Tracker technology continues to advance as applications diversify

Balance of system | The worldwide market for trackers is developing rapidly and so too are the technologies they use. Mark Osborne reports on some of the latest design innovatoins that are helping drive trackers into new markets and applications

Credit: Array Technologies

PV tracker technology and designs have advanced in recent years, notably with the increasing adoption of the technology for utility-scale PV power plants. Further market penetration of tracker systems, notably single-axis trackers is expected in 2018.

However, innovation in tracker design is not being dictated by cost reduction strategies alone; emerging markets and new solar cell technologies such as bifacial, which promise higher yields than conventional monofacial modules, are demanding attention and provide tracker manufacturers with new market opportunities.

According to a new report from market research firm GTM Research, the solar tracker systems market in 2017 increased by 32% to a record 14.5GW, while global PV installations reached around 98GW in 2017, dominated by China, which installed over 53GW. GTM Research noted that the rapid pace of solar installations in Mexico and Brazil were behind the region beating the US for PV power plants using trackers as both countries deployed over 1.5GW of tracking systems in 2017.

Scott Moskowitz, senior analyst at GTM Research and author of the study said: "Mexico and Brazil are two of the fastest growing solar markets in the world, each accounting for over 1.5 gigawatts of tracker shipments in 2017. The US utility-scale market was significantly stunted last year due to tariff uncertainty, so it took a backseat to Latin America."

NEXTracker, which has manufacturing facilities in Brazil and Mexico, solidified its market share leadership, accounting for 33% of all trackers installed, with its nearest rival, Array Technologies accounting for 14% of installations.

Innovation in tracker design is helping the technology reach new markets and applications

The leadership position held by NEXTracker was further highlighted by the fact that after Array Technologies none of the other top 10 ranked tracker suppliers came close to a 10% market share, according to GTM Research.

"Fundamentals in the global utility-scale solar industry are excellent, and trackers are an obvious choice in most developing solar markets," added Moskowitz. "We expect 30% growth in 2018, with shipments approaching 20GW."

Tracker benefits and developments

One of the key drivers in the adoption of trackers in markets such as Mexico and Brazil has been the competitive project auctions that have created the need to maximise internal rate of return (IRR), while reducing the levelised cost of electricity (LCOE) to make projects in these countries viable to develop.

The adoption of tracker systems over fixed-mount systems seems to be in contradiction to LCOE and IRR metrics, yet the high irradiance allows PV modules to reach their highest potential output (yield) with single-axis trackers that is around 20% higher than when using fixed mounting.

In 2017, an independent study by TÜV Rheinland on Array Technologies's flagship tracker, the 'DuraTrack' HZ v3, was reported to have delivered US$0.04/WDC higher Net Present Value (NPV) and 6.7% lower LCOE, driven by 37% lower lifetime O&M

Credit: Soltec

Soltec has innovated in the supply logistics of its tracker products

costs to a typical PV power plant project.

It also deserves mentioning that the project of MecaSolar in Kortuteli, Antalya Turkey (4.6MWp with Hyperion-MR trackers) rated 1,962.34kWh/kWp in 2017, almost 7% higher than the expected figures and an estimated extra 22% yield compared to a fixed mounting structure.

However, the electricity output gain from using trackers in high irradiance regions is not the only consideration. In regions such as the northern Chile's Atacama Desert, access to remote areas and the scale of projects being developed can have a key bearing on tracker selection.

A good example was the recent supply win by single-axis solar tracker firm, Soltec that used its horizontal independent-row tracker 'SF Utility' on four different plants totalling around 46MW in the Atacama Desert as the tracker design is not only supply chain friendly but Soltec has innovated in the logistics of tracker supply.

The projects were said to have benefited from Soltec's 'Solhub' warehousing and logistics system that supplies unitised tracker components on site following the 'just-in-time' methodology without intermediary handling companies, and minimal additional on-site material handling. Soltec's stock inventory and shipping activity from five factory warehouse facilities across the globe are synchronised with regional operations and project schedules with the least on-site handling.

According to GTM Research Soltec, had an 8% global market share during 2017 with 1,097MW of trackers shipped. The company had stated that a key reason for its success was down to its SF7 tracker, which it claimed solved more project challenges with a set of standard features honed over years of field experience "to make shorter work of development and execution phases across variable situations and conditions".

The competitive tracker business landscape is not only leading to continued innovation in tracker design to reduce costs; new features are also being developed aimed at boosting system performance, a factor that becomes increasingly important when projects can incur lower than desired output due to losses from issues such as plant construction variabilities and terrain undulation as well as highly variable environmental conditions where plants can be sited.

In mid-2017, leading tracker firm NEXTracker launched its self-adjusting tracker control system for solar power plants. Its 'TrueCapture' technology is said to continuously refine the tracking algorithm of each individual solar array in direct response to existing site and weather conditions. As a result the company claimed that the technology delivering a 2-6% energy gain.

NEXTracker's also recently developed SCADA (Supervisory Control and Data Acquisition) system, which communicates bi-directionally with Flex's cyber-secure SmartNexus platform, accelerating tracker system commissioning by automating the tracker configuration steps.

The company highlighted recently that Enel Green Power's 754MW plant, located in Torreón, Mexico, achieved on-time delivery of 26,000 piers and 1,624 miles of torque tubes, enabling EPC firm, Swinerton to install at a rate of 100MW per-month.

The plant was said to have been able to start generating and selling electricity in December 2017, nine months ahead of schedule as each individual row could be commissioned sequentially as the project progressed.

Credit: NEXTracker

NEXTracker has introduced its self-adjusting TrueCapture technology

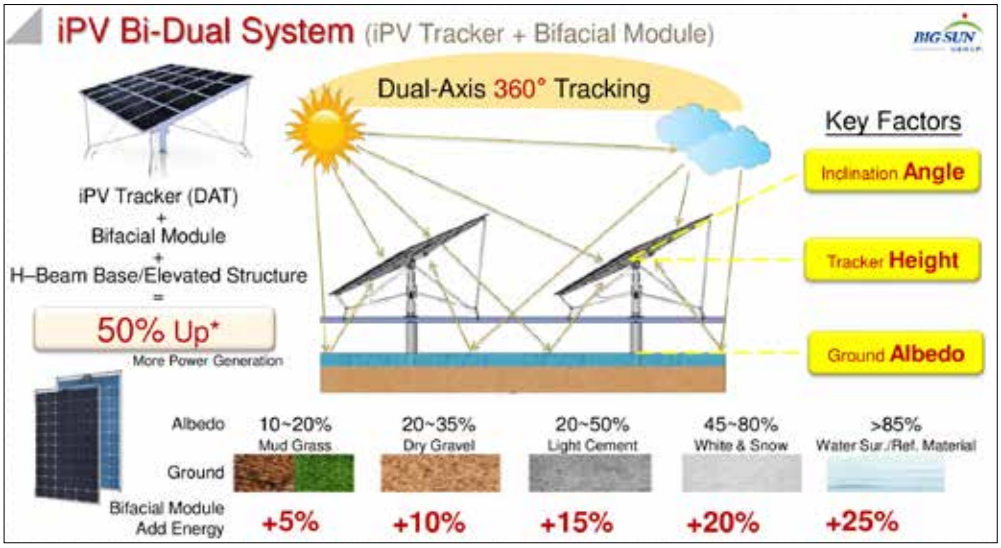
Bifacial modules

Aside from the innovations tracker companies are driving themselves, technological developments in other parts of the industry are also keep them busy. One of these is in the emergence of a new breed of bifacial modules.

By gathering light on both sides of the module, bifacial devices can provide additional yields of up to 12%. However, bifacial modules demand unrestricted rear cell access to capture scattered light and so trackers have to be designed specifically for such modules.

Bifacial module experience in the field is still very limited and numerous demonstration projects are steadily providing real data on the both the challenges and benefits of bifacial modules in utility-scale PV power plants. Numerous module manufacturers are developing and testing bifacial technologies, while TÜV Rheinland has been leading a working to develop standardised testing methods for bifacial devices, with a draft of the testing method having recently been released for review (see p.64).

Not surprisingly, tracker designs for bifacial modules are being launched. At SPI 2017, Soltec demonstrated a modified version of its single-axis tracker for bifacial modules and later in the year, Arctech Solar launched its 'SkySmart' tracking system, claimed to be specifically



Credit: BIG SUN

designed for bifacial modules. BIG SUN Energy also introduced last year a dual-axis version of its iPV Tracker, designed for bifacial modules.

With major PV module manufacturers increasingly touting bifacial module performance gains and unique characteristics, tracker innovation is expected to be further pushed to maximise bifacial module performance.

1,500 volt

In the rapidly evolving large-scale PV power plant sector, higher-voltage systems have been making inroads at the gigawatt level in recent years, making the 1,500V system market highly desirable for PV plant owners, developers, EPC firms and component suppliers from inverters to PV panels.

A simple but key attraction is that 1,500V PV systems enable longer strings, which allow for fewer combiner boxes, less wiring and trenching, and therefore less labour, reducing capex and opex for lower LCOE and improved IRR.

Typically much of the world is 1,000Vdc (Europe set the trend) but the US solar utility sector was the first to bring to market 1,500Vdc systems, namely via First Solar (modules) and GE (inverters). Going to this maximum voltage allows for a considerable reduction in current, reducing the system losses on the DC side.

However, the adoption of 1,500Vdc technology means longer module rows and therefore trackers. MecaSolar tackled this issue with its 'Hyperion-SR' system, which offers extended trackers to accommodate up to 90 modules per row for 1,500Vdc systems, increasing land coverage up to 6%.

The company notes that the system uses self-powered actuators, which renders the AC power unnecessary. Each row integrates an advanced controller equipped with electrical devices such as UPS, inclinometer and motor current monitor sending its data through a wireless mesh network (zigbee).

Raising the system voltage to 1,500Vdc allows for 50% longer strings, thus reducing the number of strings for the same amount of power, which MecaSolar says eliminates almost 30% of the related cabling and combiner boxes and means fewer inverters per project.

The market is potentially growing for 1,500Vdc systems as bidding on utility-scale projects is replacing feed-in tariffs. Bids are getting lower and lower (kWh/$) so an increasing number of countries (where applicable) are looking for 1,500V (DC) systems such as India, MENA states and Brazil to meet low bids and still make a profit.

According to GTM Research, cumulative installations of 1,500Vdc solar now exceed 20GW, but still accounts for a minority of global utility-scale solar installations. GTM expects the share of 1,500Vdc installations to continue rising steadily. There is an obvious advantage to using these products, and those that are installing 1,000Vdc systems where 1,500V would be appropriate are essentially leaving money on the table, according to GTM.

Floating solar

Just to add to the list of demands being placed on tracker firms to innovate for new solar applications that hold gigawatts of potential across the globe is floating solar (FPV).

Taiwan's BIG SUN claims its iPV tracker achieves significant power gains when used with bifacial modules

In May 2017 a global media frenzy was generated over a 40MW floating PV (FPV) power plant being completed and grid connected on a former flooded coal mining region in Huainan, south Anhui province, China, due to subsidence. This was the world's largest FPV plant ever built.

According to market research firm IHS Markit, China, Japan, and South Korea have deployed the majority of the more than 450MW of installed FPV power plant projects.

China is expected to consolidate its position as the world leader in 2018, due to plans to add a second 70MW and a third 150MW project Anhui province during the first quarter of 2018.

While China is set to stay at the forefront, new potential markets are also emerging, such as India with a 10GW tender, and the Netherlands with a 2.3GW plan by 2023.

Japan is expected to continue to adopt FPV and a growing list of new projects continues to gain momentum in France, Latin America and across Southeast Asia, notably countries such as Taiwan.

It is becoming increasingly likely that not only will FPV plants require tracking systems to maximise project returns but the use of bifacial modules will only enhance those returns, making tracker systems essential in the future for FPV to flourish.

Indeed, Taiwan's BIG SUN Energy has recently kick-started the FPV tracker market having launched a version of its iPV Tracker whether floating or water mounted that it claims to increase power gains by 50%.

"Two thirds of the earth is covered by water, by extending the application of iPV Trackers over water surfaces we will help increase power generating efficiency without impacting the local environment," noted Summer Lou, inventor of iPV Tracker and chairman of BIG SUN Energy. "iPV Trackers can be floating or mounted, when installed at a 3m height with 2.5m spacing, iPV Trackers are able to harvest 60% of light transmittance and increase power gains by 50%."

In shallow waters its 'Aqua Solar' solution is claimed to elevate the light transmittance 70-80%. By installing an iPV Tracker over a water surface using bi-facial modules, the increase in yields achieved can reach 60%, when compared to fixed tilt systems utilising mono-facial modules, according to the company.

MecaSolar interview and perspective on tracker innovation drivers

Spain-headquartered MecaSolar has been in the solar tracker market since 2005 and was one of the first companies to produce tracking systems. It has provided systems to projects in more than 45 countries over the last 15 years.

The company has worked with major global EPC companies such as IBERDROLA, Opde, TSK Group AMS–Aldesa, CELENIM and Tozzi Group among others over this period and garnered experience in many large-scale projects.

PV Tech Power spoke with Alexandros Giannis, CEO of MecaSolar on the topic of tracker design and innovation that remains a key business need for companies in the sector.

PV Tech Power: What currently are the key developments in trackers?

Alexandros Giannis: The tracker market has become increasingly price sensitive today, especially in the large 100MW plus utility-scale market. So the design has to be approached from a cost-competitive and economic perspective. But at the same time the technology has be state-of-the-art and always be innovative to support the market. This of course is a key challenge we have today, coupled with being on top of new product and market developments as well as market diversification. This requires a flexible and proactive approach to the market.

What demands are being placed on tracker suppliers today?

Nowadays, there is a lot of discussion surrounding storage, the same goes for bifacial [modules] and a lot on automation in order to optimise system operation. Similarly, although a number of technical challenges are posed, there is a lot of discussion going on for implementing tracker structures on floating surfaces. By nature, as a mounting structure provider, it is difficult to be proactive towards the market trends; however we always try to foresee the next challenges.

Although fixed-mount systems cost less than trackers and cost issues are so critical, why are trackers so popular?

The attraction of trackers comes from the ability to increase plant yield and the quality or consistency of the improved yield (performance). But the cost of the system remains a priority as well: a capex to opex debate. However, we see today that the capex increase is so low compared to a fixed mounting system, that it makes total sense on a yield, IRR and NPV basis to use the technology. In other words, going for a 20 to 22% performance gain with trackers, the small capex increase easily depreciates in a matter of a few months depending on the particulars of the project. It is estimated that the use of a tracker approximately delivers 3.5 €cents/WpDC higher NPV compared to a simple fixed mounting structure. The strength of the above financial benefits is illustrated clearly by the statistic that trackers make up the vast majority, in the range of 75% of utility-scale project in the US, for the year 2017.

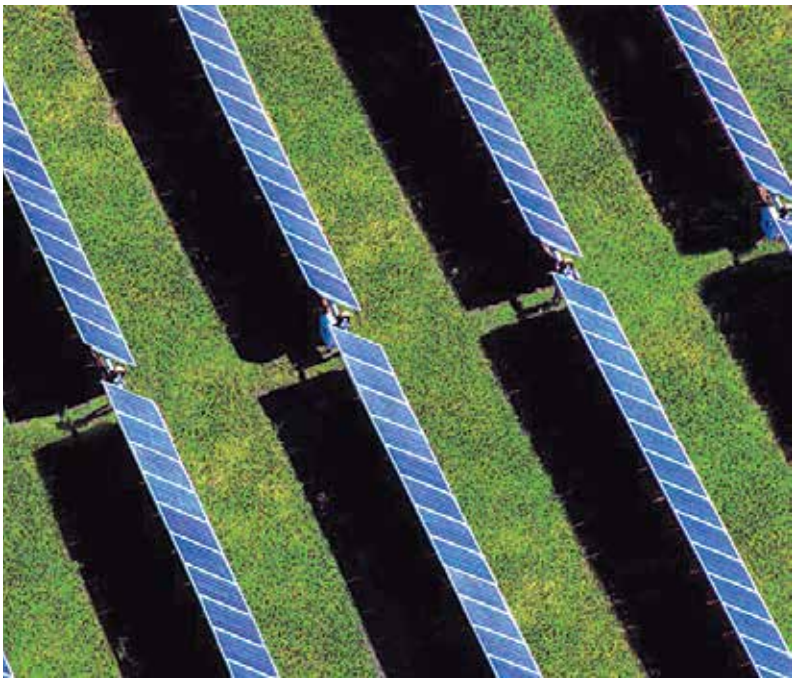
Alexandros Giannis, CEO of MecaSolar

In a market were supply is high, what distinguishes you from similar companies in the solar market?

Mecasolar is a pioneer tracker expert leveraging quality, performance, price competitiveness and history. Our mission is to meet customer's objective no matter how different and difficult those are. In addition the urgency of the market creates a necessity for continuing improvement and innovation. We stay alert to track the technological advances of module or inverter manufacturers and we constantly adapt to those evolutions. In our portfolio, we have both Hyperion-MR, a state-of-art block tracker and Hyperion-SR, a single-row, independent horizontal solution. Further to that, Hyperion-SR can be powered either with AC or DC (here we have the possibility of self-consumption). We provide almost any possible layout approach, 1V, 2V, 2H, 3H so the client can chose what is most adequate to his needs and its preferences. Engineering-wise, we provide support in many aspects like yield calculation (PV sys), design (cad), training, mechanical installation, commissioning and others. Ultimately, we recognise and respect the need for the presence of the local factor and we put a lot of effort to be present in the most active markets via local partners (Turkey, Mexico, India etc).

The emphasis on the yield capabilities of trackers must therefore be a key discussion point for developers and where the innovation in tracker design is being driven?

This is a very big discussion in the sense that the key inputs put into this equation can be defined by very diversified param-



Credit: MecaSolar

The Hyperion-SR, MecaSolar's single-row, horizontal tracker solution

eters. If we talk purely on the actual tracking technology for the strict case of the horizontal tracking movement being the prevailing current nowadays, there are not a lot of new innovations that can be made. However, if we extend the discussion on further optimisations on automations, module technologies such as bifacial, storage technology, stringing adaptations and other R&D optimisations, then yes, there are clearly a lot of improvements and innovations that can be made. New and exciting ideas pop up constantly and this is what constitutes our market as a truly exciting one to belong to!

So yield improvement opportunities exist in other emerging applications such as bifacial modules but are there still design and innovation opportunities in reducing the tracker BOS costs?

It is an undisputed fact that no other BOS component can increase the performance of a PV project like a tracker does. On the other hand as solar continues to globalise and new markets open up, we are trying to be more project oriented and to optimise the design and operating conditions of the system project by project. Trackers are significant capital investments and each feature has to show either a performance benefit or other advantages, for example O&M cost. We put a lot effort into R&D to provide superior value propositions both in cost and differentiation and I should mention here that from my experience the primary feature that buyers are looking for is just a very reliable product and a company they know will be there to service the product over its lifetime. I believe that our long history has proved in actions our trustworthiness.

One of hot topics and something you have already mentioned is bifacial modules. What challenges does this bring to trackers?

There is a lot of discussion and work being carried out on trackers for bifacial modules and there is some doubt over whether trackers are the best mounting solution for bifacial technology. If the yield makes sense to use trackers in order to provide extra performance to bifacial that meets the usual IRR parameters, then from a purely technical perspective, it is not difficult to design for bifacial modules. What is evident from a lot of research so far, however, is that many new parameters raised by bifacial module performance have to be taken into account to conclude whether tracking with bifacial modules makes sense. We are into it.

Larger modules with 72 cells and more are readily available and First Solar is migrating to its large-area thin-film modules. Is this a design challenge for trackers?

Large sized modules can be a great advantage for utility-scale projects in a number of regions especially for cases where land utilisation is of extreme importance. For instance, we just completed a project with high efficiency modules – a similar logic to the size efficiency achieved by large area modules – where in a land area of 20,000sqm we achieved the placement of 1.2MW DC. We have put a lot of effort on design efficiency and we are unique on the fact that we can provide flexible mounting solutions corresponding to 1V, 2V or even 3H, managing to achieve the maximum outcome per each case (in terms of allocation-design and power with respect to the project specifications). ■