Notes for solar presentation:

There are basically 3 components to a Solar Installation, the battery, the solar panel and the charge controller. As with any other endeavor there are numerous accessories you can add to your system that are not a requirement but could enhance your system capabilities.

1. Solar panel to generate electricity.

2. Charge Controller to control rate at which electricity from the solar panel flows into the battery and the rate at which power flows from the battery to the load (load = whatever is attached to the battery).

3. Battery to store electricity so it can be used by radio equipment.

The sizes of these components depend on the amount of current you need to draw from the battery and the duration. Once you work out these 2 requirements, you're able to figure out the capacities of the 3 components.

How do I size a system for my 100w radio?

I will use an Icom IC-718 for my example:

An Icom IC-718 draws 1 amp on receive and up to 22 amps on transmit on CW, approximately 16 amps on SSB. Generally you listen more than you transmit, so I am going to assume 25% in transmit mode and 75% in receive. Your percentages will be different depending on your ratio of transmit to receive times. A very basic formula for this would be:

((R%h * RI) + (T%h * TI)) = Capacity needed.

%h = % of hour, R = receive, T = transmit, I = current, ho = total operation period

((25% * 1) + (75% * 22)) = 16.75 amps per hour needed to operate.

Per this simple formula it looks like if you wanted to operate for 4 hours a day you would need a battery rated for 67ah. Well this is not exactly true and I will cover why when we get to battery types. Also remember that you will need to do this every item that will be used, IE: Amp, Tuner, Lights, etc….

Selecting a battery:

There are 2 basic types of batteries that we as hams would use in our solar system. They are SLA (sealed lead acid) and lithium.

I will be covering SLA batteries only because I have not used lithium batteries and really know nothing about them other than they are lighter and are more expensive, the expensive part is why I have not used them.

SLA batteries come in 2 types, flooded and gel cell/AGM (absorbed glass mat).

Flooded type batteries are fine if you are setting the system up permanently in one location and the batteries are going to be outside. They need to be outside because when they charge they generate hydrogen gas which we do not want in the shack or house. When using the flooded type batteries you have to be careful moving them because you can spill the acid they contain all over.

Gel cell and AGM batteries are better if you are going to be transporting your batteries a lot, such as operating in a public park. They are also sealed which means they can be charged inside a building.

Gel cells/AGM batteries are more expensive than flooded batteries.

We should also look for deep cycle batteries. Most gel cells/AGM batteries are deep cycle. Car batteries are not deep cycle. They can be used for experimenting with solar power but are not good for permanent use. 6 volt golf cart batteries connected in series make great batteries for your solar panel setup.

Batteries are rated in amp hours (ah), so you would assume that a battery rated 20ah means you could draw 20 amps for a hour. Well this is not true, that 20ah rating means that the battery was discharged at 1 amp and it took 20 hours to die. I said die, not to not be usable. We do not want to kill our batteries so we cannot discharge them that far. Most battery manufacturers recommend no more than 70% discharge. So that means that 20ah battery is really only a 14ah battery. So per our earlier calculation we needed 67ah but we actually need about 100ah.

To keep your batteries healthy you really should not discharge them to less than 11.9v.

Now let’s talk about the next component in our solar system, the charge controller. Charge controllers come in many different power/current configurations. They go from cheap to ouchie.

Charge controllers come in 3 varieties:

PWM (pulse width modulation) are the most common types available. PWM controllers can limit the amount of sulfating that occurs in your battery which is good. The down side to these type controllers is that they load your panels down to just what voltage that is required to meet the present charging need. So you are wasting power that could otherwise be used.

MPPT (maximum power point tracking) adjusts the voltage and current to get the maximum efficiency out of your panels. MPPT charge controllers are 20 to 30% more efficient than PWM controllers.

Cheap – These controllers slam your batteries with the maximum rated voltage and that is all they do. They either do a bulk or float charge and have no logic.

A good charge controller makes it impossible to overcharge a battery and charges using multiple stages. Charging stages include:

Bulk: Which is a fast charge up to 80% of the capacity of the battery.
Absorption: Last 20% is done at a higher current to help desulfanate the battery plates.
Float: Maintenance charge.

All charge controllers have a connection for your solar panels and batteries. Some also include a connection for connecting a load. If yours does not have a load connection then that means you have to connect the load directly to the battery.

Now we will discuss the different types of solar panels and their relative merits. Solar panels come in 3 types, polycrystalline, monocrystalline, and thin film.

	Monocrystalline	Polycrystalline	Thin Film
Efficiency	20 – 27%	14 – 20%	12 – 20%
Cost	High	Low	Medium
Size	Small area	Large area	Large area

For the same amount of wattage polycrystalline and thin film are larger than a monocrystalline.

What size panels do I need?

Let’s assume that we are getting 8 hours of usable sunlight a day. We would need to choose a panel whose current times the hours per day of sunlight meets or exceeds our battery ah rating.

So for a 8ah battery we would need a minimum of a 15 watt panel. A 15 watt panel is approximately 1 amp at 12 volts. So 1 amp per hour would charge our 8ah battery.

Solar panels work best when they are perpendicular to the sunlight.

Assembling your system:

Most solar panels come with MC4 connectors and these are the recommended connectors. But they are a little on the pricey side. I use Anderson power poles to connect my system together.

Now that we have a system together let's talk about accessories. A meter to check your output in volts, amps, and watts is useful. You can also use it to see how many amps your equipment is actually drawing. There are several on the market with the Whatt's Up being inexpensive and pretty easy to find (go to a RC store).

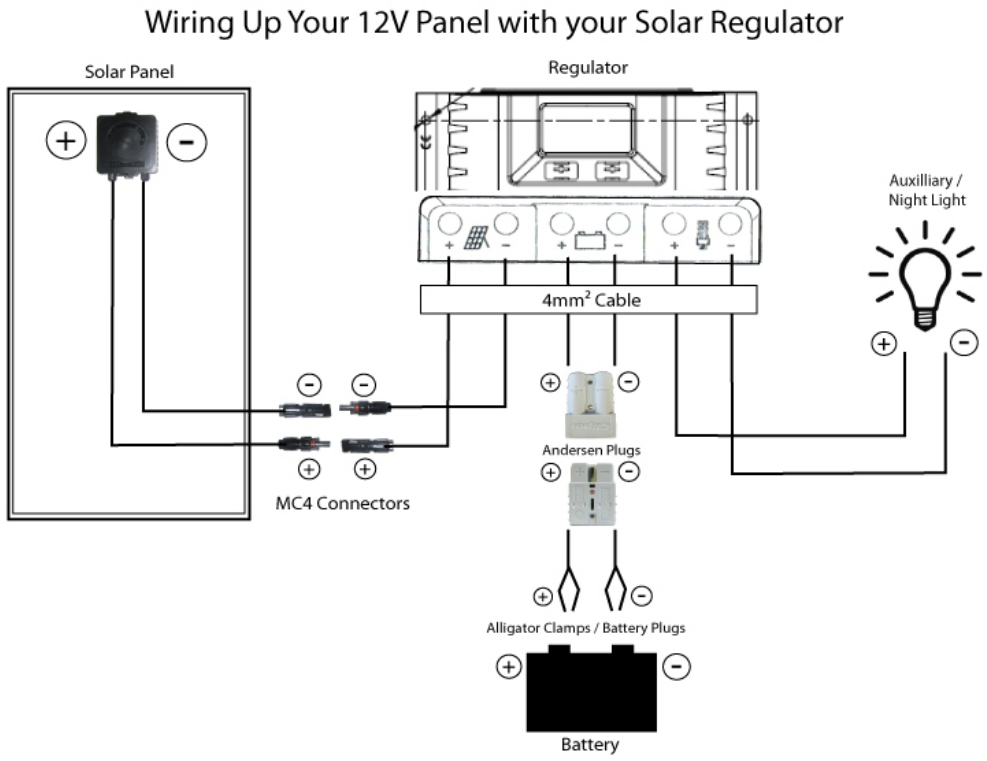
If your charge controller does not control your applied load then a LVD (low voltage disconnect) is a must as this will protect your batteries from be over discharged.

A dc to ac inverter is needed if you want to run anything powered by 110v, such as a fan, coffeepot, etc.

Inverters come in 2 types:

Modified sine wave: This type uses an ugly stepped square wave output. It is suitable for hooking up small appliances, laptop and phone chargers.

Pure sine wave: Suitable for any accessories.



References:

http://www.backwoodshome.com/articles2/yago116.html
http://www.ctsolar.com/solarpowerforamateurradiofaq.aspx
http://www.qsl.net/4s7ab/solarpower.htm
http://www.hamradiohawaii.com/solar-engergy
http://www.buddipole.com/
http://www.factsaboutsolarenergy.us/solar-panel-wiring.html
http://www.freesunpower.com/battery_diagrams.php
http://midsummerenergy.co.uk/solar-panel-information/Utilities/SolarPanelWiringDiagrams
http://www.how-to-diy.org/w3PDJFiXb89c5H/DIY-Solar-Panel-System-Wiring-Diagram.html
http://renogy.com/
http://www.bereadysolar.com/