Course: Sustainable Energy Technology 1
12110598

Title: PV TECHNOLOGY –L12

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PV System –Tracking Systems

Manufacturers are constantly making incremental improvements to their solar panels to create a higher energy yield per unit than previous and competing models.

Another proven way to increase system output is by using solar trackers, which, unlike fixed-tilt ground-mount systems, make solar panels follow the sun's path throughout the day.

- Even though a fixed flat-panel can be set to collect a high proportion of available noon-time energy, significant power is also available in the early mornings and late afternoons.

- Thus the primary benefit of a tracking system is to collect solar energy for the longest period of the day, and with the most accurate alignment as the Sun's position shifts with the seasons.

- In addition, the greater the level of concentration employed, the more important accurate tracking becomes, because the proportion of energy derived from direct radiation is higher, and the region where that concentrated energy is focused becomes smaller.

PV System –Tracking Systems

Solar collector mounting systems may be fixed (manually aligned) or tracking.

Tracking systems may be configured as:

Moving collector-PV systems

Fixed collector / moving mirror – CSP systems

Non-tracking fixed mount

Residential and small-capacity commercial or industrial rooftop solar panels and solar water heater collectors are usually fixed.

Advantages of fixed mounts over trackers include the following:

1- **Mechanical Advantages:** Simple to manufacture, lower installation and maintenance costs.

2- **Wind-loading:** it is easier and cheaper to provision a sturdy mount; all mounts other than fixed flush-mounted panels must be carefully designed having regard to wind loading due to greater exposure.

3- **Indirect light:** approximately 10% of the incident solar radiation is diffuse light, available at any angle of misalignment with the Sun.

PV System –Tracking Systems

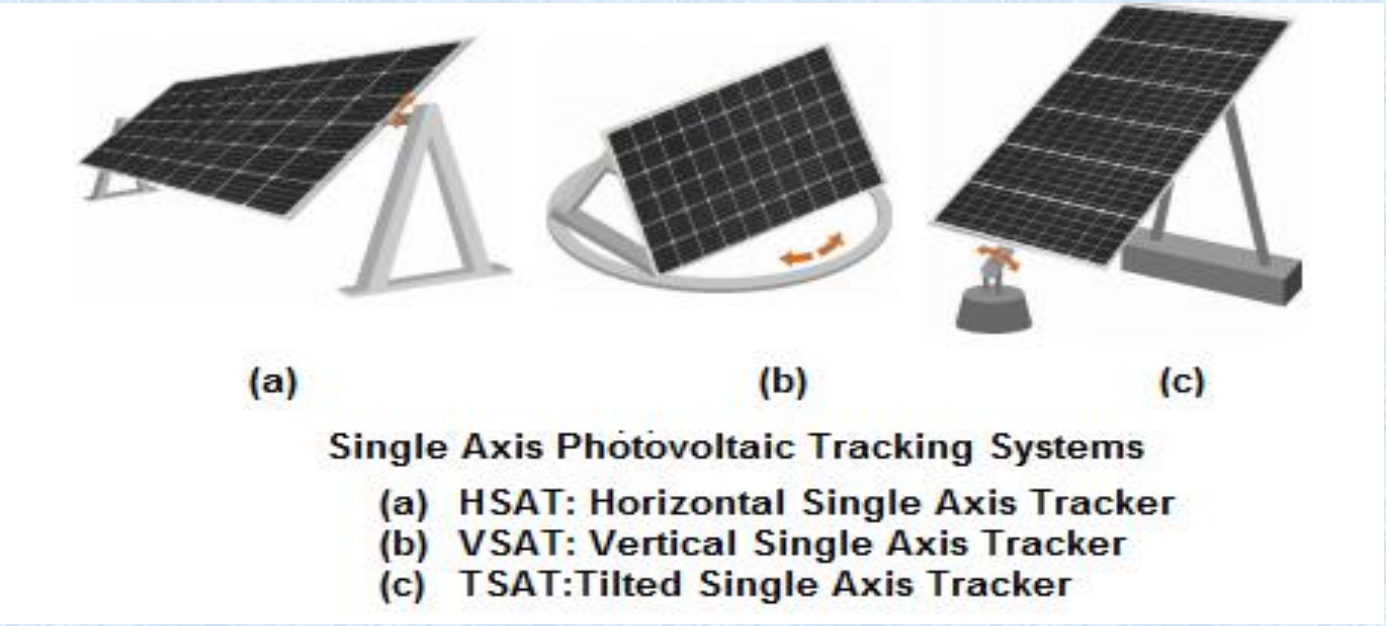
Single axis trackers

Single axis trackers have **one degree of freedom** that acts as an axis of rotation.

The axis of rotation of single axis trackers is typically aligned along **a true North meridian.**

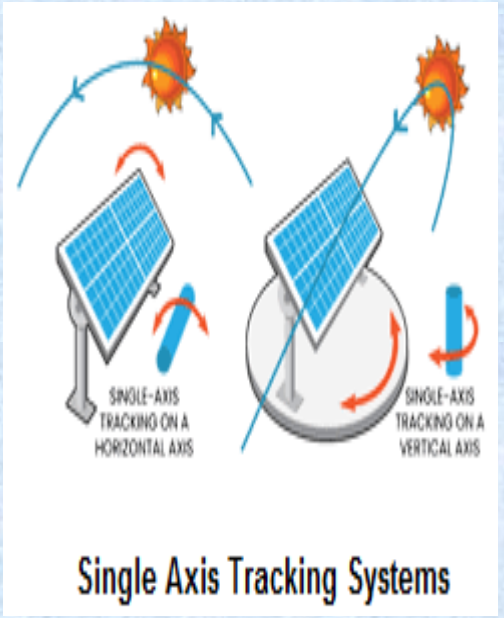
It is possible to align them in any cardinal direction with advanced tracking algorithms.

There are several common implementations of single axis trackers.



Single Axis Photovoltaic Tracking Systems

(a) HSAT: Horizontal Single Axis Tracker
(b) VSAT: Vertical Single Axis Tracker
(c) TSAT:Tilted Single Axis Tracker



Single Axis Tracking Systems

PV System –Tracking Systems

Single axis trackers

Single-axis trackers are split into **centralized and decentralized tracker types**. Centralized or distributed trackers use a single motor to power a driveline between rows that will move an entire segment of panels.

Decentralized systems have one motor per tracking row

PV System –Tracking Systems

Dual axis trackers

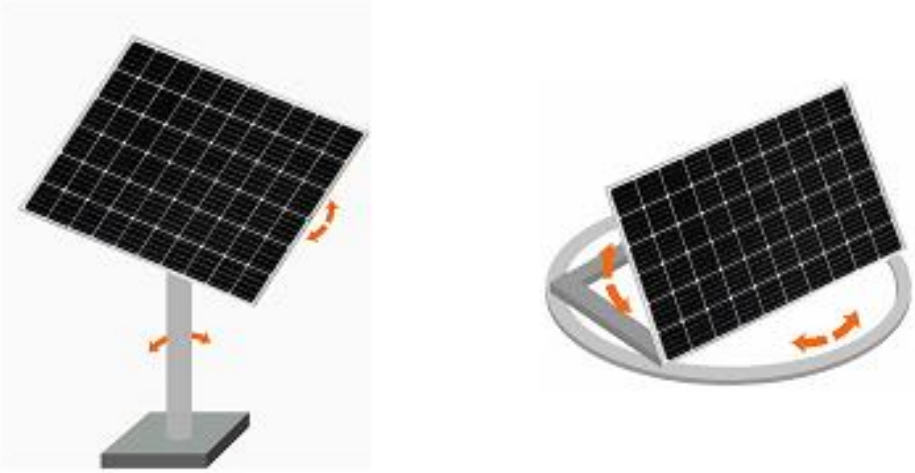
- Dual axis trackers have **two degrees of freedom** that act as axes of rotation. These axes are typically **normal to one another**. The axis that is fixed with respect to the ground can be considered a primary axis.

- Dual axis trackers allow for **optimum solar energy** levels due to their ability to follow the Sun vertically and horizontally. No matter where the Sun is in the sky, dual axis trackers are able to angle themselves to be in direct contact with the Sun.

PV System –Tracking Systems

Dual axis trackers Types

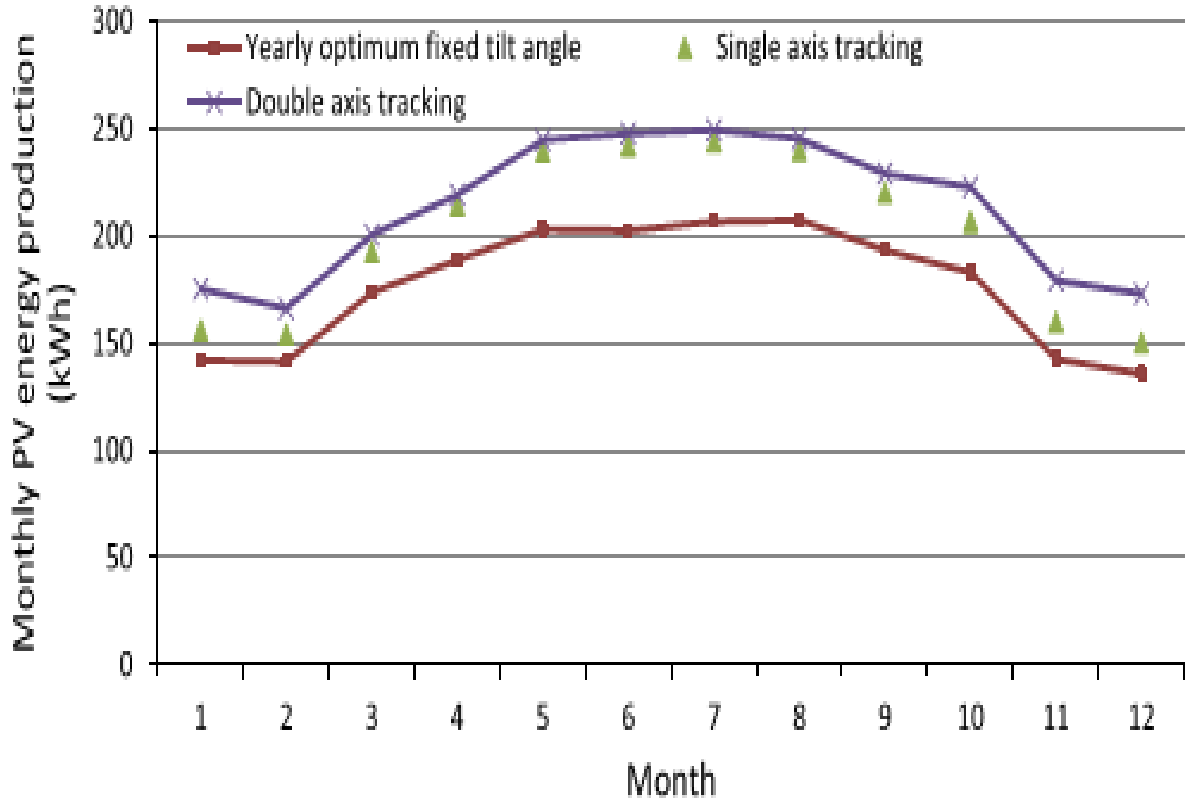
- The axis that is referenced to the primary axis can be considered a secondary axis. There are several common implementations of dual axis trackers. They are classified by the orientation of their primary axes with respect to the ground. Two common implementations are tip-tilt dual axis trackers (TTDAT) and azimuth-altitude dual axis trackers (AADAT).



Dual Axis Photovoltaic Tracking Systems
(a): TTDAT: Tip-Tilt Dual Axis Tracking System
(b): AADAT: Azimuth Altitude Dual Axis Tracking System

TTDAT has its primary axis horizontal to the ground, while the secondary axis its normal to the primary axis
AADAT has its primary axis vertical to the ground, while the secondary axis is normal to the primary axis

PV System –Tracking Systems



Monthly energy production by a 1 kWp PV panels fixed on an inclined surface by a yearly optimum tilt angle or fixed on a single axis or double axis tracker.