PV ARRAY SIZING

Why is PV array sizing important?

PV array sizing is crucial in solar energy systems for several reasons:

- **Meeting Energy Demands:** Properly sizing the PV array ensures that it can generate enough electricity to meet the energy demands of the system's intended application, whether it's for residential, commercial, or industrial purposes. Undersized arrays may not produce enough energy, leading to insufficient power supply, while oversized arrays may result in unnecessary costs and wasted space.

- **Optimizing Performance:** Sizing the PV array correctly helps optimize the performance of the solar energy system. It ensures that the array can capture enough sunlight to generate the desired amount of electricity, maximizing energy production efficiency. This is particularly important in locations with varying solar irradiance levels throughout the year.

- **Cost Efficiency:** Proper sizing helps achieve the best balance between system performance and cost. Oversized arrays may require more upfront investment in solar panels and associated equipment, increasing initial costs unnecessarily. On the other hand, undersized arrays may lead to higher electricity bills or the need for additional energy sources to supplement the shortfall.

- **System Reliability:** A well-sized PV array contributes to the reliability and stability of the solar energy system. It helps ensure consistent power generation, reducing the risk of power outages or disruptions due to insufficient energy production. This is especially important for off-grid systems that rely solely on solar power.

- **Environmental Impact:** By accurately sizing the PV array, solar energy systems can minimize their environmental footprint by maximizing energy production from renewable sources. This reduces the reliance on fossil fuels and helps mitigate greenhouse gas emissions associated with conventional electricity generation.

Now the question remains; how do I size a PV array to meet my needs and maximize it to its full potential?

Calculating the size of a PV (photovoltaic) array involves several steps to ensure it meets the energy demands of the system efficiently. Below shows a basic outline of the process:

1. **Determine Energy Requirements:** Start by determining the energy consumption or demand of the system. This involves analyzing past energy bills or estimating the energy needs based on the appliances, devices, or equipment to be powered by the solar system. Express the energy requirements in kilowatt-hours (kWh) per day or month.
2. **Account for Efficiency Loss:** Consider efficiency losses due to factors such as shading, orientation, tilt angle, temperature, and system losses. Typically, these losses can range from 10% to 25% depending on the specific conditions of the installation site.
3. **Calculate Daily Solar Insolation:** Determine the average daily solar insolation for the location where the PV array will be installed. Solar insolation refers to the amount of sunlight energy received per unit area over a specific period of time, usually expressed in kWh/m^2/day.
4. **Size the PV Array:** Divide the daily energy requirements by the daily solar insolation to calculate the size of the PV array needed to meet those requirements. Use the following formula:

$$\textbf{PV Array Size (kW)} = \frac{\textbf{Daily Energy Requirement (kWh)}}{\textbf{Average Daily Solar Insolation (kWh/m}^2\textbf{/day)}}$$

5. **Consider System Factors:** Consider additional factors such as the type and efficiency of solar panels, the system voltage, battery storage (if applicable), and any regulatory or safety requirements.
6. **Review and Adjust:** Review the calculated PV array size and adjust as necessary based on specific site conditions, budget constraints, and other project considerations. It may be beneficial to consult with a solar energy professional or use specialized software tools for more accurate sizing.

Always check with the AHJ (Authority Having Jurisdiction) before installing solar to make sure to follow with the compliances put in place to meet the requirements for a system. Also seek the help of professional installers and electricians. One can never be too safe with electricity! This will also ensure all the connections are up to code and installed correctly.

There are many ways to go about sizing an array, but the most important thing is that it is done correctly. It is always recommended to have the work done professionally, but it never hurts for one to do their own homework.

The next page has a few examples of different tools the user can utilize to help them on their solar journey.

1. https://pvwatts.nrel.gov/pvwatts.php: Here one can input their information to get a better look at what the PV array will produce for the year.

SYSTEM INFO

Modify the inputs below to run the simulation.

DC System Size (kW):	4
Module Type:	Standard
Array Type:	Fixed (open rack)
System Losses (%):	14.08 (Loss Calculator)
Tilt (deg):	20
Azimuth (deg):	180

RESULTS

Print Results

5,911 kWh/Year*

System output may range from 5,769 to 6,042 kWh per year near this location. Click HERE for more information.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)
January	4.07	406
February	4.14	368
March	4.92	473
April	5.82	531
May	5.96	548
June	6.42	564
July	6.58	594
August	6.81	610
September	5.74	515
October	5.26	495
November	4.56	429
December	3.76	379
Annual	5.34	5,912

2. https://footprinthero.com/solar-panel-angle-by-zip-code: This is an excellent resource for determining the optimal year-round tilt angle of the arrays.

Solar Panel Angle by Zip Code Calculator

Zip Code, City, or Address

Enter a location

or **Use Your Current Location**

Your optimal year-round tilt angle:

28.3° from horizontal

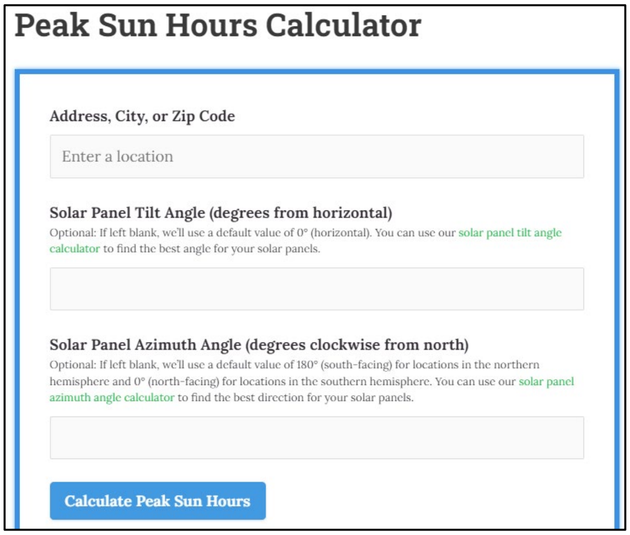
Your optimal tilt angles by season:

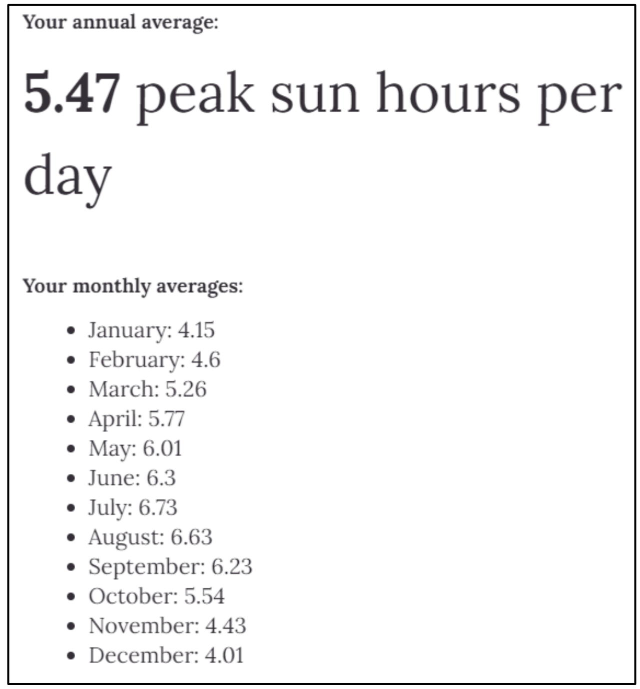
- Spring: 28.3°
- Summer: 13.3°
- Fall: 28.3°
- Winter: 43.3°

Your optimal tilt angles by month:

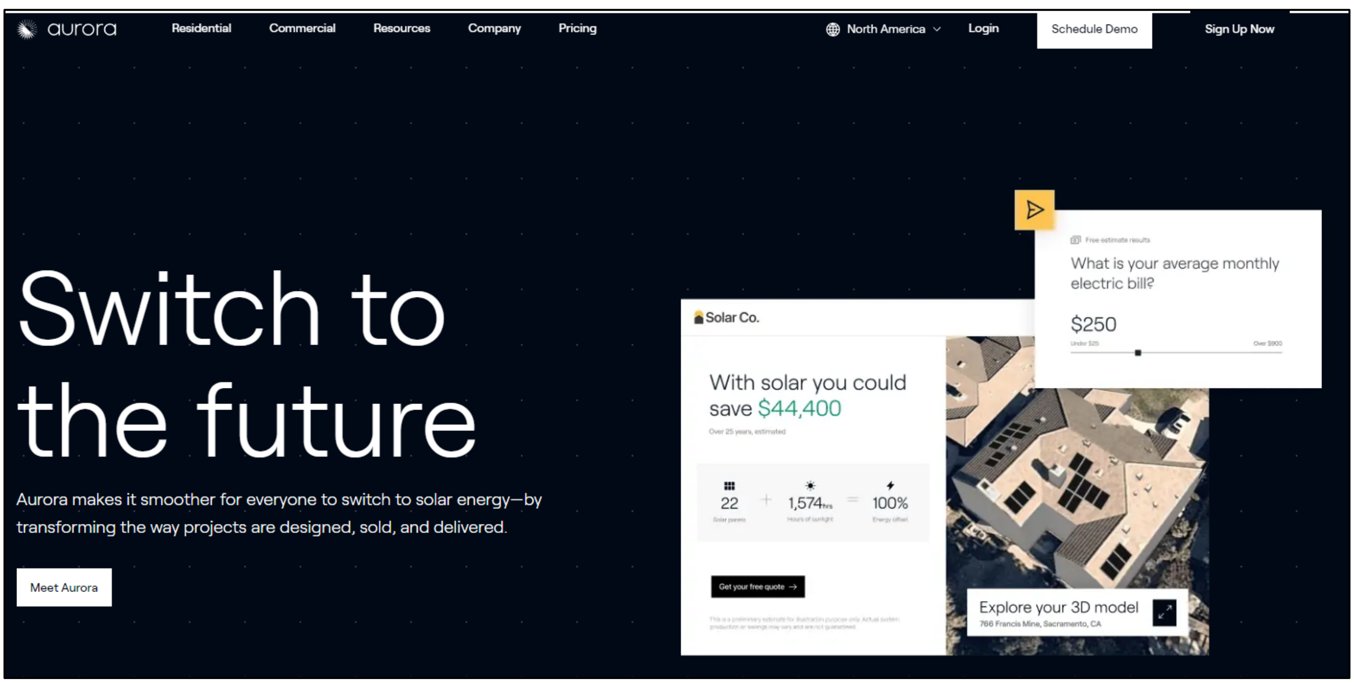
- January: 38.3°
- February: 33.3°
- March: 28.3°
- April: 23.3°
- May: 18.3°
- June: 13.3°
- July: 18.3°
- August: 23.3°
- September: 28.3°
- October: 33.3°
- November: 38.3°
- December: 43.3°

3. https://footprinthero.com/peak-sun-hours-calculator: This is a great tool to determine the peak hours of sun for your location. This is extremely helpful when sizing the arrays.





4. https://aurorasolar.com: This tool is great for looking up the system location and designing the system based off of your roof location or ground location. This is a very helpful tool, but it is always recommended to consult with a system design specialist.



PV array sizing may be intimidating, but by using these helpful resources one should feel much more comfortable throughout the process and as always, please consult a system design specialist for more information regarding maximizing the system's potential.

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