PV SIZING

What's PV sizing?

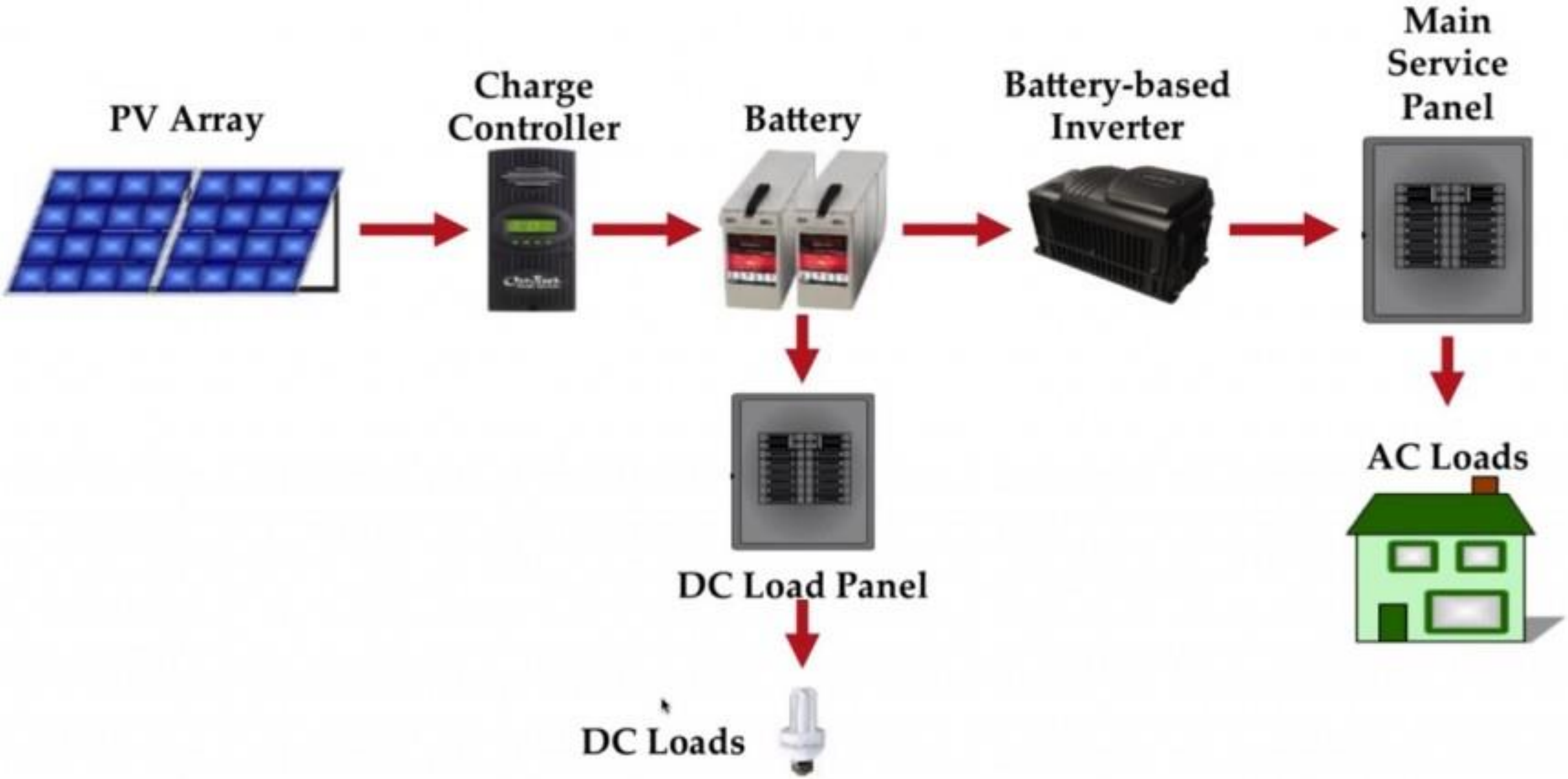
- It's the way is used to give the exact rating of each components of PV system.

    such as the battery, inverter, charger controller, and number of the panels

PV sizing

1-Excel Sheet 2-Manual calculation 3-PV Sol software program

Off-Grid System



PV sizing

Loads:
5x lamps 30Watt   operates for 2hr/day
Refrigerator 500 watt operates for 5hr/day
3x Fans 45Watt operates for 8hr/day
Washer machine 1500 Watt operates for 0.86hr/day
TV 200Watt operates for 4hr/day
Toaster 1500Watt operates for 0.25hr/day

- Total load Power = [5x30] + (500) + ([45x3]) + 1500 + 200 +1500 = 3985 W
- Now, Total load energy = (5x30x2)+(500x5)+(3x45x8)+(1500x0.86)+(200x4)+(1500x0.25) = 6345W

Inverter sizing

$Adjusted\ Factor\ (inverter) = 0.85$
Input voltage = 24VDC
Output voltage = 220VAC
Inverter power is 1000Watt

$$Inverter\ input\ power = \frac{AC\ power\ requirement}{Adjusted\ Factor} = \frac{3985}{0.85} = 4688W$$

$$DC\ energy\ per\ day = \frac{AC\ energy\ per\ day}{Adjusted\ Factor} = \frac{6345}{0.85} = 7463\ Wh$$

$$Number\ of\ inverters = \frac{Inverter\ input\ power}{inverter\ Max.power\ rating} = \frac{4688}{1000} = 5\ inverters$$

Battery sizing

DOD of battery = 80%
Battery bus voltage =24V
Selected battery voltage = 12 V
$Days\ of\ storage\ required = \mathbf{7}\ day\mathbf{s}$
$Ah\ of\ each\ battery = \mathbf{478}Ah$

$$Total\ amp\_hours\ demand\ per\ day = \frac{DC\ energy\ per\ day}{Battery\ bus\ voltage} = \frac{7463Wh}{24V} = 311\ Ah$$

$$Required\ battery\ capacity = \frac{Total\ amp\_hours\ demand\ per\ day \times Days\ of\ storage\ required}{DOD\ of\ battery}$$

$$= \frac{311\ \times 7}{0.8} = 2721Ah$$

$$Number\ of\ batteries\ in\ parallel = \frac{required\ battery\ capacity}{Ah\ of\ each\ battery} = \frac{2721}{478} = 6\ batteries$$

$$Number\ of\ batteries\ in\ series = \frac{battery\ bus\ voltage}{Selected\ battery\ voltage} = \frac{24}{12} = 2\ batteries`$$

PV array Sizing:

$$Battery\ round\ trip\ efficiency = 0.85$$

$$Required\ array\ output\ per\ day = \frac{Total\ DC\ energy\ per\ day}{Battery\ round\ trip\ efficiency}$$

$$= \frac{7463}{0.85} = 8780\ Wh$$

PV array Sizing:

Power Specifications*

Model	M55
Power (typical +/- 10%)	53.0 Watts
Current (typical at load)	3.05 Amps
Voltage (typical at load)	17.4 Volts
Short Circuit Current (typical)	3.27 Amps
Oopen Circuit Voltage (typical)	2.18 Volts

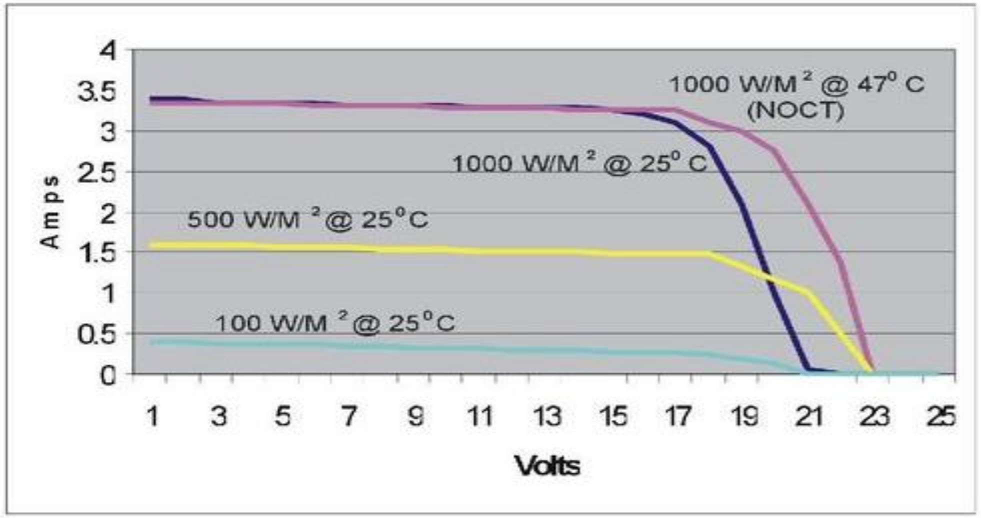
Physical Characteristics

Length	50.9 in/1293 mm
Width	13 in/330 mm
Depth	1.4 in/36 mm
Weight	12.6 lb/5.7 kg

*Power specifications are at standard test conditions of: 1000 W/M², 25⁰ C cell temperature and spectrum of 1.5 air mass.

Performance Characteristics

@ 25°C	(pink line)
1000 W/M² @ 47°C (NOCT)	(dark blue line)



The IV curve (current vs. Voltage) above demonstrates typical power response to various light levels at 25°C cell temperature, and at the NOCT (Normal Cell Operating Temperature), 47°C.

PV array Sizing:

$$selected\ PV\ module\ max.power\ voltage\ at\ (STC\ \times 0.85) = 17.4\,V\ x\ 0.85 = 14.79V$$

$$Selected\ PV\ module\ max.power\ output\ at\ (STC\ \times 0.9) = 53W\ \times 0.9 = 47.7W$$

$$Energy\ output\ per\ module\ per\ day = max.power\ \times sun\ hours$$

$$= 47.7\ \times 3.8 = 181.3\ Wh$$

$$Degradation\ coefficient\ of\ module\ energy\ output\ at\ operating\ temperature\ for\ hot\ climate = 90\%$$

$$Module\ energy\ output\ at\ operating\ temperature = 0.9\ \times 181.3 = 163\ Wh$$

$$Number\ of\ modules\ required\ to\ meet\ energy\ requirements = \frac{Required\ array\ output\ per\ day}{Module\ energy\ output\ at\ operating\ temperature} = \frac{8780Wh}{163Wh} \approx 54\ module$$

$$Number\ of\ modules\ required\ per\ string = \frac{bus\ voltage}{Vmpp} = \frac{24}{14.79} \approx 2\ module$$

$$Number\ of\ strings\ in\ parallel = \frac{54}{2} = 27\ module$$

Charger Sizing:

- $charger\ current$
  $= \ Number\ of\ strings\ in\ parallel\ \times short\ circuit\ current\ of\ module \times Safty\ factor$
  $= 27 \times 3.27 \times 1.56 = 137.7\ A \approx 140A$
- $Charger\ voltage = 24V$