

Introduction to Solar PV System Installation

Introduction to Solar PV System Installation

(Photovoltaic – PV – systems that convert sunlight into electricity)

1. Basic Concepts

Term	Definition	Relevance to Installation
Solar PV Module	A collection of solar cells encapsulated in a frame.	The primary energy-producing component; must be mounted securely and oriented correctly.
Inverter	Converts the DC output of the modules to AC for home or grid use.	Determines system size, efficiency, and type of monitoring.
Mounting Structure	Racks, rails, or trackers that hold modules in place.	Affects tilt, azimuth, wind loading, and roof penetration.
Balance-of-System (BOS)	Wiring, combiner boxes, disconnects, fuses, grounding, and monitoring equipment.	Completes the electrical path and ensures safety and code compliance.
Net Metering / Feed-in Tariff (FiT)	Utility compensation mechanisms for excess electricity exported to the grid.	Influences system sizing and financial return.

2. Planning & Site Assessment

1. Site Survey

- Measure roof/ground area, slope, orientation (azimuth), and shading obstacles (trees, chimneys, nearby buildings).
- Verify structural integrity (load-bearing capacity of roof or ground).

2. Solar Resource Evaluation

- Use tools such as PVWatts, SAM, or local irradiance maps.
- Determine average daily peak sun hours (kWh/m²·day).

Introduction to Solar PV System Installation

3. Regulatory Review

- Local building codes, fire codes, and electrical codes (NEC 2023, IEC 61730, etc.).
- Permit requirements (building, electrical, zoning).
- Utility interconnection standards (e.g., IEEE 1547, UL 1741).

4. System Sizing

- **Load analysis:** List all loads, calculate daily kWh consumption.
 - **Desired coverage:** 100% self-consumption, 70% offset, or grid-tied export.
 - **Module selection:** Power rating (W), temperature coefficient, efficiency.
 - **Inverter sizing:** Typically 80-120% of DC array rating (depending on clipping strategy).
-

3. Design Fundamentals

3.1 Electrical Layout

- **String Configuration**

- Connect modules in series ? voltage increase, current stays constant.
- Parallel strings ? current increase, voltage stays constant.
- Keep string voltage within inverter MPPT range (usually 150-600V).

- **Combiner Box**

- Groups parallel strings; includes fuses or circuit breakers per string.

- **DC Disconnect**

- Mandatory safety device located close to the array, before the inverter.

- **AC Side**

- Inverter output ? AC disconnect ? service panel ? utility meter.

- **Grounding**

Introduction to Solar PV System Installation

- Grounded frames, grounding electrode conductor (GEC), and equipment grounding conductors (EGC) per code.

3.2 Mechanical Layout

Parameter	Typical Value	Design Note
Tilt Angle	Latitude $\pm$ 10° (optimal)	Adjust for seasonal performance or roof constraints.
Azimuth	180° (true south) in N?Hemisphere; 0° (true north) in S?Hemisphere	Deviations reduce output; compensate with higher?efficiency modules if needed.
Spacing	Minimum	