A 240 Watt Solar Panel Often Provides Less than Ten Watts Continuous

Here's the Math. Usage is much of the problem.

When I originally wrote this article, it seemed straightforward. But then I began to realize the losses were so great, so numerous, so nebulous, that the article became confusing. So bear with me, I'm going to assume a 240W panel with 10% solar efficiency to simplify things. This makes the "effective" surface area about 2.4 square meters. And I will try to summarize at the end for those of you, like me, who easily get lost in this maze.

First, understand that the panel only receives optimal sunlight for less than 6 hours per day on average, especially in winter months when the day is short. This means that over a 24 hour period you can expect that 6 hours of sunlight to provide 6/24 or 1/4 as much power as if sunlight was continuous. One fourth of 240W is on average of 60 watts when spread over the 24 hour period. This is not an efficiency loss but it is a stark reality.

Second, over most of the US there is also a 40% overcast, leading to yet another 40% reduction in power, we are now down to 36 watts.

Third, and now comes the tricky part, the actual efficiency losses. Most inverters, for example, are less than 80% efficient, converting DC to AC, another 20% loss, now down to less than 30 watts.

Fourth, in addition, battery losses, to store the energy and play it back generally approach 50%. This means the 30 watts is suddenly degraded to a little more than 15 watts by the battery so that less than 15 watts are left as continuous power. For over a thousand watts of solar power striking a 2.4 meter square panel. Sunlight provides 1KW per square meter so we have taken 2.4KW and converted it into 15 W continuous.

Fifth, you could have that 15 watts continuous in the household... if it held the 10% to 15% stated efficiency of the solar panel over it's lifetime. but it doesn't! Efficiencies are often less than 5% after a few short years, some panels even begin at that number. But because of weathering and photochemical destruction of the panel, another 50% loss will occur meaning you are now down to around 7-10 watts, or between 9 and 15 watts roughly speaking depending on age. Wow!

But let's go back

Assuming a new panel, and multiply by 4, full gonzo on a bright day, and again and granting a generous 15W continuous, we might say 60 watts were salvaged out of 2400 watts of sunlight, about 2.5% efficient, all the rest has been turned into heat, talk about your **global warming**, being down wind of a solar electric farm can get mighty toasty, killing animals and plants living below that expensive expansive umbrella from hell (even more toasty than a solar thermal farm where some losses are visual but efficiencies can approach 50% instead of the less than 3% of solar electric). Remember those 50% battery, 40% overcast, and 20% inverter losses. Not good. Compared to worrying about the efficiencies of the tungsten light bulb where all the heat is captured as winter heating fuel, solar electric starts to sound pretty darn lame. And note, as I mentioned at the beginning you are now down to maybe 9 watts, barely enough to light a night light 24-7.

But, Just For humor,

Suppose you wanted to heat a home using solar electric panels. With overcast and inverter losses you might expect 6 hrs at ~144watts or 860 watt-hours total per day. But a large home, over 24 hours, could easily consume up to 300,000 watts-hours, or slightly more than ~24 hrs @ 12,000watts continuous, and therefore you would need between 300 and 500 solar electric panels just to do that job, with no battery losses but you would have to rely on great insulation and a fantastic thermal reserve system, like a swimming pool, to absorb and administer the load. So, solar **electric** panels really won't do it but you can do it with evacuated tube solar **thermal** panels where actual efficiencies approach 80%, and there is no conversion to electricity, only heat. Now, of each 2000 watts of sunlight captured per panel, some 1600 watts become available for home use. But with a simple 2:1 reflector, you could harvest an added 3200 watts per panel. Run that for 6 hours you have 18,000+ watt hours and you could do the whole house heating job with as few as 20-40 panels, still a lot of panels but not so much that it breaks your pocket book or brings about Armageddon due to heating or overuse of exotic metals. Sadly, when winter really sets in, it often will deny you even that meager amount of sun power and therefore an alternate form of power like wind or nuclear starts to sound much better.

So what ARE solar panels really good for?

If you live in the desert southwest or on the side of a mountain in Pakistan, and you only use the panels to run a small machine shop or supplement line power during daytime hours, then our grim scenario does not hold. This is where people often use solar panels. you gain back almost 50% by not using batteries, another 40-50% by avoiding overcast locations, and another 4 fold by not distributing over a 24 hour period (144+ watts continuous), but you still have the weathering and the inverter losses. In some applications, this might be appropriate but you are never going to heat a 12kw house in winter or do your Spring planting with solar electric, that's a whole different horse and buggy! You might keep your animals or greenhouse watered in winter, provide light and water to your cottage on an Island in Rainey Lake. But there are more efficient ways to capture and store solar energy like selling it back to the power companies, reverse metering… or using thermal solar evacuated tubes for home heating.

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===Summary of Losses===

POWER as WATTS/PANEL as spread across 24 hours

Initial-> 10% panel eff.-->6/24 dark-->40% cloudy--> inverter--> battery--> aging

Watts	2400W --->	240W --->	60W --->	36W- -->	30W --->	15W ----->	7W
% eff.	100% --->	10%--->	2.5%--->	1.5% --->	1.2% --->	0.6% --->	0.3%!

========== Net: 7 Watts/panel ==========

*Not a loss but a serious problem with local availability

§ November 2018, latitude 41, Longitude W82, Fort Wayne, Indiana

Of the nearly 297 hours of potential sunlight, only 22 hours were actually received!! You would have to save a month's energy in less than 3 days! For this analysis the total average hourly delivery, is a mere 3W.. Holy cow!! Only….

========== Net: 3 Watts/panel ==========

Rewritten for clarity 3-27-2017. Rewritten for Post Script – 11-30-2018 & 8-12-2022