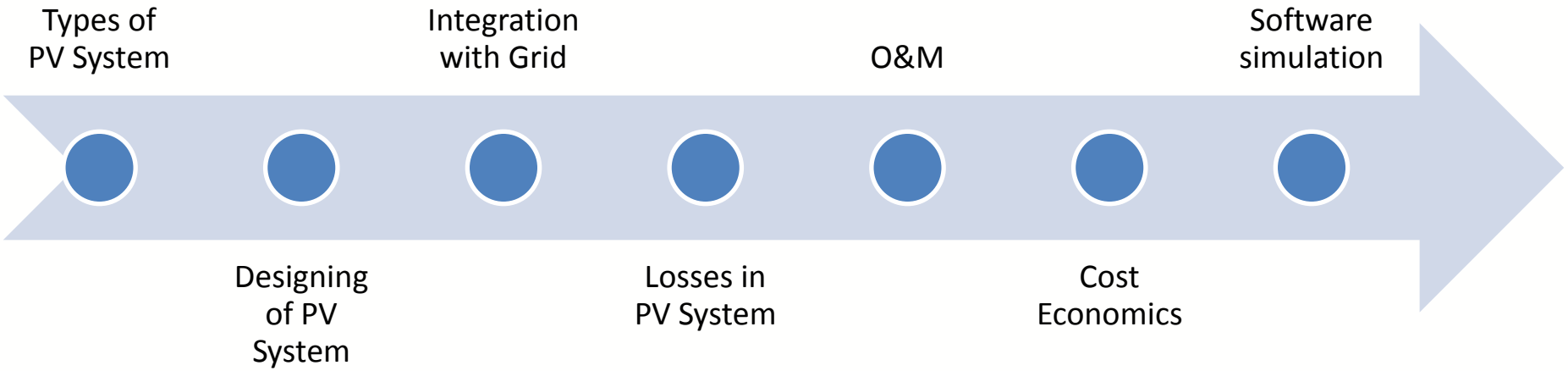
Practical aspects of designing Rooftop Solar PV Power Plants

kWatt Solutions Pvt. Ltd.

economising renewables

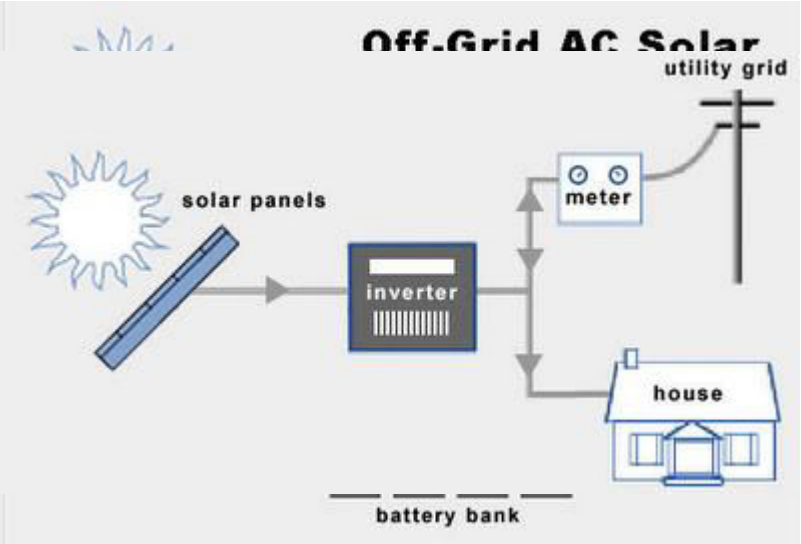
Contents



kWatt Solutions Pvt. Ltd.
economising renewables

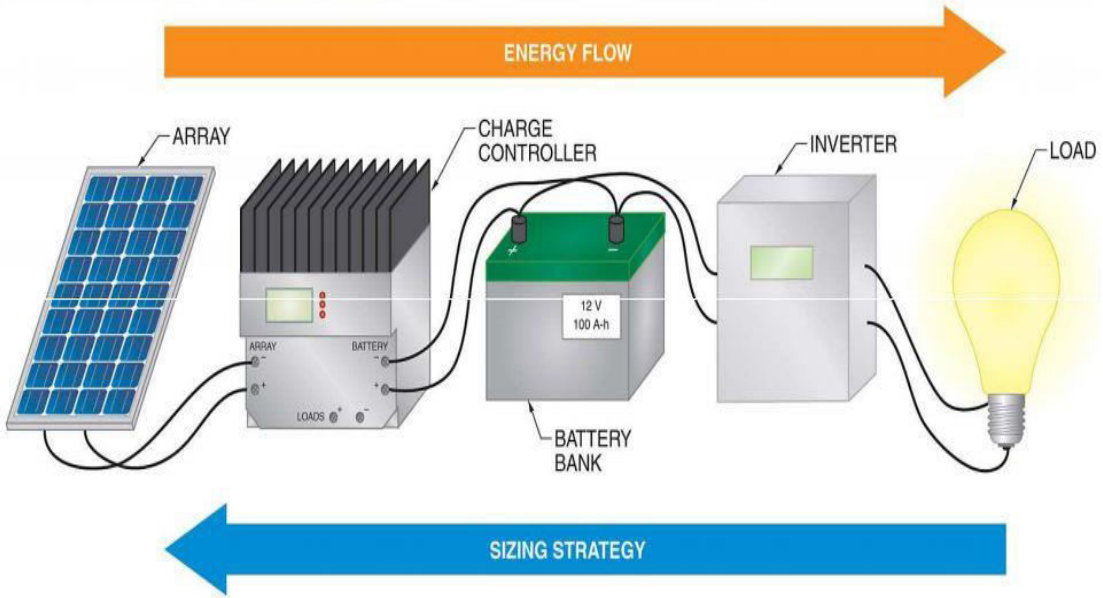
Types of System

1. Grid Connected / Grid-Tied / On Grid
2. Off Grid



kWatt Solutions Pvt. Ltd.
economising renewables

SYSTEM DESIGN CONSIDERATION (Off Grid System)



kWatt Solutions Pvt. Ltd.
economising renewables

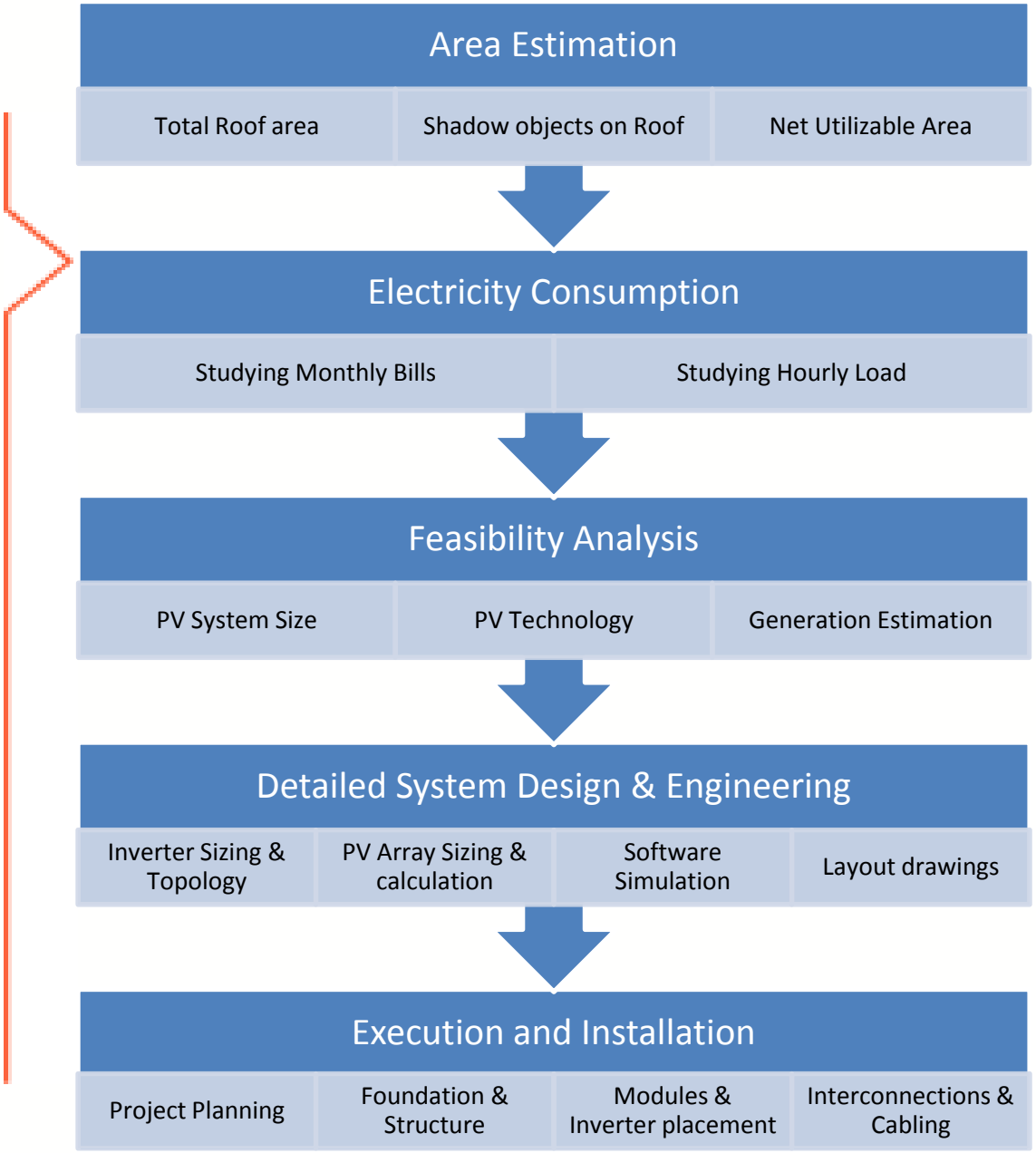
On Grid System

1. Most common type of solar PV system
2. Connected to the electrical grid
3. Need not to produce 100% of the electricity demand
4. When electricity demand is more than PV power (at night), the difference is supplied by electricity grid, and
5. When electricity demand is less, excess PV power is supplied back into the grid
6. This is facilitated through Net Metering

On Grid System

7. As it is a grid connected system, synchronisation is required
8. Inverters take Grid as reference while inverting the power from DC to AC
9. Thus, system works only when Grid is ON!
10. Solution: Alternate Grid can also be created with Diesel Generators when Grid is OFF
11. DG needs to operate at only ~30% of its rating; 70% can be supplied by Solar PV

SYSTEM DESIGN STEPS (On Grid System)



Integration with Grid

1. Two consumption modes:
   i. Captive
   ii. Open Access

2. Captive consumption
   Where energy generated by PV plant is completely consumed
   i. Advantage: No policy issues like
      a) Net Metering
      b) Open Access
   ii. Disadvantage: small size PV plants

3. Open Access
   Where energy generated by PV plant can be transmitted through utility network and consumed at some other place

Integration with Grid

Due to large scale integration, many practical issues can occur:

1. Islanding becomes a problem in case of large number of interconnected microgrids

2. Though grid parity has occurred for on-grid systems, it is not valid for off-grid
3. As batteries are expensive, and other storage technologies are still under test

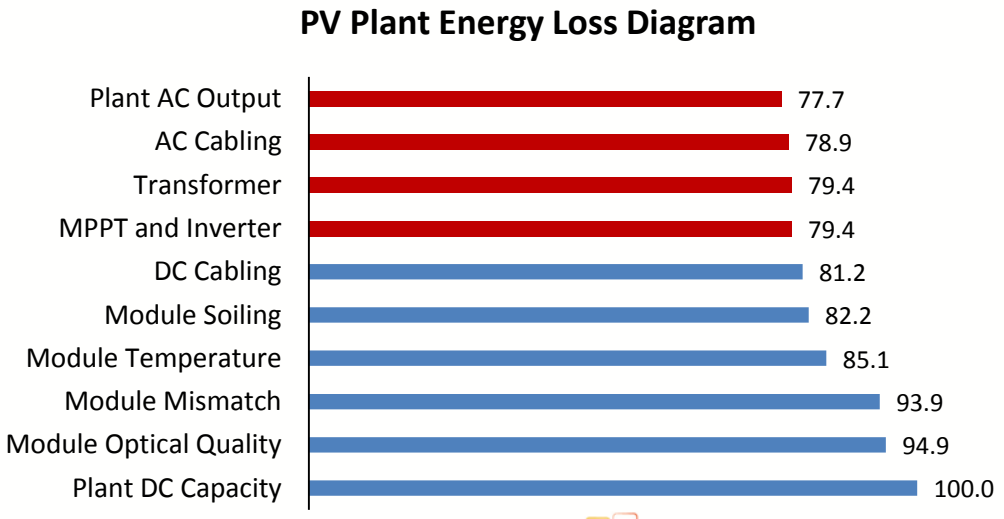
4. Thus, still the reach of solar is limited

5. Slowly, Policies are developing which eventually will be wide spreading Solar

Operations and Maintenance (O&M)

O&M is the most important area in this field

1. Designed not just to withstand 25 years; rather generate power even beyond that
2. Without proper O&M, plants can drastically under-perform within one-two years
3. To understand this, let us first look at the typical losses in a PV power plant:



kWatt Solutions Pvt. Ltd.
economising renewables

OFF-GRID SYSTEM LOSS FACTORS

Factors	% Loss
PV Response to Irradiance	2-4
PV Mismatch	1-3
PV Soiling	1-3
PV Thermal Loss	5-10
DC Cable Loss	1-2
MPPT Charge Controller	1-2
Battery	10-15
Inverter including Transformer	4-6
AC Cable Loss	0.5-1
Total System Loss	**25-40**

Operations and Maintenance (O&M)

4. Even one under-performing module can affect the entire plants performance, as it will create mismatch in the combination

5. Thus, regular monitoring of Plant performance needs to be done

6. Advanced O&M:
   i. Automated cleaning of modules
   ii. Central monitoring platforms (SCADA)
   iii. Thermal (IR) imaging of modules and hot-spot detections
   iv. String I-V characteristic comparison
   v. Shadow analyser
   vi. Shutdown analysis

Cost of Components (Commercials)

Typical costs of various components are:

1. PV Panels: 35-45 Rs/W
2. Inverter: 5-15 Rs/W
3. Structure: 4-7 Rs/W
4. Cables, connectors etc. (BOS): 4-6 Rs/W
5. Battery:
   Lead Acid: 15-20 Rs/Wh
   Li-ion: 25-40 Rs/Wh
6. Installation: 3-6 Rs/W
7. Total cost: 51-79 Rs/W for on-grid
   90/100-120/150 Rs/W for off-grid (LA/Li-ion)