SunWize Power & Battery

How Long Does It Take to Recharge Solar System Batteries?

Customers often ask how long it takes for a solar array to recharge the battery bank in a solar electric system. The answer is, it doesn't matter. The battery bank is always being charged or discharged so it's in a constantly changing state. Therefore, the time needed to recharge a battery bank from a solar array constantly changes.

Consider a solar array using a single 110 watt solar module and a single 120 amp-hour battery powering a 750mA, 12VDC continuous load. Assume the system is operating in the Houston, TX area. Houston gets 3.6 hours per day of sun on average in the winter and 4.8 hours per day in August (at a 50-degree array tilt angle, facing south). There are many factors to think about:

- What does it take to recharge the battery?
- What battery recharge efficiency are we going to assume since the efficiency changes as the battery state-of-charge increases?
- What level of battery discharge are we considering at the start of our recharge cycle?
- Since the levels of solar radiation change monthly, what time of year are we considering?
- How are we interpreting the solar radiation – as an average daily amount for a given month?
- Is the load constant during the recharge period?

Let's determine the battery recharge time based on the following :

1. Assume it is winter at 3.6 hours/day of peak sun.
2. Assume the load is a constant 750mA at 12VDC.
3. Assume the battery is fully discharged to the 20% state-of-charge point when recharge begins.
4. Assume there are 10% system losses.

⇒ The peak current rating of our 110 watt solar module is 6.43 amps. The output of the array for an average winter day is: 6.43 amps x 3.6 hours/day x 0.9 (system losses) = 20.8 amp hours/day

⇒ 80% of the battery = 0.8 x 120 amp-hours = 96Ah

⇒ The load is 0.75 amps continuous = 18Ah/day

⇒ The difference between the array output and the load is: 20.8 – 18 = 2.8 Ah/day

⇒ 96Ah/2.8 Ah/day = 34.3 days to recharge (assuming no temperature impact on battery recharging efficiency)

According to these calculations, it would take 34.3 days to recharge the battery to 100% state-of-charge if all of the assumptions made above held true for those 34.3 days. Of course, that is never going to be the case, which makes our 34.3 day conclusion of little to no value.

The fundamental job of the solar array is to replenish all the daily energy the load consumes back into the battery each day. The array must do so during the worst-case time of the year when solar levels are lowest and while overcoming system losses.

The solar array is large enough to accomplish the above, and the battery bank is sized to carry the system through periods of inclement weather in order for the system to perform successfully all year long.

Nowhere in the above information did we consider the time required to recharge the battery. Does that mean the battery is sufficiently recharged to keep the system operational? Absolutely!

Properly designed solar electric systems always have an adequately sized solar array to offset the daily load draw under worst-case solar conditions. They also have an ample amount of battery autonomy to carry the system through periods of inclement weather when solar levels are below the daily average. As a result, we simply don't need to worry about how long it takes to recharge the battery.

We verify this through advanced sizing software and we prove this through thousands of SunWize solar electric systems operating successfully worldwide.

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