How to Use Mesonet Solar Radiation

Solar Panel

There are basically two types of solar panels. They look similar but are very different in construction and function. A solar heat panel basically produces hot water or air and can be constructed of wood, tubing and glass panels (Figure 1). A solar photovoltaic panel is made up of silicon wafers and converts sunlight into direct-current electricity which can power appliances (Figure 2). The silicon material is very advanced, and these panels must be bought from manufacturers.

Figure 1. Solar Water Heater Panels (NREL)

Figure 2. Solar PV (Electric) Panels (NREL)

Using Mesonet Solar Data to estimate the power output of solar panels:

Mesonet has a variety of solar data sources. By clicking on “Past Data” – “Mesonet Long Term Averages Maps” one can get to the Long-Term Averages Solar Maps. One can then choose a particular year and month. Or one can simply choose a season or full year. On the product category, select Solar Radiation. To find the amount of solar energy that would reach a solar panel, select Average Total Solar Radiation. Next, select Display Map. You will see something like Figure 4 below. The map is displaying the yearly average solar energy striking a square meter horizontally flat at ground level for all Mesonet stations. The energy is in Mega Joules. To convert this to kilowatt-hours (kWh) simply multiply the Mega Joules by 0.27778. Notice that Payne County is showing 16.6 Mega joules per square meter for a yearly average. This is equivalent to 4.6 kWh per square meter.

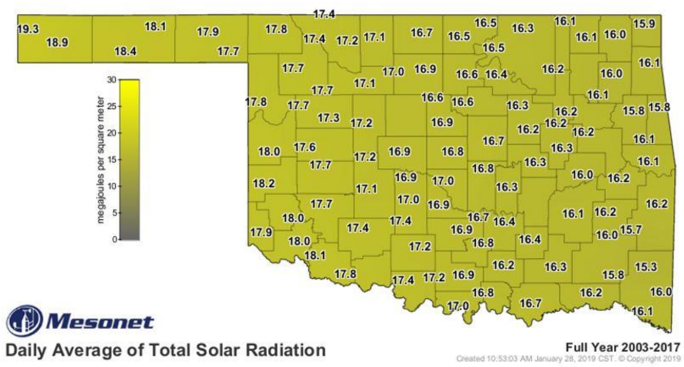

Figure 4. Mesonet Average Daily Solar Radiation per year (averaged over 14 years)

Solar panels are not 100% efficient in converting sunlight into electricity. A typical value for lower-priced solar panels is 15% efficiency. So, one is unable to harvest the full solar radiation values on the above map. Therefore a one square meter panel would actually produce (0.15 x 4.6 kWh) **0.7 kWh** over a year in Payne County (notice, we converted to kWh first). Twenty such panels would generate about **13.8 kWh** and so on. All of this assumes an "average" amount of sunlight.

Examination of individual months in the Mesonet data shows the average solar energy for Payne county peaking in June and July at 24.3 MJ (6.8 kWh) and bottoming out at 8.1 MJ (2.3 kWh) in December. Remember, a solar panel will only "harvest" a percentage of this. This may or may not be an issue for a solar powered piece of equipment. Perhaps the equipment is summer garden irrigation with solar powered pumps. Compared to something that operates in the winter, more light is available in the summer to make power with fewer panels. Again, one must keep in mind the Mesonet solar data are simply long term averages. In reality, there could be entire weeks with dense, cloudy skies and lower solar light power available than the averages.

Example - Selecting Enough Panels to Power Something:

The first step is to determine what it is you are wanting to power. For this example we will power a small irrigation pump without a battery system. In essence, this system will run only when the sun is out. This could be a solar-powered cattle watering trough for example. We will assume the ground water level is not deep and a ¼ HP pump will provide the needed flow. First we convert the motor horsepower to kWh. Looking at a particular 1/4HP motor specification sheet shows 24 volts at 11 Amps fully loaded. The kWh power is volts x amps ÷ 1,000 which works out 0.264 kWh for our example. So, on a sunny July day in Payne County the motor would need 0.26 kWh ÷ 1.0 kWh/m2 = **0.3 m2** of solar panel area. In the winter, the needed panel area would increase to 0.8 m2 to maintain the same pumping rate (see footnote).

Footnote: Assuming a 15% panel efficiency, the summer output from a 1 square meter panel would be 0.15 x 6.8 kWh/m2 = 1.0 kWh/m2. In winter this would be 0.15 x 2.3 kWh/m2 = 0.35 kWh/m2. For an actual system we might increase the panel size a bit to allow for the electric motor start-up amp draw which can be significant.

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