Who gives a Watt? How much power is enough for solar tables?

Schools, corporate campuses, municipalities, entertainment venues, resorts, and communities are looking to provide their workers, visitors and others with outdoor charging stations to support more people being productive outdoors. But how large of a system do you need to meet user demands and avoid being disappointed with your purchase? As you can imagine the answer is it depends.

We'll take a look at a few use cases to provide a better sense of how large a solar array needs to be and the electronics behind it to support your target needs. But first let's look at the primary building blocks of the system and those variables that reduce the sun's potential for energy generation.

The Building Blocks

While there are a number of electronic elements necessary to make the system work, the primary ones are:

1. **The Solar Array** - Solar panels exposed to the sun turning the sun's energy into electricity. Solar panels are typically rated to produce a set amount of energy measured in watts.

2. **The Battery** - The device that stores the energy from the solar panels. All systems need one or more batteries since the energy from solar panels has to be stored and normalized for use by the devices being charged. The battery also, obviously, stores the electricity for use when the sun is not shining or is shining less than necessary to meet the electricity demands.

3. **The Inverter** - The device that turns the electricity stored in the battery (DC) into electricity usable by the devices to be recharged (AC). The inverter is also the gatekeeper of how much electricity can be pulled from the battery and at what rate.

These three elements, along with other elements, turn the available sun into available electricity to charge devices outdoors.

The Power Reducers

We all know the sun doesn't shine with the same intensity from place to place, nor does it throughout the day, or day to day over the course of a year. And of course there are clouds, dust, pollution and other bits that get in the way of the sun making it to the solar panel.

So how much do these impact the available energy? The following chart provides a sense of the variability from place to place by time of year.
We've taken one of the top solar producing locations in the country, Las Vegas, and measured other cities against that gold standard to give you a sense of how much solar potential is lost with location and time of year. Assuming Las Vegas in June is the 100% mark, and all other cities are measured as a percent of that standard.

Solar Potential of Various Cities Measured Against Las Vegas[1]

City	June	December
Las Vegas	100%	48.2%
Seattle	74.5%	16.6%
Kansas City	80.8%	35.0%
Chicago	79.2%	24.8%
Boston	75.3%	31.3%
Durham, NC	77.9%	43.3%
Miami	71.2%	56.6%

While many cities have good solar potential in June, as you can see, the percentages drop off aggressively in December, with some cities seeing less than half as much solar potential in December vs. in June.

[1] Based on measurements of solar radiation measured as kWh/m2/hour as reported by PVWatts calculator. These calculations take into consideration average cloud cover for the month reported.

The Use Cases

The following provides a handful of use cases and the power needs of each to help right-size the solar workstation.

Only Mobile Phones, Only During Daylight Hours

If you are interested in providing power only to recharge mobile phones during the day, the solar demands can be relatively light just about anywhere in the country in the summer. The way to figure this out is to work backwards from the demand.

The average mobile phone battery requires anywhere from 5 to 22 watts for charging. If you anticipate four phones to be recharged simultaneously you'll only need 20 watts of power at the low end and 88 watts at the high end. At the low end, 20 watts is a small amount of power, however, when you factor in you'll only see optimal charging for 4 hours per day and you may need twice the size of the solar array to cover the degradation in winter, a solar array of 100 watts should be fine for the lower powered phones. However, for the higher powered phones, 100 watts will work during the optimal sun periods, however, could leave users without sufficient power on cloudy days and or in the winter.

Batteries are used to store power for cloudy days or winter power needs, however, if all or most of the available power is going into phone charging, it will not be available to recharge the batteries in the solar charging station.

If you want to ensure available power for larger phones like the iPhone 12 or Samsung Galaxy S21 a solar array of 300 watts will provide much greater reliability.

Only Mobile Phones and Laptops During Daylight Hours

Adding laptops into the equation can dramatically change the power needs. An average laptop uses around 60 watts to recharge. Adding one laptop to the low end 20 watts necessary for the four phones brings the load to 80 watts, two laptops obviously brings the power load to 140 watts. Again, seeing optimal charging for 4 hours per day doubles power needs to also charge batteries to support charging outside of the 4 hour optimal charging window. And the power load can double again for winter, bringing the power needs up to anywhere from 320 to 560 watts. Adding new iPhones and Samsung Galaxy phones into the mix can significantly bump these needs even further.

Yes, devices will likely not be charged continuously but your system should be oversized given the potential for extended periods of clouds and no one wants a customer or visitor to end up powerless. Remember, a cloudy day can cut the potential power generation by half again.

And again, batteries in the solar table are used to store power for charging outside of optimal sun hours, cloudy days and winter power needs, however, if the available power is going into phone and laptop charging, it will not be available to recharge the batteries in the solar workspace.

Under these conditions, a solar array of at least 600 watts will be necessary to support the power needs.

Charging Mobile Phones and Laptops into the Evening

Charging devices into the evening changes everything since the solar array must provide enough power for phone and laptop charging while also charging the batteries of the solar workstation since these batteries are the only power source when the sun goes down.

As provided above, if the array needs to produce up to 560 watts just to keep charging during the day, the array will need to be sized even larger to provide enough additional power to support charging when the sun goes down.

As a rule of thumb, if the goal is to fully charge the batteries while the sun is shining, a system should be designed to provide an additional 50% of power over the anticipated ongoing needs to charge the solar workspace batteries for charging phones and laptops after dark.

Using this 50% guide, and wanting to size a system for winter and cloudy days use, the solar array will need to provide a minimum of 900 watts of power. Doubling anticipated power needs and sizing the array at 1.2 kilowatts would provide even more security of available power for your users.

Another consideration of these power demands is the size of the inverter. Remember, the inverter plays the dual rule of (1) converting DC power (electricity stored in batteries) into AC power (what we need ro charge our devices), and (2) acting as gatekeeper to fix the amount of energy that can be pulled from the battery.

To support this use case, the inverter in the system will need to be sized at a minimum of 600 watts for those instances when phones and laptops are being charged simultaneously.

Charging Mobile Phones, Laptops and Rechargeable Power Tools

If your use case for a solar workstation includes providing outdoor classrooms or other instances where other devices may also need charging, the array should be designed to accommodate these extra power needs. For example, an outdoor classroom setting on a farm may also need to recharge battery operated power tools such as drill or saws.

Recharging batteries of power tools can require 250 watts. When added to phones and laptops, one can easily see how quickly the power needs will overwhelm undersized solar arrays. Under this scenario the power demands of phones, laptops and power tools can quickly push the solar array into the 1.2 kilowatt range.

In addition, the inverter will need to support the larger power demands. Remember, the inverter turns the energy stored in the workstation battery into energy usable by the devices plugged into the workstation.

Assuming the solar array is right-sized, to support phones (20 to 88 watts for four phones), laptops (up to 120 watts for two laptops) and one rechargeable power tool battery (250 watts), the inverter will need to support up to 460 watts of power delivery. If this use case will be primarily during daylight hours an array sized at 900 watts with corresponding battery storage will likely provide sufficient power. If more than one power tool battery will be charged the array should be increased to well over 1 kilowatt to ensure there is sufficient power to fill batteries while users simultaneously draw power.

However, this use case also calls for a more robust inverter. If the inverter is undersized at 300 watts, a common inverter on the market, large phone and laptop users may come up short on recharging, while recharging power tools is a non-starter.

In this case an 800 watt inverter would be the safest inverter to ensure access to the desired power.

Conclusion

Location, time of year, and cloud cover and user demand make sizing solar tables as much art as science. As demonstrated, the solar array for any solar table or outdoor classroom must generally be double the size of the anticipated power needs to ensure power in the winter and to accommodate extended periods of clouds.

The system must also be matched with appropriate batteries to ensure consistent power availability under the anticipated use case, and the inverter must be right sized to deliver the anticipated peak electricity demand.

Solar tables require a meaningful investment but can return many times that investment in productivity, convenience, resiliency and good will when right sized. Lumos is proud to provide a family of solutions with minimum solar arrays of 600, 900 and 1,200 watts to ensure your users are not left in the dark.

We'd love to talk with you about how we can rightsize an outdoor charging station for you. Please contact us at info@lumossolar.com.