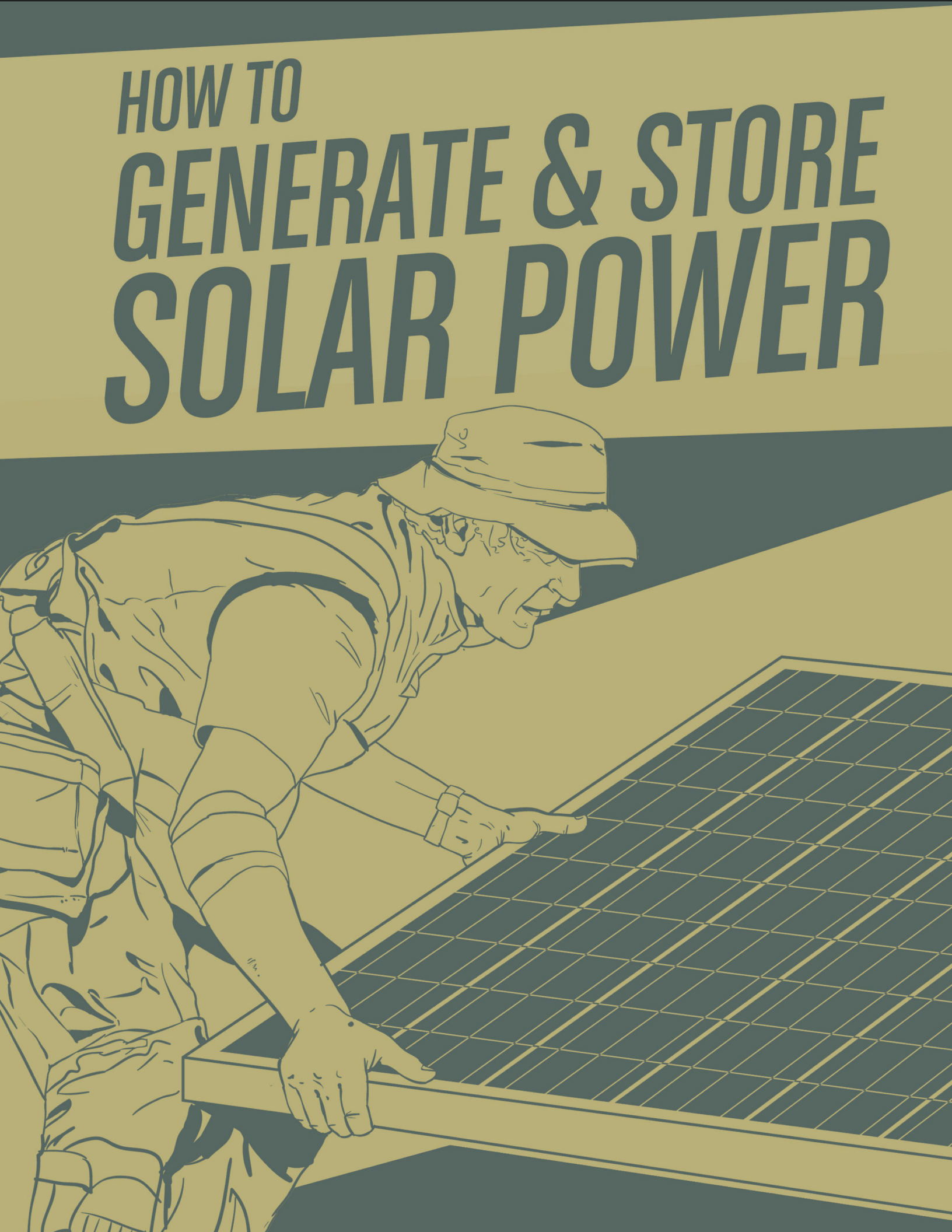
HOW TO GENERATE & STORE SOLAR POWER



WHY YOU NEED SOLAR POWER

If you're seeking independence and a sense of security regarding your electrical power, going solar is a good option. Rolling brownouts during peak summer months, storm damage to the electrical grid during winter months, or unexpected natural disasters ranging from floods to tornados to hurricanes can leave the municipal power grid completely unreliable. If you have your own solar power, or a combination of solar and wind or solar and a gas powered generator, then you never have to worry about keeping yourself and your family safe and warm.

Financially, solar power is a long term investment in your own independence. There are some significant initial setup costs, but modern solar power systems can last 25 years or more. If you expect to have a limited income during your retirement, it makes sense to set up a solar power system before retirement. If your investments or retirement income disappear, you'll still have one of life's basic necessities covered.

If your region gets strong but inconsistent sun, you might want to consider supplementing your solar energy system with either an emergency generator or, if local weather permits, a small windmill. Modern windmills move slowly enough they won't cause any damage to birds and can be hand painted to look like a whimsical artistic addition to your yard instead of a big white boring pole. You can also get small, subtle, roof mounted

versions which generate a little less power but are also a lot less likely to irk the neighbors.

ESSENTIAL KNOWLEDGE ABOUT SOLAR POWER

The Photovoltaic Effect

Solar cells turn sunlight into usable energy via the Photovoltaic Effect. Man made materials can capture up to 4% of the sun's total energy. That may not seem like a lot at first, but keep in mind the sun has the power to blind you in ten minutes if you stare directly at it. There's a lot of solar energy available to harness.

A photovoltaic cell typically has four main layers. The top layer is glass or clear plastic. That's basically just there to sandwich everything in place. Next come what's called an N–Layer, a junction and a P–Layer.

"N" and "P" stand for Negative and Positive. The sun's energy is composed of photons, which is where we get the first half of the word photovoltaic. The sunlight hitting the N–Layer causes the semiconductor to give off a negative charge on an atomic level while the P–Layer causes a positive charge. Sandwiching the N and P Layers allows your solar cell to capture the most possible energy from the sun. The two layers are typically both made from silicon. One is treated to have the positive charge and the other is treated to have a negative charge.

Since most solar panels have about the same level of efficiency, size determines how much power you can generate. Some people put up a single panel to power a specific appliance. Other people cover the roof on the sunny side of their house with as many panels as possible in order to get off the grid.

In order to power the needs of a conservative house with a well insulated refrigerator, microwave oven, 30 inch LCD television, desktop computer with an 18 inch monitor (but no printer—they're energy hogs), compact fluorescent lighting for four rooms, and a little bit of miscellaneous power usage, you're probably going to need about a dozen panels which can generate 80–100 watts each plus an array of 20 batteries.

BATTERY SOLAR POWERED SYSTEMS

There are two main types of solar power systems. The most common is called grid inter-tie. This means you power your home using solar energy during the day, but

you're still on the grid at night. Since you're connected to the grid, if you create any surplus power, you actually feed it back into the system. Since you're not generating your own power at night, you won't be making money off your solar power by feeding the grid. However, you can power yourself by day and any excess power you generate helps you save money on the power you use at night.

A grid inter–tie system can cut down on your total electrical bill while also ensuring you have daytime power available during a disaster, brownout, or emergency situation.

If you want to go off the grid for full energy independence, you'll need more than the solar cells. You'll need a rechargeable battery array.

Without a battery array, you can't store any electrical energy. You don't want your entire house to go dark when the sun goes down, so in addition to the solar cells you're going to need some chargeable batteries. Getting the power in and out of those batteries requires a little extra equipment.

Charge Controller

A charge controller regulates the power going into and out of your batteries. A rechargeable battery has a limited capacity, so if your battery is nearly full, the charge controller stops it from trying to absorb extra energy, which can break, disable, or otherwise damage your battery. It also regulates the current in your battery to help prevent accidental discharge. In essence, the charge controller helps make sure your batteries don't blow up.

System Meter

The system meter tells you how much power your solar panels are producing and how much energy your home is using. This allows you to make the best decisions about what appliances to use at what times.

Main DC Disconnect

This is just like the breaker box in your house. You can use it to literally disconnect the solar cells from the batteries for maintenance, just like you do when dealing with the electrical system of a house on the grid. It will also automatically disconnect the power if there's an electrical overflow and helps reduce the potential for battery related fires.

Battery Bank

This is where you store your surplus solar power so you'll have energy to use after dark. There are a lot of batteries to choose from. As is the case so often in life, there's a direct relationship between cost and quality.

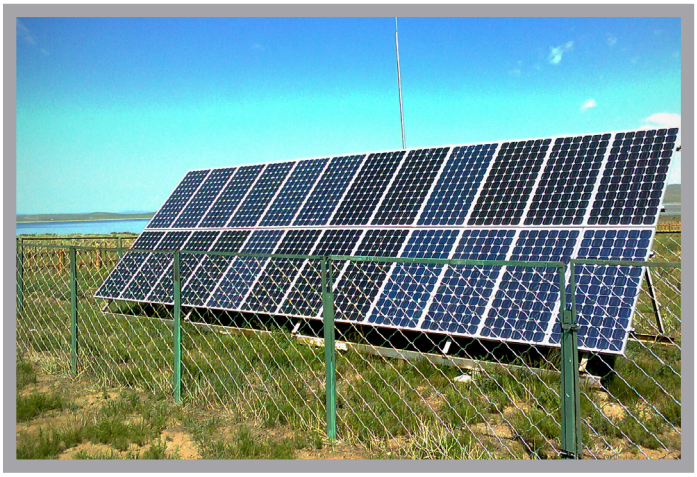
RV/Marine/Golf Cart—These small batteries aren't powerful enough to run an entire house, but if you have specific appliances you want off the grid, they'll do the job. The

golf cart batteries won't last as long and don't have the capacity of bigger, more robust batteries, but they are some of the cheapest available on the market. This is where a lot of home solar experimenters begin.

Flooded Batteries—Lead acid batteries are produced specifically to be used with home solar systems. They're called "flooded" because you add water to them over time. They offer medium efficiency and medium affordability. However, using flooded batteries produces a gas during charging, so they can't be stored or used indoors.

Gel Batteries—Gel batteries function much like flooded lead acid batteries, but they don't produce any gasses. That means they're safe for indoor use. However, they're also notably more expensive.

Absorbed Glass Mat—These are considered some of the safest, most effective batteries for long term home solar use. They don't give off any gasses, don't have any risk of acid spillage, last longer, discharge slower, and maintain voltage better than golf cart, flooded, or gel batteries. The catch? You get what you pay for—and you'll pay a lot more for absorbed glass mat batteries. People who have used solar for years swear by them, but most of them also admit they started with a golf cart battery when they were first learning the ropes.



BUILDING YOUR OWN SOLAR CELLS

You can build your own solar cells from scratch, but for maximum efficiency and safety, it's best to buy professionally made systems with all the electronics in place.

If you want to save money on your solar panels, you can make your own by repurposing old, broken solar panels. One of the neat things about photovoltaic cells is that if you break one into a hundred pieces you now have a hundred small photovoltaic cells. You can get bags of damaged or broken photovoltaic cell pieces dirt cheap and assemble them into a solar cell using nothing more than plexiglass, a soldering iron, some screws, lumber, and wires.

The reason there are so many broken photovoltaic cells on the market is they're typically thin as paper and fragile as glass. Keeping them intact is actually something of a challenge.

Start by building yourself a plain wooden box to hold your solar cell. It doesn't need to be fancy. For a small, experimental cell, try a 12 by 18 inch piece of 3/8 inch thick plywood with some ¾ by ¾ inch pieces of wood lining

the edges. This small cell will only produce enough power to charge a 12 volt battery, but building it will teach you all the principles you need to build a large home array.

Every 3 inches, drill ¼ inch vent holes into your ¾ by ¾ inch liner. Nail or glue the liner to the plywood. Paint the wood the color of your choice in order to protect it from moisture and wind damage.

Cut a piece of peg board to fit inside the frame. Paint it the same color as your frame.

Once the peg board dries, you're going to use it to connect all the scraps into a single, electricity generating unit. You want to put down a piece of stiff plastic or something else you can use to carry and move your fragile photovoltaic cells. Carefully arrange all your solar panel scraps tightly together, as neatly as possible, back side facing up. Lay the peg board on top of them. You're going to use the peg board to connect all the scraps into a single, electricity generating unit. Get a good look at where the holes line up with the scraps.

Lift the pegboard backup and carefully apply glue or silicone based caulk to parts of the photovoltaic cell scraps. Make sure you don't cover any parts where there are holes in the pegboard. Carefully reapply the pegboard to the scraps and wait for the glue or caulk to dry.

Once dry, let the holes guide you in arranging wire between the scraps. Carefully solder the wire from one hole to the next, connecting all the pieces of solar cell scrap into a single unit.

Carefully turn the pegboard over and gently lower it into your wooden frame. Once it's in place, screw the pegboard directly to the frame. Your wire should extend outside the frame. Gently lower a clear piece of plastic on top of the new solar cell and use clear caulk to secure it in place.

You'll now need to carefully connect your exposed wire to a rechargeable 9 volt battery and wait. It takes about a day to charge.

As you can see, while it is possible in principle, your home made cells will lack durability and capacity. If you want to power your homes, it's best to purchase pre–made solar cells and related supplies.

BUILDING YOUR OWN HOME SOLAR POWER SYSTEM

Solar Panels

These are the core of your system. They can be mounted on your roof, on stands in your yard, or on poles, depending on the sunlight in your area and your personal needs.

Decide how many standard 90 watt solar panels you need. A typical house will need about a dozen. Once you pick a number, increase it by 30%. Everyone uses more power than they think.

Solar Panel Mount

Your solar panels need somewhere to live. It doesn't matter if you put them on your roof, in your yard, or up on poles above your

house. Pick what works best for you. The mounts are angled to best access the sun. For extra efficiency, you can buy some with levers and timers which will change the angle of your solar panel slightly so it best follows the sun over the course of the day.

Battery Box

If you're storing your rechargeable batteries outside, you're going to need a safe place to keep them secure from the elements. The battery box is also where you're probably going to mount a lot of your other electronics, such as the charge controller, system meter, and main DC disconnect. A lot of people find it handy to build what looks like a bus stop or a small, open air shed for their battery box. If that seems like too much hassle and expense, they upgrade to the indoor safe varieties of batteries. If you store your batteries indoors, you'll still need a box to safely contain your array and provide a place to mount your electronics.

Inverter

The power coming from your solar cell is in the form of direct current. You'll need an inverter to convert it into alternating current to use it in your home. You should be able to connect a quality inverter to the breaker box in your home and thus connect the power coming from your solar units to the actual electrical system of your house.

Home Solar Kits

If you're concerned about getting all the right pieces or fitting them all together, you can buy a wide variety of home solar kits. These cost a little more than piecing things out individually, but you're guaranteed to have all the parts you need and electronics designed to work well together. Most people recommend you use a kit the first time you add solar capacity to your home. Once you learn from it, you can always buy your own parts to add later. One of the great things about solar power is you don't have to change over your entire home electrical system all at once. You can do it a bit at a time, dictated by your budget and enjoyment for do it yourself projects.

OTHER WAYS TO USE SOLAR POWER AT HOME

Solar Pool Heating

Nothing could be simpler than solar pool heating. In fact, a lot of people do it without even realizing. Most floating pool covers are actually solar blankets. All you need to do is leave them lying on top of your pool

whenever you get out and they'll warm the water all summer long. Most solar pool covers cost less than $100 and take less than 2 minutes to pull off the pool and to putback into place when you're done swimming.

If you live in a colder climate and already have a pool heater in place, connecting the pool heater to a small standard solar array (the same kind you use for powering your house) is one of the best possible introductory solar projects. You'll learn everything you need to know about building a solar array for your home without any risk of messing up your home electrical system. By the time you've connected your solar cells to your pool's heater, you'll be ready to build a full sized solar array to power your house.

Solar Water Heating

Solar water heating is cheap, easy to do, and has been used for decades. You can easily generate most of your own hot water needs for all but the coldest parts of the year without using any electricity or gas.

A passive solar water heating system requires a little basic plumbing redesign. For starters, you hot water tank now goes on your roof instead of inside. This allows the hot water tank itself to be warmed by heat from the sun. The most basic system consists of a black painted metal tank enclosed in a wooden box with all exterior pipes also being painted black. This allows everything to absorb as much heat as possible. People started using simple black painted, roof mounted hot water tanks as early as 1896. The oil crisis of the 1970's sparked a new interest in energy independence. That led to a whole new wave of solar hot water technology.

For warmer, more reliable hot water, you can connect a solar panel to your solar mounted hot water tank. Instead of gas or electricity powering the coil inside your hot water tank, you connect the inverter coming off your solar panel into your hot water heater and allow it to power the heater directly. These passive systems require very little maintenance, but in most climates they rarely get hot water up to the scorching temperatures people prefer for washing dishes and heavy duty laundry.

For those, you'll need an active system, which includes monitors, controllers, reservoir tanks and sensors. An active solar hot water system is more reliable than a passive system, but is also hugely more complicated and prone to breaking down. Home DIY enthusiasts love them because they need endless tinkering. In general, they're not recommended for people who want a low maintenance, worry free way of getting off the grid.

Solar Space Heating

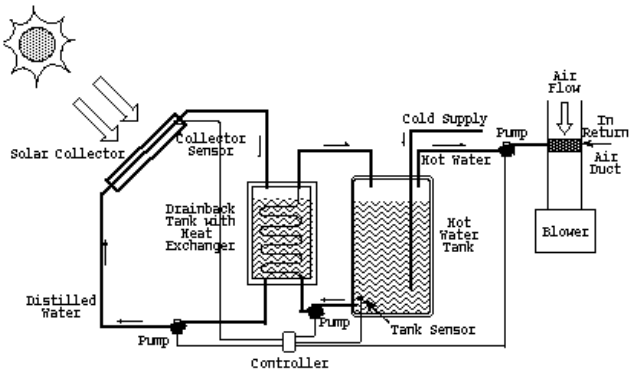
If you're not ready to go off the grid but you do have a perpetually cold room in your house, solar space heating is a low tech way to generate inexpensive heat.

Basically, you're going to build a box that traps heat, put a fan at one end of the box,

and then connect it to your home with the same sort of return duct you use to vent heat from your dryer.

Solar space heaters aren't pretty, but they are cheap. You can build one for under $200 using the basic tools many people already have in their garages. If you own a cabin, don't have nearby neighbors, or are otherwise isolated from people who would want to tell you how your house should look, this is a good, cheap, effective heating solution.

Cut a 4 by 8 foot piece of plywood down to 2.5 by 8 feet to make a nice, long rectangle. Cut in input hole at one end and an output hole at the other. These should both be round holes, four inches wide, designed to fit a standard crimped dryer hose.



Next, build an open box by connecting 1 inch thick by 4 inch wide boards around the edges. You should now have a very large, shallow, four inch deep box with two holes in it.

Fill the box with a sheet of extruded polyethylene insulating panel. This is cheap stuff that comes in bulk, so you'll probably have to cut it down to size. Don't worry about having any left over. Once it's in place, cut through the backs of the holes so you have matching holes in your insulating panel.

Paint a clear plastic roofing panel with black, high temperature paint. Once that dries, cut it to size and fit it inside your box.

Cut a corrugated tin roofing panel down to size and screw it to the exterior of your box. Caulk up any holes to make it as airtight as possible. You now have a heat sink. When the sun shines on that roofing panel and heats the interior, it's going to get unbearably toasty inside. Lean it against the sunny side of your house, outside the room it is going to heat.

The next challenge is getting that warm air into your cold house.

Fit some standard 4 inch wide dryer hoses to the input and output holes. Modify a window or cut a hole in an exterior wall so one of the hoses can come inside. That's now your output hose. Put an inexpensive bathroom fan or small box fan in front of the dryer hose to pull the warmed air into your house. Outside, you want to leave a short stub of dryer hose connected to the input hole. Cover it with some wire mesh or netting to keep animals and leaves out while letting air in for proper circulation.

To make things even warmer, either build a bigger box or a collection of boxes.

You can also increase the efficiency of your box by positioning some inexpensive thrift

store mirrors on the ground in front of your box. Use rocks or bricks to prop the mirrors up so they reflect the light directly at your newly built solar room heater.

This won't transform your coldest room into a sauna, but it can easily raise the temperature of a room by 15–20 degrees, depending on the amount of shade and sun available in your yard.

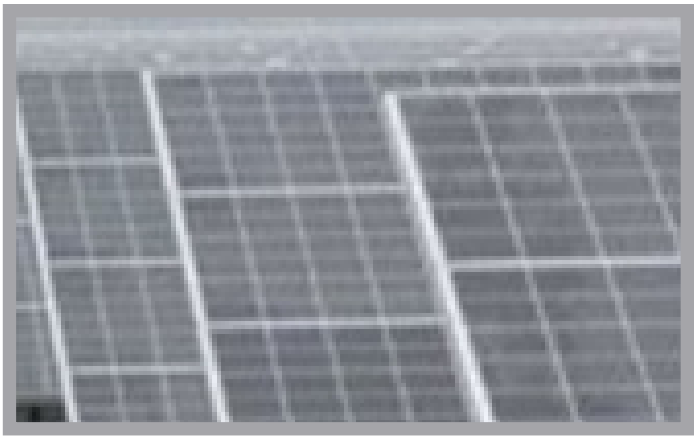
SOLAR POWER OUTSIDE THE HOME

Solar power isn't limited to home use. Many Recreational Vehicles include their own small solar panels on top and battery array inside. This is useful not only when you're parked far from a RV campground, but also in case of emergency or natural disaster when the usual sources of electricity may not be available. Extra power from the solar cell can keep your RV battery in good enough shape to allow you to charge your cellphones to keep in touch with loved ones, and heat food in a microwave, and even run a small portable television in order to help keep you abreast of news developments during a disaster. When you know you're charging your battery with a solar power, you remove the temptation to waste precious gas in order to power appliances inside your RV.

More importantly, a strong enough solar panel can recharge a dead RV battery within a day. A solar backup means you never have to worry about being stranded if you do drain your battery.

In addition to RV battery chargers, you can buy foldable, portable solar battery chargers for small appliances, such as cellphones and GPS units. After a disaster, charged phones and GPS units are vital for finding lost people and keeping in touch with friends and family.

As you can see, the uses for solar power are varied, as are the means for generating and storing it.



Published by:

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