The Ugly Side of Solar, Part III

The Ravages of Shading

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If you read Part I of the Ugly Side of Solar series, you learned that proper design, product selection, and installation make all the difference in the aesthetics of your solar system and can mean the difference between a good looking system that's the envy of your friends and neighbors and one that discourages those same people from ever considering solar for their own homes.

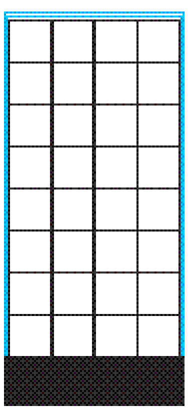
In the second part of the series, I discussed the ugly side of solar from an installation perspective. While many systems look fine on the surface, underneath they are ticking time bombs of rust, roof leaks, ground faults, and corrosion. In part II, I also covered the ugly side of picking the wrong solar contractor and gave you pointers to help you avoid getting ripped off. In Part III, I will cover shading: the most deleterious of solar production killers.

While most folks agree that shaded solar panels produce less power than unshaded ones, many consumers grossly underestimate just how big an impact shading has on the annual production of a solar system. The photo above shows a particularly egregious example of solar shading. As you will soon learn, this customer would have been much better off NOT buying the five panels installed on the upper left roof. Why? Read on…

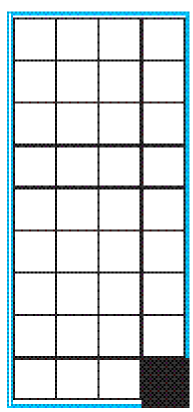
The vast majority of solar systems (95% +) installed today are designed with 'String Inverters'. The SMA SunnyBoy inverter is an example of a string inverter you may have heard of. String inverters rely on solar modules to be connected in series (aka 'strings') to achieve the minimum power output the inverter needs in order to turn on and operate efficiently.

Without going into a tremendous amount of detail on the subject (which is outside the scope of this article), know that whatever happens to one panel in the series affects every panel in the series. An analogy that may help you make sense of this phenomenon is one involving a battery powered toy car. If your toy car takes eight AA batteries, and you put eight brand new batteries in it, it'll run fast and furious. This is because the batteries are fully charged (i.e. unshaded). Take one of those brand new batteries out and replace it with a half charged battery and that same toy car will run more slowly (i.e. a half shaded solar panel). Replace a brand new battery with a dead one, and the car may not work at all or run very slowly (i.e. a fully shaded panel or panels). With this information, please examine the photo below:

The shading in this photo is akin to having two dead and two half dead batteries in your toy car. Sure, the rest of the array looks fine, but the array as a whole could be operating at a little as half capacity. To illustrate this further, please consider the following examples:



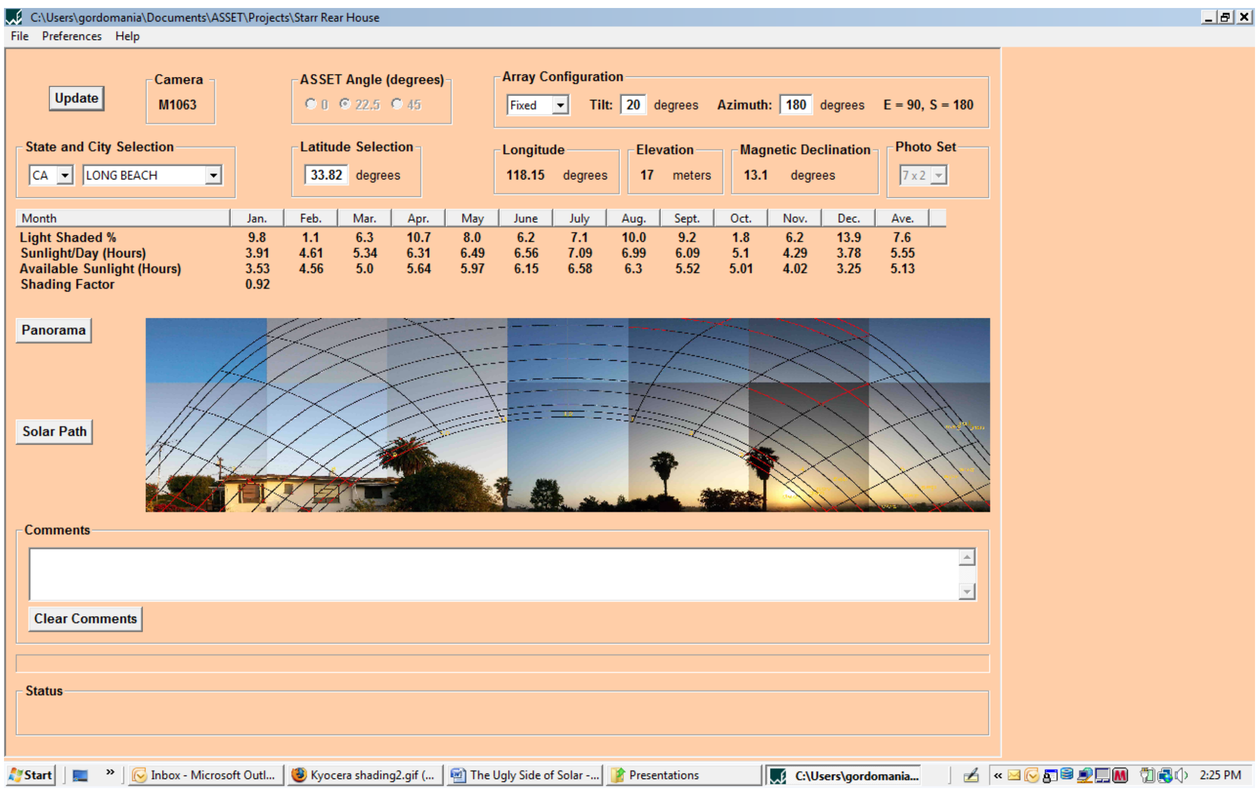
Example of full-cell shading that can reduce PV module power to zero



Example of full-cell shading that can reduce PV module power by ½

As you can see, it doesn't take much shading for a panel's production to plummet to zero. Shading of just one cell (bottom right), cuts the whole module's production by one half! This drop in production affects the entire string thereby robbing the solar system of hundreds or potentially thousands of kilowatt hours per year. Over the 25+ year expected lifespan of the system, this adds up to some serious cash. In this scenario, you are in fact buying very expensive solar panels that are providing you with very little benefit.

So how do we solve this problem? One way is to chop or top trees. Sometimes, as is the case with palms, the tree needs to be removed altogether. Other times, as is the case with a tall chimney, we lose an entire section of roof. Often we employ shading analysis tools to help us find an unshaded or less shading spot on the roof. Here is what the output of a typical shading analysis tool looks like:



The data presented in this tool (Wiley ASSET) aids an integrator in proper panel placement and gives us insight into the objects doing the most significant shading. In the analysis above, it's a neighboring house and neighboring trees causing all of the problems. Fortunately, we were able to find a place on the roof where these shading issues are mitigated, but removal of the house and the neighbor's palms are not an option. Overall, we can expect 92% performance from this system.

Another way to address shading is to skip the string inverter altogether and design your system with micro inverters (Enphase is the most popular of this technology). Micro inverters treat each solar panel individually. Thus, shading that affects one panel is isolated to only that panel. This increases your overall system yield in highly shaded situations. To learn more about the pluses and minuses micro inverters, please see Solar Professional's excellent article on the topic by Ron Burden and Joe Schwartz: http://solarprofessional.com/article/?file=SP2_6_pg6_TOC. You may need to register for a free subscription to view the article, but it'll be well worth your time.

Lastly, many folks wonder what happens if their neighbors or others plant trees that eventually grow into a shading problem. Many states, such as California and New Mexico, have 'right to light' laws that protect home and business owners who install solar panels. In brief, the law can be summed up as follows: if the solar is there first, solar wins, and the tree must be removed or topped, otherwise, if the tree is there first, the tree wins. If it's your tree, you can take appropriate action, but if it's your neighbor's tree, you'll need to work out a solution or you might be out of luck altogether. In fact, some states go as far as to state that neighbors can't add a second story or build a home that will shade your solar system. You'll need to check your local state law to see how this applies to your particular circumstance.

In summary, make sure you are aware of any shading that may affect your solar system. If your solar installer brings any shading issues to your attention, take heed. They are bringing this to your attention for good reason. Shading will not only affect electrical production, but will also lower your state rebate amount. Likewise, if you are aware of shading issues and your solar installer doesn't mention them, find yourself another solar installer. If you don't you are likely to end up with an underperforming system, for the dollars you expended.

Please stay tuned for a bonus Ugly Side of Solar Part IV coming soon. As always, I wish you the best of luck in your solar power endeavors.

