

# Solar Guide: Fundamentals of Solar Energy & Panels

## 1. What is Solar Energy?

Solar energy is energy from the sun that is converted into thermal or electrical energy using photovoltaic (PV) panels.

## 2. How Do Solar Panels Work?

Solar panels convert sunlight into electricity using the photovoltaic effect. When sunlight hits the solar cells, electrons are knocked loose and generate an electric current.

## 3. Important Terms:

- Solar Irradiance: The power per unit area received from the Sun in watts per square meter (W/m<sup>2</sup>).
- Efficiency: The percentage of solar energy converted into usable electricity. Higher efficiency means more power from the same panel.
- Tilt Angle: The angle at which the solar panel is installed relative to the ground. It affects how much sunlight the panel receives.
- Azimuth: The compass direction the panel faces. South-facing panels are ideal in the Northern Hemisphere.

## 4. Estimating Daily Power Output:

Estimated Power Output (kWh) =

$$\text{Solar Irradiance (kWh/m}^2\text{/day)} \times \text{Panel Area (m}^2\text{)} \times \text{Panel Efficiency} \times \text{Performance Ratio}$$

Example:

If solar irradiance = 5.5 kWh/m<sup>2</sup>/day, panel area = 10 m<sup>2</sup>, efficiency = 18%, and performance ratio = 0.75,

then output =  $5.5 \times 10 \times 0.18 \times 0.75 = 7.43$  kWh/day.

## 5. Factors Affecting Solar Output:

- Weather (cloud cover, rain, dust)
- Tilt and orientation
- Shadowing from nearby objects
- Seasonal sun angle

## 6. Frequently Asked Questions (FAQs):

Q: What maintenance do solar panels need?

A: Mostly cleaning and occasional checks for wiring or inverter issues.

Q: How long do solar panels last?

A: Typically 25-30 years with decreasing efficiency over time.

Q: What are the types of solar panels?

A: Monocrystalline (high efficiency), Polycrystalline (cheaper), and Thin-Film (flexible, low efficiency).

Q: Can I run AC on solar?

A: Yes, but you need proper inverter capacity and battery backup for nighttime use.

This guide is meant to support solar energy queries in AI-based chatbot systems.