SOLAR PHOTOVOLTAIC (PV) TRACKING SYSTEM FOR LARGE SCALE SOLAR POWER PLANTS

By Mahindra Susten Pvt Ltd

Many large scale PV plants being installed today have solar panels mounted on fixed structures, which leads to lesser generation as they are fixed only at a particular angle. To capture maximum solar insolation, a solar tracker system can be designed which changes its position automatically in accordance with the sun's movement.

A PV solar tracker is a system that orients a Solar PV panel toward the sun. Trackers are used to minimize the angle of incidence between the incoming sunlight and a photovoltaic panel. This increases the amount of energy produced from a fixed amount of installed power generating capacity. Thus the primary benefit of a tracking system is to collect solar energy for the longest period of the day.

Figure 1 shows typical comparison of fixed Vs horizontal single axis tracking system. The 'output power with a tracker' increases by 16% to 24% as against fixed tilt system depending on site location and array layout. Typical increase over 'fixed tilt' system in various parts of India can be seen in Figure 2.

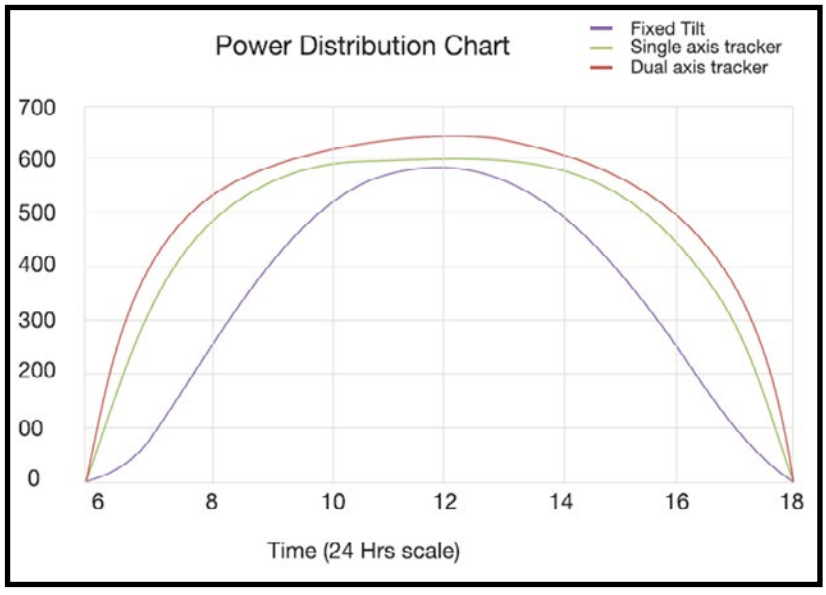

Figure 1: Daily power generation comparison for fixed and single axis tracker

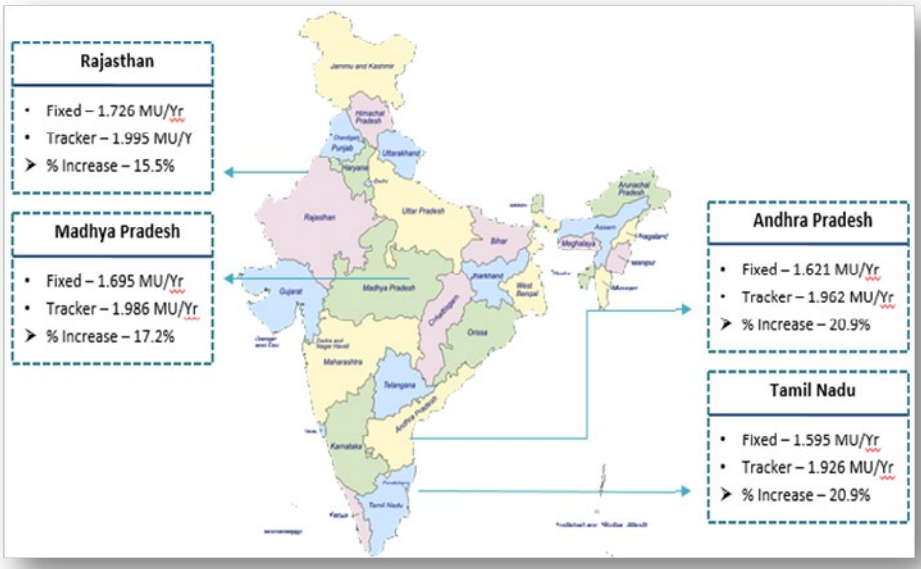

Figure 2: Comparison of Tracker system over Fixed Tilt System (These are indicative numbers and actual analysis with site coordinates are needed for calculations)

To improve generation and optimally use the land it thus becomes imperative to install trackers. The additional benefits reaped by installing trackers overweighs the incremental capex costs of tracker. Indian PV industry has seen a record low tariffs that are leading to IRR pressures for developers. Installation of trackers will help ease these pressures for the developer by improving the IRR by 2-3% over fixed tilt systems.

The most popular tracker systems used are:

a. Single Axis Solar Tracking System:

These have one degree of freedom that acts as an axis of rotation thereby ensuring perpendicular incidence between the sun and the panels. The axis of rotation of single axis trackers is typically aligned along a true North meridian, and advanced tracking algorithms allow movement in any direction. Horizontal single axis tracker, and tilted single axis tracker are the most common variants of these trackers.

b. Dual Axis Solar Tracking System:

These trackers have two degrees of freedom that act as axes of rotation. These axes are typically normal to one another. 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.

c. Seasonal Tracker:

These trackers provide flexibility of changing the orientation and tilt angle of the panel during various seasons. Often, these trackers are used for changing the angle every 4 months and help achieve 4% to 5% additional generation. However, the manual operation and the limitation of not being able to track the sun every day makes them an unattractive proposition.

Selection of Tracker:

Multiple factors including installation size, electric rates, government incentives, land constraints, latitude, and local weather are used for deciding the type of tracker. Horizontal Single Axis Trackers (HSAT) are typically used for large distributed generation projects and utility scale projects. As these are commercially viable and lead to substantial energy improvements, they become the preferred choice for large scale installations. In addition, the strong afternoon performance is particularly desirable for large grid-tied PV systems so that production will match the peak demand time. Substantial amount of productivity is achieved during the spring and summer seasons when the sun is high in the sky through HSAT. HSAT systems over the last few years have improved significantly, thereby increasing the robustness of the system without any additional complexity or maintenance. Single row tracking provides better cleaning access and inbuilt back-tracking algorithms prevent shading. On the other hand dual axis trackers are not only cost prohibitive but also add considerable costs to maintenance. Panel accessibility is also a challenge in dual axis trackers thus limiting their usage to smaller residential installations. The IRR with HSAT trackers improves by 2%-3% as against 0.5%-1% in seasonal trackers when compared with fixed tilt systems. The technology and reliability improvements in HSAT makes it the preferred choice for tracking systems.

Trackers helps improve efficiency, still, they have not been widely deployed in the solar industry. Most developers have reservations regarding reliability, installation difficulty and environmental suitability of trackers. Mahindra Susten has developed in-house Horizontal Single Axis Tracker (MSAT-100) which overcomes traditional disadvantages of using trackers. MSAT is self-powered, and hence doesn't require any additional cabling at site. The entire system has been designed keeping Plug and Play philosophy in mind which allows easy installation without any welding requirement. Each row is independently tracked, thereby making both installation and maintenance easy. It comes with Auto Stowing features and its mechanical components have been tested for 25 years to ensure reliability. The Wireless Integration helps control and monitor the tracker's Critical Parameters with minimal cabling. It allows real time monitoring of the additional benefit of tracker over fixed tilt system. Mahindra Susten's installation of 2.7MW tracker system at two sites in TN & AP have started showing benefits ~19% at site. Susten also has another 8.5 MWp of trackers under installation. Susten's experience in solar industry of over 654MWp has gone into the design of these trackers thereby making it the Best in Class.