Solar for a Small Building

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****The big mistake many people make see below***

It is highly recommended you read and understand our beginners book offered for free. It's available from our website under Guide Books.

To make a solar system for a small building or tiny house, ***you need to have some idea of how much power you're going to need. Knowing this will prevent disappointment and save money.***

How do I calculate how much power I'm going to need ?   Well, add up the items you want to run inside your building. Lights, fan/s, water pump, small cooking utensil like an induction cooker or small microwave. Those are the basics.

Our tiny shed will be 8 ft wide and 20 ft long. This is big enough for a small garage or for a few people to live in. That's 160 square feet.   Let's assume two people are going to live in it with the understanding that it's a compromise in living. A water pump is an option that will be included here to run a small sink. Water can be provided by storing rain water or a well. This system is not designed to pump water from a well, it's designed to pump water from a small tank to the sink or perhaps a toilet too. And depending on water available, maybe a small shower.

Cooking can be done on a modern device called an "induction cooker" which requires iron or some other magnetic material in the skillet or pot to cause heating to occur. No aluminum cookware will work. Why am I choosing this type of cooker? Because the only thing more efficient in cooking is a microwave oven.

Let's say you're located in a warmer climate during the summer and will need at least a fan for cooling. There are efficient fans available that are a must for a small system like this one.

Efficient fans are usually powered by DC motors, not AC, but can be powered by AC. A good example of this is "Better Homes & Gardens" model from walmart here:
https://www.walmart.com/ip/Better-Homes-Gardens-16-12-Speed-Pedestal-Fan-and-Remote-BHS23619315319R-New-Black/214590627?classType=REGULAR

price $46.xx as of 4/30/2025.

You can also choose DC powered ceiling fans which use little power. The fan mentioned above moves a lot of air and uses less than half the power of a AC motor fan.

Remember, saving electricity or power is a prime concern, and every little bit you save adds up

big time. A cheap box fan needs 80 watts of power on high, this fan pictured below is 36 watts on high, and it moves more air, and is quieter.

And no, I don't get any money from anyone who's photo's are displayed in this book. Notice on the box it says "DC Motor for Energy Efficiency". I use one of these and they deliver on their promise of low energy use and quiet operation, and they move as much or more air than the cheap box fan.

So let's try to get an idea of how much energy you're going to need each day. Of course there's no simple answer to that since every installation is different but we can get pretty close. And if you have money you can always expand your system {within limits}. So we have 2 people who will eat 2 meals a day that are cooked. You can figure each meal will need about 1 kw of power. If you don't know what that means you need to read the beginners book first. I'm assuming you have read and understand what the power terms mean.

So you have 2 people eating 2 meals a day and each meal needs about 1 kw of power for a total of 2 kw for the day.

Lighting: Hopefully you have at least a single window for some light during the day. This will save on power during the daylight hours. Searching for "led 12 volt rv light fixtures" will render hundreds of choices. The important thing to remember is these fixtures use LED bulbs that run on 12 volts DC from a battery, not AC like your wall socket. There are many advantages to using these types of fixtures. They are low cost, low or no maintenance, easy to install, and available with a large choice of brightness. Brightness is directly related to power so avoid models using more than 6 watts of power. 2 watt bulbs provide plenty of light at night and will not run your batteries down for hundreds of hours. At typical RV with 2 watt bulbs can turn on every bulb in the RV for less than 40 watts of power ! All of them..

You can get 2 for porch lighting that have yellow lens to keep from attracting bugs. We're going with 40 watts for all fixtures on for our energy calculations.

A water pump works on demand and can be operated with a switch to turn it on and off or you can leave it on and let it run. 2 people just drinking water and washing dishes should only be about 10 gallons per day. This equates to less than an hour of run time but we're going to use 1 hour per day at 120 watts to run the pump. The pump will be a 12 volt operated model available on amazon. A good brand is Delvac.

So we have energy needs listed below, this will help us figure out how big a system we need.

Power needs (Energy).

Lighting: 25 watts average for 10 hrs = 250 watt hours

Cooking: 2 kilowatts per day 2kw

Water pump: 120 watt hours

Fan: 36 watts 12 hrs per day = 12 x 36 = 432 watt hours

Misc. chargers, tablet, etc.   200 watt hours.

Small refrigerator: 1 kw per day. (optional)

Total: 250 + 2000 + 120 +432 = 2802 watt hours of energy per day. NOT INCLUDING REFRIGERATOR.

TOTAL: **<u>2802 OR 2.8 KWH per day.</u>**

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Now we need to select a battery that can give us that much power in a single day that can stand up to that kind of use. A LiFePo4 12.8 volt 200 ah battery can give us 2560 watt hours per day. This is a bare minimum and won't last an entire day with no sunlight. A better choice would be the 300 ah battery with 3840 watt hours of storage but costs are a concern here..

Next is solar panels, we need to design for 5 hours of good sunlight in a single day to fully recharge the battery/'s. **Now for some surprises they don't tell you… Solar systems are only about 80% efficient as a complete system.. this means you loose 20% percent in system losses.** So you need to account for those losses in you design. We are using 2.8 kwh per day and need to add another 20% to that number to account for losses in the system. The formula is 2800 x 1.2 = 3360 watt hours. Now take that number and divide it by 5 (for hours of sunlight) to get the size of solar system you need. 3360 ÷ 5 = 672 watts of solar panels. Rounded up to 700 watts or seven 100 watt panels. Now we can finish our list of parts needs based upon these numbers. Keep in mind that this is a bare minimum system and relies on good sunlight every day to fully charge the batteries. In the real world this doesn't happen and standard designs call for enough battery storage for 3 days of no/weak sunlight. As we've seen, we need 2.8 kw per day times 3 days = 8.4 kw of battery storage and that's not including losses in the system. However, 2 of the 300ah batteries comes close and would greatly help this system. But then again we would need twice the solar panel power to keep up with an extra battery.

So lets look at some numbers for a small building/shop. Maybe your energy needs won't be this high, maybe you only need 1 kw per day, if this was the case then a single battery and 700 watts of panels would work out fairly well most of the time. It's still a little small for the 3 days without sunlight rule but it's still workable.

What we need to build this small systems is:

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Bare minimum system.

1. 700 watts of solar panels
2. 200 ah 12.8 LiFePo4 battery
3. One Charge controller * 60 amp for 12 volt system.
4. Inverter 2500 watt to generate AC
5. Mounts and wiring for above parts

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Reasonable system w/good power backup

1. 1.8 kw of solar panels
2. 2 x 300ah LiFePo4 batteries
3. Two, 100 amp Charge Controllers for 12 volt system.
4. Inverter 3kw to generate AC
5. Mounts and wiring

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Tiny house system

1. to be continued…..
2.
3.
4.
5.

====================CHARGE CONTROLLERS================

* Next is the part some of you downloaded this book for, just to read about the mistake many people make so here it is:

Many people don't understand the ratings of Charge Controllers ….. Let me say that again: "Many people don't understand the ratings of Charge Controllers" and the manufacturers don't make easy or clear either. This mistake is so common, it happens to almost everybody who buys solar system parts. You see, charge controllers are rated mostly by their output current or amperage. You will see 20 amp charge controllers, 30 amp, 50 amp and even 100 amp models. Most people THINK the amperage rating is for the solar panels they connect to…. But what that amperage rating is really saying is "this is how much current or amps I can put into the batteries". ***This rating is talking about maximum current/amps INTO your batteries, NOT the amps coming from the solar panels. !***

So what does that all mean ? It means you have to calculate how big a charge controller you need based upon your batteries amp hour rating and maximum charge current. {NOTE: current and amperage are the same thing).

In the example above, we calculated we need 700 watts of solar panels to charge our 200 ah battery per day. That's assuming 5 good hrs. of sunlight. Here's the fun part: In full sun, we get 700 watts and our battery system is 12 volt (12.8 nominal) to we now know that our charge controller needs to handle the 700 watts from our panels and put that into our battery. We need to know how much 700 watts is converted to amps for our battery. Formula is P for power, divided by (battery) voltage = amps. $700 \div 12.8 = 54.6875$ or 55 amps. Since it's not a good idea to run the controller at it's maximum rating we choose a 60 amp model rated for 12 volt battery systems. It's fairly simple but many people are confused by the amp rating being for the battery, not the solar panel…. Sometimes I think the manufacture don't realize the confusion this rating brings.

========================INVERTERS===========================

Next is the last piece of equipment you need to round out your solar system. The Inverter.

The inverter is essentially your own power company and your in charge of it. It generates the AC (alternating current) 120 volt power for the appliances that need it. It's the same 120 volts your house plugin sockets have and it's dangerous if not installed properly and safely.