Solar Panel System Basics

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SOLAR PANEL SYSTEM BASICS

The solar panel system at the Audubon Family Park Shed was donated and installed by Riggs Distler & Co. Sustainable Audubon deeply appreciates and acknowledges the generosity of Riggs Distler & Co.

Please note that the solar panel system at the Shed is more typical of one that would be installed on a recreational vehicle or a situation where roof area would be very limited. Sustainable Audubon intends to use this system as a demonstration project to educate the community on the use of solar energy. The small size of the system is perfect for illustrating and describing the components making up a solar panel system. However, the expected real-life application would be typically scaled up to a single-family home or a commercial operation.

There are several basic components of any solar panel system. These include: The solar panel (1); The charge controller (2); The inverter (3); The storage battery (4); The battery monitor (5); The fuse block (6); and The connection to where the power is used or sent (7).

Rich Solar Model RS -M100, monocrystalline 100-watt panels (No. 1)

The solar panel is what converts sunlight into useable power through the photovoltaic effect. The panel is comprised of many photo-voltaic cells which are silicon (a semiconductor) wafers with an additional layer of boron or indium as well as a layer of phosphorous or arsenic. These composite wafers are wired together and encased in a framework to eventually form the more easily recognized panels that are mounted on roofs. Sunlight causes the release of electrons from the parent material as energy in the form of photons is absorbed. The electrons are then collected by the solar panel which produces direct current electricity. The typical panel produces between 200 and 400 watts of power. Linking panels together is how larger amounts of power are generated.

Panels come in two types. In monocrystalline panels, the wafers are cut from a single source of silicon whereas in polycrystalline panels pieces of silicon are fused together to form the wafers. Monocrystalline solar panels are more efficient than polycrystalline solar panels and may reduce the number of panels needed to produce a given amount of

power. However, monocrystalline panels may also be more expensive on a per panel basis. Despite this, typically monocrystalline panels are the preferred choice for home system use.

Rich Solar Model RS-MPPT20 Charge Controller - Maximum Power Point Tracking (No. 2)

The charge controller is the heart of a battery storage solar panel system. Its main function is to ensure the battery is not overcharged by regulating the energy supplied. Overcharging is bad because it adversely affects your battery storage capacity. There are two types of charge controllers: pulse width modulation and maximum power point tracking. Pulse width modulation charge controllers are more typical of smaller, simpler domestic systems which are between 4 and 60 amps in size and lower voltages. They are best used in locations with large amounts of constant solar input. Maximum power point tracking charge controllers are more complex and are able to maximize power generation under varying solar input conditions (shaded areas, areas subject to snowfall, more northerly and southerly latitudes, etc.). However, they are more expensive.

Krieger KR1500 1500-Watt Power Inverter (No.3)

The inverter is the brains of the solar panel system and converts the direct current into alternating current. This is the more usable form of power for most domestic and commercial equipment. The inverter also does the important job of routing the flow of electricity between the various solar panel system components.

There are different types of inverters so care must be exercised in selecting the right inverter for your situation. String inverters and microinverters are two major types of inverters. String inverters are used when there is an array of panels in full sun. Microinverters are mostly used when individual panels in an array are partially shaded. Microinverters are installed on each of the panels and allow individual panels to be addressed separately. A subset of shaded panels can cause reduced efficiency in all the panels in an array if a string inverter is used. Note: The selection of a good inverter is an extremely critical decision because when a solar panel system fails, the inverter is the prime suspect.

SOK 12V 206Ah LiFePO4 Lithium Iron Phosphate Battery (No. 4)

Storage batteries are used to store energy for future use. The storage battery can be lead-acid (flooded/wet cell or sealed) or lithium. Wet cell lead-acid batteries have the advantage of being cheaper but require much more maintenance as well as ventilation. Sealed lead-acid batteries are either the absorbent glass mat type or the gel type. Both are maintenance free, but the absorbent glass mat type has a higher charge and discharge rate versus the gel type and is consequently preferred. Lithium batteries are much more expensive than lead-acid batteries; however, they also last much longer. So, the cost differential evens out over time. The faster recharge and discharge rates of lithium batteries as well as their maintenance free nature, generally favor their selection over lead-acid batteries.

Renogy Battery Monitor (No. 5)

The battery monitor potentially allows you to see electrical production, electrical consumption, current battery storage capacity, record energy exported to the grid, etc.

Blue Sea Systems ST Blade Fuse Block (No.6.)

The fuses are present to protect the system from overloads, short circuits, and ultimately potential fires.

Connections (No. 7)

Connecting wires transfer power to the battery and subsequently to fixture, appliances, etc. or alternatively, they route power to the grid.

Information sources:

GoGreenSolar; Interesting Engineering; & Solar Power World

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