"e-Learning Workshop: Solar Policy Interpretation & Implementation Processes" 2020

# Solar PV Rooftop Technology Overview

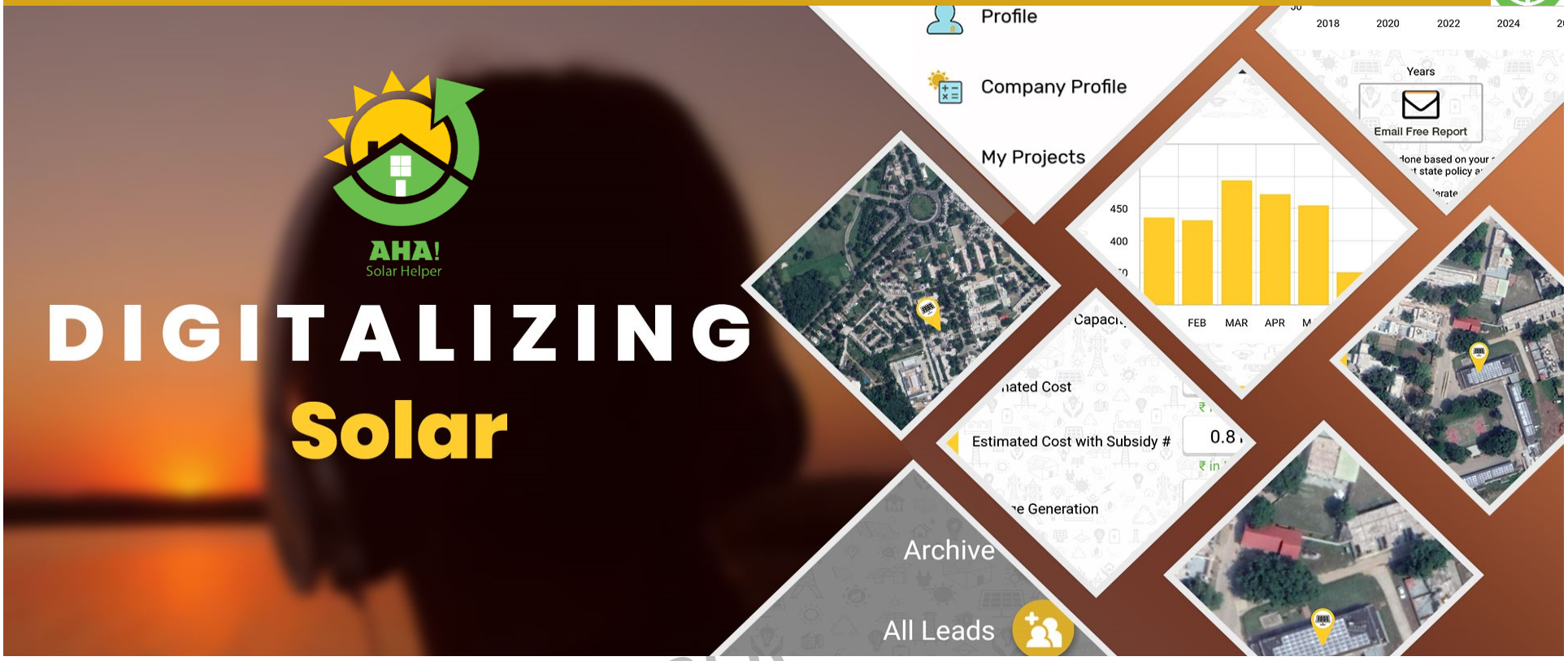


Presented by: Shatrughan Yadav
(AHASolar Pvt Ltd )
22nd April 2020, Ahmedabad (India)






# Outline




- Tools for site assessment
- Undertaking a site assessment
- Typical site survey format for rooftop PV project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- Undertaking a site assessment
- Typical site survey format for rooftop PV project

# Tools For Site Assessment



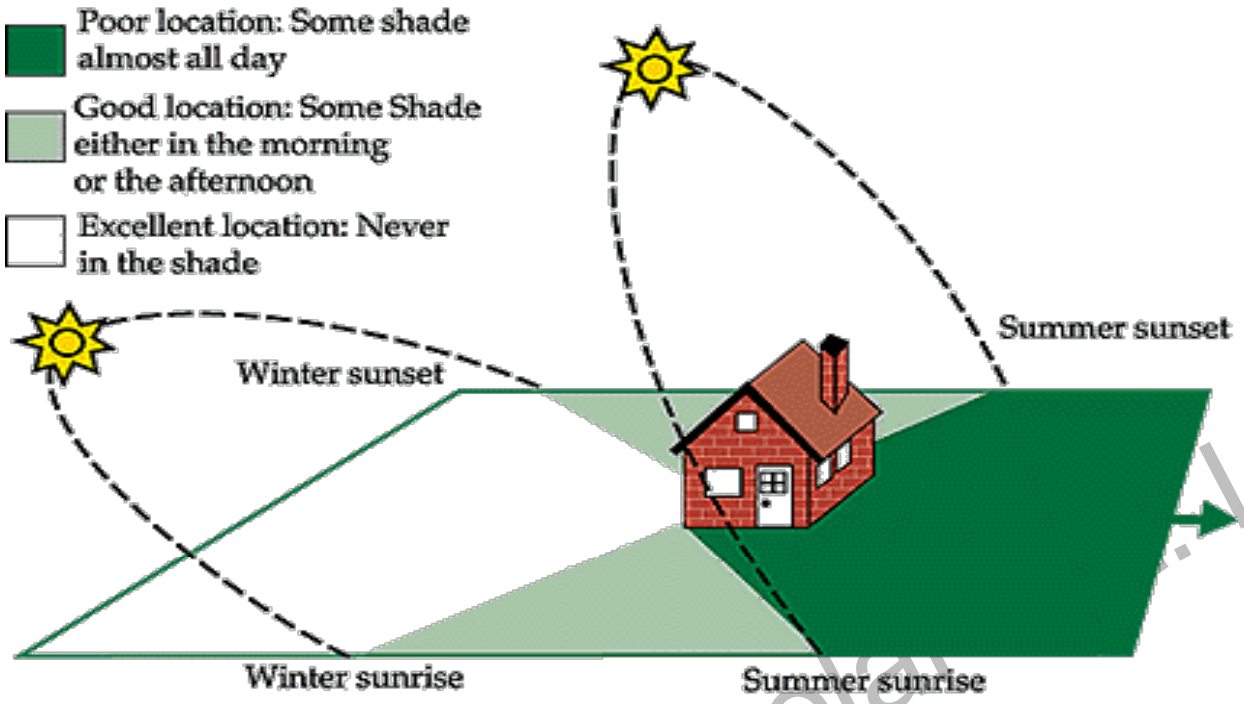

# Site assessment – tasks to carry out

- Assessment of OHS
- Assessment of location for installation of  PV plant
- Shadow analysis of site
- Determine PV array orientation and tilt
- Assess how the PV modules will be mounted
- Identify suitable location for inverters and other electrical equipment
- Determine cabling routes and cable run distances
- Study of site parameters that likely to affect the design considerations

# Site assessment – assessment of OH&S

- Safe access to the roof
- Exposure to the sun
- Falling from the roof
- Injuries from lifting and installing heavy inverters
- Injuries from falling objects from roof
- Cut, bump and burns from sharp and hot metallic items/ tools
- Insects biting – some insect may be poisonous

# Site assessment – assessment of PV array location




- Free from shadow in all days of the year – Use solar path finder
- Access for array maintenance
- Provide ample space for air cooling
- Prevails aesthetic of the building or premises
- Not far from the charge controller/ inverter/ battery bank
- Protect array from theft and vandalism

# Site assessment – Shadow analysis

- Objects which come in the path of the incident solar rays, any time during the day, will cast shadows and would reduce the solar generation

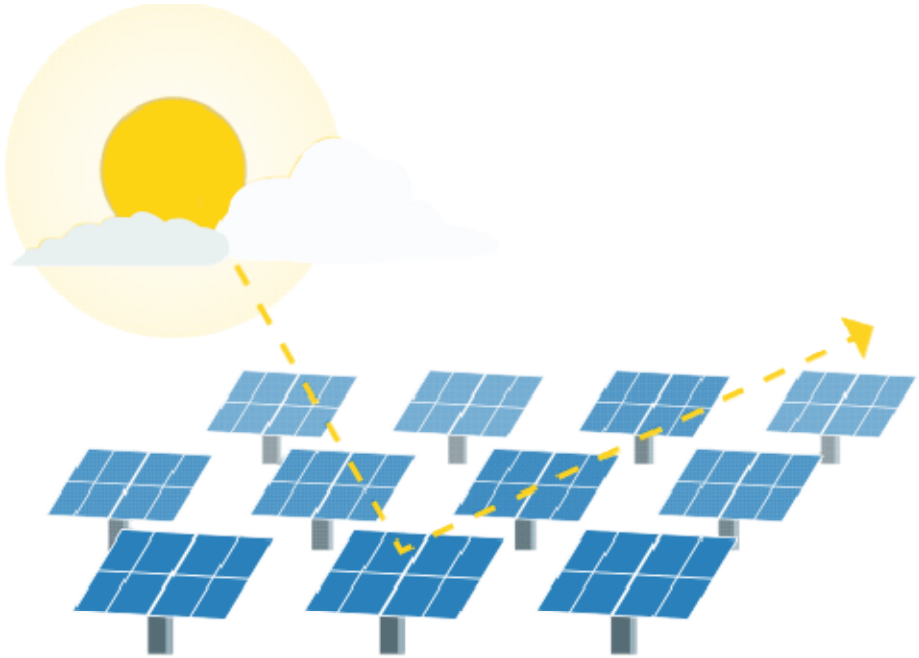
- Even on south facing roof, a taller object in the eastern side would cast shadows during morning and a taller object on the western side would similarly cast shadows during the afternoon.

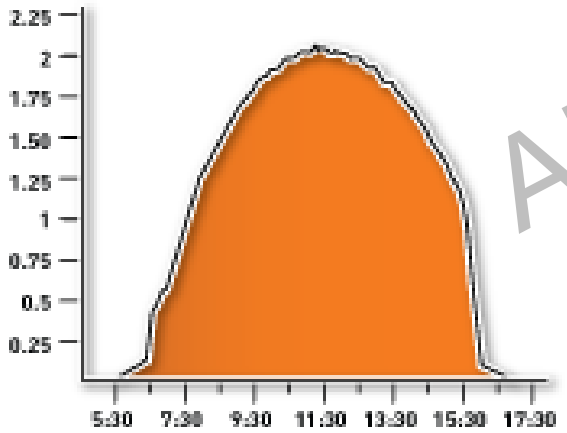
- Shading can not only lead to lower generation but can also over a period of time damage the panels.

- Roof s inclined towards south, would receive the sun rays all through the day. However roofs inclined towards east and west will have a lesser window while roofs facing north will receive the least sunlight.

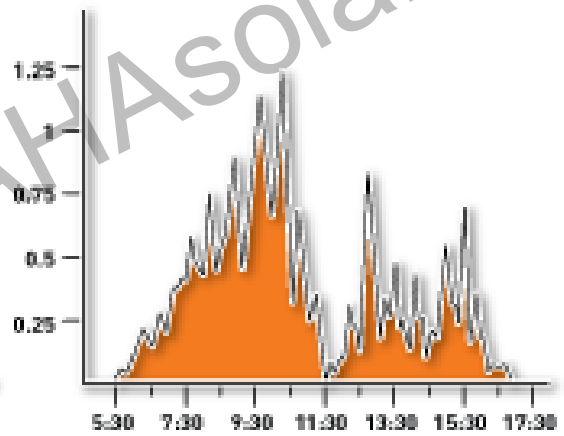
# Partial Shading Due to Improper Cleaning

# Cloud Cover

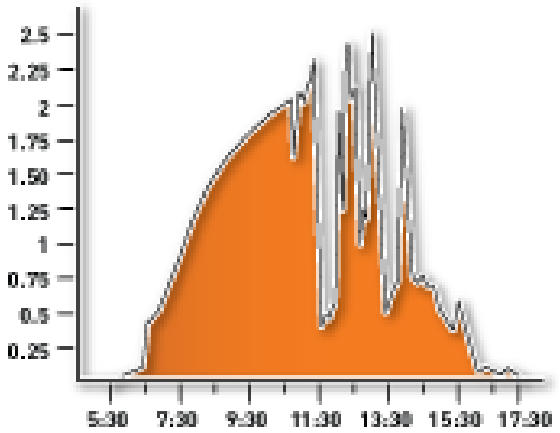





CLEAR SUNNY DAY




CLOUDY OVERCAST DAY

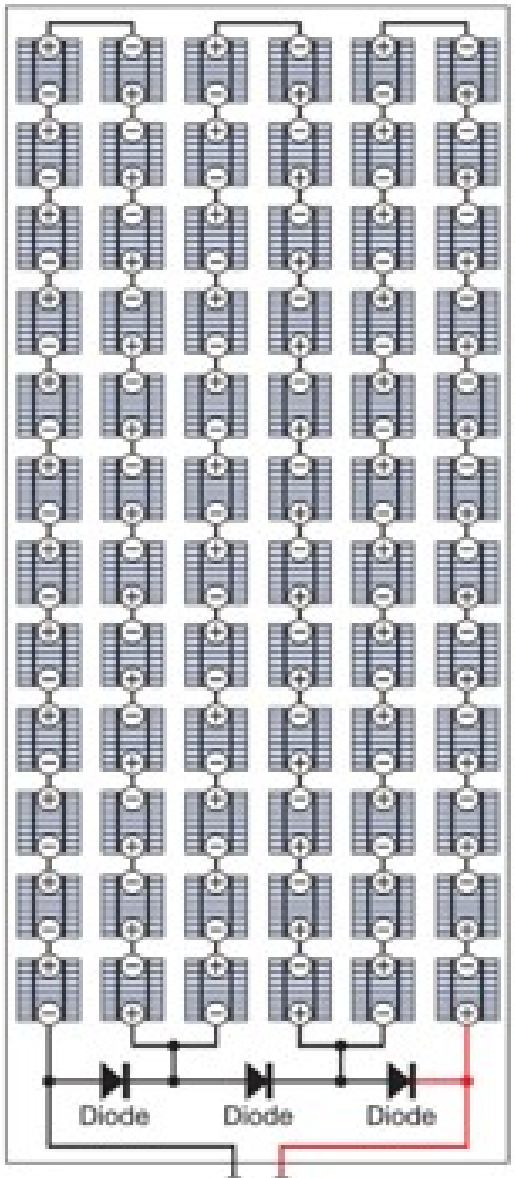



CLOUD COVER CAME IN AROUND MID MORNING

# Effects of shading on Performance of System

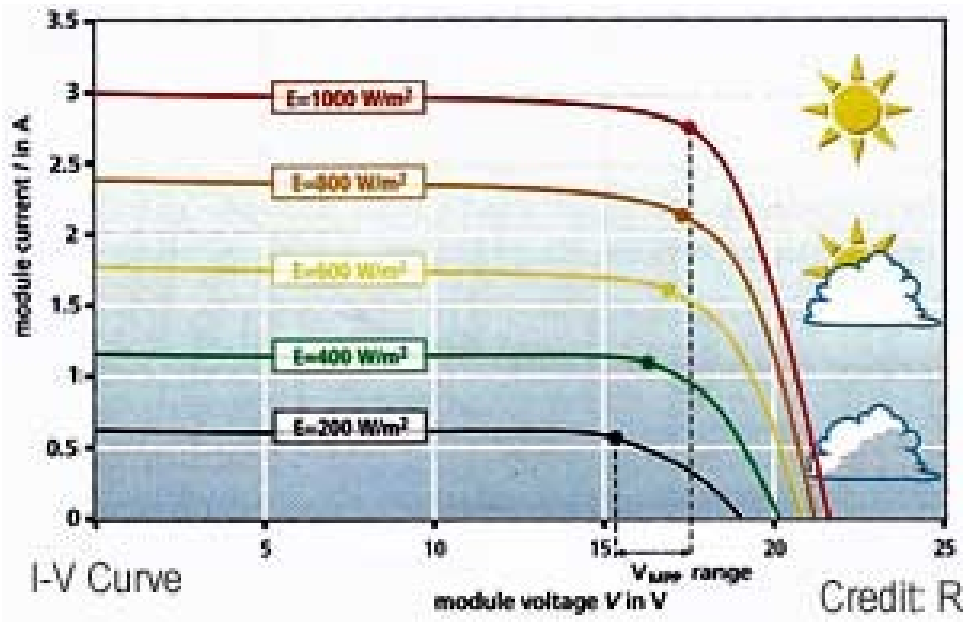
- Effect of shading depends upon following factors
  - Number of shaded modules
  - Cell and bypass diode interconnection
  - Degree of shading
  - Spatial distribution and the course of shading over time
  - Interconnection of module
  - Type of inverter
  - Type of module technology

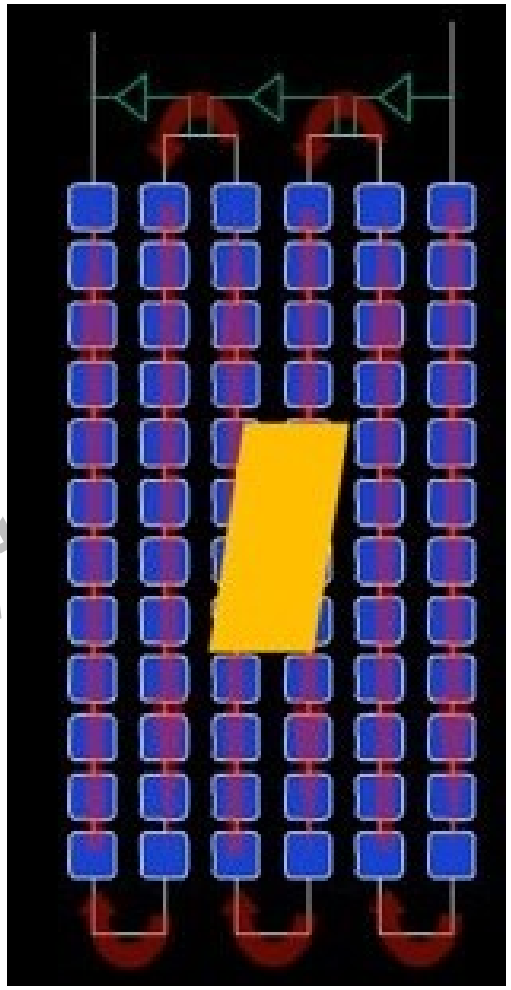
# Factor Affecting Loss of Power due to Shading

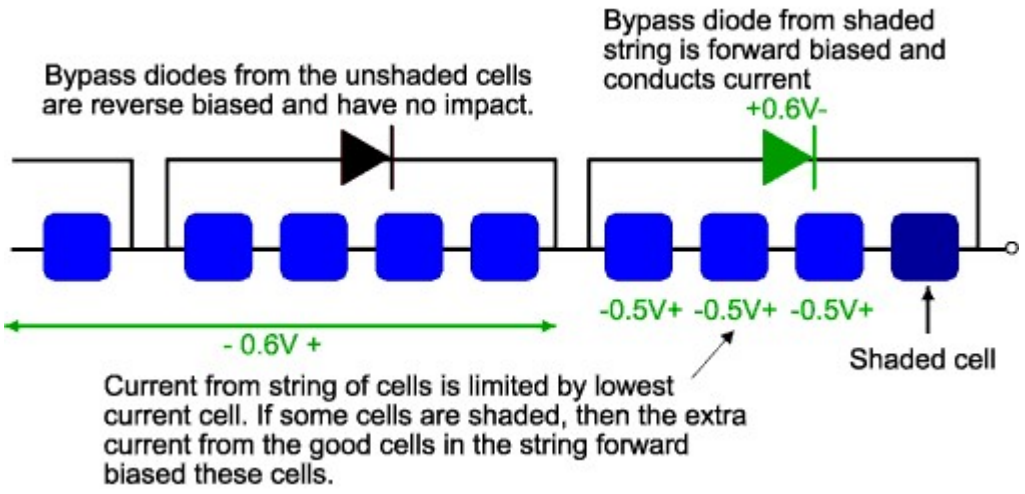



- **No cells shaded:** Current passes through all cells. No current passes through bypass diodes.
- **One cell shaded:** Current bypasses the 24-cell series string and passes through the bypass diode in parallel with that string.
- **One row of cells shaded:** Current bypasses three 24-cell series strings and passes through three bypass diodes.
- **One column of cells shaded:** Current bypasses the 24-cell series string and passes through the bypass diode in parallel with that string.
- **Entire module shaded:** Current bypasses all cells and passes through three bypass diodes.

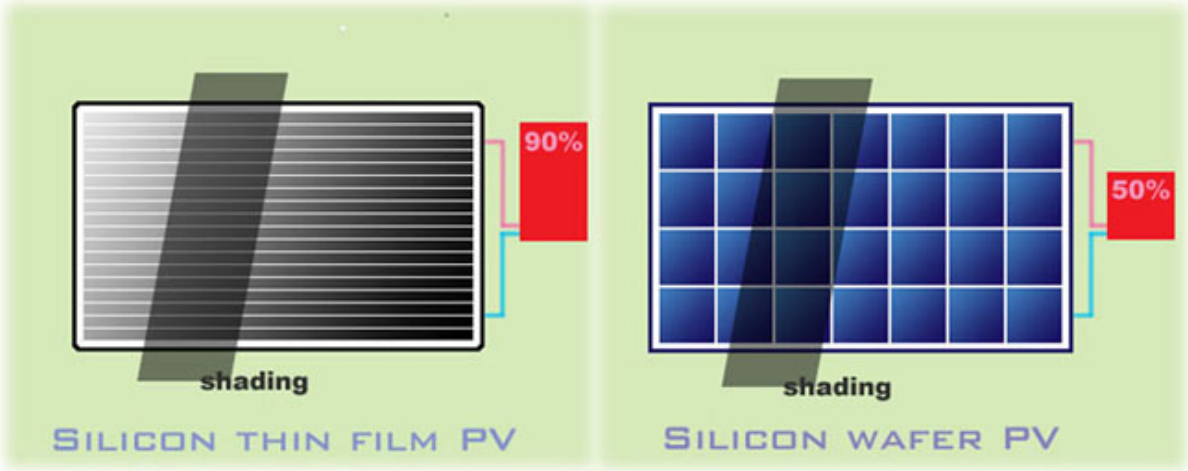
# Electrical Behaviour of SPV Modules Under Shadow

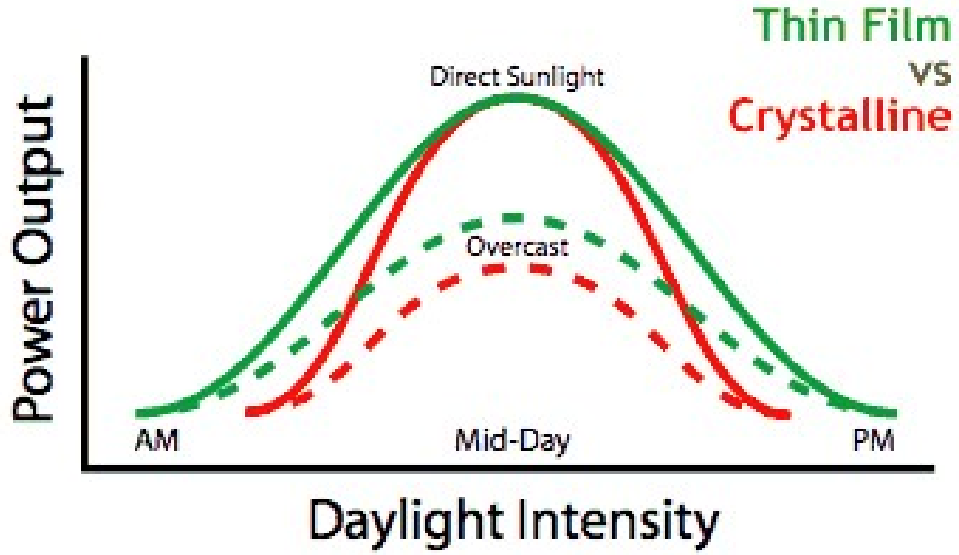


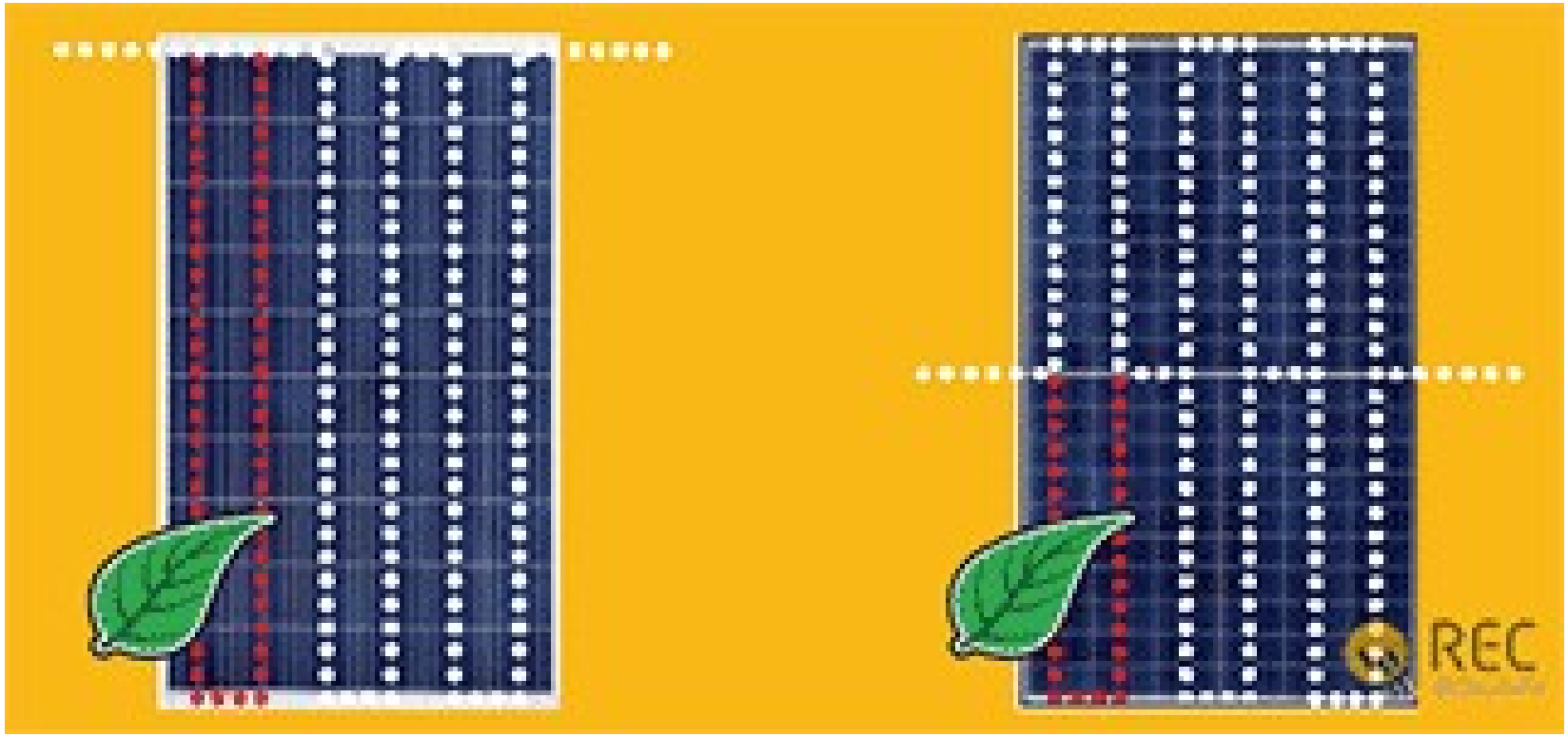


# Solar PV Module Technology

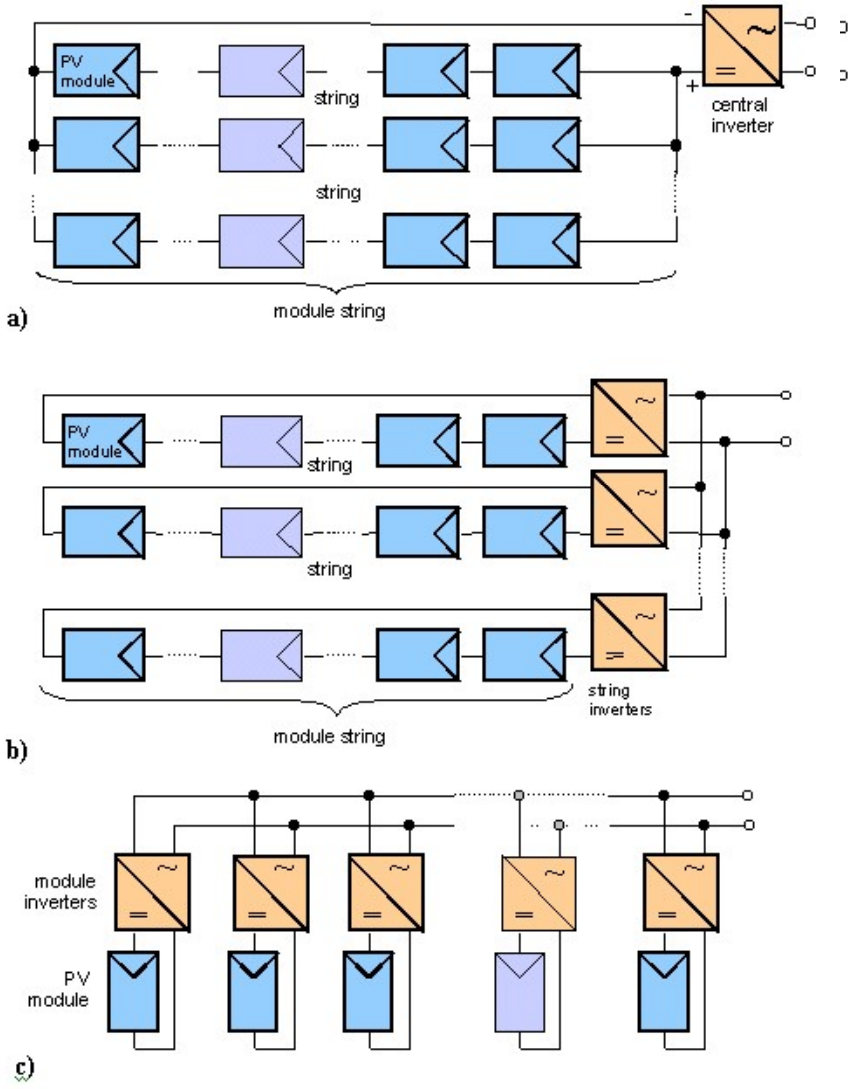


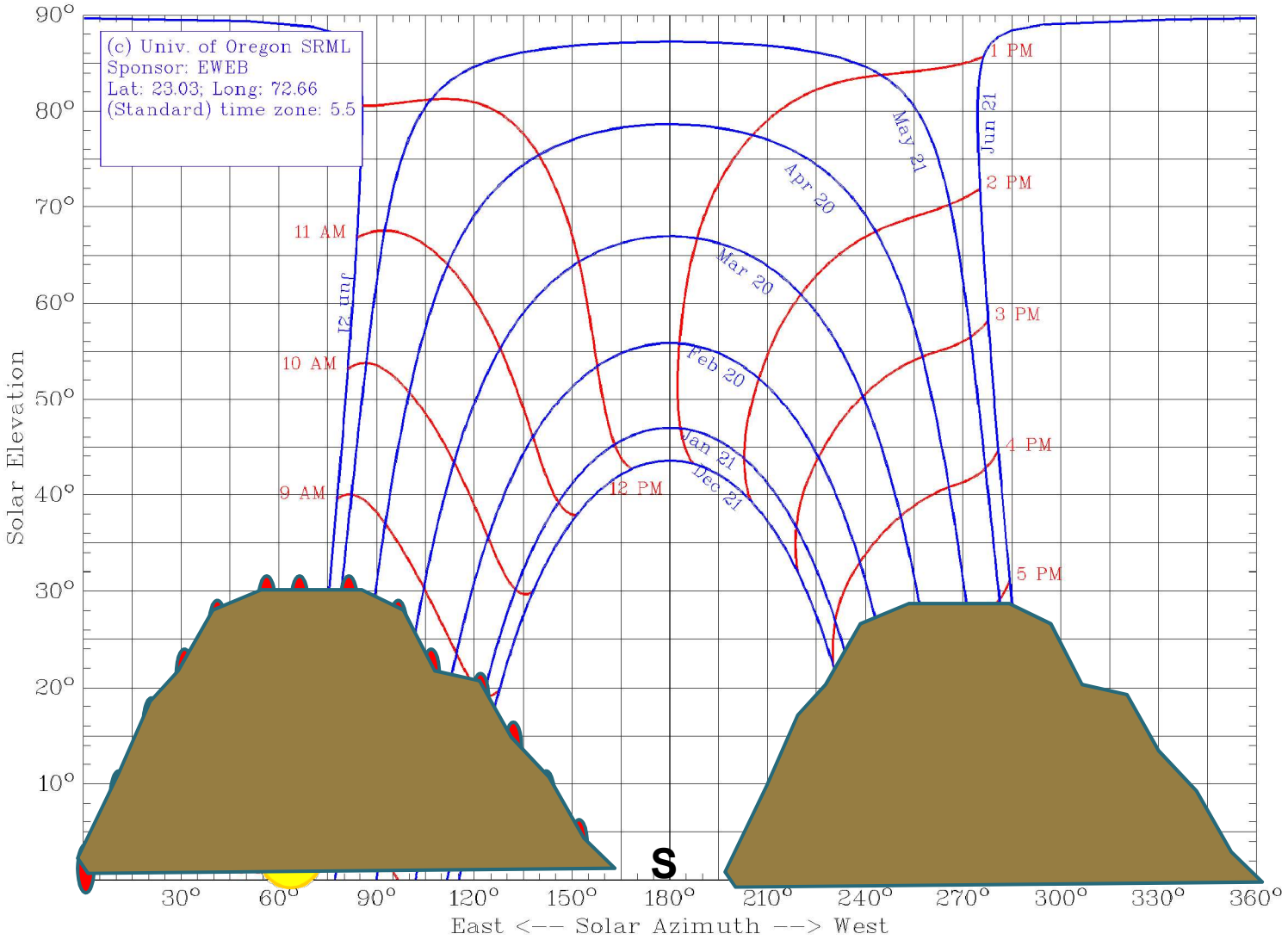
# Solar PV Module Technology- Half cut cells



# Inverter Technology

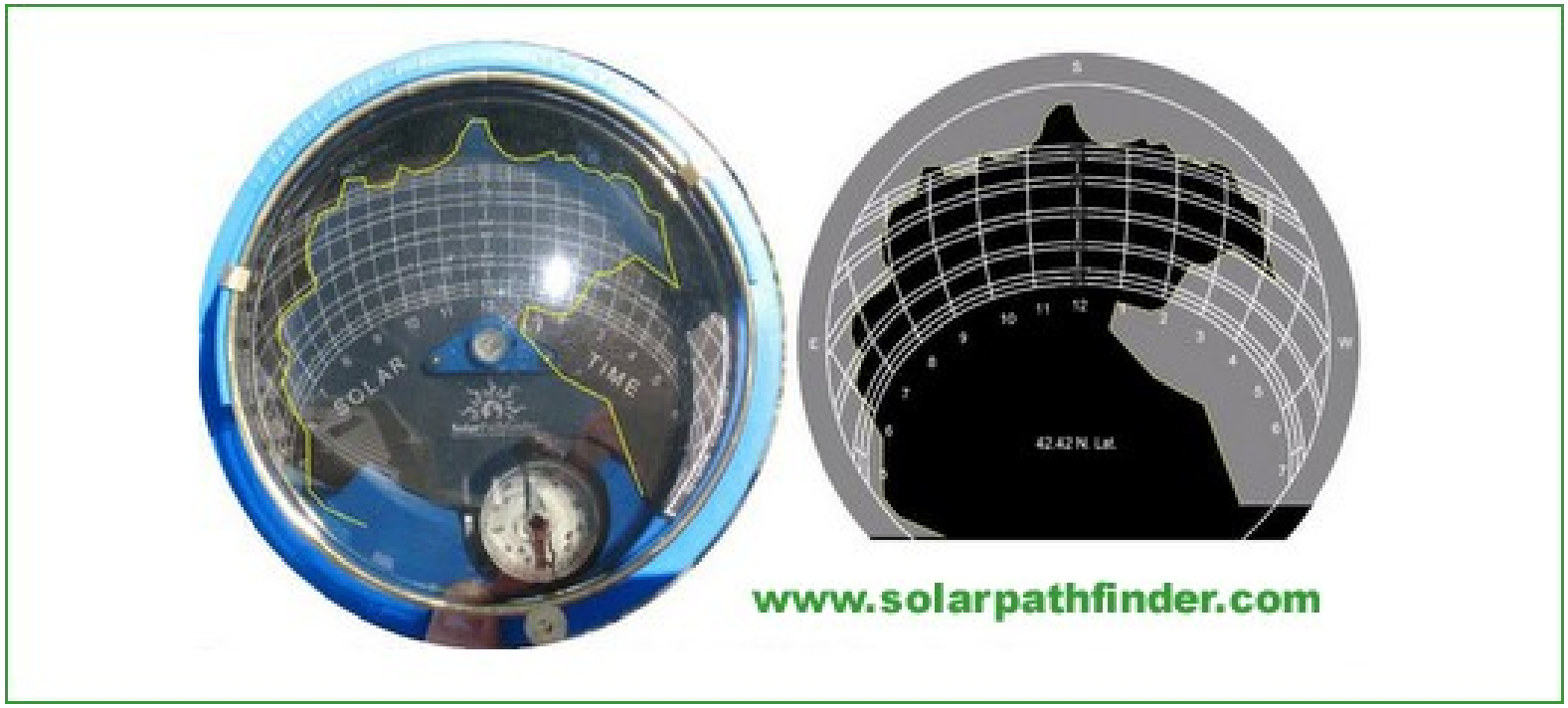



# Calculate Loss of Solar Energy for Shaded Period



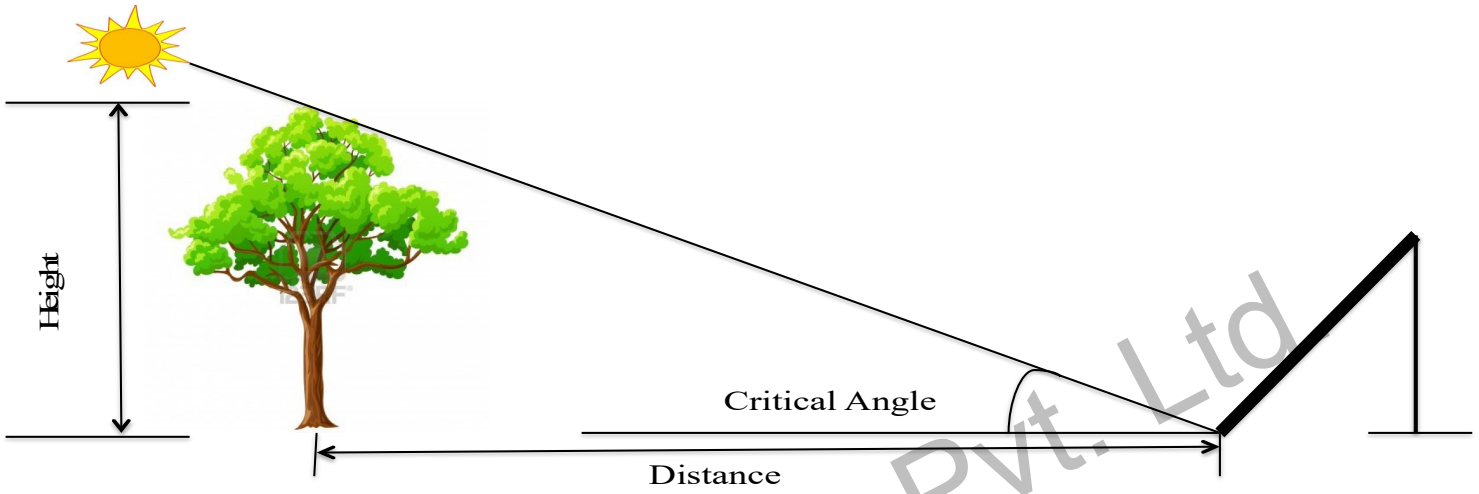
# Site assessment – Shadow analysis

- **Shadow analysis - using of sun pathfinder**

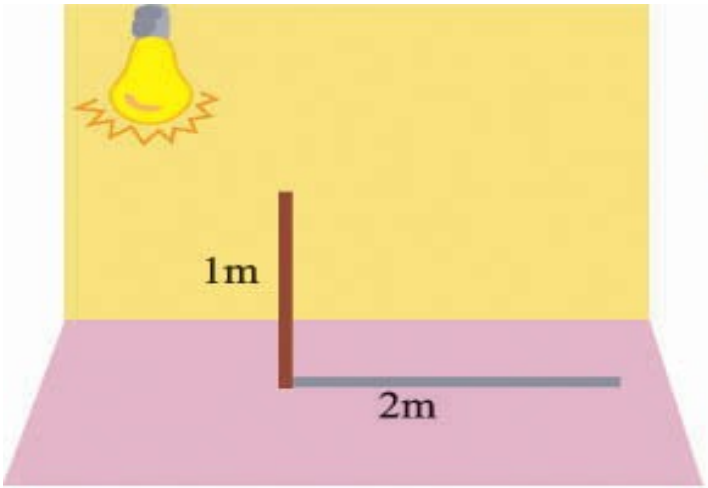


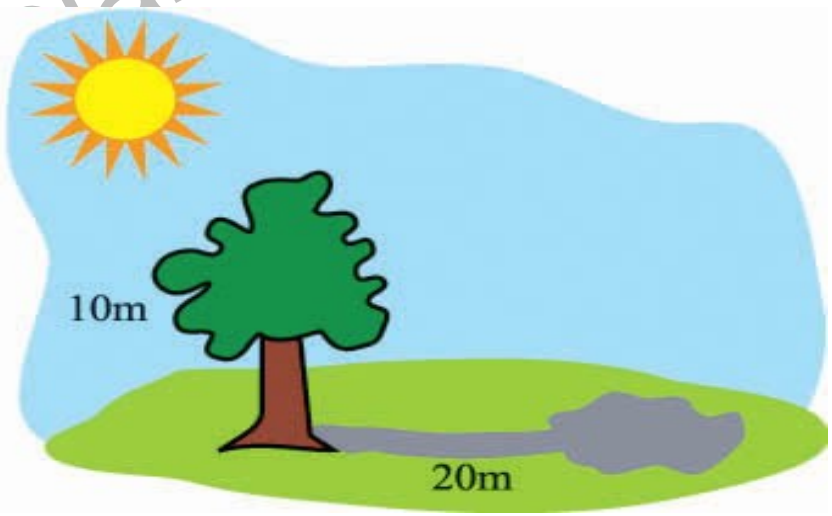
# Site assessment – Shadow analysis

- **Shadow analysis - using sun position (azimuth and altitude angle)**

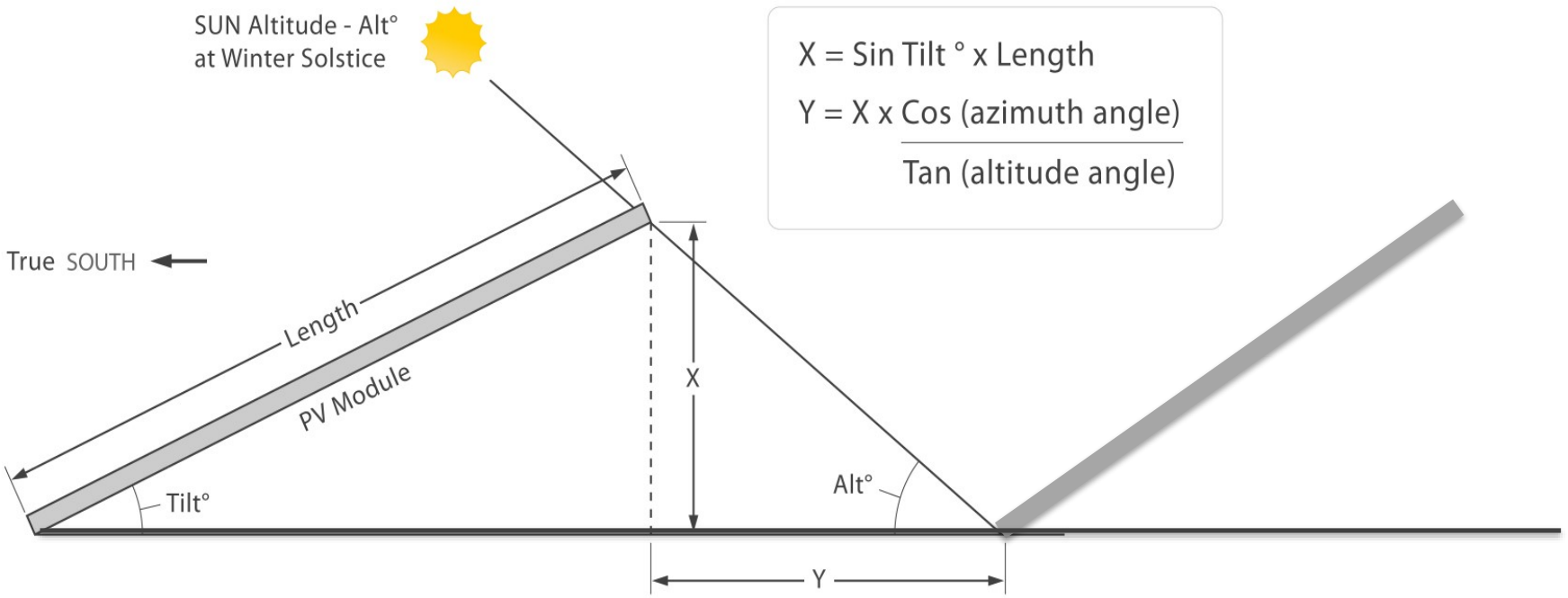



- **Shadow analysis –Thumb Rule**



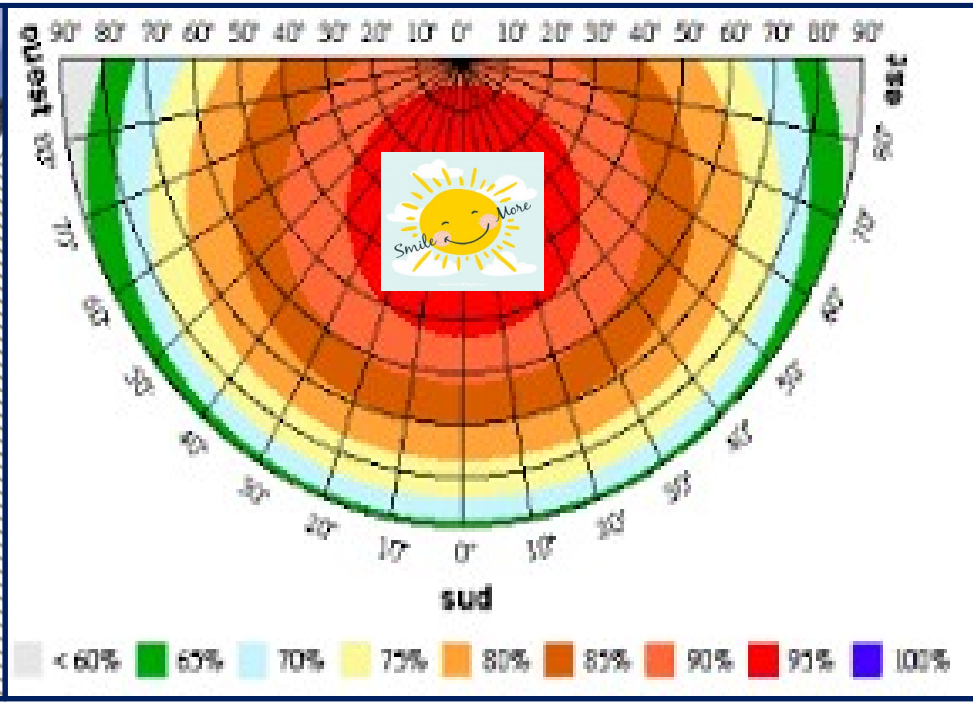
# Site assessment – Space between two rows



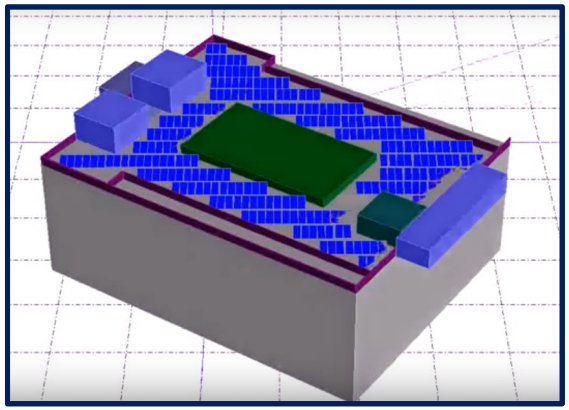

Row in the South

Row in the North

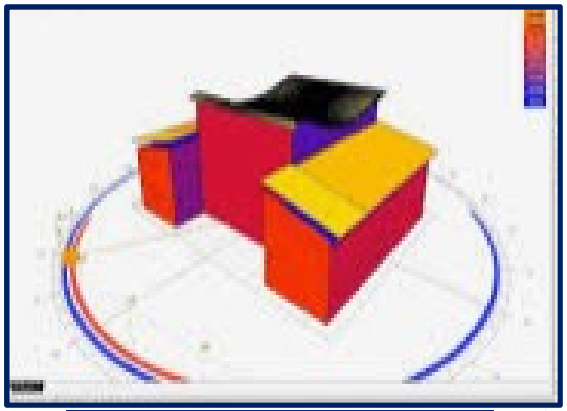
# Site asssesment – Array orientation and tilt



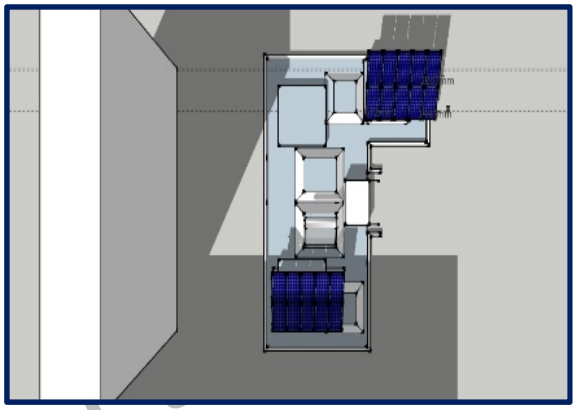
- **Shadow analysis – using Software**



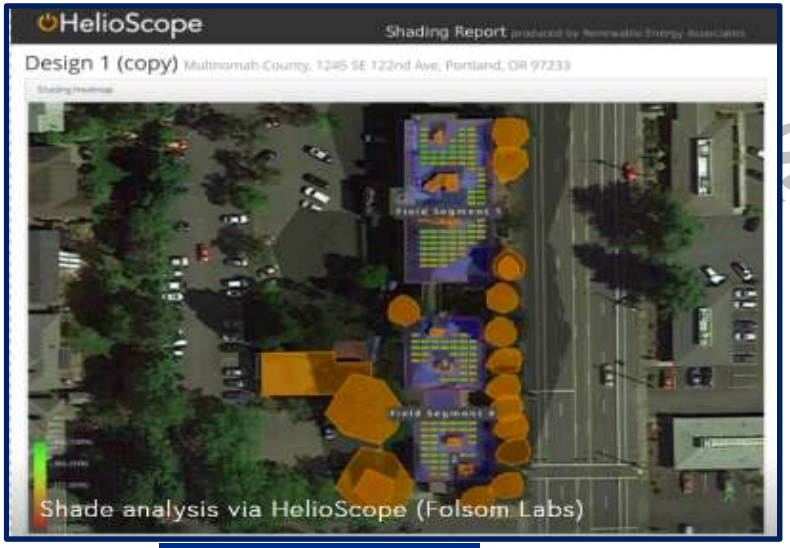
PV Syst



Autodesk Ecotect



Sketchup




Helioscope


Sun Analyzer

# Site assessment – Location of electrical equipment

- Location of inverter should be such a way that access is controlled
- Minimize distance from the Solar PV array  to reduce losses
- Protection from environment as needed by the inverter class
- Sufficient ventilation for cooling
- The location of overcurrent protection devices and/or load breaking disconnecting means should be at the end of the cable that is electrically most remote from the PV modules.

# Site assessment – Mounting of PV array

- PV array mounting arrangement would depend on the type of roof



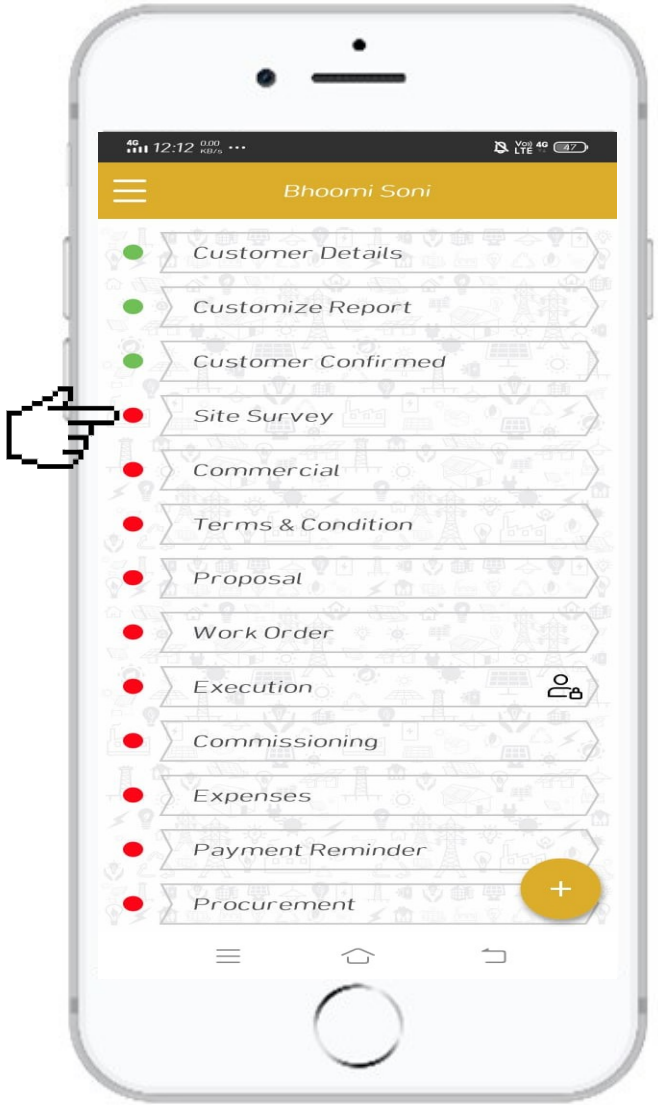

# Site assessment – Design consideration

- Load bearing capacity of roof depends of the age of roof
- Typically RCC Roof has a life of 100 years, Asbestos roof have much lower life at 30 years, Depending on the grade, corrugated metal has life span between 20 and 100 years.
- Usually the load of the structure including PV and the supporting structure varies from 30 Kg/m2 to 60 Kg/m2
- As per MNRE technical specification the total load of the structure should be less than 60 kg/m2.
- For large system a suitable walk-way will be required for maintenance purpose

# Site assessment – Design consideration

- Operating Temperature affects performance. Therefore arrays should be installed such way that there sufficient air flow/ ventilation for cooling
- High wind pressure can damage the structure and modules. Therefore mounting  structure should be opted such a way that there is minimum wind pressure
- High Humidity and salty atmosphere can corrode the structure and the extreme levels in the site should be known.
- Lightning strikes can damage the electrical equipment and some times the modules. So lightning vulnerability in the site should be known

# Site assessment – Site Survey



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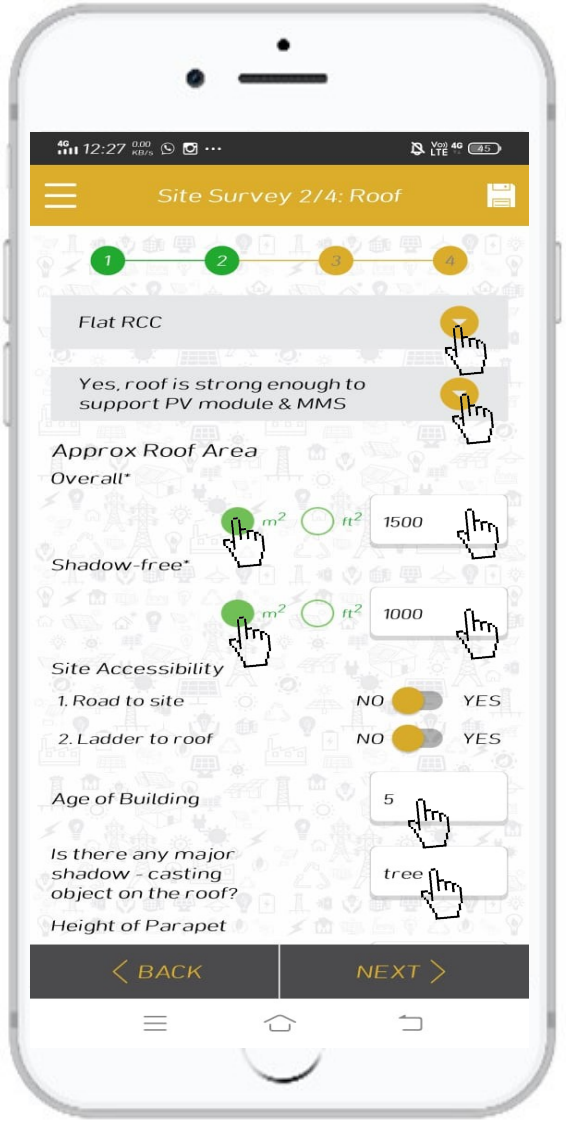


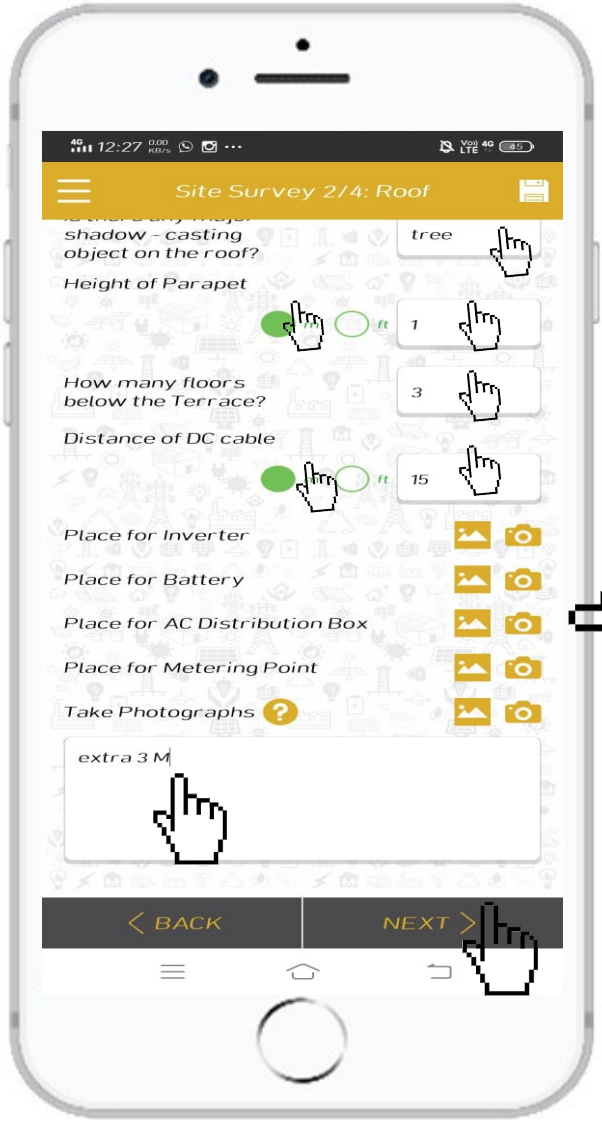

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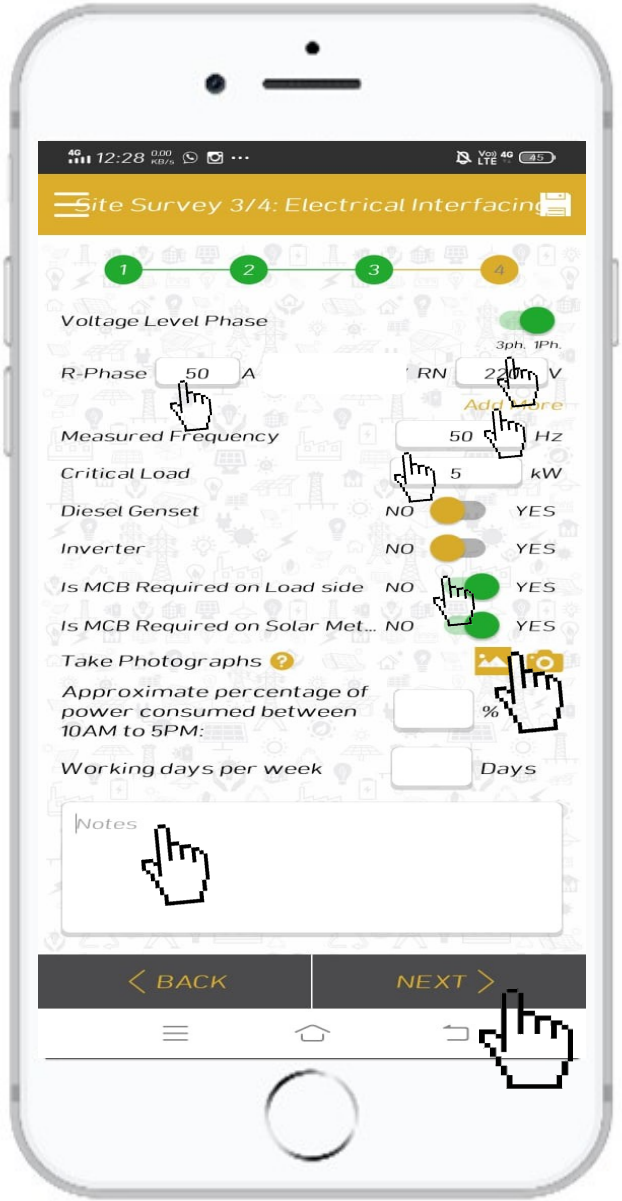

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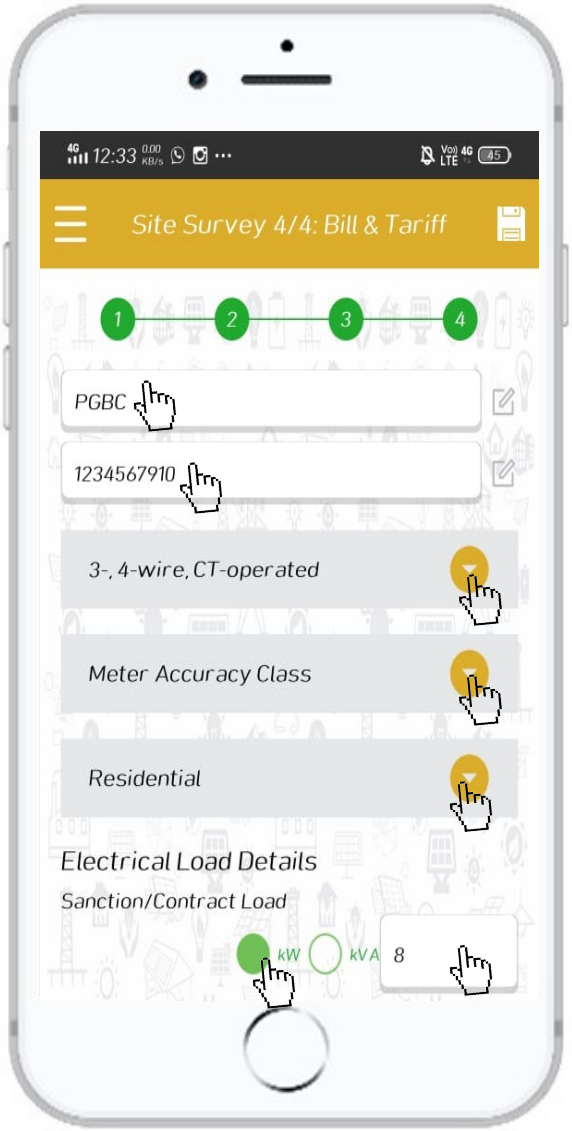
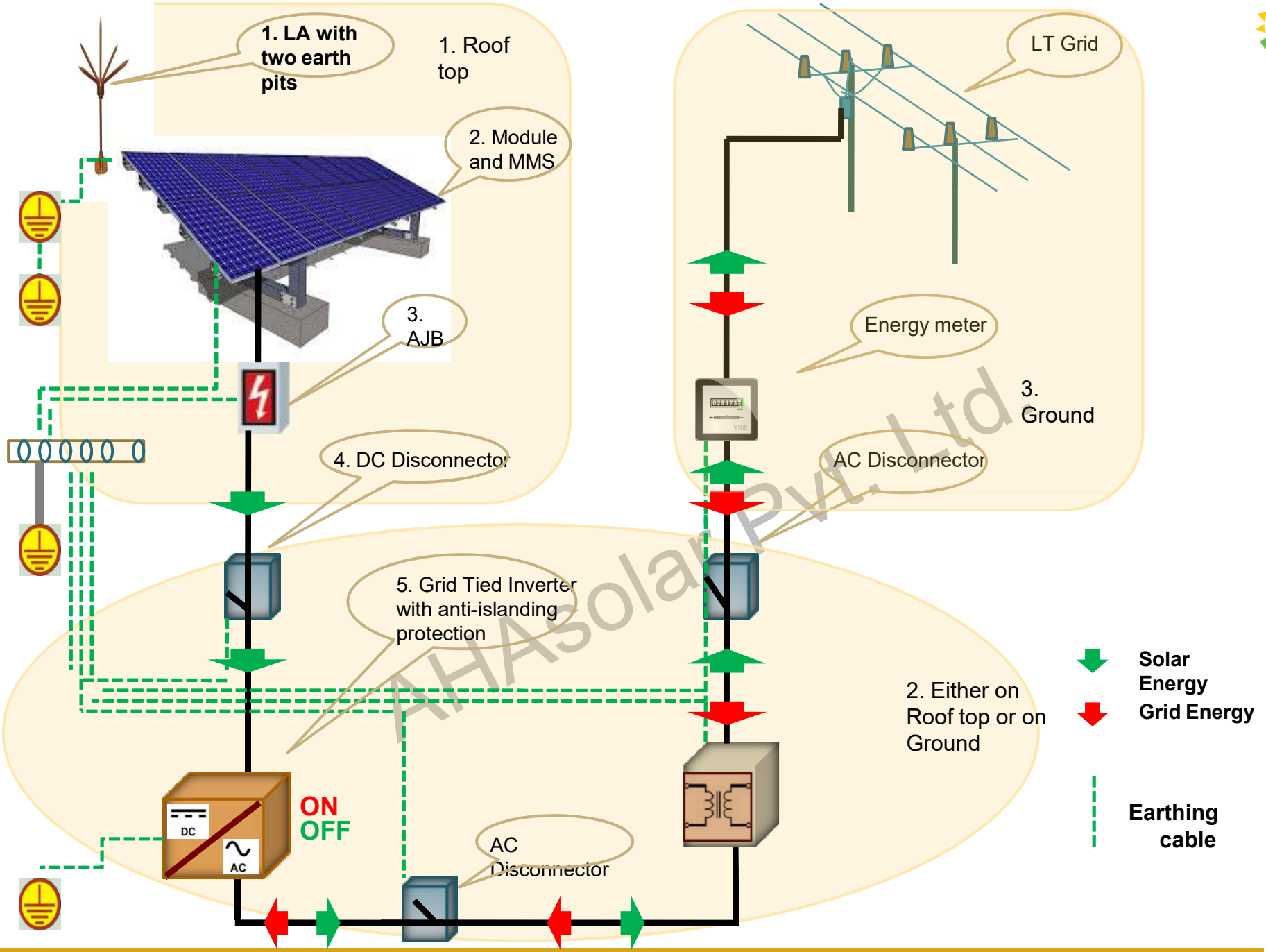



# Thank You



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