

Build Your Own Solar Generator

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Table of Contents

Home Made Solar Power Systems.....	1
Table of Contents	3
Solar Power Explained.....	4
Homemade Solar Generators – a Fact	9
How to Build a Portable Solar Power System	9
How to Build a Grid-Tied Solar Power System.....	12
How to Build a Grid-Tied System with Battery Backup	13
How to Build an Off-Grid Solar Power System	14
On the Parts Necessary to the System.....	16
Solar Panels – How to Get Them for Free	25
Solar Panels – How to Build Them.....	26
On the Parts Necessary for Building the System.....	26
The Steps of the Project	29
How to Maintain a Homemade Solar Panel.....	35

Solar Power Explained

The Sun is an extremely precious source of energy, and the only reasons for which people don't use solar power at the extent they presently use fossil fuel in order to cover their electricity needs are linked to some technological and financial issues.

Once these issues are solved, solar power will be used to meet our demands, as it should, and, at the same time, the implications of consuming fossil fuel will no longer be a concern.

In order to make electricity from the energy released by the Sun, panels designed to collect solar energy are needed. Such panels work on the basis of some integrated photovoltaic cells meant to – as the name itself suggests – turn the light (“photo”) into electricity (“voltaic”).

Solar cells represent the basic unit responsible with generating energy within a solar power generating system. Even if materials used in producing solar cells are various, silicon is the most common among them. Silicon solar cells are semiconductors in solid state able to generate direct current if stimulated by photons.

At their turn, silicon solar cells can be categorized in three types: single crystal cells, poly crystal cells, and amorphous cells, also referred to as thin film cells or vapor deposition cells. Single crystal cells prove to be the most efficient when it comes to producing energy. The other two types have their own degree of efficiency; however, they do not manage to equalize the productivity of single crystal cells.

By force of the semi-conductors of which these cells are mainly made of – these semi-conductors being the crucial “active ingredient” which make solar panels practical – some chemical reactions are triggered by the sun rays once they meet the surface of these semi-conductors.

Basically, the chemical composition of solar panels is stimulated to set the electrons free from the atoms they belong to, and this process in which electrons are released generates 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 solved, solar power will represent an increasingly reliable source of energy.

But 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 exploit it for necessities. Photovoltaic cells represent perhaps the most efficient measure; however, we can exploit, just as successfully, provided that 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 it is not valid with respect to our complete needs for energy. Yet, passive solar heating is not something we should disregard in case, let's say, 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, may they be homes or offices, warm up. For this purpose, large windows strategically positioned on the south side of a building are able to transmit infrared radiation to furniture, walls and floors which, at their turn, are able to absorb this radiation, and produce heat.

Undoubtedly, in order to obtain this kind of heating, one has to live in an appropriate climate. But this doesn't mean a warm climate is needed – if it were so, then 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 ones that can encumber passive solar heating, since the light alone is what anyone needs in order to obtain it.

The meaning 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 able to absorb shortwave infrared radiation. By absorbing

this radiation, objects – preferably, dark colored objects – are able to produce heat.

Any one may say that this manner is a good one if we want to produce heat, but it is surely defective when it comes to storing or having a certain control on it.

However, it must be said that a minimum control is possible if we refer to preventing the loss of heat during night time. 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, determining 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 from our behalf is also necessary, but that only regards our duty to open the curtains or the blinds while the sun shines, and to close them on cloudy weather or at night. Moreover, 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 we have to consider if we opt for this kind of passive solar heating. For instance, those objects we will be using for absorbing infrared radiations will be damaged from an aesthetic point of view, since color fades if constantly exposed to light.

In addition, long term fluctuations of weather can severely affect the inner climate within our homes – 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 able to maintain a constant temperature, and so on.

Besides, we have to make sure walls and roofs, and ceilings and doors, and windows are perfectly insulated, because it's only reasonable to presume we don't want to waste on one side what we strain to gather in the other.

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 periods of time.

Thus, 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, in case 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 they are able to release long wave infrared radiation in such circumstances.

This is one advantage one 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 to heating will be. However, at the same time, it is beyond question preferable to use more concrete or 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 occurs.

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 the idea of building their homes from such materials, because, first of all, they are not as appealing from an aesthetic perspective as other materials – which, on the other hand, are not 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 above, 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 accordingly.

Side hill constructions are buildings with 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 by force of the fact that the long sides of the building face the north and the south, the southern side having as many windows as possible, whereas the northern one has as few as possible, and is 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 we assume them as we should.

However, the sun can do more for us than heating our homes. Solar energy can be used to power our fridges, our TVs, air conditioners and virtually all appliances commonly found in any home. But the best way to harness solar power with this purpose 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 with a low budget, and since the topic of this book is to teach the ones that are interested in this subject how to build a system of this kind, the following material will focus on what we need for building it, and how to actually build it.

Homemade Solar Generators – a Fact

As advanced as it may sound, the technology used in building solar generators at a professional level can be reproduced with the means available in any average home, and the costs will not go beyond \$ 200.

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

An important observation on 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 thing 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 .5 volts. We do have the same voltage per unit, but the current output will only mount up to 1 ampere, which means the quarter of the initial whole unit. This note must be kept in mind when building a solar panel because it can direct out way of manufacturing the panel.

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

How to Build a Portable Solar Power System

Portable solar power generators represent systems producing energy 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.

Mobile solar power system



An energy source represented by a solar panel (or more 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 for manufacturing the system.

This is the most basic structure, but people who do not care about budget may add some extra elements. With respect to the solar panel needed for the system, people may buy them, but anyone interested in actually building one should know that there are ways to do it. How to build solar panels is one of the following topics I will deal with in the present book.

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 supplementary element that may be considered is a system meter. These devices are meant to "read" for the user how full the battery is and how much power is being consumed at a given moment. Obviously, system meters are to be set between the battery and the inverter.

Any appliance can be supplied with energy from this system. Fridges, for instance, 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, and the best way to store this device, as well as other electrical elements of the system, is to keep them in the garage.

How to Build a Grid-Tied Solar Power System

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



The 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. The idea is to observe what is the proportion of consumed energy to the one generated by the solar system.

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

How to Build a Grid-Tied System with Battery Backup

This system requires the following elements: solar panels as energy sources, an array DC disconnect, a charge controller, a deep cycle battery, a system meter, a main DC disconnect, an inverter, an AC break panel, a kilowatt per hour meter, a grid and appliances.



The difference between this system and the previous is that the former 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

Solar panels as energy source, an array DC disconnect, a charge controller, a deep cycle battery, a system meter, a main DC disconnect, an inverter, a generator, an AC breaker panel and appliances – all 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, source of energy, whenever it's not available, more precisely on cloudy weather.

On the Parts Necessary to the System

The Solar Panel



Solar panels cannot be removed from manufacturing a solar power system, because they represent the one defining element of the system. Their role is to collect solar energy, that is, sunlight, and turn it into direct electricity.

The energy generated by the panels is measured in watts. In order to see how many panels are necessary to provide the correct amount of energy meeting someone's needs, the measured output of the PV panel must be taken into consideration.

If more solar panels are needed, then they will be connected in a series. It must be mentioned that a correct rating of the output can be realized only by determining the maximum energy generated in adequate circumstances – sun and temperature.

This means that while or before building the system, we have to be aware of the fact that the current output of the system will be highly influenced by factors that do not necessarily regard the elements used in building the system.

The amount of light that hits the cell in order to produce direct current can vary within a single day or within a single year due to weather conditions (moisture, clouds, and other particularities of the air), or to the moment of the day or to the season.

For instance, according to the position of the sun, sun rays hit the cells differently, which means that angle variations can influence the amount of current produced. Moreover, we should pay special attention to the temperature of the cells. When this temperature increases, the current output diminishes.

DC Disconnect



This part is extremely important for an efficient turning off of the power. This operation is necessary especially in case of maintenance interventions.

The Charge Regulator

This is a part highly recommendable to use, even if it may seem unnecessary at first. Due to the fact that it monitors and it controls the charging of the battery, preventing it from being overcharged, and, as the case may be, because it also controls the battery with respect to discharging at night, a charge regulator helps expanding the life span of the battery.

Consequently, the investment made in purchasing the charge regulator will prove to be worthwhile since, in time, will drastically reduce your need to make supplementary investments in buying, again and again, batteries.



The Deep-Cycle Battery



Deep-cycle batteries should be chosen over regular batteries. They represent a better alternative because they store all the amount of 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 help disconnect the inverter.

The System measuring device



Should the user be interested in how much energy is produced and how much is consumed, a system measuring device is what they need. A system measuring device is essential if they care about how fit is a solar electricity system for their needs.

The Inverter

Most of the appliances we commonly use run on alternating current (AC). But the solar panels only generate direct current. An inverter is precisely what anyone needs, because it is able to turn direct current into alternating current.

The inverter is unnecessary if users do not use appliances like TVs, refrigerators, and computers and so on, that is, devices that need AC in order to run. In this case, a DC input is sufficient.



The Generator

Any solar power system that is not grid-tied needs an alternative source of energy for episodes like maintenance of improper weather. In order to make sure the energy supply is not cut off in such moments, users 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 customary, because most energy sources are connected to the electrical wiring in any home by an AC breaker panel.



This part is a kind of border, an intersection point between what is actually the energy source and what is the assembly of appliances running on the power delivered by the energy source.

It is a distinct element of the system that can be stored outside the house or the building, in utility rooms or garages.

The difficulty with AC breaker panels is that one can not tamper with them unless they are an authorized person – an electrician or so – and if they do not announce the local energy provider about the fact that they want to connect their

solar energy system to the panel. In addition, it must be said that each country has its own regulation regarding the way such connections should be realized.

The Kilowatt per Hour Indicator

This unit is necessary in case the user builds a grid-tied system. The purpose of the kilowatt per hour indicator 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

This element is essential in case a grid-tied system is to be built. Irrespective of building a solar power system, the grid is the one that provides energy to all appliances in our homes.

The Appliances

Any device that needs electricity in order to run counts among the household loads everyone is familiar with. Our energy needs are defined by these appliances which require power in order to work.

Solar Panels – How to Get Them for Free

As a rule, people buy solar panels if they need them. But 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 that should be looked for is a telephone number from a maintenance shop. Such phone numbers are to be found near construction sites on signs that are solar powered. Calling to that number will give anyone the possibility to talk to a head mechanic or to a person in charge.

In most cases, if they are asked about damaged panels, they will say such panels are available. In addition, since they are damaged and can not be sold, they will be given for free for whoever 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, anyway, they can be repaired. Some silicone is perfect for scratches and cracks, and soldering the wires is not such a complicated job. But repairing damaged panels is not the only manner you can get panels for free. Another opportunity may be considered.

For instance, acquiring used solar panels is a good chance to take 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 to someone whatever it is that they wanted to throw 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

chances 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 this one are generally much cheaper than the ones sold on the market.

Solar Panels – How to Build Them

Homemade solar panels are a possibility one should always explore, since this way they get the opportunity to save serious amounts of money. The units necessary for building a solar panel are as it follows: solar cells, plywood, glass, copper wire, and silicone, solder, and UV protector.

On the Parts Necessary for Building the System

When building a solar panel, one should always pay special attention to the photovoltaic cells they are going to use, since these cells basically represent the heart of the system. Photovoltaic cells come in different shapes and sizes. Thus, one 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 adequate for manufacturing 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 ones who actually turn sunlight into energy for our appliances. Again, they can be bought from eBay, and, again, one can get either cheaper or more expensive cells, according to their calculations.

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.

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, they present discoloration or they lack reflective coating.

But some cosmetically damaged cells can also be flawed with respect to their efficiency. For instance, 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, since the cell will reflect more light than it is able to take 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 proper for commercial panels.

Should one choose to purchase such cells, they should keep in mind that a low efficiency of the cells will render 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 straightforward project of building the solar panel. They don't want to complicate the process with unnecessary actions, in case they have an appropriate budget. In this case, they may just as well buy unspoiled cells. This is, however, recommendable for the first panel one ever builds.

One must 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 are looking for. For instance, transparent cells, even if damaged, are more expensive than other types of damaged cells.

Anyway, 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 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 such tests, since there is always the chance that they get flawed during transportation or during handling. 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, anyone should know that tests provided by manufacturers are rather expensive.

This is why a cheaper – even free – version of a test should be employed. Keeping the cells in the sun, as indicated above, is just what anyone needs 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 when the test is made.

All 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, anyone should be able to rely on its results.

When it comes to plywood, people should know they don't need to buy the most expensive type of plywood they 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 anyway.

Cells adhesion to the plywood is ensured by silicone. Copper wire, on the other hand, is what connects them together. In order to be able to distinguish between positive and negative poles, one may consider using wires colored differently.

But one also must be sure that the copper wire is stuck where it should, that is, 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.

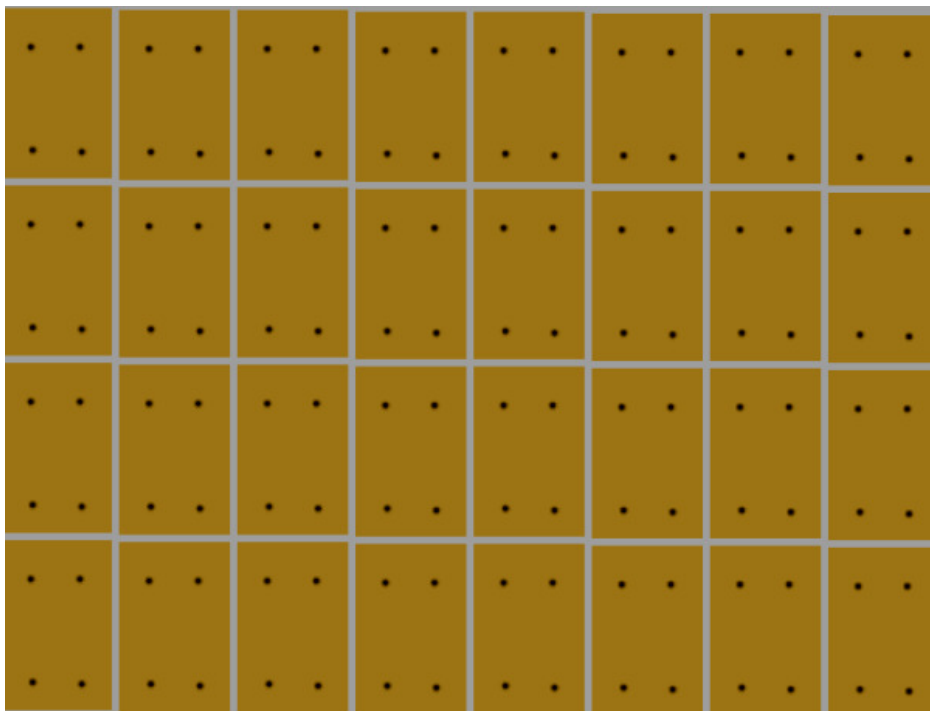
The Steps of the Project

The first step: First of all, anyone should know that 100 watts of power need 80 solar cells working on producing that amount of energy. The number of cells is relevant not only to how much energy the user needs, but also to the size of the plywood they are going to use. Thus, the first step consists of cutting the plywood according to the number of solar cells.



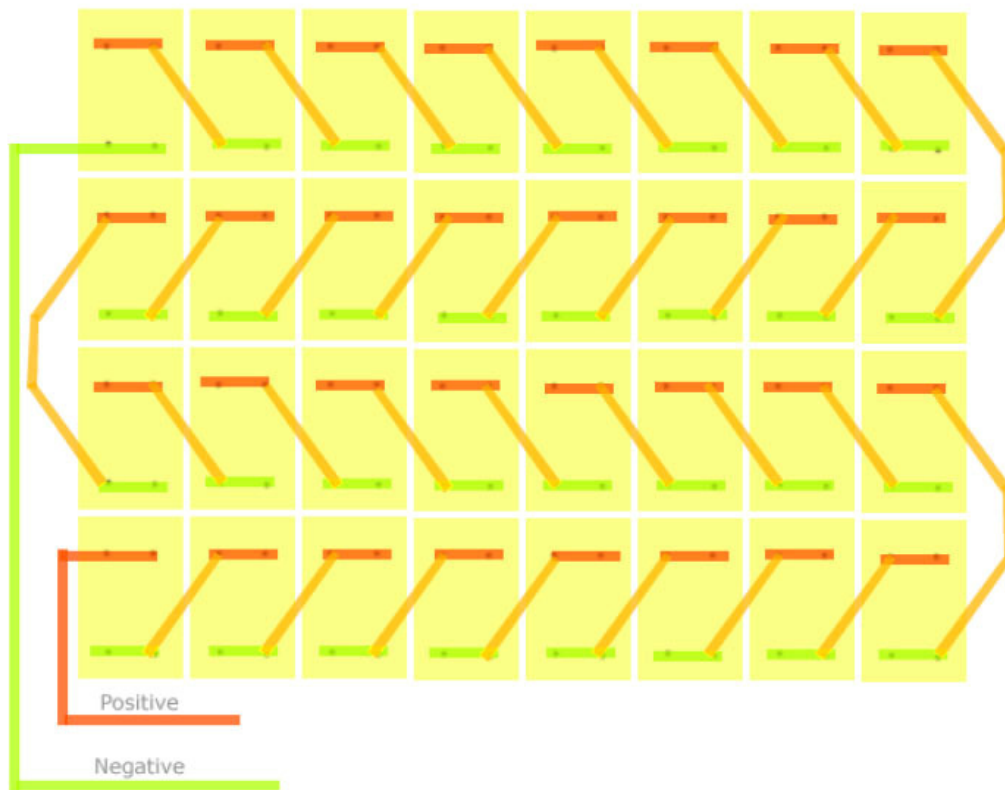
The second step: This step refers to covering the plywood with the UV protector. 3 layers of UV protector are recommendable for satisfactory results.

The third step: At this point, wiring and soldering are the main concerns. This step assures the combination of the cells into a single unit. In order to do that one should apply some solder on the back of the cells, more precisely, on the tabs noticeable on their back. A pencil-like solder iron could ease and speed up the process and it will also optimize the soldering of the copper wire.

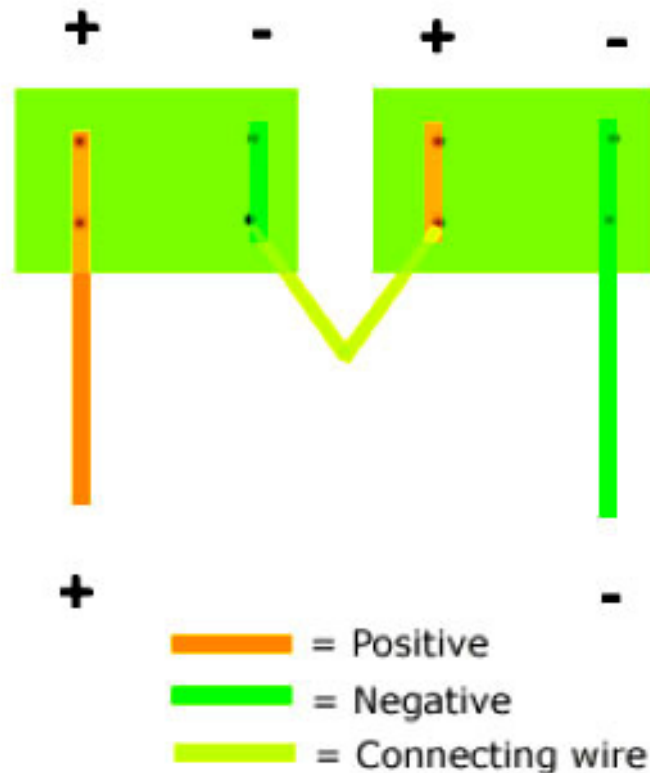


Wiring is not a complicated process. One should begin by wiring the bottom of the cells, which represents the negative pole. The negative will be connected to the negative.

Then, the top of the cells should be taken care of, which means that the positive will be connected to the positive. The solder has the role to help the copper wire stick to the back of the cells. The solder iron eases the process a lot.



Any person who decides to build the system must focus on this step. A particular detail they have to pay attention to is the following: positive and negative wires should not meet at their ends; otherwise the efficiency of the system will be challenged, in case the system will work at all.

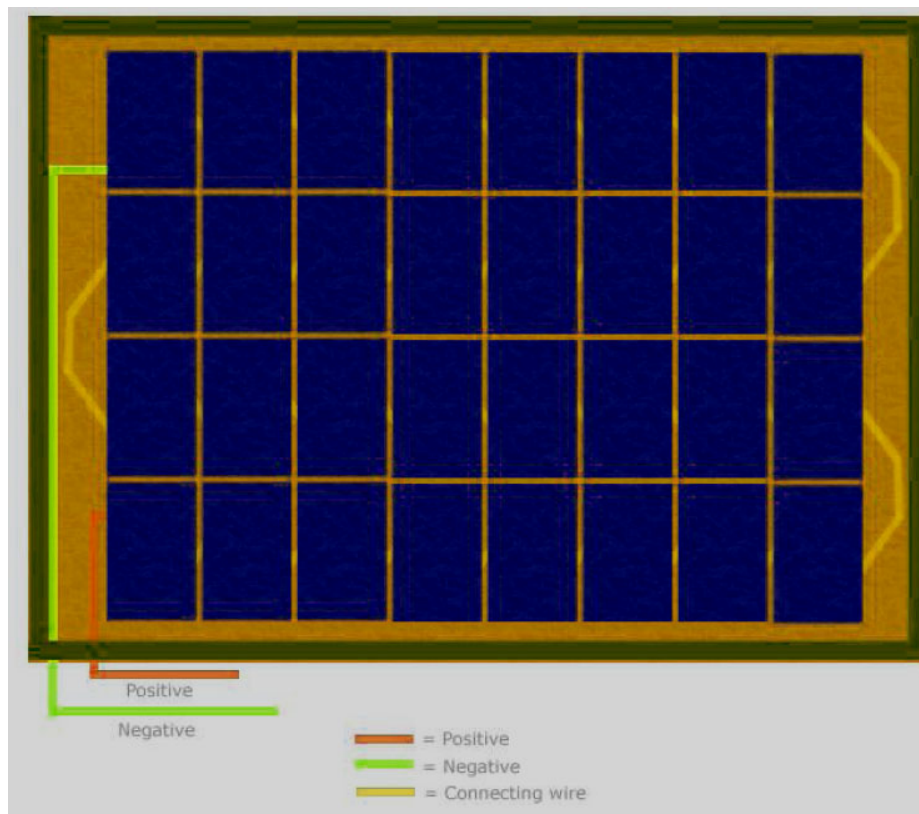


A series wiring is actually a simple thing to do, and it also represents a type of wiring that allows the supplementary connection of other cells, if necessary.

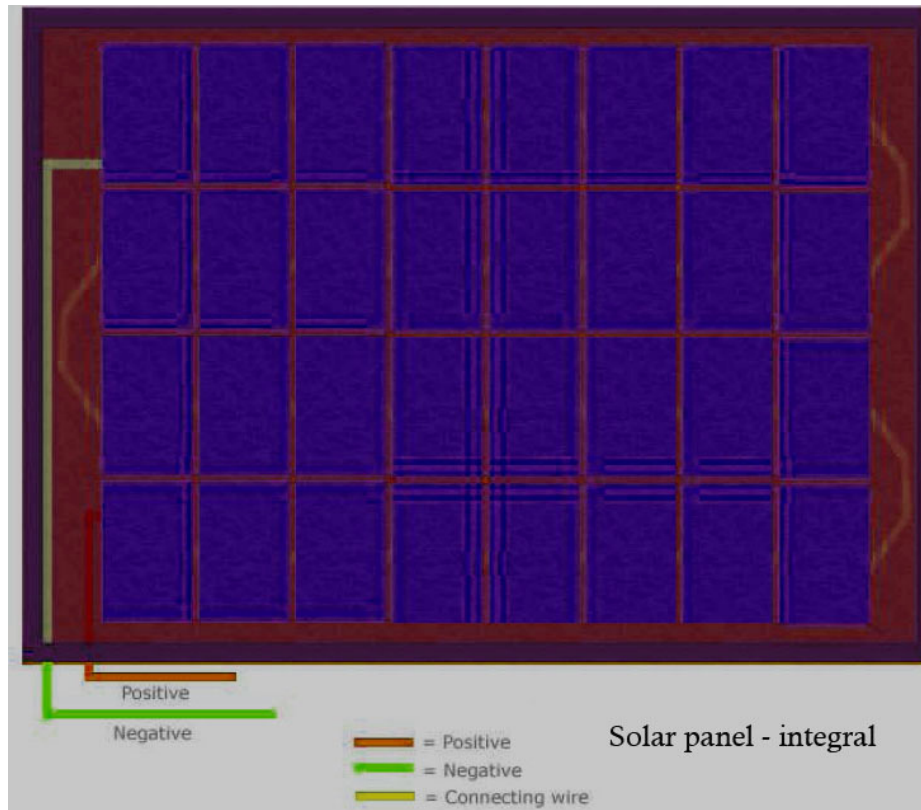
The fourth step: Sticking the solar cells to the plywood is what must be done at this point. Some silicone is perfect for this job, and there is no need to exaggerate with applying it. Cells must not be drowned in silicone in order to make sure they don't slip from the plywood.

The fifth step: The wire ends must go through the plywood in order to reach to the back of the board. In order to do that, some holes must be drilled in the plywood. One should remember that using a single hole for two wires – positive and negative – increases the chances to make the wires meet, which is compromising for the functionality of the entire system. Drilling more than one hole will keep these chances as low as possible.

The sixth step: A wooden frame must be attached around the plywood. This step prepares the following one.



The seventh step: Since the wooden border is readily attached, fixing the glass should not be a problem. Some silicon will be perfect for making the glass stick to the wood.



The eighth step: All the gaps and the holes must be insulated with silicone, including the ones through which the copper wires go through to the back of the panel.

The ninth step: Since the panel is not airtight, a hole must be drilled at the bottom of the panel in order to avoid moisture.

The tenth step: The panel is virtually completed. All that needs to be done now is to connect the copper wires to an electrical wire. Thus, the panel will be ready to be connected to the batteries which also are a significant part of the system.

How to Maintain a Homemade Solar Panel

Sticking to the following tips may help with the maintenance of the solar panel one has 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, one must take care that the solar cells and the appliances do not exceed, with respect to the power produced and consumed, the levels indicated by the ratings.

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

Regarding the wiring, one should make sure no wire connections are affected in any way, and that no wires meet each other in case 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, one 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 periods of time.

Some general maintenance is also recommendable. 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.