So, You Want to Go Solar with Your GMC

Here is how to do it, what you can expect and how not to be disappointed

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There is a nearly magical notion many have of being able to take all your power needs from sun light, living off the grid and never needing your generator again. This notion comes from the technology surrounding solar panels - those intriguing devices that convert photons of light energy into electrons of electricity that can power your world while on the road in your GMC.

The trouble is that is a notion that is a far reach for many. Some people who have "gone solar" are deliriously happy with their decision and others are deeply disappointed. How is it possible to find both of these experiences from the same technology? In this article we are going to explore that question and lay out the details of what it will take to bring you into the happy, if not deliriously happy camp, if you want to "go solar" with your GMC.

The answer lies in several factors which I can summarize with "4-6". 4-6 comes first from the fact that the most common solar panels suitable for use in the limited space on the top of your GMC are 100 to 120 watt flexible solar panels. They are about 48 to 54" long and 22 or so inches wide and generally produce somewhere between 4 and 6 amps per hour under ideal conditions. While 2 amps difference doesn't sound like much, it is a 50% difference! I will point out more 4-6 examples as we go along, but keep in mind that the most power you are going to be able to harvest from the sun will be 4-6 amps per common solar panel. If you can live with that, you will be happy. If you can't, if that is simply not enough for the way you live, you will likely be unhappy.

Another prime factor is where you spend your time. The sun does not pass directly over head. The earth is tilted on its rotational axis so the sun appears to pass in an arc that starts in the east, moves to the south for most of the day and sets in the west. That arc is higher in the sky during the summer months than in the winter and is higher in the sky the further south you are. The higher in the sky it is where and when you are determines a lot about how much light is available to fall onto your solar panels to produce electricity for you.

It is also important to know how solar panels behave. They work best when clean and pointed directly at the sun. Since the sun is always appearing to move, to keep solar panels pointed directly at the sun requires you to constantly change how they are pointed throughout the day - a tedious task few will make the effort to do. The power

output from solar panels drops off a lot as the sun angle changes from 90 degrees to the face of the panels. Most people mount the solar panels flat on the roof of the GMC where the sun angle is rarely correct for maximum output.

There are published charts that will show you how much total sun light you should expect under ideal conditions based on where you are. This is typically measured in what is called, "sun hours" by averaging the intensity of the sun that can fall on the solar panels both during that short time when it is 90 degrees to the panels and the intensity as the sun moves off of 90 degrees. In North America we will generally see somewhere between 4 and 6 sun hours a day on a perfectly sunny day with no clouds in the sky. Under those conditions you can multiply the 4-6 amps per hour each 100 to 120 watt solar panel can harvest for you times the number of sun hours per sunny day to determine how many total amps each panel can put back into your batteries in a day under ideal conditions.

If that is more amps than you use in a day, then your batteries will be fully charged each day. If it is less than you use in a day, then your batteries will discharge day after day until you have to plug into shore power or run your engine or generator to recharge them. The longer you can go before needing to externally recharge your batteries the more likely you are to be in the happy camp. Notice the wide spread here. If your solar panels are producing around 4 amps per hour per panel and you are in an area where you will see 4 sun hours a day, you will only be putting 16 amps back into your batteries from each panel - not very much. If your panels are producing closer to 6 amps per hour and you are where you will see 6 sun hours per day you will be putting 36 amps back into your batteries from each panel - more than twice as much.

A third factor important to determining whether you will be in the happy or the unhappy camp is that solar panels, and most of the other things you will also need, are rated at their ***maximum possible output under the most ideal of conditions***. In short, most all the solar components are over rated for what most people experience in real world terms. For example, a solar panel rated to deliver 120 watts of power will generally output a maximum of just under 20 volts and around a maximum of just over 6 amps when in full sun, in the middle of the summer, with the panel pointed 90 degrees to the sun, when the panel is perfectly clean, with no clouds in the sky nor any shade falling on any part of the panel, and only when you are in southern parts of the US. Under those conditions 20 volts times 6 amps equals 120 watts.

But, that doesn't sound like conditions you normally would expect to encounter in every day life on the road in your GMC, does it? More commonly, you will find the day-in-day out output from that panel will average more like 16 to 18 volts and 3 to 5 amps for 48 to 90 watts - far short of the rated output of 120 watts. Spend time further north or in more winter like conditions, or in clouds, atmospheric haze or rain showers and that panel will more likely average 30 to 60 watts of power.

Unless you are parked in the desert much of the year, you more likely will be in ideal conditions only 40% to 60% of the time, or even less. If you start with that assumption

you will more likely fall into the happy camp. ***If your expectations are set by how the manufacturers rate their products, you will more likely fall into the unhappy camp.***

A forth factor effecting how happy you will be pertains to how you get whatever power comes from the solar panels to do useful work for you. The most common purpose of solar panels is to recharge your batteries in order to run all your lights, appliances, fans, etc. off of the batteries directly or through an inverter. To do that you need a solar charge controller that will convert the constantly changing voltage and amps coming from the solar panels into the correct values needed to recharge the batteries.

There are some who want to connect lights or other things directly to the solar panels. That almost never works since the sunlight is always changing which means the voltage and amps available are also always changing and rarely will be correct for whatever you are trying to power. You are far better off running everything from your batteries or an inverter and use your solar to recharge the batteries.

Solar charge controllers come in two types. The least expensive type, called PWM (pulse width modulation) controllers, simply regulate the voltage down to the 13+ to 14+ volts the batteries need at any given time and act like an on-off switch to pass that on to the batteries in bursts so the batteries don't over heat or become damaged by too much charge current. Any excess voltage is simply thrown away.

The far better type, called MPPT (Maximum Power Point Tracking) controllers work in a very different way. They, too, regulate the ever changing voltage coming from the solar panel down to the voltage required by each different battery chemistry, but they also convert any of the excess voltage into additional amps to recharge the batteries faster. You can expect an MPPT solar charge controller to recharge your batteries 20% to 50% (or even more) faster than a PWM charger can under the same conditions. ***In all GMC solar installations I recommend nothing but a MPPT controller. Use of an MPPT controller will most often result in 40% to 60% more useable output than you will get under the same conditions with a PWM solar charge controller.***

A fifth factor which will determine whether you are happy or disappointed with your solar set up is the size and type of wire you use. Yup, something as seemingly simply as wire can make a huge difference in your level of satisfaction with your solar efforts. From the solar panels to the solar controller you want to make sure the wire size is sufficient to carry the amps the solar panels are likely to produce in whatever are the ideal conditions wherever you are. DC voltage drops as the length of the wire increases and drops even faster if the wires are too small for the amps being carried. Also, wire that is too small for the amps being carried over any distance will cause the wire to heat up and could even melt the insulation if it is severely under sized or of the wrong type. Any wire on the roof must have insulation designed for full sun exposure or the insulation will degrade over time. Such wire is made specifically for the runs from your solar panels to your solar controller.

From the solar controller to the batteries the wire size and type is even more important since the whole objective is to recharge your batteries as fast as you can under all conditions. Keep the distance from the charge controller to the batteries as short as you can, and use wire as large as you can afford in order to make sure as much of the output from the charge controller as possible gets to your batteries. Again the 4-6 rule applies here too, only it is even more pronounced that a 4-6 spread suggests. Using larger wire will allow you to get closer to 6 amps per panel per hour back into the batteries. Using wire that is too small or too long could drop that down to closer to 2 amps under the same conditions.

Wire comes in three basically different types - solid (good only for house wiring and should never use for any mobile applications), stranded automotive wire and true stranded marine wire - by far the best for a GMC solar application. Just make sure it is copper wire (or better yet, tinned copper wire) as some sources will try to sell you vastly inferior CCA (copper coated aluminum) wire and you do not want that!

Marine wire is more flexible than automotive wire and has superior insulation so can carry more amps for a given wire size and distance. As I said above, the very best wire to use, and my recommendation, is ***stranded marine tinned copper wire in the largest sizes you can afford.*** Wire is expensive and you will be surprised by how much you will spend for quality wire and connectors.

The final factor is the kind of house batteries do you plan to use. Don't even think about solar on your GMC if you are using any type of lead acid battery. Some will find some degree of satisfaction with relatively new AGM or Sealed Lead Acid batteries, but they charge so slowly that the relatively small number of amps you will be able to harvest from solar panels will less likely result in fully charged batteries on a daily basis. That, in turn, can be a negative factor in terms of your degree of satisfaction.

Far better than AGM batteries are Lithium Iron Phosphate (LiFePO4) batteries. See my presentation on house batteries, called "A heart/lung transplant for your GMC" for all the reasons why. The bottom line is LiFePO4 batteries will deliver two to three times more usable power, will recharge 5x to 6x faster and cost less over their useful life than any kind of lead acid battery. The much faster recharging means whatever amps you harvest from your panels will more likely keep your batteries fully charged on a daily basis which, in turn, will mean you are far more likely to be happy than unhappy.

Ok, now that we know the factors that will influence our degree of satisfaction with a GMC solar system, let's now turn our attention to how to do it right so we will more likely wind up in the satisfied to deliriously happy camp.

The first thing is to consider is where you will be spending most of your time. Draw a line of latitude at the 37th parallel. That will run roughly from San Francisco across the country to half way between Virginia and North Carolina on the Atlantic Ocean. If you plan to spend most of your time south of that line you will likely be happy with a properly designed solar system on your GMC. If you plan to spend most of your time north of that line, plan on over designing every aspect of the solar system on your GMC. You will need that extra capacity just to make up for the lesser amount of sun light available to you year round. The amount of over design you will need will depend on how far north of that line you are. If you are near or above the Canadian border, plan on doubling everything.

For a solar system on a GMC the most difficult challenge is trying to find enough roof space to fit enough solar panels. The top of your GMC has one or two air conditioning units, one or two vent vans, a couple of holding tank vents, a refrigerator vent and often a roof storage pod to boot. That doesn't leave a lot of space for solar panels! The solar panels cannot be where they would get shaded by any of those other things so space planning is a big deal.

Solar panels come in basically two forms - rigid glass panels or semi-flexible plastic covered panels. There is not a huge difference in performance between these two and don't worry about the difference between mono silicon and poly crystalline panels. Both will perform about the same on a GMC roof. The thin film panels are a technology whose time has not yet come so I don't recommend them.

The semi-flexible plastic panels appear to be easier to mount to the curved roof structure on a GMC, but there is a gotcha you need to watch out for. Solar panels work best when cooler rather than hotter! Counter intuitive for something that is supposed to be in direct sun, but keeping air flow under the panels will generally keep them a bit cooler than fastening them directly on the aluminum roof of your GMC. Semi-flexible panels are often depicted as being held down with a strong tape all around the edges. Over time, the panels that are applied that way may actually develop burned spots which will negatively effect performance and could even start a fire on your roof.

You can find lots of recommendations on how to mount both the rigid and the flexible panels to try to keep them cool. The rigid panels are held down with brackets that

keep the panels off the roof and allow air to flow below as well as above the panel carrying heat away and allowing the panels to produce more power than they would without that air flow since they will be running cooler. But, those brackets most often mean holes in your aluminum roof and therefore leak potential so be diligent about how you fasten the brackets to your GMC. The panels held off the roof also are far more visible from the ground, especially with the lower roof line on your GMC than you will find on most RVs these days. That can become an aesthetic issue for many owners and will influence how happy or unhappy you are with your solar investment.

For the flexible panes - semi-flexible is a better term as they cannot be bent much without damage - placing a sheet of corrugated plastic between the panel and the roof can provide some degree of insulation and air movement. That can allow you to fasten that sandwich to the top of the GMC with strong tape along each side and a bit in the middle front and rear and still get the desired air flow and insulation. As you decide on placement, be mindful of anything that can cast a shadow on the panels. Even a small amount of shadow can greatly reduce the amps output by that panel. And, with the very limited space on top of a GMC you have for panels anyway, loosing even some of that power to shadow will negatively impact how you feel about solar on your GMC. You may very well find yourself in a conundrum having to decide between keeping your storage pod or removing it, and between keeping both AC units (if you have two) or having to sacrifice one. Same with your vent fans. If you are clever you may be able to mount panels on top of the pod or an AC. The aluminum framed rigid panels are especially good for these applications since the top of the pod and the AC are simple molded plastic parts that are not very strong.

The objective is to get as many panels as you can onto the roof of your GMC and you may also want to augment them with portable, foldable panels that you can set on the ground when in less than ideal conditions. Just be sure you know where you can store those when not in use.

Now I am going to make what will be a controversial recommendation for some. Most of the information you will read on the internet or watch on You Tube will tell you to connect your panels in series. That will result in higher voltages and lower amps going to your charge controller which can mean smaller and less expensive wire. The problem with panels in series is that any shadow falling on any one of those panels will bring down the output of all the panels, ***just what you don't want.*** Because of the limited roof space on a GMC, keeping all the panels away from any shadowing is a daunting task.

I recommend instead installing your panels in parallel, not in series. That will mean fewer volts and more amps going from the panels to the solar charge controller. In turn, I that will mean larger wire and a larger solar charge controller, both of which are more expensive than their smaller counterparts. But, it will also mean that any shadow falling on any one of your panels will effect the output of only that one panel while all the rest will remain unaffected - ***just what you do want***.

On a GMC the refrigerator vent is an ideal place to run the wires from the solar panels down inside the coach. Place your solar charge controller as close to your batteries as possible so you can get as much of the power output from the panels into your batteries to recharge them as quickly as possible. Remember, with your solar panels connected in parallel you need larger wire to carry the increased amps so don't scrimp here. If anything, over size the wires running from your panels to the solar charge controller.

Buy only a quality MPPT solar charge controller. One rated for 40 amps is ideal for a GMC. That should be plenty of capacity for the number of panels you can fit onto your roof. Add up the max amps each panel can produce and make sure that is less than 40 amps. If it is over 40 amps, add a second 40 amp MPPT controller mounted to your batteries in parallel with the first one. They are wired internally so one will **not** feed back into the other.

If your solar charge controller(s) is/are mounted where you can easily see it/them, most have a display that will give you all the info you need - an approximation for state of charge of your batteries, voltage and amps coming in from your panels, volts and amps going out into your batteries. If you want to keep closer tabs on everything, install a quality battery monitor with a shunt which will directly measure the state of charge quite accurately. If your solar charger(s) is/are mounted where they are difficult to see, then buy ones with a blue tooth connection and an app for your phone so you can read everything there, or one with a remote display panel that you can mount where it can be conveniently seen. Once your system is up and running, and the novelty has worn off, you won't look at those displays very often but you do need to have some idea about the state of charge of your batteries so you know whether or when to run your generator. You do not want to run out of battery capacity during the night!

Most sources will tell you to use the same size and brand of panels throughout your system. That will be very difficult for many to achieve given the limited roof space on your GMC. Mixing and matching is fine so long as you stay with the same voltage solar panels. On a GMC use panels nominally rated for 12 volts. In reality the output of the panel will be closer to 20 volts under ideal conditions since you need higher voltage than where the battery is in order to force charge current into the batteries. If they are all rated as nominal 12 volt panels you can use both semi-flexible and rigid panels and panels of different watt output within the same system. A quality MPPT solar charge controller will integrate them all together for you.

So, should you go solar on your GMC?

It certainly is a great convenience and most owners will be happy with this decision if you can live with the limitations we have discussed and if you are on the right side of the 4-6s:

If the panels you buy have a max output closer to 6 amps than to 4 amps

If you travel south of the 37th parallel more than you travel north so you will experience closer to 6 sun hours per day than 4 sun hours per day

If you buy a 40 amp MPPT solar charge controller instead of a PWM controller

If you can mount your panels so they get air flow top and bottom to keep them somewhat cool

If you invest in the largest marine stranded tinned copper wire you can afford to inter-connect all your components

If you use Lithium Iron Phosphate batteries instead of lead acid batteries

If you base your output expectations on real world experience rather than the ideal conditions the manufacturers of each component use to rate the output of their devices

If you are willing to spend the time to keep the panels clean, free of falling debris and away from shadows

And, most importantly, if the number of amps your solar panels produce in a day can come close to keeping your batteries charged on a daily basis