Introduction To Solar Power

www.Earth4Energy.com

Copyright © 2009

Legal Disclaimer

The author and publisher hereby disclaim any liability, loss, or risk, personal or otherwise, that may be incurred as a direct or indirect consequence of the application of and use of any of the contents of this eBook.

Copyright

You are not authorized, or allowed to transmit copies of this file without written permission. The use of this file is limited to your personal use. You may not give away any copies to anyone who hasn't purchased it from the Publisher, author, or their representatives. Any such distribution is illegal, under international copyright laws and will be submitted for legal action.

Table of Contents

Solar Power Explained:

Due to technological and financial issues, the sun, with its extremely precious source of energy, is not being used for its solar power to the extent that fossil fuels are being used to cover electricity needs.

Once these issues are resolved, solar power will be used to meet our demands, as it should be. The implications of consuming fossil fuels will then no longer be a concern.

Panels designed to collect solar energy are needed, in order to generate electricity from the energy released by the sun. Such panels work on the basis of some integrated photovoltaic cells meant to – as the name itself implies – turn the light ("photo") into electricity ("voltaic").

Solar cells represent the basic unit responsible for generating energy within a solar power generating system. A variety of materials is used in producing solar cells, with silicon being the most common material among them. Silicon solar cells are semi-conductors in a solid state, and are able to generate direct current, if stimulated by photons.

Silicon solar cells can be categorized into three different types: single crystal cells, poly crystal cells, and amorphous cells (also referred to as thin film cells of vapor deposition cells). Single crystal cells have proven to be the most efficient for producing energy. The other two types have their own degree of efficiency; however, they do not come near the productivity of single crystal cells.

By the force of the semi-conductors, of which these cells are made of, mainly – these

semi-conductors being the crucial "active ingredient" that make solar panels practical – some chemical reactions are triggered by the sun's rays, once they meet the surface of these semi-conductors. The chemical composition of solar panels, basically, is stimulated to set the electrons free from the atoms they belong to. This is the process by which released electrons generate electricity.

The progress made in optimizing solar panels concerns a serious matter, that is, how to make them collect an increased amount of energy. Should this matter be resolved, solar power will represent an increasingly reliable source of energy. However, relying on photovoltaic cells in order to harness solar power, is not the only solution by which we can turn the sun into a source of energy, and use it extensively for necessities.

Photovoltaic cells represent, perhaps the most efficient measure. we can, however, also exploit, just as successfully, (provided the climate we live in allows it) what is referred to as passive solar heating. It's true that this concept is applicable only when it comes to heating, and is not valid with regard to all of our needs for energy. Yet, passive solar heating is not something we should disregard in case, if perhaps, the rest of our needs are covered by other solutions. Thus, basically, passive solar heating can be obtained by a conjunction of means through which our interiors, whether they be homes or offices, warm up. For this purpose, large windows, positioned strategically on the south side of a building, are able to transmit infrared radiation to furniture, walls, and floors. In turn, the floors are able to absorb this radiation, and produce heat.

Of course, in order to obtain this kind of heating, one must live in an appropriate climate. This doesn't mean that a warm climate is needed. If that were so, the whole purpose of heating our homes would be superfluous. Passive solar heating is just as reliable in cold climates.

The only aspect one should take into consideration is cloudy weather. Clouds are

the only things that can encumber passive solar heating, since the light alone is all anyone needs to benefit from solar heating.

The purpose of those large windows mentioned above, is to allow light and shortwave infrared radiation to pass through them, in order to get to those objects placed in the building that able to absorb shortwave infrared radiation, which then produce heat. Dark colored objects are preferable for this purpose.

Anyone may say that this manner is a good one, if we want to produce heat. However, it is surely defective when it comes to storing the energy absorbed, or having a certain control over it. It must be said then, that a minimum of control is possible, if we figure out how to prevent the loss of heat during the nighttime. Blinds or curtains at the windows can do that, since they act as a border between the already heated air in the room, and the windows, which, by force of a natural process, tend to turn cold at night, allowing the loss of energy. What is great about this type of heating is that it can be obtained on a low budget. Large windows facing south, dark couches, and carpets, and some adequate curtains or blinds, are sufficient.

At the same time, some care on our behalf is also necessary, but only regarding our duty to open the curtains, or the blinds, while the sun shines, and to close them during cloudy weather and at night. In addition, we can benefit from this system in winter, since snow, itself, reflects sunlight, sends it to our windows, and enables the heating process within our homes.

On the other hand, we have to admit that there are some limitations to considered, if we opt for this kind of passive solar heating. For example, those objects we will be using for absorbing infrared radiation will be damaged from an aesthetic point of view, since color fades when constantly exposed to light. In addition, long term fluctuations of weather can severely affect our homes' inner climate – long periods of cloudy weather are the worst thing that could occur, if we rely on this kind of passive solar heating.

Moreover, some of us have homes that literally make it impossible for us to employ this system: windows may not be placed southwards; walls may not be built from a material with the ability to maintain a constant temperature, etc. Besides, we have to make sure walls, roofs, ceilings, doors, and windows are perfectly insulated, as it's only reasonable to presume we don't want to waist on one side what we strain to gather on the other side. Passive solar heating in the form presented above is not sufficient by itself. In order to optimize it, other means enabling passive solar heating are required, if we want to avoid significant fluctuations of temperature between sunny and cloudy days.

Therefore, thermal mass is an excellent way to improve the efficiency of this process. The idea is to use high density materials, such as concrete, brick, stone, or adobe to improve the structure of a building, if, of course, it is not already built from such materials.

Such materials are extremely sensitive to light and shortwave infrared radiation, absorbing it and releasing heat instead. In addition, high density materials are able to produce heat in the absence of light, and shortwave infrared radiation, since it is able to release long wave infrared radiation in such circumstances.

This is one advantage we should never forget, even if the affixed downside is that the more material we use at building or consolidating the building structure, the longer the time necessary for heating will be. However, at the same time, it is, without a doubt, preferable to use more concrete, adobe, or bricks simply because a larger mass of such materials will release more heat for a longer period of time -- provided that a long period of cloudy weather doesn't occur.

Another upside of homes built from concrete, for instance, is that they are much more resistant to other circumstances, such as extreme winds or fires, than houses built from ordinary materials.

Despite all these benefits, some people are reluctant to build their homes from such materials, because, first of all, they are not as appealing, from an aesthetic perspective, as from other materials – which, on the other hand, are not as efficient as concrete with respect to heating – and, secondly, the cost for building or consolidating a house using them can be really high. At its turn, passive solar heating, by means of high density materials, can be improved, if combined with a system of large windows, as presented earlier, and with serious insulation.

Moreover, if we incorporate all these means into a side hill construction, the chances to benefit from constant temperature within the inner climate of our homes, increase greatly. Side hill constructions are buildings with an asymmetrical roof made from windows, well insulated, that are able to absorb a large quantity of shortwave infrared radiation. This style of building homes is efficient due to the fact that the long sides of the building face the north and the south, the southern side having as many windows as possible, and the northern side has as few as possible. It is also extremely well insulated.

It's obvious that the means to optimize the inner climate of our homes, are various and excellent, if we combine them appropriately. Thus, the sun can be exploited as an excellent source of energy, provided that we accept some limitations, and assume them as we should.

However, the sun can do more for us than heating our homes. Solar energy can be used to power out refrigerators, our TVs, our air conditioners, and virtually all appliances commonly found in any home. The best way to harness solar power for these purposes is to use solar panels, within the larger frame of solar power generating systems.

Such devices can literally replace the grid or, at least, significantly cut down our electricity bills, and reduce our reliance on the grid. Because solar power systems can be made at home on a low budget, and since the topic of this book is to teach those interested in this subject how to build a system of this kind. The following material will focus on what is needed to accomplish this, and how to actually build it.

Homemade Solar Generators – a Fact:

As advanced as it may sound, the technology used to build solar generators at a professional level can be reproduced by means available in any average home. In addition, the costs will not go beyond $ 200.

Anyone can build their solar generators, with minimum resources, and with maximum efficiency. In the following pages some applications will be presented, along with the method, and the resources needed for building them.

An important observation of the electrical features of solar cells, concerns the fact that each cell, regardless of its size, is able to generate about .5 volts, or less, according to the type of cell used in manufacturing the panel. The issue is that, even 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 only .5 volts. We do have the same voltage per unit, but the current output will only mount up to 1 ampere, which means a quarter of the initial whole unit.

For instance, it's much more productive to use larger cells, since that will save us

time, and tab and connection elements, for the panel. In the following sections we will deal with homemade solar panels as the main essential part of a solar power system. So, this observation must be kept in mind.

Portable Solar Power System:

Portable solar power generators represent systems producing energy that is able to supply about any appliance commonly found in any home. Building such a portable system is simple enough, and rewarding, since the results will begin to show no later than a few weeks after manufacturing it.

An energy source represented by a solar panel (or several solar panels, as the case may be, that don't need to go beyond 12V), a charge controller, a battery, an inverter, and, finally, an appliance of any kind, are the main elements needed

to manufacture the system.

This is the most basic structure, but for those who do not care about budget may add some extra elements.

With respect to the solar panel needed for the system, you may buy them. However, anyone interested in actually building one, should know that there are ways to do it. How to build solar panels is one of the topics covered in another eBook available at www.Earth4Energy.com.

Regarding the batteries, a useful tip should be taken into consideration: they are much more efficient in operation at warmer temperatures, which is why they should be stored in a battery box. The battery box may add a little to the initial budget, but it is highly useful also in case children or pets happen to be around.

A system meter is an additional element that can be considered. These devices are meant to "read" how full the battery is, and how much power is being consumed at a given moment. The system meter is set between the battery and the inverter. Any appliance can be powered with energy from this system. Refrigerators, for instance, run extremely smoothly connected to this system, and the results will show in the monthly electric bill. Appliances can be connected directly to the inverter in order to receive electricity. The best way to store this device, as well as other electrical elements of the system, is to keep them in the garage.

Grid-Tied Solar Power System:

The parts necessary for this kind of system are as follows: solar panel(s), an array DC disconnect, an inverter, an AC breaker panel, a kilowatt per hour meter, a grid, and appliances.

The system is also referred to as an 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. The idea is to observe the proportion of consumed energy versus the one generated by the solar system.

If the energy produced by the system exceeds the energy consumed, the situation works to your benefit. Thus, you can benefit from an agreement with the local electricity provider. This agreement is called a net metering or billing. It is made on the basis of the information delivered by the system regarding the energy consumption at a given period of time.

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 breaker panel,
9. a kilowatt per hour meter,
10. a grid,
11. appliances.

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

Off-Grid Solar Power System:

Solar panels as an energy source, an array DC disconnect, a charge controller, a deep cycle battery, a system meter, a main DC disconnect, an inverter, a generator, and an AC breaker panel – all of these are necessary for building an off-grid solar power

system.

For this system, the generator is meant to undertake the function of the sun. That is, a source of energy whenever it's not available from the sun -- more precisely, during cloudy weather.

Components of the Solar System:

Solar Panels

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

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

Array DC Disconnect

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

Charge controller

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

Deep cycle battery

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

System meter

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

Main DC disconnect

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

Inverter

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

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

Generator

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

AC breaker panel

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

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

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

Kilowatt per hour meter

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

Grid (utility grid)

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

Household loads

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

Solar Panels – How to Get Them for Free:

As a rule, people buy solar panels when they need them. However, if one wants to build a solar power system and to keep to a rather low budget previously established, they should know there are ways to acquire a solar panel without paying for it, or paying a very small amount.

The first thing to be looked for is a telephone number for a maintenance shop. Such phone numbers are found near construction sites on signs that the building is solar powered. Calling that number will give anyone the possibility of talking to a head mechanic, or to a person in charge.

In most cases, if they are asked about damaged panels, they will say that such panels are available. In addition, since they are damaged and cannot be sold, they will be

given at no charge to whomever solicits one – or more, as the case may be. The only inconvenient fact about damaged solar panels is that they don't work at full capacity. However, this is a minor drawback and they can also be repaired. Some silicone is perfect for scratches and cracks, and soldering the wires is not a complicated job. But repairing damaged panels is not the only manner with which you can get panels for free. Another opportunity may be considered. For example, acquiring used solar panels is a good way to get a hold of a perfectly operable panel. Such items come from users who change their old panels for new ones. The companies that sell panels can not resell the used ones, or, if they do, they only do it with major price cuts.

For them it's much more convenient to proceed this way or, in any case, they have nothing to lose if they give the used panels to someone. Whatever -- they wanted to throw the panels away.

However, if one doesn't manage to get a solar panel either by acquiring a damaged one for free, or by paying a modicum for a used one, there are still opportunities for them. Surfing on eBay, for instance, is a solution. Entering a simple keyword and, wait for the searching engine to do its job, is all that needs to be done. The search will surely come up with satisfactory results, since the products sold on websites like eBay, are generally much cheaper than the ones sold on the market.

If you cannot get any free panels from the above methods then do not give up hope. We have sourced MANY cheap solar panels from eBay. All you need to do is start an account at http://www.earth4energy.com/recommends/ebay.php and visit the following link for a list of solar panels for sale: http://www.earth4energy.com/recommends/ebay-solarpanels.php. Buying these online are much cheaper than buying from large companies.

How to Build Solar Panels:

Homemade solar panels are a possibility one should always explore, since they get the opportunity to save serious amounts of money. The items necessary for building a solar panel are as follows: solar cells, plywood/acrylic, glass, alloy c-frame, tabbing ribbon, bus ribbon, silicone, solder, and UV protector.

Parts Necessary for Building the System:

When building a solar panel, you should always pay special attention to the photovoltaic cells that they are going to use, since these cells basically represent the heart of the system. Photovoltaic cells come in different shapes and sizes. Thus, you can choose either square or pseudo square cells, or, on the other hand, round cells.

Each of these types can be purchased at low prices. However, the shape is not as important as the type of the cell – already mentioned above, that is, single or poly crystal cells, or the amorphous cells. We can also count dye titanium dioxide cells or ribbon cells, but it must be stated that single crystal cells, or even the poly crystal ones, are much more popular and is adequate for the manufacturing of a solar panel.

There is no such thing as a solar panel without solar cells. Solar cells are the most important part of such a panel, since they are the parts that actually turn sunlight into energy for our appliances. Again, they can be bought from eBay, and one can get either cheaper, or more expensive cells, according to their budgets. For cheaper cells, one should look for broken or chipped solar cells. Damaged items are always cheaper – sometimes, ridiculously cheaper – and they can be mended.

There are two types of spoiled cells. They can be either cosmetically flawed or cells

that are off specification. Cosmetically flawed cells are cheapest, even if they work at full capacity. However, sellers choose to cut down prices because the cells have chipped corners or sides, they present discoloration, or they lack reflective coating.

However, 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 condition can have a serious impact on the output of the cell, as the cell will reflect more light than it is able to absorb.

Cells that are off specification are the ones that failed the test before marketing. That is, they do not comply with the output standard imposed on them, which means they do not produce the current and the voltage that would make them usable for commercial panels.

Should you choose to purchase such cells, they should keep in mind that a low efficiency of the cells will produce a low efficiency of the entire system, despite the fact that such cells are more appealing, due to the purchase price.

But there are people who want a straight-forward project of building the solar panel. They don't want to complicate the process with unnecessary actions, when they have an appropriate budget. In this case, they may just as well buy unspoiled cells. This approach, however, is recommended for the first panel you ever build.

It is important to remember that, even among damaged cells, prices can vary according to how spoiled the items are, but also according to what type of cell they want to use. For instance, transparent cells, even if damaged, are more expensive than other types of damaged cells. Those who are interested in purchasing items like these should know that virtually all cells can be repaired, regardless of how damaged they are. All in all,

once the cells are bought and repaired, as the case may be, one must determine how much energy they can generate, before you actually building the panel. In order to do that, the cells must be kept in the sun for a while. A voltmeter will then be used to measure the amount of energy produced by the cells.

Indeed, one should test each cell before building the panel. Even apparently undamaged cells should be subjected to testing, since there is always the chance that they get flawed during transportation, or during manipulation. Anyone can get their cells tested by the manufacturer. Their tests are extremely accurate and can measure the exact output of a cell. However, since we want to stick to a previously established budget, you should know that the tests provided by manufacturers are rather expensive. This is why a cheaper – even free – version of a test could be employed. Keeping the cells in the sun, as indicated above, is just what anyone needs to do in order to see how efficient the cells are.

However, if the free test is chosen, one should consider the fact that the results of the test will not be accurate, unless they take into consideration atmospheric features, moisture in the air, the time of the day, or the season of the year when the test is taken.

All of these factors can interfere with the results; thus, deceiving us with respect to the real output of a cell. This is why the test should only be run at noon, in the summer, on a cloudless day. It's true that this kind of test has its own limitations, but, if correctly planned, any one should be able to rely on its results.

When it comes to plywood, you should know that you don't need to buy the most expensive type of plywood you can find, since its only purpose is to provide the backing of the panel, and since it will be covered with UV protector. Yes, plywood must be protected against UV in order to increase its life span, which makes the UV protector an

essential “ingredient” of the entire system. However, strong plywood is recommended in any case.

A cell's adhesion to the plywood is ensured by the use of silicone. Copper wire, on the other hand, is what connects them together. In order to be able to distinguish between positive and negative poles, you may consider using wires of different colors. But you also must be sure that the copper wire is stuck where it should be, on the back of the cells.

In order to make sure of that, solder must be employed. Finally, what holds the whole thing together into a single unit, is glass. For best results non-reflective glass is recommended.

The Steps of the Project:

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

Solar cells:

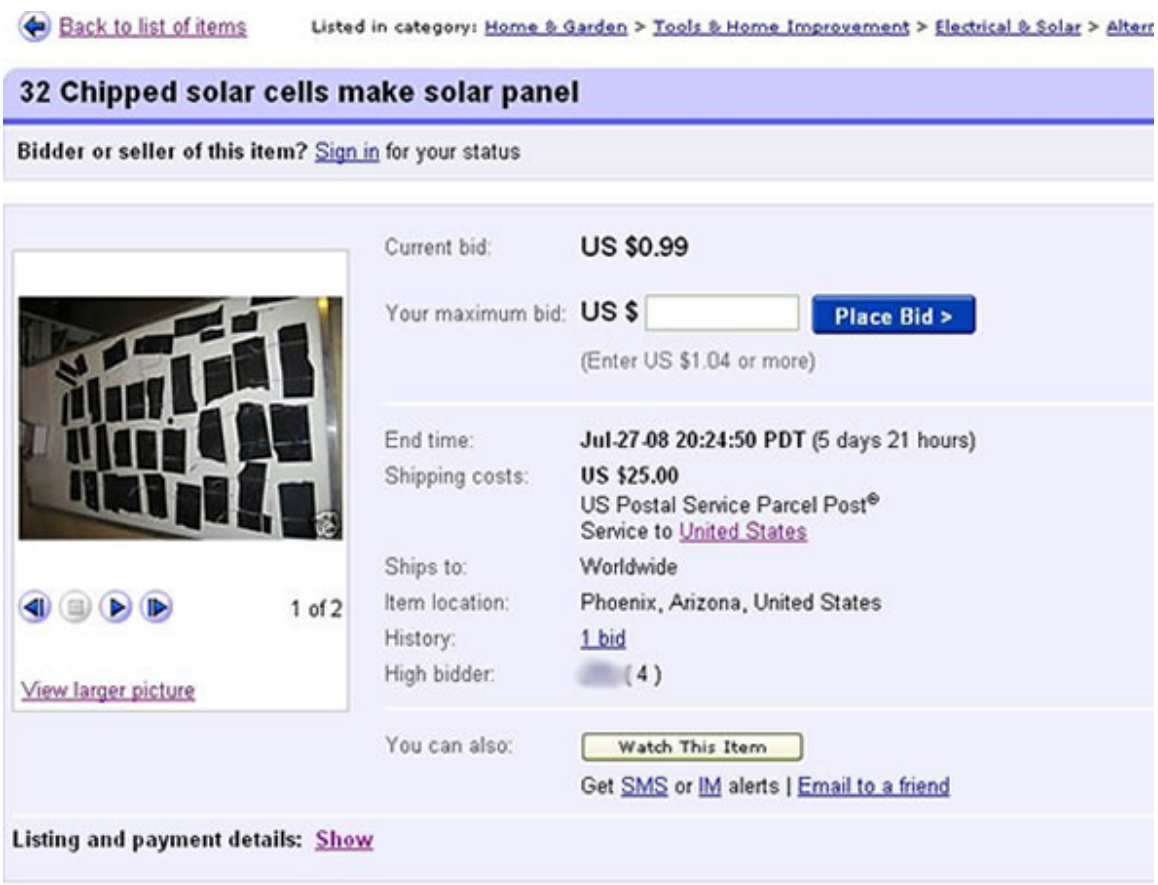
Obviously the most important part. The BEST place for old broken solar cells is again eBay. This time search eBay for “chipped solar cells” or “broken solar cells” etc. Below are a few listings that we have found and you can see that these are seriously cheap. All we need to do is fix them up! If you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

Below are a few eBay auctions for chipped solar panels to give you a rough idea of the

type of thing to look for:

These are transparent cells and are a little more expensive.

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



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

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

Plywood / Acrylic:

This will be the backing and is what will hold all of the cells. About 10 to 15mm is enough. Don't go out buy expensive hardwood as we are going to cover the wood in UV protector anyway. You can also use an acrylic sheet for this. We actually recommend an acrylic sheet as it's more durable however if you are on a tight budget plywood will do.

Wood / Alloy C-Frame:

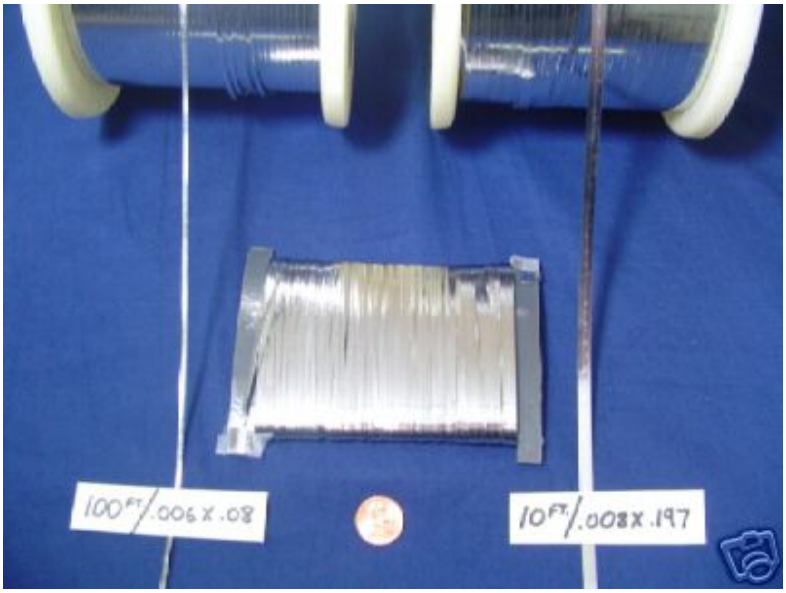
We will need to make a wooden border around the cells. This is what we will fix the flexi-glass too. This can be picked up from your local hardware store. Make sure it is not too thin because it will split when screwing it to the plywood backing and border. Again, this is the cheaper option, we recommend using alloy c-frame. This is slightly more expensive however it looks a lot neater and will last longer.

Plexi-Glass:

This is used to go over the solar cells to make the whole unit one piece. The plexi-glass should be about ¼ inch think. You can buy this from your local hardware store. Just give them the measurements you are after and they will cut it for you. It is a good idea to get this last so you will know the exact measurements.

Tin coated tabbing wire:

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



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

The thin wire (tabbing ribbon) is used to connect each cell together and the thicker wire (bus ribbon) is used to join each string of cells together.

Silicone:

This is what we use to hold the cells onto the plywood (or acrylic) and the flexi-glass to the border.

Solder:

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

Rosin flux pen:

This is used to help the wire stick to the cells. Please watch the Earth4Energy instruction videos to see how it is used.

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

UV Protector:

If using plywood for your backing you will need to coat it in UV protector so that it will last longer out in the sun.

Volt meter:

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

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

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

Let's Start Building:

1. You need to cut your plywood/acrylic backing to size depending on how many solar cells you have. This is what the individual solar cells will be glued too. The average cell produces about 2 watts so you should use 32 solar cells to produce about 64 watts from your solar panel. For more power we need to wire multiple panels together and this will be discussed at the end of the

chapter.

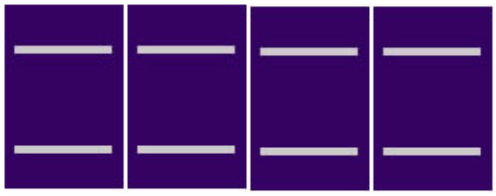
2. Apply 3 coats of UV protector to the plywood. Any type of deck or fence coating as show below will do the trick.

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

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

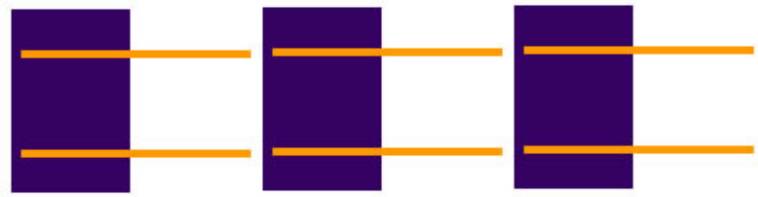
Below is an example of what your solar cells look like. Remember these cells are very fragile so take care when moving them around.

Front of cells:



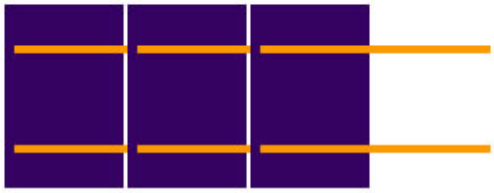
copyright 2008 www.earth4energy.com

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



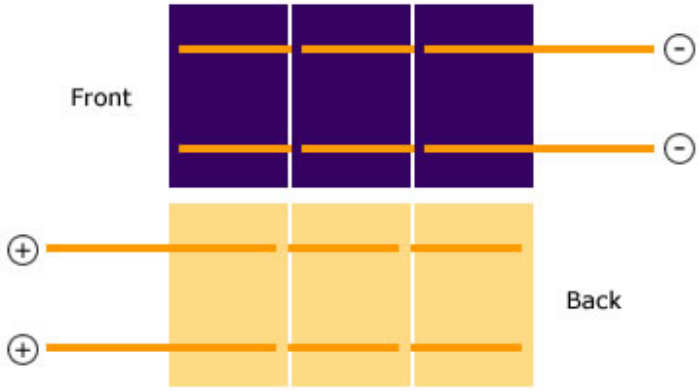
copyright 2008 www.earth4energy.com

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



copyright 2008 www.earth4energy.com

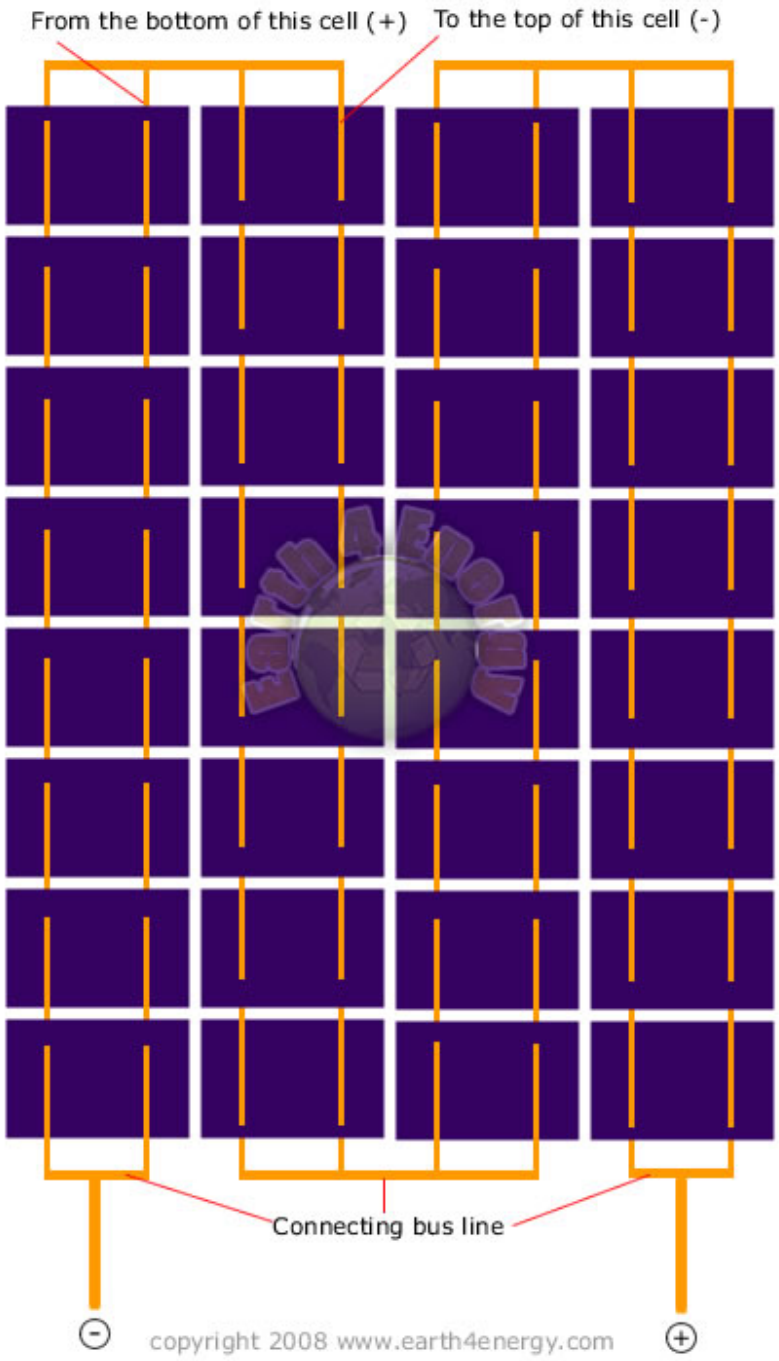
In the below diagram you can see what the front and back look like after they are connected:



copyright 2008 www.earth4energy.com

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

Wire the cells togethor in Series



Series connection means the wires go from negative to positive to negative to positive etc. This type of connection will increase the total voltage of the solar panel.

If each cell produces .5 volts and there are 32 connected in series, this complete circuit will produce 16 volts. So the above panel with 32 cells would produce about 64 watts of power at 16 volts and about 4 amps. For further understanding on how the string of cells are wired together please watch the videos in the Earth4Energy member's area.

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

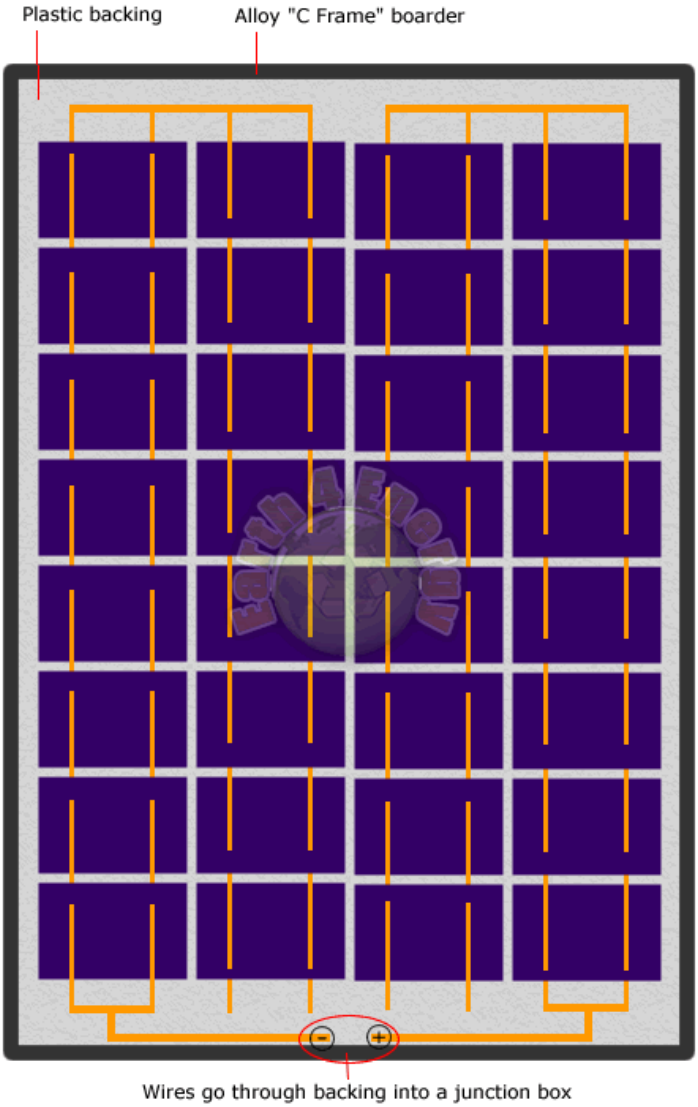
4. Now let's fix the cells to the plywood or acrylic backing. For this purpose we use silicon. You really do not need to use much silicon at all, just use enough to hold the cells in place. Any type of sealant that you have lying around will do the trick. There is no need to cover the wires, just use a small blob in the middle to hold the cells in place.

5. In the above diagram of the cells wired together (previous page) you will notice the 2 wire ends. These wires need to go through the plywood or acrylic backing and into a junction box. Drill a couple of holes where the wires end so you can feed the copper wire to the backing. Drill a hole for each wire; don't just pass them through the same hole, as you want to reduce the chances of these coming into contact with each other.

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

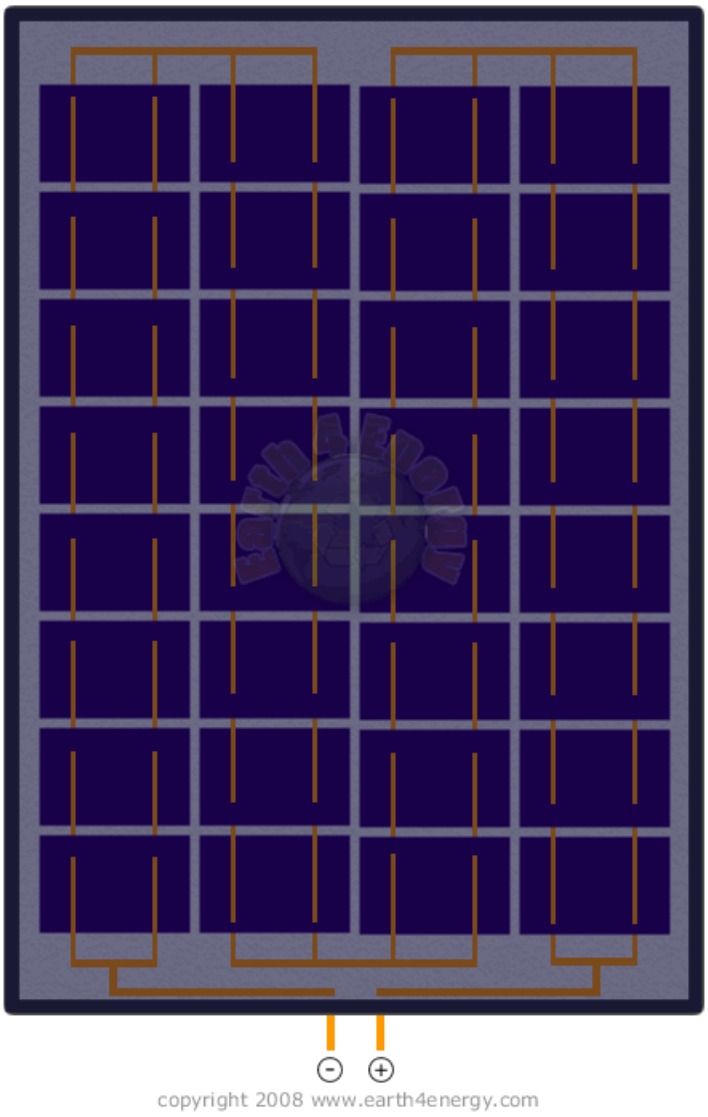
If you are using a plastic or acrylic backing you can use alloy “C frame” as a frame around the panel. This is lighter than a wooden frame and looks more professional.

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



7. Now we can fix the plexi-glass to the border and cover the cells. To do this we use the same silicon that was used to hold the cells to the backing. You should also screw the plexi-glass down. Do not just screw through the plexi-glass as this will crack it. You need to drill a hole that is just smaller than the diameter of the screws you are using. Then screw into the holes.

Complete solar panel

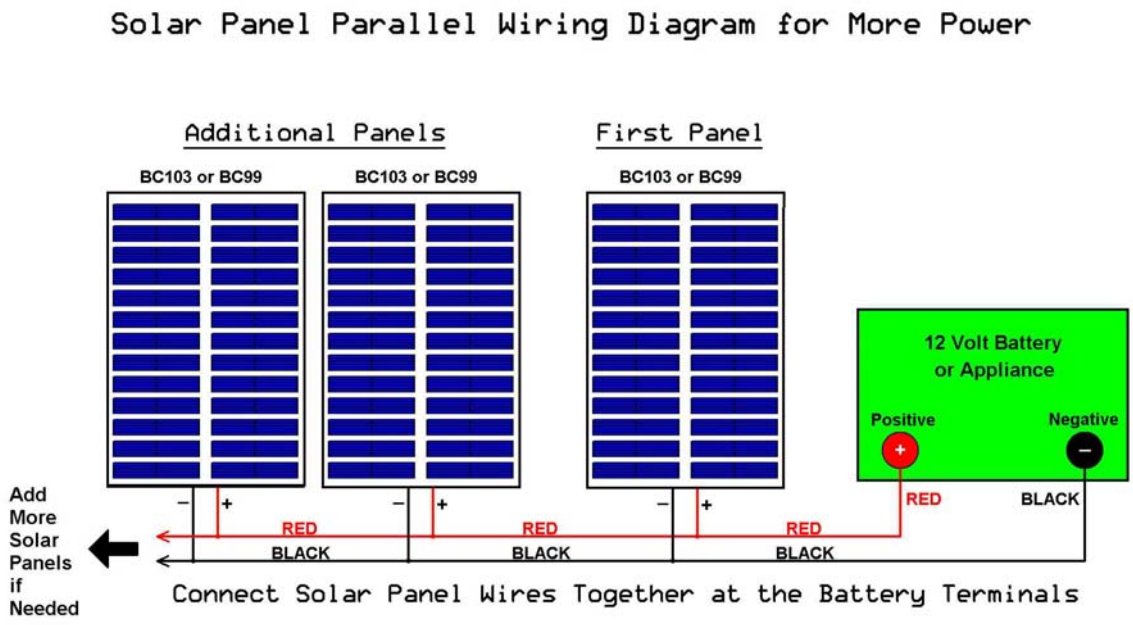


8. Silicon up the holes around the negative and positive wires that you have out the back of your panel and into the junction box. If you notice any other gaps or holes make sure you also fill them in.

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

NOTE: Before you start gluing anything down it is a good idea to put your cells in the sun and use a volt meter to check what sort of power your cells are putting out.

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



How to Maintain a Homemade Solar Panel:

Sticking to the following tips may help with the maintenance of the solar panel you have just built, so that it works properly. Most of these tips refer mainly to the way the parts of the panel should be taken care of.

To begin with, you must take care that the solar cells and the appliances do not exceed, the levels indicated by the ratings with respect to the power produced and consumed.

Then, you must pay attention to choosing the right type of battery. This tip concerns the prevention of some damages subsequent to building the system, but it is important all the same.

Regarding the wiring, you should make sure no wire connections are affected in any way, and that no wires meet each other if they are not meant to come in contact, as the case is with the endings of the wires.

With respect to the charge controller, users should know that a proper environment is essential for an efficient operation of this unit. It must periodically be examined so insects, dirt, or deterioration of any kind do not affect the charge controller.

Then, you should make sure this unit is not “suffocated”: The air flow must not be hindered by anything. Another concern related to the charge controller is the following: its functions must be adjusted to the demands of the entire system in a certain period of time.

Some general maintenance is also recommended. For instance, 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 solar panel: first by reducing the amount of light allowed to reach to the photovoltaic cells, and then by diminishing the generated energy, even with 75% of the normal amount. Inspecting and cleaning the panel at least once a month will assure a proper operation, both of the panel and of the entire solar energy system.

For a complete guide to building a solar panel for under $100 please see the guide entitled, “The $98 Solar Panel”.