

After you have your cells you will need to know how much energy they can generate before actually building the panel. In order to do that, keep the cells in the sun for a while and then use a voltmeter to measure the amount of energy being produced. Do this for each cell.

You can get a manufacturer to do it with great accuracy, but they can be rather expensive. The above test should be find for your needs as long as conditions are noted. Moisture in the air, time of the day or the season all play their part in affecting the results you get. So, to get a feel for the real output of the cell make sure the test is conducted at noon on a cloudless day, in the summer.

When it comes to plywood, you don’t need to buy the most expensive kind since its only purpose is to provide the backing for the panel. It will also be covered with UV protector to extend its lifespan. However, the plywood should be quite strong.

Copper wire is used to connects the cells. It’s a good idea to use different colored wires to distinguish between the positive and negative poles. Silicone allows the cells themselves to adhere to the plywood. You’ll also need to ensure that the copper wire is stuck on the back of the cells by soldering it. Glass is then used to hold the entire panel together (non-reflective glass is the most effective and the type I recommend). Anyway, let’s get into the exact steps you need to follow.

The Steps of the Project

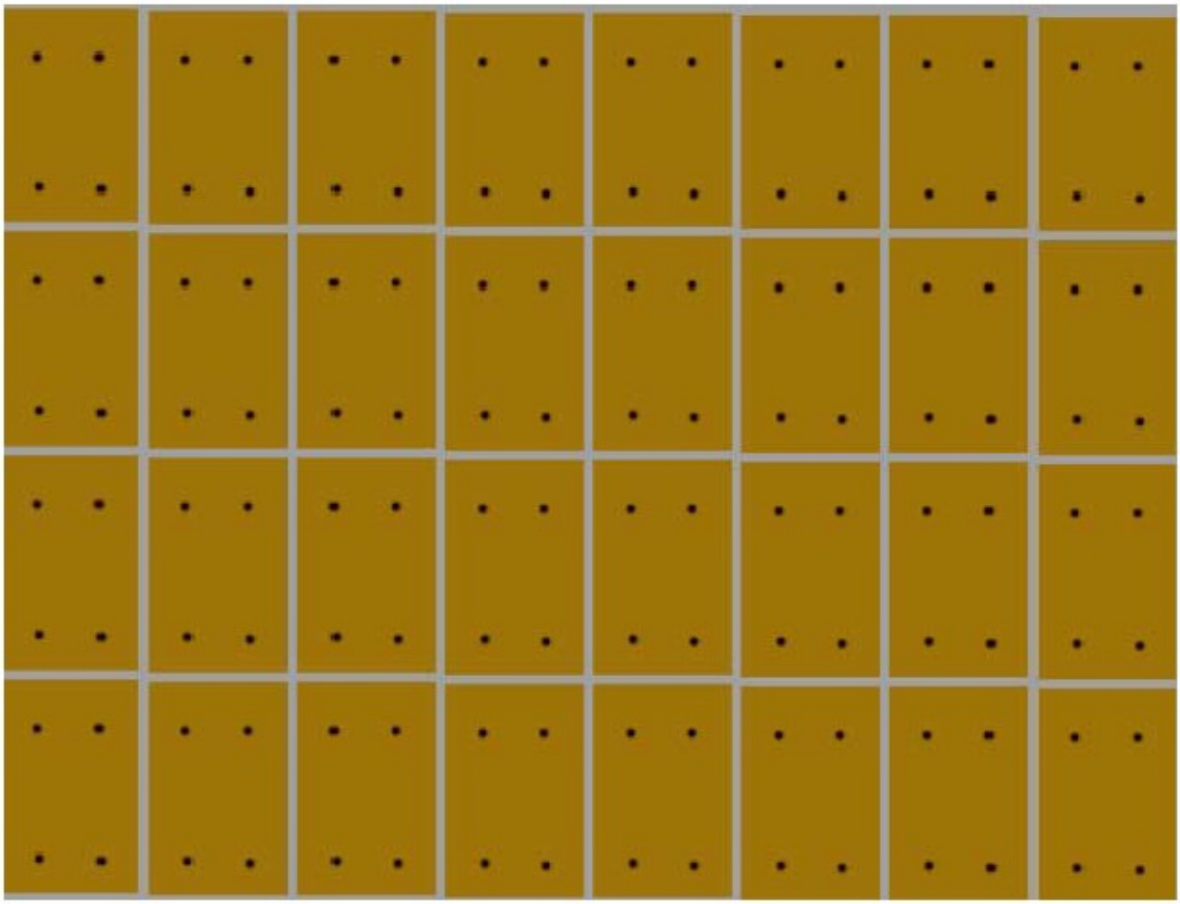
STEP #1 : The Plywood

The number of cells used will determine the size of the plywood required. You will need to cut it to the right size. As a guide, 100 watts of power will require 80 solar cells.

STEP #2 : UV Protection

Now cover the cut plywood with the UV protector. Three layers are recommended.

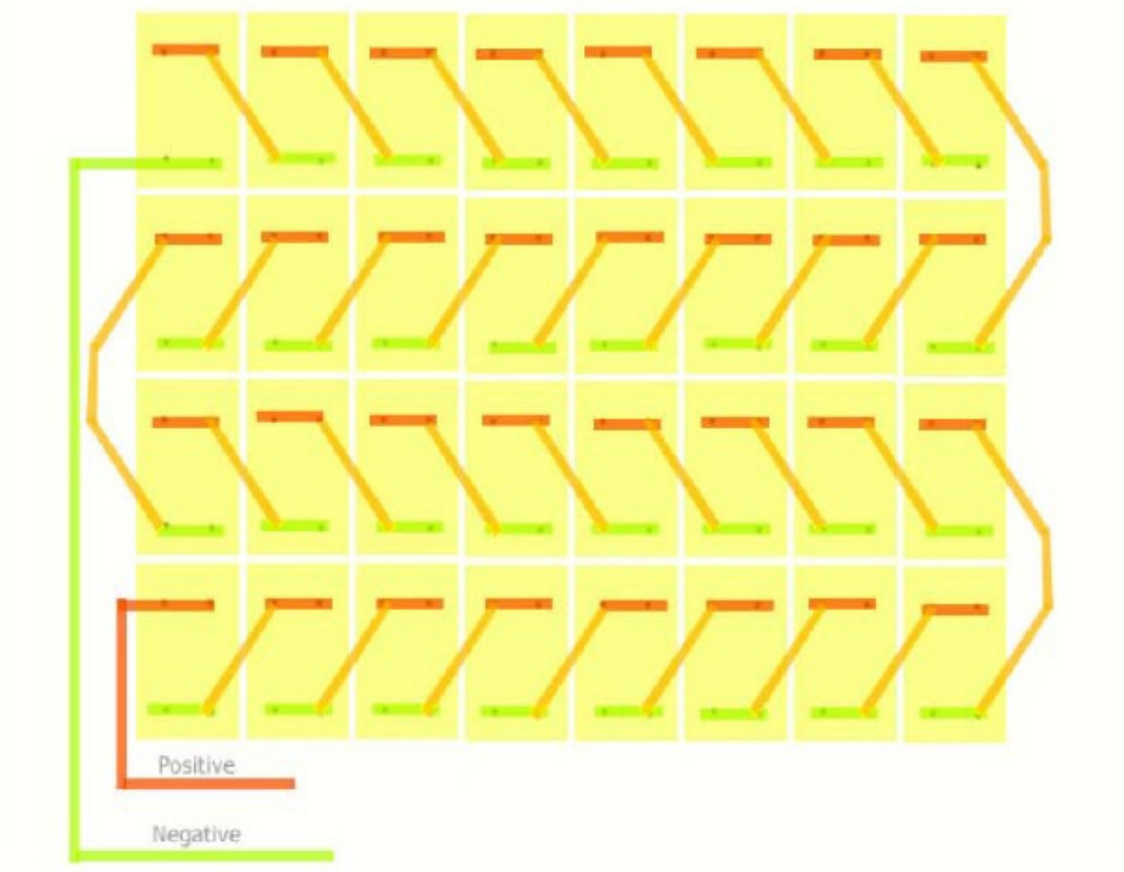
STEP #3 : Wiring and Soldering



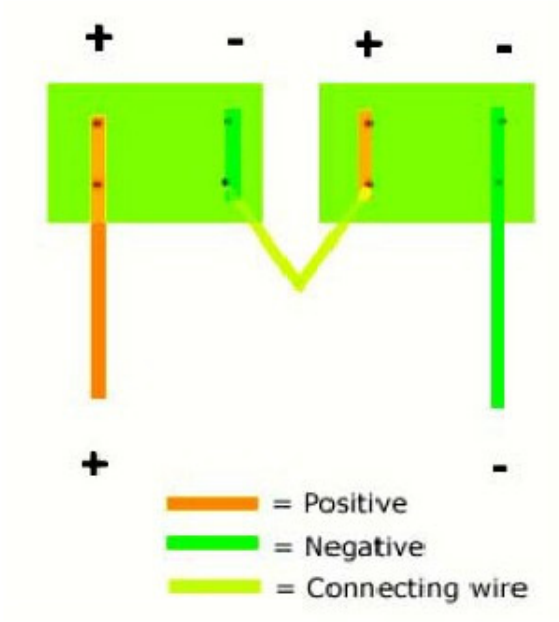
Here you combine the cells into a single energy-producing unit. You'll first need to apply some solder on the tabs at the back of the cells. A pencil-like solder iron will ease and speed up the process and it will also optimize the soldering of the copper wire.

Wiring is not a complicated process. One should begin by wiring the bottom of the cells (the negative pole). The negative will be connected to the negative.

Then the top of the cells (the positive) should be wired and connected to the other positives. The solder will help keep the copper wire stuck to the back of the cells.



It's important to get this step right. Failure to pay attention to correct wiring will cause the system to lose efficiency if, indeed, it works at all! The most common error people make is to allow the ends of positive and negative wire to meet, so make sure you avoid that.



A wiring series is a simple thing to do, and is a type of wiring that allows the supplementary connection of other cells, should they be needed at a later date.

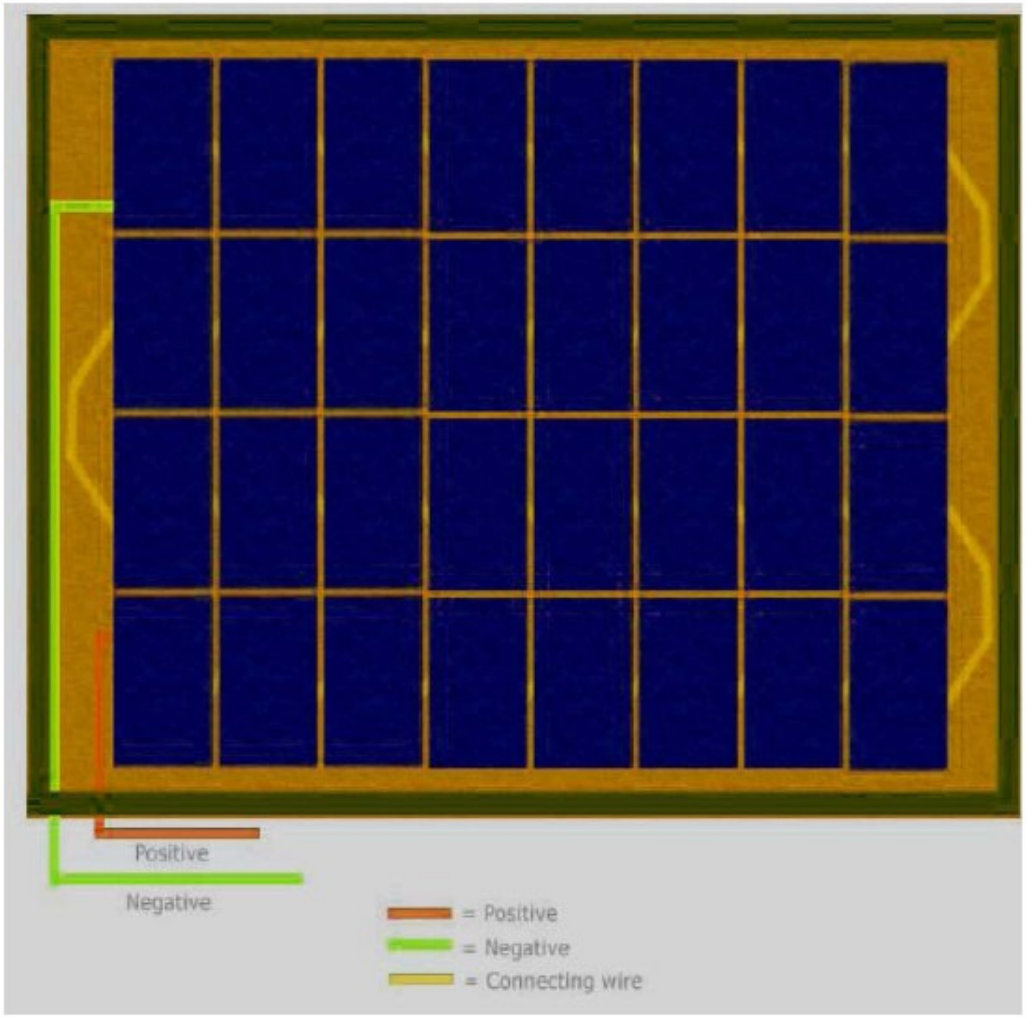
STEP #4 : Sticking the solar cells to the plywood

Silicone is perfect for this job, and there is no need to go over the top in applying it. Cells need not be drowned in silicone to stop them slipping from the plywood.

STEP #5 : Drilling holes in the plywood

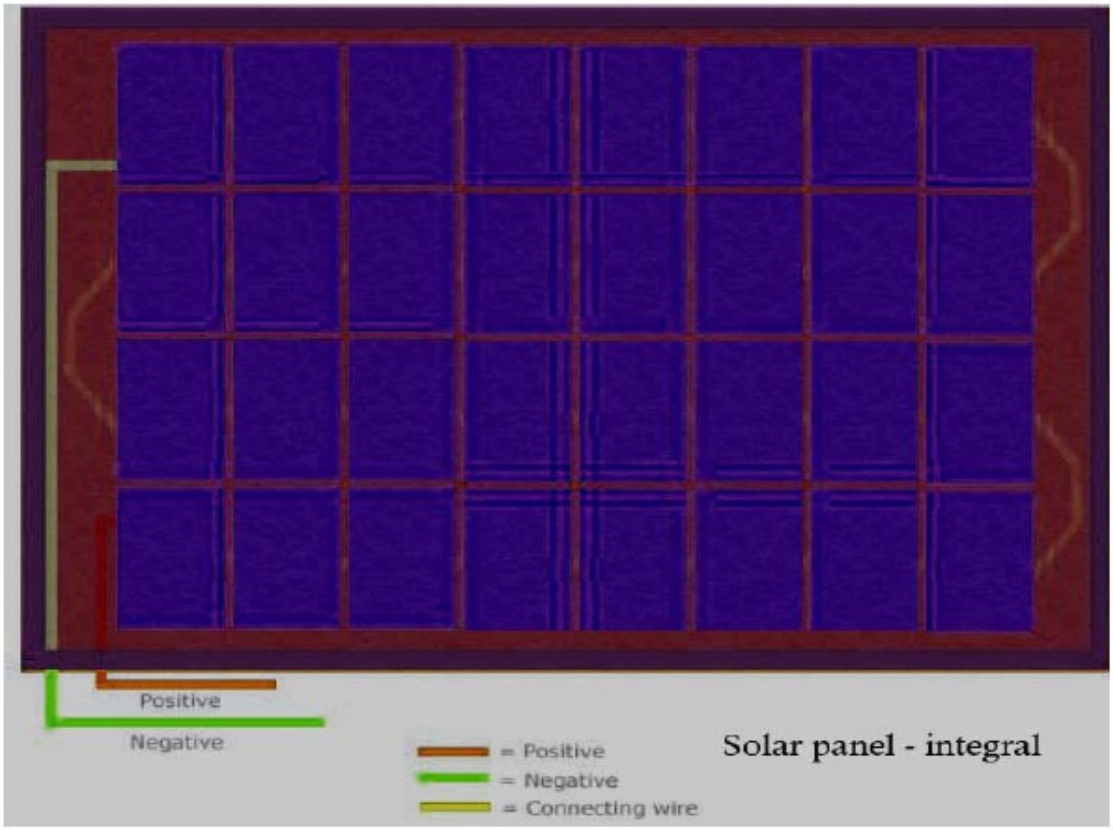
The wire ends need to go through the plywood in order to reach the back of the board. In order to do that, some holes must be drilled in the plywood. It is best to use a hole for each wire as using a single hole for two wires – positive and negative – increases the chances of them making contact, which in turn compromises the functionality of the entire system.

STEP #6 : Attach a wooden frame around the plywood



STEP #7 : Fix the glass

Once the wooden border is attached, fix the glass into place. Again, silicone will be perfect for making the glass stick to the wood.



STEP #8 : Insulation

All holes and other gaps must now be insulated with silicone; that includes the ones through which the copper wires run at the back of the panel.

STEP #9 : Moisture protection

Since the panel is not airtight, a hole must be drilled at the bottom of the panel in order to avoid the build up of moisture.

STEP #10 : Connect electrical wires

Now the copper wires need to be connected to an electrical wire. Once done the panel will be ready to connect to the batteries.

How to Maintain a Home-made Solar Panel

Solar panels will last many year before they need replacing, but maintaining them will help prolong their efficiency. Having no moving parts, they are not difficult to keep in good condition. The tips below will help you to maintain a healthy PV solar panel.

TIP #1 : Ensure that your solar cells and appliances do not exceed, with respect to the power produced and consumed, the levels indicated by the ratings.

TIP #2 : Make sure you use the right type of battery.

TIP #3 : Make sure no wires are connecting that are not meant to be connecting, including the ends.

TIP # 3 : Periodically examine the charger controller to remove insects, dirt etc. Ensure it is not “suffocated” by making sure the air flow around it is not restricted by anything. Also, charge controllers need to be adjusted to the demands of the system at certain periods.

TIP # 4: Solar panels should be inspected and cleaned at least once a month. Build-up of leaves, dust or other airborne particles can compromise the efficiency of the panel, first by reducing the amount of light reaching the PV cells and, second, by diminishing the generated energy by up to 25%.

Wind Power Explained

Nowadays wind power evokes in the minds of most people some highly advanced technology to which only a certain financial elite has access, but in fact using the power of the wind is not at all new. Thousands of years ago ancient peoples would rely on wind power to make their ships sail across seas and rivers, and this way of employing wind power prevailed until the advent of steam in relatively recent times. Another use of wind power was of course in the mills, in the grinding of grains.

It was only at the end of the 19th century that people started to understand the true power of wind to generate energy, when they were constrained to find a source of energy in very specific circumstances (villages of the U.S.A. needed a source like this one in order to cover their electricity needs). Today wind power exists on a large scale.

But how does wind produce energy? A wind turbine contains some rotating blades which actually transform the power of the wind into kinetic energy. This kinetic energy is then collected by a generator. The part which enables the transition of kinetic energy to the generator is the shaft.

Within the generator the electricity is produced by means of electromagnetic induction. Energy is released as the magnet spins around a coil. Electrons are set free from their atoms due to the force of the wind which moves the magnetic fields thus generating power; this power, called kinetic energy, is then turned into electricity.

Wind Turbines – Why Buy a Wind Turbine?

Home-made wind turbines do exist but many think that building one is either too hard or too unusual and so they opt to buy one instead. The truth is that wind turbines are not difficult to build.

In fact all the elements needed for building one have been mentioned above and, other than keeping it in the wind and establishing a control system, there is little else to it. On the other hand, buying a ready-made turbine is less complicated nevertheless.

Despite the fact that the prices are somewhat high – some thousands of dollars, or even tens of thousands of dollars – it must be said that wind turbines are worth buying as they can generate enough electricity to cover all the energy needs of the average user. The initial investment will be recovered, since the electricity bills will be diminished by 50% or even up to 90%.

But technologies in wind turbine are developing and prices are coming down. However, before purchasing one you will need to determine if your locale is suitable. This is done by working out the proportion of the wind speed compared to their monthly energy consumption. Below are some links to sites that give you data on average wind speeds, though you need to understand that local circumstances (such as being situated at the side of, or on, a hill for example) will affect the wind stream.

In order to interpret these data you will need to know that grid-tied turbines require an annual average wind speed of 5 m/s (meters per second) which is about 11 miles per hour. 3-4 m/s (7-9 mph) should suffice for marginal application such as the charging of batteries in systems not connected to the grid. You will see that most places possess or exceed these figures and so for many people building a wind turbine will be effective.

USA

http://rredc.nrel.gov/wind/pubs/atlas/maps/chap2/2-01m.html - http://rredc.nrel.gov/wind/pubs/atlas/

Canada – This site has a wind-turbine formula feature

http://www.windatlas.ca/en/maps.php?field=EU&height=50&season=ANU

http://www.windatlas.ca/en/maps.php?fie

Europe

http://www.wasp.dk/Support/FAQ/WebHelp/Wasp9.htm - EuropeanWindAtlas.htm

Australia

http://www.bom.gov.au/climate/averages/wind/wrselect.shtml

Wind Turbines – How to Build a Wind Turbine

As previously mentioned, wind turbines can be pretty expensive to buy and though you will get th emoney back it is nevertheless an initial investment than many cannot afford. But there is another option – build your own! Although this will of course take longer, the cost should not exceed around $ 100.

All the parts necessary for building a wind generator can be purchased from the Internet – eBay is one of the most popular solutions – at extremely convenient prices. You will have to have the necessary tools too: screwdrivers, grinder, jigsaw, socket set and some sandpaper.

With respect to the parts (see below) there should be no problem finding them either. Of course you will also need to have somewhere to place the finished wind turbine. A tower that is in the wind stream and out of harm's way. It should also be noted that there is another reason other than safety for keeping the wind turbine out of the way – they can be rather noisy and though you may get used to it, your neighbors may not!

Let's now take a look at all the parts you will need to build your wind turbine.

On the Parts Necessary to the Wind Turbine

The Batteries

Batteries are essential because they store the energy produced by the generator. eBay is a good place to search from some batteries.

You might be lucky and be able to find a store that is getting rid of batteries that are near the expiry date, and get them for free. Deep-cycle batteries are what you really need.

The DC Motor

Again, eBay is a great place where anyone can purchase an inexpensive DC motor. You can go straight to their current DC motor offers by going to

The Blades

Modern turbines have 2-3 blades which are built from high-density materials such as hardwood (straight clear grain), glass fiber or epoxy composites. Wooden blades may last longer, but take a bit more effort and time to build.

Blades are sensitive, and the most breakable, part of your system. They are constantly creating mechanical stress caused by centrifugal forces and fatigue. So designing and making the blades correctly is important or else they will break or not function efficiently. For example, they will need to be aerodynamic as well as robust.

Performance of the blades can be optimized by different control devices which to manage the rotor speed, which in turn prevent or delay fatigue and even the failure of the blades; as well as preventing overheating or overloading of the electrical generator.

However, the steps below, if followed, should result in blades that will serve you well.

First you'll need some ABS or PVC piping. If you use PVC pipe then it will need to be coated in UV protector so as to extend its lifetime.

Cut 3 blades and keep a proper diameter for all of them. Keeping to a single diameter and to some pre-established sizes should not be difficult. Cut the first blade by the book and it can serve as a template or measure for the other two. An 8-foot diameter is perfect for most turbines, but if circumstances don't allow for that size then they can be shortened.

The pipe should be cut in quarters. The length of the blades should be around four or five feet in order to attain a total span of 8 feet. A well-designed blade resembles the wing of an airplane.

But sizes can be different if the diameter of the pipe is different. For instance, for a ten-inch diameter pipe the blades should total seven inches at the bottom and five inches at the top. After cutting the right sizes, some extra cuts and holes must be made for later use.

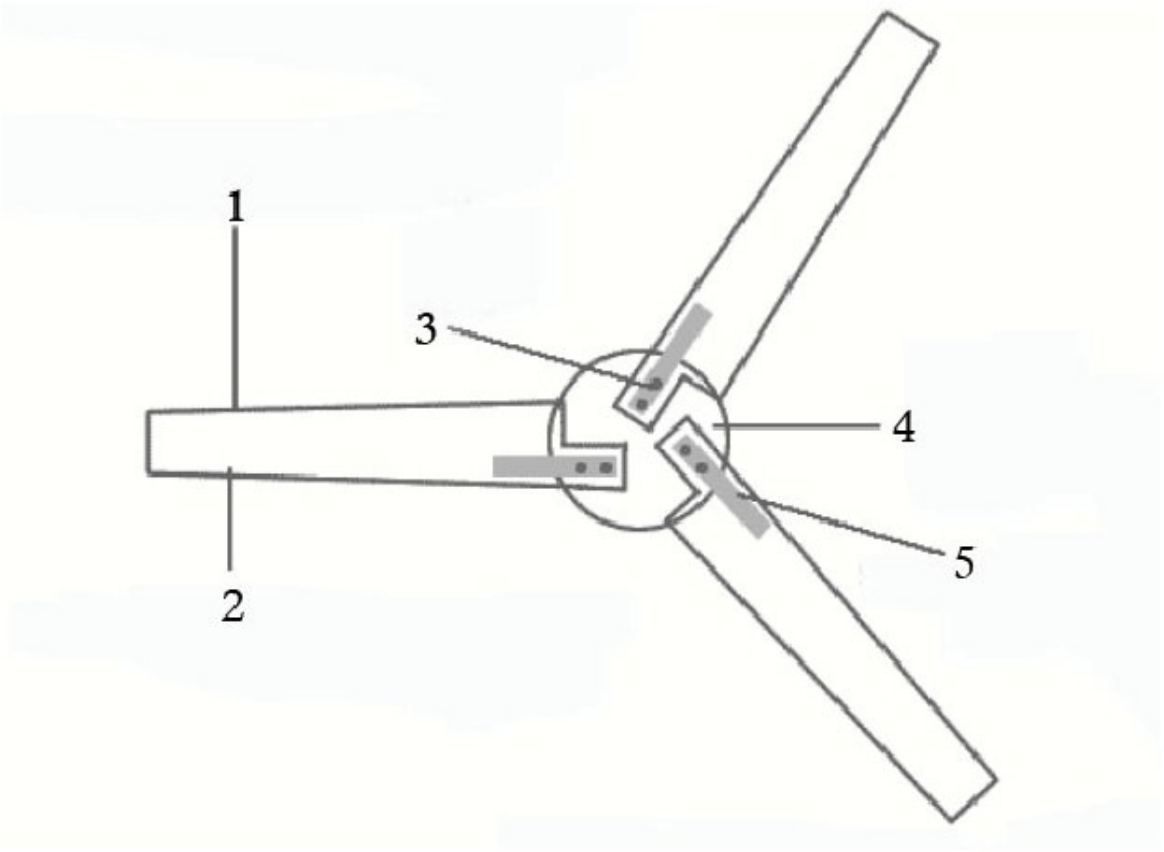
Today, as previously stated, two or three seems to represent the optimal number of blades for the system. The number of blades that exist in a system will depends upon its use. Structural dynamics, the weight of the nacelle (the housing of the generating components), the design tip-speed ratio (TSR), the power coefficient, and many other factors all play their part in this regard.

A three-blade wind turbine, in contrast to turbines with two blades, has a much more constant power production and also a much steadier gyroscopic force. It’s true that two-blade rotors are much simpler to assemble and lift, but efficiency is more important than the ease of building the system, not to mention the fact that two blades can suffer more from turbulence and damage during high winds.

The Hub

A hub is not difficult to find. Junk yards or local stores specialized in selling similar products, or, again, eBay are the best places for acquiring a hub. You do not actually build a hub.

All you have to do is to attach your cut blades to the hub with some bolts and flat steel bars. Before attaching them, though, make sure the diameter of the hub is compatible to the shaft on the DC motor.



1- Leading edge polished even to diminish friction

2- Trailing edge diminishing pull

3- Bolts

4- Hub

5- Steel bar

The Axis

The proper axis is necessary in order to assure an efficient rotation of your blades. The blades need to be able to rotate even when the wind is not that strong. The axis will ensure this.

However, the blades also must rotate efficiently in the opposite situation, that is, they must not move irregularly in stormy weather, otherwise the wiring and some other parts of the generator risk being compromised in their functionality either then or later.

It is an issue of some debate today as to whether one should choose a vertical or horizontal axis. Vertical axes have the advantage of greatly easing installation of the entire mechanism, since they simplify it by force of a vertical drive shaft. In addition, being omnidirectional, a vertical axis eliminates right from the start the need of a yaw mechanism (which adjusts the turbine to the direction from which the wind blows).

A limitation of vertical axes is in the attachment of guy wires at the top of the axis. Another difficulty is that they are much more difficult to control with respect to power output during periods or moments of extreme winds.

The Tail Piece

Scrap metal from some old appliance or a junk yard is perfect for manufacturing a tail piece. A tail shape must be cut and attached to the back of the system. Its purpose is to provide some extra stability and balance to the generator, which, eventually, leads to an increased efficiency of the rotation of the blades.

The Charge Controller

Although you can build a charge controller, it's not worth all the trouble since they can be found at ever-lower prices at places such as eBay.

The charge controller on a wind turbine has the same purpose as the charge controller on the solar power system, i.e. it monitors the amount of energy stored in the battery so that overcharging can be avoided. Overloading is damaging for the battery because it reduces its efficiency and life span.

The Dump Load

Since overcharging the battery is not recommendable, the extra energy must be taken care of. A dump load is where such energy is sent. A number of items, such as a water heater or a backup battery pack are fit for a dump load.

The AC Inverter

The inverter is meant to turn the direct current into alternating current. This process is essential because most of the appliances commonly found in a house run on AC only. eBay is again the most recommended source for purchasing AC inverters.

The Wiring

There is no standard way to do the wiring on a wind turbine since it depends on the material and on the particularities of each turbine. However, there is a recommended order in which the wiring should be made.

Beginning with the DC motor, going through the charge controller and the battery pack and ending with the AC inverter is the most advisable pattern. However, asking an electrician or an authorized person for help can also be a solution, especially if you are not familiar with such things.

The Tower

Anything that stands eight to twelve feet above the ground can be defined as a tower for our purposes. Of course, the base needs to be quite solidly fixed in the ground and it must be able to sustain both the turbine and the entire process developed by the turbine. Should no tower be available, one can always build it if you have the necessary skills and tools.

Other Things To Consider

The section below briefly covers some other solutions and ideas to save money by looking at alternative sources of energy. Perhaps you can find some that you could explore further in the links provided or by your own research.

Dealing with Oil Reliance

There are many ways of reducing oil consumption. Car pooling, using coaches, or even getting that old bike out of the garage or walking a bit more – ideas that can save use money and make us more healthy.

Other solutions concern the use of some alternative or hybrid technologies. For example, grease-powered conversion kits turn a normal diesel engine into one that runs on vegetable oil. It has one drawback – the engine still needs some fossil fuel in order to start and warm up (which makes the kit less effective for people who don't drive long distances without stopping). But there is virtually no other disadvantage in using such conversion kits. What is so great about vegetable oil when compared to normal oil is that it generates a much cleaner combustion, it's much cheaper, and it's also a renewable resource.

Cars can also be powered by solar energy. And, finally, another alternative consists of electric cars.

What is so appealing about electric cars is that they can be supplied with power from a variety of renewable sources: wind, water, and the sun. Apart from the fact that electricity generated by using such sources is not damaging to the environment, it is also budget friendly.

Towards Completely Ecological Homes

The future prospect of self-powered homes is very appealing, and not just from the obvious environmental and financial angle – they will also mean that you and your family can take comfort that you are no longer at the mercy of a regional or centralized grid system that could go down at any time.

In reality, most homes using renewable energy today will still need to rely upon the grid because the alternative sources will not always provide enough power (due to lack of sun, wind etc.) and building a totally self-powered home is still outside of the majority's budget.

Having said this, it is encouraging that prices are now coming down and, when more affordable, we shall see more and more homes becoming more and more self-powered with renewable-energy resources. For now, supplemental alternative energy and a provident lifestyle seem a wise course.

On Ethanol

Ethanol is a controversial alternative solution to our energy needs due to the conflict between the benefits people can get from using ethanol and some implications regarding the process through which it is obtained. Irrespective of this controversy, countries like the USA and Brazil have implemented it and the combination of ethanol with gasoline has become widely used.

It was Henry Ford that first designed a car to run on ethanol. At that time using oil was much more convenient but the present cost of fuel has now brought ethanol back on the scene.

The main advantage of ethanol as a fuel is that it has a very clean combustion. As a consequence, the emission of carbon monoxide is dramatically reduced or even eliminated.

On the other hand, though ethanol is technically a renewable resource, in order to produce it in quantity large amounts of corn or sugar – the main two resources out of which ethanol can be obtained – are needed.

The problem is that such resources, that is, corn and sugar, are already destined to satisfy other needs: both human and animal consumption. Producing ethanol from corn or sugar seriously interferes with these.

One can not allot more land for corn at the expense of other necessary grains or vegetables. So if ethanol is produced more abundantly as a renewable energy it will only be done so by cutting down on resources for human and animal needs. The implications will not just affect corn prices, but products like meat and dairy will suffer too.

But there is yet another issue with ethanol that must be faced. The production of ethanol seems to be a little more costly than expected for a renewable source of energy. The land used to cultivate corn, the production process itself, transportation and storage, byproducts and secondary implications (both positive and negative) – all these must be considered in considering the cost and effects of ethanol production.

Ethanol, in terms of money alone, does work out lower than fossil fuels fossil fuel, and the purchase price may drop anyway if it becomes more popular. What happens in the future will largely depend upon us, of course.

On Water Power

Water has long played a part in the history of energy production. It represents one of the most widely-used sources of renewable energy. Its prestige is not so much as a clean source of energy but rather as one that can and does compete with any other source of energy - fossil or not. The benefits of using water as a source of energy are undeniable.

However, there are some aspects that must be noted as drawbacks. For example, in order to be able to use water as a source of energy, dams and barriers must be built and these may adversely affect the natural course of water in such a way as to cause damage to the local area or even create potential disasters and put people at risk, though of course such changes can be beneficial too.

Perspectives

One can never predict with exactness what will happen in the future. However, one is more likely to be precise about the things that will not happen, provided that we decide and do everything possible to prevent them from happening. For instance, it is a fact that humanity will not be able to rely on fossil fuel forever. Below are some ideas as to the future, in addition to the ideas already discussed in this book.

Solar Energy Unobstructed

Solar-power systems are great, but the main inconvenient feature is that they don't work during cloudy periods of time. But theoretically at least, there are ways to constantly collect sunlight, avoiding at the same time all the hindrances entailed by regular solar power systems. One solution is to place huge PV panels in orbit, thus eluding the clouds and other issues that normally obstruct or diminish solar energy.

This will enable people to receive energy virtually continuously. But this project will be realized only if scientists solve another matter, that is, how to make the connection between those panels and the users located down here, on the earth. Anyway, this idea is rather unlikely to be put into practice in the near future.

Flying Wind Farms

This idea may seem like something out of a science-fiction story. Of course, if they do ever exist it will not be anytime soon. Yet once the technological limitations are no longer a concern, the project may seem more reasonable than it does now. Such farms would collect wind power from presently inaccessible places such as over the oceans, for example.

Nanotechnology

This is an area that looks promising. Nanotechnology (the field of science that deals with the control of matter on the atomic or molecular level) concerns far more than the theme of renewable energy but it has the power change the way we think about alternative sources of energy, because it is able to increase the efficiency of the technology involved in this field.

The Power of Earth

Our planet is full of resources – renewable, of course – that could offer to us the benefits we now obtain from exploiting limited reserves. Earthquakes, storms, the power of the waves, volcanoes and many other phenomena are, potentially excellent sources of energy. Of course, ways to exploit these still need to be explored and developed and it is hoped that in the not-too-distant future great progress will be made in these fields as, indeed, it has already in wind and solar power over the last few decades.

Afterword

Since it's always comforting to finish a project on a positive note, it must be said that changes will occur in the near future with respect to alternative sources of energy. The degree of awareness increases and technology advances, and people are empowered to make decisions regarding ways to reduce their energy bills, preserving their environment and be more self-reliant.

Future generations will benefit from such thinking, but we can start the process by changing our behavior and our attitude today. Because it is by little changes that big revolutions are triggered.