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Can I run an air conditioner on my small off-grid solar power system?

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I have been receiving this question often lately. This is a hard question to answer but let me provide some information to help you answer this question yourself.

There is power and there is energy. Energy is power used over time. Power starts an appliance, energy keeps it running. We need to evaluate both.

Power:

1. This value is expressed in watts.
2. You need to find the specifications of the air conditioner under consideration. Look for watts. If you can't find watts, look for operating amps, not the breaker size. Watts is amps times volts. A 5 amp AC unit at 120 volts consumes 600 watts.
3. Compare the watts required to the watts generating capability of your inverter.
4. Here is an example: A popular inverter is the Outback VFX3648. It can generate 3,600 watts. This is more than the 600 watts in our example so this inverter can more than likely start the AC unit. Your inverter will be powering other equipment as well, but it is usual to have some reserve capacity.

Any motor momentarily draws more than its rated power when first starting. Most inverters are designed to accommodate this surge, so I recommend not worrying about that consideration.

Now that we know the AC unit can start, we need to know how long it can run before our batteries are depleted.

Energy:

These values are expressed in watt/hours. The question is: Do you have enough surplus energy to run the proposed AC unit? To evaluate this we need to know how much energy you create, store and consume. The formula is: Energy generated must be greater than energy consumed.

What I am about to present ignores the option to supplement your solar production by using a generator. If you determine you are close to able to run the AC unit, a generator can take up some of the deficit. Keep in mind that generator auto-start systems can use the generator inefficiently. When this happens, your propane usage and carbon impact will increase.

How do you know how much energy you are using, how much you are producing and how much more energy you will need to run the air conditioner? There are three methods to acquire this data, listed below in order of most to least accuracy.

1. By energy monitor.
2. By calculation.
3. By monitoring battery voltage.

Below are details on each of these methods.

1. If you have a modern controller connected to the internet, we can look up historic consumption values. Your historic production displayed not apply here because your system will not deliver full production unless needed.

    a. Note the historic consumption from your controller.

    b. Production: Calculate the wattage of your solar panels. Take the wattage of each panel and multiply the number of panels to get the total solar watts. In most parts of the continental United States southwest, multiply the solar watts by 5 hours to get production in watt/hours. The result will give you the energy harvest on the equinox. You will harvest less energy in the winter and more in the summer.

    c. Air Conditioning energy: Take the wattage used by your proposed AC unit and multiply that by the hours you think the unit will run. Keep in mind that after your space reaches the target temperature the unit will cycle on and off. How long it takes to reach temperature and how often it cycles depends on a lot of factors, including outside temperature, size of space, insulation vales, etc. It is up to you to do some studying and possibly observe a similar AC unit in operation.

    d. Solar Production must be greater than Historic Usage + AC Usage. This assumes your batteries and the rest of your electrical system is healthy.

2. Here is another approach using calculations.

    a. Consumption: Make a list of all energy using devices in your home and their consumption in watts. Tally how long you use them in a given day. Multiply the watts times the hours of usage. Add them all up. This is your

consumption in watt/hours. You can compare that with how much solar energy you are harvesting.

b. Production: As in 1.b., above.

c. Calculate AC energy: As in 1.c., above

d. Apply results: As in 1.d., above

3. Your battery voltage might be an indicator we can use. This is the most inaccurate of indicators. If you exceed your energy budget on a given day, your battery voltage will run low. If you are not using all of the power you create and store, the battery voltage will remain high. Let's look at some readings for a 48 volt lead-acid battery system.

   (If your system is 24 volts, divide these values by 2. If it is a 12 volt system, divide the values below by 4. If you use other battery chemistry consult with the manufacturer's literature to determine a median charge value.)

   a. If your battery regularly gets below 46 volts at night, you are running on the bottom of the tank, so to speak. If this is the case, you may not be able to support this AC unit.

   b. If your battery stays up near 48 volts overnight, this is a sign that maybe you can use this air conditioning unit.

Generally speaking, most off-grid systems run at maximum capacity. Adding an Air Conditioning system will likely put you in deficit energy usage. This can be sustainable temporarily and/or with a generator

If you need further assistance answering these questions, feel free to contact us. We will be happy to run the calculations for your system but we get so many of these requests for evaluation that we must charge a design fee to account for our time.

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