



Basic solar system for dummies

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A solar system is a setup that generates electricity by utilizing the solar energy. A typical solar system consists of solar panels (which absorb sunlight), inverter (which converts DC into AC), mounting structure...

Welcome to the first installment in our 6-part series on Solar Basics 101, updated in late 2024 with the latest information. This comprehensive solar 101 series explores the key drivers behind the technology's rapid growth. It also delves into many of the most important considerations when designing and customizing new solar photovoltaic (PV) systems from the ground up -- including financing, shading, and how best to optimize your customers' savings based on their energy bills and properties' solar power generation potential.

Solar power is playing an increasingly important role in the transition to a world powered by renewable energy. In just the past decade alone, the solar industry has grown by a staggering 25% annually on average. Along with (and largely aided by) this meteoric growth, solar prices have fallen by a corresponding 43% -- making the technology more affordable than ever before.

The Solar Energy Industries Association (SEIA) reports that there are over 5.1 million PV installations nationwide, which is enough installed capacity to power over 35.8 million homes. In strictly carbon terms, this is equivalent to planting almost 4 billion trees or decommissioning 58 coal-fired power plants.

The chart below illustrates the correlation between the solar installed capacity and decreasing PV panel costs. It shows that the price of a solar installation has decreased by more than 40% over the past decade, while annual installations have grown during the same period of time.

In addition to helping us move away from fossil fuel, SEIA also highlights how the solar industry continues to be a powerful engine for economic growth and job creation. Just in the US alone, the solar industry employed over a 280,000 people by the end of 2023, almost doubling over the past decade.

Solar panels generate energy by converting the sun's photons (or light particles) into an electric current to power homes or businesses. We use the terms "irradiance" or "insolation" to refer to the power density of sunlight on a surface. In layperson's terms, these values represent a roof's solar potential.

In solar, we usually define the size of a PV installation in terms of its power output (in kW). And irradiance is measured in units of kWh per square meter per day (kWh/m²/d). The amount of irradiance hitting the Earth's surface is often measured as the number of hours of "full-sun" (defined as 1 kW/m² of solar energy). To review:

We can estimate the solar potential of a rooftop using its area and local irradiance. The US Department of Energy's National Renewable Energy Laboratory (NREL) published irradiance data in its report: Solar

Radiation Data Manual for Flat-Plate and Concentrating Collectors.

It is fairly straightforward to calculate the solar potential of a rooftop using this data. For example, a South-facing residential roof face (seen above) receives an average irradiance of approximately 1,900 kWh/m²/year. (It's a little lower, at 1,538 here due to shading.) Dividing the annual irradiance value by the number of days in a year yields the average daily irradiance.

This is the ratio of the actual solar energy available -- taking into account shading cast by objects in the environment -- to the theoretical solar energy that would be available in the absence of shading:

This is where we get the 1,538 kWh/m²/year for Mt. Vernon. For a deeper dive into what Solar Access means, be sure to review our guide on the Effects of Shading on PV Systems.

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