feature **f** solar tracker

Track Them Down!

Aggressive competitive bidding has increased the need to explore means of reducing the cost of generating power, and with solar tariffs down to a level no one imagined, trackers are the only known technology which can enable 10-20 per cent reduction of LCoE, thereby becoming the preferred option.

Renewable Energy (MNRE) the country added 5,526 MW of new solar capacity (up 83 per cent over FY15-16). While these numbers are impressive, it is worth noting that the solar capacity addition including rooftop solar is almost 50 per cent below the annual target of 12,000 MW.

In case of solar tariff, the disruption has already started, and according to analysts, it is likely to go further down from the current Rs 2.44/kWh level. Ironically, the sector, in the coming six months will witness an intense competition from major and minor players. Although, the sentiments looks visibly positive, but in a quest to improve solar portfolio, the players have overlooked one important factor – the performance of a solar plant. How, is the question, nevertheless SOLAR TODAY has the answer.

Despite abundance of solar power in India, the availability of the same varies widely with time. As sunlight varies daily due the day-night cycle and depends on seasons, the time available for solar power generation is limited. Hence, to avoid such limitations and to capture maximum solar insolation, a solar tracker system can be designed which changes its position automatically in accordance with the sun's movement.

The developed economies around the globe entering into large scale ground mounted solutions are investing only into tracking. The US has about 75-80 per cent penetration of ground mounted tracking today. Whereas a country like India, blessed with abundant sunlight, is languishing at around five per cent penetration of tracking technology.

WHY SOLAR TRACKER?

There are many reasons to believe, but essentially increasing the output performance of solar plant tops the chart. As **Vinay Goyal, Chief**



QUICK FACTS

- Installations of solar trackers will reach 3-4 GW by 2020 in India.
- India solar industry will remain in focus with 9 GW installations planned in 2017.
- Asia Pacific solar tracker market is expected to witness significant gains by 2022.
- Global solar tracker market will reach \$6.83 bn by 2022.
- Tracker technology can give an incremental power output of 15-25 per cent.

Executive Officer, Ganges

International (P) Ltd explained, "compared to a fixed mounted PV system, the use of tracker technology can give an incremental power output of 15-25 per cent, depending upon the location being installed."

He added, "It is the nature of the system to track the sun at every point of time (based on the algorithm) from dawn to dusk, hence helping in generating maximum generation from the same solar panel used for fixed ground mounts."

On a price performance basis, the solar tracker has an advantage. Consider this: The fixed tilt plant with a capex of around Rs 4.75 crore, generates approx 15.70 lakh kWh units. This gives an unlevered Internal Rate of Return (IRR) of 16.73 per cent and a levered IRR of 19.98 per cent. With the installation of trackers though, there will be a 10 per cent increase in capex, the plant will generate 18.88 lakh kWh units, an increase of 20 per cent from fixed installation. That said, unlevered IRR will increase by 1.78-18.51 per cent and levered IRR will witness an increase of 22.67 per cent, compared to a fixed tilt plant.

INNOVATION AND EVOLUTION

At present, solar tracker companies such as NEXTracker, AllEarth

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India, blessed with abundant sunlight, has around five per cent penetration of solar tracking technology.

Renewables, Scorpius Trackers, L&T, Ganges International and Vikram Solar has made some amazing technological developments. To begin with, Vikram Solar's HELITRAC can change the solar industry by further improving PV efficiencies. It can change its orientation throughout the day to follow the sun's path to maximise energy capture; and allows east-west land undulations up to 3-5 degrees. Additionally, its IP65 gears and drives make the system weather proof and robust. The product is a breakthrough development, as it introduces certain unique features for the first time in India that includes link tube with

articulated joints, dust avoidance and rain mode.

Highlighting the importance Siddhartha Sengupta, President-Engineering, Vikram Solar commented, "In large scale MW projects, utilisation of sun tracking systems is becoming increasingly prevalent as it enables developers to make maximum utilisation of available land by generating more electricity even from a shredded down DC capacity."

In case of Ganges International, the company in a joint venture with SunLink is supporting India's 100 GW National Solar Mission.



Under the agreement, Ganges manufactures, install and provide O&M support for SunLink TechTrack single-axis trackers in India. SunLink will provide not only its proven technology but also PowerCare engineering services and VERTEX software platform to Ganges and its customers. The solution is based on hydraulic technology which no other competitors possess or have introduced in the market.

"Hydraulics is always superior in handling larger loads with very low operation and maintenance cost. Only one actuator is used for handling 1.2 MW capacity plant. It is a single axis horizontal tracking system with tilt angle of +- 52.5 degree which is compatible for all major module manufacturers," explain Goyal.

Meanwhile, L&T is India's only EPC player to execute solar trackers using solar PV and concentrated solar project (CSP) technology. L&T is India's first company with a portfolio of approx. 140 MWp solar tracker projects. Said **Paintamilselvan M S, Product Manager, L&T Solar Tracker**, "L&T has constructed India's largest azimuth tracker based power plant during 2011 in Gujarat. It is been consistently rated as the plant with highest PLF (Plant Load Factor) for past 6 years as per data published by Gujarat government."



Panels with solar trackers need to be spaced out so one does not shade out another; this requires proper project implementation.

L&T's horizontal single-axis solar tracker, designed in-house, moves 1,200 solar panels mounted on 30 rows using a single gear drive housed in the middle. The movement is synchronised with precision of ± 1° even in desert winds. This technology evolved during the last five years. The benefits of this technology are multifold: enhanced solar energy production, sustainable use of land and other resources, reduced CO₂ emissions and more affordable solar energy.

NEXTracker which has recently achieved 1 GW of solar tracker in India has incorporated control systems into their trackers which monitor the angle of each row of solar panels in real time and report back on tracking accuracy in order to keep panels facing directly into the sun all the time. The company's NX Horizon product is a self-powered tracker (SPT) which has a self-contained motor, enabling it to be deployed on each row of panels which in turn eliminates wiring and trenching as well as saving power. Notable projects and awards include the largest solar plant in the state of Punjab (100 MW), installed by Adani and seven SkyPower projects totalling 400 MW, both utilising NEXTracker's NX horizon trackers.

AllEarth Renewables' Dual-axis Solar Tracker seems like an amazing new development in the solar segment. AllEarth's tracker uses GPS and wireless technology to track sun's arc in sky throughout the day. The result? Soaking up 45 per cent more energy than traditional rooftop solar. Over 4,000 trackers have already been installed, and AllEarth is poised to take the rest of the solar market by storm. The trackers are designed for residential, commercial and industrial operations, along with small and large utility-scale installations.

Mahindra Susten has developed in-house horizontal single axis tracker (HSAT) (MSAT-100) which overcome 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 Tamil Nadu and Andhra Pradesh, have started showing benefits, approx. 19 per cent at site. Susten also has another 8.5 MWp of trackers under installation. Susten's experience in solar industry of over 654 MWp has gone into the design of these

POPULAR TRACKERS

There are two types of tracker technologies being used in India centralised and distributed. The major difference between the two is the number of structures that it can drive and the type of drive technology hydraulic and motor gearbox assembly. Indian market has both these technologies for different types of capacities on ground.

Centralised tracker can drive as big as 1.2 MW of solar block, whereas distributed tracker can drive only 300-500 kW of solar block. Thus, because of fewer components in case of centralised tracker, there are less chances of failure and are easily serviceable. Therefore, centralised finds more customers globally when opting for a large scale projects.

Single Axis Tracker: These have one degree of freedom that acts as an axis

Solar Installations in India/Capacity (in MW)

FY	2017 (Est)	2018 (Est)	2019 (Est)
Total	10,500	16,000	25,000
%increase	55%	52%	56%
Tracker installations	1050	3100	7200
%increase	10%	19%	29%

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.

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.

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 four months and help achieve 4-5 per cent additional generation. However, the manual operation and the limitation of not being able to track the sun every day makes them an unattractive proposition.

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 per cent as against 0.5-1 per cent in seasonal trackers when compared with fixed tilt systems. The technology and reliability improvements in HSAT makes it the preferred choice for tracking systems.

TRACKING THE MARKET

The Indian solar tracker market is still evolving with installed capacity of below 2 GW. Steep fall in tariff, localisation of technology, government policies and techno savvy investors were the major factors driving tracker market. Two third of current installed capacity has come up in past three years with compounded annual growth rate (CAGR) of 65 per cent.

"Indian tracker market is expected to maintain a year-on-year growth of 34 per cent," believes Paintamilselvan M S. A fall in module prices and reduced plant CUF criteria (below 20 per cent) in certain tenders have slowed down the market demand. However, industry is keeping close watch on recent developments such as increasing module prices, antidumping petitions and constraints in land acquisition.

Also, advancement in energy storage, scheduling and forecasting requirements will to play crucial in tracker deployment going forward. In addition, tracker's ability to provide more stable generation to grid during early morning and evening hours is under consideration too.

FACTORS TO BE CONSIDERED

Multiple factors including installation size, electric rates, government incentives, land constraints, latitude, and local weather are used for deciding the type of tracker. That said, all agree that return on investment (RoI) is the umbrella factor to be considered while adopting any technology and there is variety of factors that effects Rol while deciding to adopt solar trackers.

Land constraints being the most important factor, and it concerns **Ashish Khanna, ED & CEO, Tata Power Solar**. He adds, "Panels with solar trackers need to be spaced out and typically require 6-6.5 acres so that continuous movement and consequent tilting of one panels does not shade out another panel or else it shall reduce power output immensely." This requires proper project implementation.

"There are backtracking technologies available that help avoiding shading effects, however that comes for the additional cost," Khanna warns.

According to him, operational & maintenance costs have to be taken into account as an additional constituent. If solar trackers break down (they are more likely to be damaged in stormy conditions compared to panels) it leads to significant dent in energy production. Moreover, a solar tracker comes with an average warranty of 5-10 years, while the panels have the warranty of 30 years.

Here, Paintamilselvan from L&T advice to consider maintenance philosophy, spares management, warranty and services support for lifetime as these are crucial factors to select solution partner. "In roof top segment, the viability needs to be assessed in detail considering multiple factors like load bearing capacity, roof pitch, wind effects and shadow objects due to surrounding," he said.

Largely, land constraints, weather, and latitude, beside other considerations like electric rates, government incentives, etc., are the factors that impacts the decision of using solar tracker in a project. Given the current pricing of modules, trackers and the cost benefit analysis, off late not many developers are opting for trackers.

- RAHUL KAMAT