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ELECTRICITY FROM THE SUN -- Is It For You?

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Is It For You? The answer is an unqualified "Yes, but...." *all things considered*, it's the best way to provide reliable electricity. **But**, there are many considerations. So here are some "**butts**" to consider:

It's practical. **But**, so are wind machines and fossil-fueled generators. **But**, people don't like to park in high winds. Nor do they like to assemble and raise wind towers. Fossil-fueled generators are dirty, messy and make a racket. Using them routinely, for extended periods, means lots of fuel and maintenance and is guaranteed to irritate your neighbors. **But**, **TANSTAAFL**, (There Ain't No Such Thing As A Free Lunch). The fuel for solar electricity is free, **but** the photovoltaic (PV) modules certainly aren't. Solar systems are clean, quiet and relatively maintenance free. **But**, the panels must be kept clean. Electrical contacts must be maintained. **But** you can park in regular RV parks where electricity is available (sometimes). And if you drive a lot, your batteries will be fully charged anyway. **But** if you want to park in a pristine spot, you won't have commercial electricity, won't want to ruin it with a noisy generator and won't be driving every day.

Solar electricity can free you. **But**, what if there's no sun for several days? Or maybe the weather gets hot enough to require air conditioning? You can, technically, run anything from solar electricity. the number of inverters, batteries and solar modules you'd need prohibit giant loads like air conditioners. It's easy to say, "If it's hot, move; if it's cold, move." **But**, sometimes you can't. Generally, the vehicle (and your careful planning) allows living in places that don't have extremes and a solar system will serve you so well you'll treasure the freedom.

But, it's not just a matter of tossing a panel or two on the roof. They have to be properly located (you can spend more time figuring out the best place to put them than it takes to install them). They have to be properly mounted (so they don't fall off or create water leaks). (See the "Handling Moisture" poopsheet for more on leakproof installations.)

Eventually, you'll need a regulator and if you want to use your 120 volt AC

appliances, you'll want an inverter. This will cost money. **But**, it's not like buying a truck, where you have to buy the whole thing at one time. You can start with the basics and add on a bit at a time.

But, I'm not a solar purist. When commercial power is convenient, I often 'hook up." If your life style is such that you like the amenities of commercial camp grounds, that's fine. **But**, what will you do when the power gets cut off? What about a fuel crunch? What about a long rally or a few extra days in some beautiful wilderness spot? My solar system lets me decide. That's the important thing--**the freedom to choose!**

All things (not just some) considered, the most desirable way to be electrically independent is with a solar system. Initially, commercial power can be the primary source. Eventually commercial power or generator can just be a back up. Even if living in a regular house with the RV in back, I'd have some form of solar system. Candles and dying batteries after a storm don't interest me at all.

But, there's no rush. Do some research and reading. Shop around. Don't buy a pile of stuff just because someone says, "It's your last chance at this price." Or, "The oil companies are going to buy it all out." Or any of that other malarky. **But**, don't believe the "pie in the sky" nonsense about solar cells coming down to 50¢ each either. Research is critical. **But**, you can spend a lot of money on books and catalogs. **But**, the library is free. **But**, some books are outdated. **But**, it's a good starting point. Look for "*The New Solar Electric Home*" by Davidson (ISBN 0-937948-09-8). "*RVers' Guide to Solar Battery Charging*" by Kirkby (ISBN 0-937948-08-X). Buy Kirkby's Solar Booklet--"*System Installation Guide*" (\$5 refundable) RV Solar Electric, 14415 N. 73d St., Scottsdale, AZ 85260 (800) 999-8520 (www.rvsolarelectric.com) whether you buy the equipment from him or not. It includes about everything you need to know and includes details on RV installations not found elsewhere. Ask for his added sheets on sizing a system when ordering.

There are ads in lots of magazines for solar modules. The best is "*Home Power*" magazine, on newstands or PO Box 520, Ashland, OR 97520 (800) 707-6585 (www.homepower.com) and current issue is free on the web site. Module prices vary, **But**, you need to know what to look for. As an example: There are a number of small modules, up to about 12 watts

output, that are often sold for \$200 or less. **But**, these will not charge a battery. They're intended only for topping off a battery with a trickle charge. If the going rate for a full-sized module is over \$400, you're not going to get one for half that. Think TANSTAAFL! My "[Sources](#)," "[Battery](#)" and "[Inverter](#)" poop sheets will show you how to get into alternative energy without getting screwed.

When shopping and comparing, you must determine how many **Watts** a panel produces. **But**, if it's not about 50W or more, it will not be suitable. (Current state of the art models range from 47 to well over 75 W.) Beware of so-called "self-regulating" modules. These look like a normal panel, but have fewer cells (and are cheaper). **But**, they will not provide sufficient power to fully charge a battery under some conditions. Older, reclaimed (from a dismantled solar power plant) modules are available (35W) at great dollar savings. These can be a bargain. Consider though, when shopping, that two, new, full-size panels will put out over 100W while three or more of the bargain used models would be needed. Compare dollars and space needed for mounting on an RV.

This might sound complicated. It's not. A bit of basic reading is all that's needed. A solar panel is just like a battery, except that it makes, rather than stores, electricity. It has (+) and (-) connections, just like a battery. Follow the simple instructions provided and, technically, that's all there is to it. **But**, of course, there's more to it than that. Mounting, wiring, paying attention to a meter once in a while, require attention. **But**, any good dealer will furnish instructions.

"Sizing," the process of calculating how many panels and batteries are needed, can get complicated. **But**, again, a good dealer will provide work sheets to simplify. What it amounts to is adding up the amount of electricity used (in amp hours), comparing it to the amount of amp hours that can be stored in the batteries then determining how many batteries and panels are needed. **But**, it's not a one-time job that must be done right the first time (like selecting a tow vehicle). If you miscalculate solar modules, you can always add more later. (Sizing instructions later.)

Some guidelines:

- Follow the sizing steps. You'll be adding up amps used over time to

determine what you need as one of the first steps. Be accurate and honest in time totals (nobody will know that you watch too much TV).

- Just because you have a 105AH "rated" battery, don't think you can get 105AH out of it. Ideally, you shouldn't use more than 20% of a battery's rated capacity if you want it to last (no matter what kind of battery or charger you use). That's about 20+ amp hours a day. You can take 50% out of a battery safely. BUT (it's a big but), you must recharge it fully. Anything more is a "deep cycle," and a battery is only good for so many of them.
- Plan on a charging system that will replace what you use PLUS 10%. (The laws of physics demand that anytime energy is transformed, there must be some loss.)
- You will *probably* find that if you are an average RV couple, you can initially fulfill most of your needs with three, full-size modules and two batteries. **But**, this rule of thumb can vary widely depending on your life style.
- You can increase panel output by tilting them toward the sun. **But**, they must also point in the right direction. If you mount them on the RV so they tilt, but can't be rotated, then you'll have to rotate the RV. Sometimes you can't do that. **But**, you can add an extra panel (or two) and leave the whole thing lying flat and not have to fiddle with it.
- You can mount panels on the ground, on a portable frame, and point easily. **But**, they can be damaged and are easily stolen. **But**, then you can park in the shade and leave panels in the sun. You can mount panels on the tow vehicle and "remote" them to the RV. **But**, what about when you go for groceries?
- You can spend more time figuring out where to put panels and building a quality mount for them than it takes to actually install them. **But**, you'll save in the long run with no leaks, no damage and maximum output.
- You can skimp on wire size, good connectors, the equipment itself and several other things. **But**, you'll rue the day you did.
- You can operate your system with no metering or regulating devices.

But, you'll never know anything's wrong until it's too late. You can control panels with a simple, cheap on/off switch. **But**, you'll forget.

- You can install a solar system successfully with no more information than is in the basic instructions (or pay someone to do it for you). **But**, you won't have the faintest idea what's going on. On the other hand, you can read a few, simple books, make a hobby out of the whole thing and learn lots of neat tricks. How many hobbies pay for themselves?

CAUTION: Some RV manufacturers are now "roughing in" solar panel wiring (or even offering whole system installation) --commendable; **But**, many are skimpily wired, thus defeating the whole idea. You must know what questions to ask.

WHAT SOLAR SYSTEMS, BATTERY BANKS AND INVERTERS WILL (OR WON'T) DO

Technically, modules can do anything any electrical system will do. You just need to have a lot of 'em. There are residential and commercial installations that do have a lot of 'em. Cost is the only limitation. On an RV, space and weight are the primary considerations. You can't create a blivet (that's 10 pounds of horse poop in a 5-pound bag). You only have so many square feet of space on/in an RV and part of it's already occupied. Further, some of the stuff on the roof casts a shadow and since solar modules don't generate full output in the shade, you're further restricted. You also need to store the energy you produce. There are nooks and crannies in any RV where more batteries can be stashed, but even el cheapo batteries weigh 50 pounds and you can only carry so many pounds. And you must be able to get to a battery to service it--or you won't service it and it will die.

What all this amounts to is that most RVers find they can **easily** handle four, large batteries and six, full-size, solar modules (at about a 50 watt output each, or fewer modules in the larger watt outputs. Ideally, you will want the fewest number of panels and batteries that will get you by since cost is also a factor. If you use a lot of electricity and are willing to pay the price, you can cram in some more.

So, while a solar system *could* operate an RV air conditioner, the system that will fit an RV won't because ACs use a lot of power and run a long time. And, so, the blivet analogy. You can only produce so much energy in

the space available (weight no big deal as modules weigh comparatively little). You can only store so much energy in the space available for batteries (that weigh a lot). And the amount of electricity you take out of those batteries is then limited, not only by what's available, but by how much you can put back in and how soon you can do it. (The best way to kill a battery is to deep-cycle it then not fully charge it before deep-cycling it again, and again, etc.)

BALANCE is the key. Balance and conservation. Balance your system (solar or otherwise) so that you can put in 10% more than you use. Conserve what you have (don't go to sleep with a color TV running all night). You'll do OK.

HOW ABOUT INVERTERS? (That change battery 12VDC to an approximation of commercial 120VAC.) There was a time I scoffed at the things. Now, though, many are well over 90% efficient due to incredible technical advances. I use them all the time. But most "approximate" a 120VAC pure sine wave (as obtained from commercial power). Fortunately, a close approximation is all that's needed with very few exceptions. (This is of concern to people with some very sophisticated electronic gear--like a laser printer). There are "pure" sine-wave inverters available now. An inverter will run any load, as long as you like, if it is big enough, if you have enough batteries and if you can keep them charged. In an RV you don't have the space or weight carrying capacity for that. Forget air conditioners, electric heaters, etc. Don't even consider a standard household refrigerator/freezer (they're so inefficient it's incredible). A reasonably-sized inverter (1,300 to 2,500 watts) will run about anything else in an RV. Micro-wave ovens and things like vacuums do use a lot of power, but only for a short time.

Consider the simple arithmetic of power vs time when setting up your system. You'll know what you can or can't do.

Can you be electrically independent with a solar system? Yes, if you're willing to manage your system (rather than ignore it as most RVers do). It's not difficult. If you have a minimal, one-panel system, you'll have to be very conservative. Larger systems give more flexibility. Any RV electrical system, solar charged or charged from any other source, requires simple monitoring. You can't take out more electricity from your batteries than

you put in--it's like a checking account. And overdrawing either account can cause problems.

What do I use? I started with one panel and one battery in '80. I was very conservative. I built a tiltable, rotatable mount to eke out every bit of electricity I could. It took up too much room and weighed too much. Two panels and one battery took less space and weight with more electricity. Four panels and two batteries equaled self sufficiency. I now use 13-15 panels and six batteries. I lack for nothing and run elaborate audio, visual and computer systems. Expensive, but I didn't buy it all at once. I haven't had to hook up in 10 years, though I've done it for convenience. **What price freedom?**

Where do I find out more and how do I find a reputable dealer? See my "Sources Resources" poop sheet. Reputable dealers are listed as are sources for more info. Get the RV Solar Electric "Installation Booklet" for sure. Come to an Escapade, where there will be dealers and seminars. At an Escapade, you can ask questions, put your hands on the equipment and compare prices and products.

SIZING A SOLAR SYSTEM

There are a number of ways to determine how many solar panels and batteries are needed for a system. Some are quite complicated when used to calculate the large amount of costly equipment used on a fixed residence. Sizing an RV system is simpler since the largest RV is still a basic system. Below is the basic system that is needed for an RV along with some "rules of thumb" that might assist you in shopping.

The Balanced Solar System "Rules of Thumb":

RoT #1 One panel and one (105AH or =) battery per person provides adequate electricity with conservative use. This assumes extra conservation and tilting panel in winter.

RoT #2 But, bad weather and dark winter is when you use more electricity and tilting panels becomes a chore, so this rule says one panel and one battery *per person* plus one extra panel. Again, with conservative use, panels can be left flat.

RoT #3 Four panels and four batteries usually provides enough electricity for two people even when panels are flat and allows rather generous use of tools and appliances.

RoT #4 People who use electricity lavishly usually find that six panels and six batteries handles most any situation.

While the above RoTs work for most people, you really should calculate battery amp draw and running time for each item in the RV and compare average use with what you can expect from your batteries.

Basic Solar System Sizing

1. Write down the electrical "draw" for each item. If possible read it from the label. It will usually appear as Amps (A), Watts (W) or Volt Amps (VA). For our purposes, Watts and Volt Amps are the same thing. We need to be consistent, so we'll convert everything to Amps first. Watts = Volts x Amps, so 17W would = 12V x 1.8A for example.
2. Write down the amount of time the item runs each day. Again, to be consistent, we'll use hours. If something runs less than an hour or some number of minutes more than an even number of hours, convert it to tenths of an hour. 15 minutes = $15 \div 60$, which in turn, = .25 and 2 hrs 10 min would be 2.17 (when rounded off).
3. Multiply the "draw" by the "time" to obtain the average Amp Hours (AH) the item uses daily. For example: An RV water pump drawing 8 Amps, running 12 minutes a day (which is .2 hrs) = 1.6 Amp Hours per day.
4. Add all the AH totals and you have your average daily consumption.
5. Now you need to compare your consumption against the Amp Hours you can realistically expect from your battery. Let's use the standard, Group 27, 12V RV battery as an example: Rated as 105AH by the manufacturer (usually BS), you can *realistically* expect a max of 80% of its rating--even when new--that's 84AH you can count on (if it's a good battery). **But**, you don't want to use more than 50% of available battery Amp Hours, so you have, really, safely, 42AH available. If all the items you added up in 4. above are 42AH or less, you're in fairly good shape.
6. Let's say you came up with 40AH in step 4. You can count on any of the full size panels of today to put out 20AH to 30+AH on a bright,

sunny day. You would need to get two panels. This would not give you much reserve for bad weather days, so you might want to get three panels. In step 5 we used an example of one battery. Obviously, you'd want to use two. That would give you a reliable battery resource of about 84AH. As to which specific panels to buy, your dealer should have sheets showing wattage, Amp output, etc., for various models available.

NOTES:

The calculations above are based on a "standard" solar module of about 50 watts output. Larger, higher output modules are available. Just adjust the figures accordingly. 75 watt and 120 watt modules take up less space in total, but 120 watt can be rather large. Dealer catalogs and info sheets should list dimensions and weight.

Even if you don't decide to "go solar," you ought to go through the sizing steps above so you will know what your actual needs are. If you're relying on an RV converter, consider that it actually puts out only 3 to 4 amps to charge batteries. About the same, over 24 hours, as a three-panel system.

The electric "draw" in step can be determined from labels. Draw on some, few, items is not easily found. #1041 standard RV incandescent bulbs = 1.5A. Standard 15watt RV fluorescent tube = 1A; two tube fixtures = 1.6A. RV furnace a whopping = 5-8A (for long periods). Water pump = 8A (short periods). 3-way reefer on 12 volts = 28-35A for long periods (Wow! You sure won't want to do this.).

Watts at 12VDC and watts at 120VAC confuses some people. Just remember that watts are always the same (watts is watts is watts). It's the Amps and volts that differ. 100W at 120VAC = .8A whereas 100W at 12VDC = 8A. When sizing, if you'll run an AC item from an inverter, multiply AC amp draw by 10 to get actual battery amp draw.

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