Using a Solar Panel with the AyrScout Outdoor Camera

Introduction

Many people have asked about the possibility of running the AyrScout Outdoor Camera off a Solar-charged battery. It is possible, but it does require a fairly large solar installation and battery.

The Facts

The AyrScout Outdoor Camera, because of its large array of Infrared LEDs, has a fairly substantial current draw. At 12 Volts DC, it draws about 0.38 Amperes, which can be usefully rounded up to 5 Watts (Watts of power = Volts x Amps). 5 Watts at 24 Hours/Day comes to 120 Watt-Hours or, at 12 Volts, 10 Amp-Hours of electricity needed per day to maintain the Camera.

Battery Basics

To size the battery, I like to figure that you'll want at least 48 hours without any sunshine, although you may want to use a higher or lower number. If you want to charge the battery using a solar panel, you'll use a solar charge controller. Most modern solar charge controllers have a “shut-off” at 11 volts or so to prevent over-discharge of the battery (preventing damage to the battery and its enclosure). This usually represents about half the total capacity of a deep-cycle battery.

Given that you need 120 Watt-hours or 10 Amp-hours per day to run the Hub, to keep it going for 2 days you'll need 20 Amp-hours of battery life.

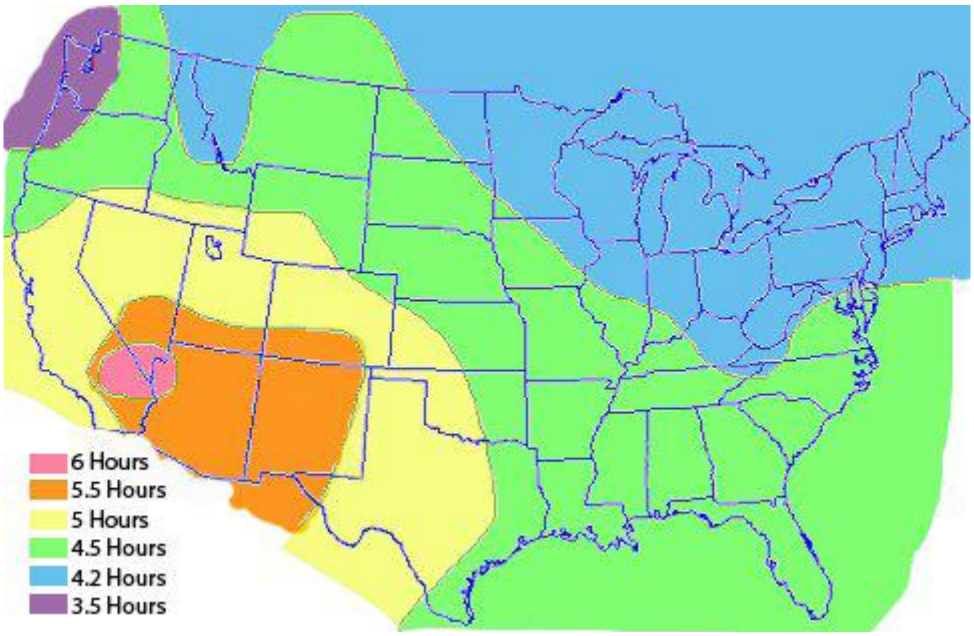
Since you only want to discharge the battery to half its rated capacity (because the solar charge controller will turn off the camera at that point), you'll need a battery rated at 40 Amp-hours or more. If you decide you want the camera to go 4 days without sun instead of 2 days, you'll want an 80 Amp-hour battery.

One other variable is important in sizing the battery: the climate. The efficiency and capacity of lead-acid batteries diminishes very rapidly as the temperature goes down, so you want to oversize the battery (perhaps dramatically) in colder climates. If you want the camera to operate continuously without charging for 48 hours at 0 Fahrenheit, you may want to double the size of the battery.

Sizing the Solar Panel

To keep the camera working consistently, the solar panel must consistently collect more electricity than the camera uses and deliver that electricity to the battery.

The most important factor in determining how much electricity a given solar panel will deliver is the "insolation rate" for your locale. You can find detailed insolation figures online; here's a sample chart that shows insolation as hours of full sunlight per day, on average:



For instance, if you live in a place that gets an average of 4.5 hours of sunlight per day (most of the Midwest and South), your solar panel needs to be big enough to deliver 120 Watt-hours of electricity to the battery in 4.5 hours, which means it must be capable of delivering 120/4.5= 27 Watts of electricity.

However, the solar panel delivers that electricity at varying voltages to the solar charge controller, so the type of solar charge controller being used is an important consideration. A common PWM charge controller is quite inexpensive, but may be 70% or less efficient, while an MPPT type charge controller, which is much more expensive, may be as much as 90% efficient.

You must consider these efficiency figures in sizing your solar panel. If you are using a 70% efficient PWM solar charge controller, you'd need to increase the size of the solar panel from 27 Watts to 27/0.7= 39 Watts. For a very efficient MPPT charge controller, the solar panel would only need to be 27/0.9= 30 Watts.

It is also considered good practice to use a solar panel that is rated at least 20% (some say 2x) more than the expected requirements, and, of course, solar panels usually come only in "standard" wattages. However, you can "stack" panels (e.g. a 40 Watt and a 20 Watt to reach 60 Watts) in parallel to the solar charge controller. So you'd want to choose a panel (or combination of panels) rated between 50 and 80 Watts for a PWM controller, and a panel rated between 40 and 60 Watts for an MPPT controller.

A few more Sample Calculations

If you are in the sunniest sections of southern Nevada and California, you may get as much as 6.5 hours of sun per day on average, so you only need 120/6.5= 18.5 Watts of electricity at the battery, so a 30-60 Watt panel will be needed (depending on the solar charge controller and your chosen "fudge factor").

On the other hand, if you are in an area with 4 hours of sunlight per day on average, you need 120/4= 30 watts of power, so you'll need a panel rated at 40-90 Watts (again, depending on the controller and "fudge factor").

Cost

In a casual survey on the Internet, I found 40 Amp-hour deep-cycle lead-acid batteries for $170, but a 79 Amp-hour battery from the same vendor was $245. Similarly, I have purchased pretty good PWM charge controllers with low-voltage cutoff circuits for $35, but similar MPPT units start at about $120 (there are some less-expensive units, but it's not clear that they work well and I'd be wary about them). Solar panels start at under $100 for 30-Watt polycrystalline panels (less efficient, and therefore larger than monocrystalline panels) to about $250 for an 80-Watt monocrystalline panel. Of course, you also need mounting hardware and weatherproof enclosures for the batteries and electronics.

Obviously, prices change all the time, so use these only for VERY ROUGH estimates.

The Awful Truth

Even with all this planning, an exceptional period of sunlessness (one big storm or several small storms without enough time between them for the battery to recharge) will still knock the camera off the network. Bigger batteries will allow them to last longer without sun, and bigger solar panels will charge the batteries faster when the sun is out, so increasing each will increase the reliability of the system, but the cost will also rise quickly. You must make the tradeoff between cost and reliability.