

The 2019 briefing

Technology & markets | After weathering some major upheavals in 2018, the global solar industry looks in decent shape to take on the year ahead. Our team of reporters scope out the big themes for 2019, exploring the technology and market trends that will set the agenda over the next 12 months and beyond

Welcome to our comprehensive scene setter for 2019. With a succession of disruptive events behind it, the solar industry largely knows the parameters it will be working under – for a change. Questions remain about how China will proceed following the sudden cap on deployment it announced in May. The early signs are that the country wants to continue deploying solar at a comparable scale to previous years, but only on the right terms.

The US is a little more predictable heading into 2019 than it was this time last year. The industry did fantastic work to finish the year feeling optimistic. That was largely through the hard work and ingenuity that kept projects viable, as well as a little luck from falling global module prices. A slew of new US states are now clearing the final obstacles for greenfield solar development, offering more sustainable business conditions.

Europe meanwhile is entering a new era of subsidy-free projects from Spain to the UK after a solid but unremarkable 2018.

Of the major markets India arguably has the most clouds hanging over it but the demand for electricity and the political will at the very highest level would suggest obstructive bureaucracy will be swept aside.

All of this positivity running into 2019 is bolstered by the benefits of emerging technologies. We could see bifacial modules secure sufficient backing to attain bankable status. The full impact of First Solar's Series 6 panels on project economics will become clearer as installations begin in earnest. Also, look out for trackers chipping away at the levelised cost of energy in some markets where their use has not previously been the norm.

Storage technology will bring another new route for post-subsidy deployment by providing new revenue streams in those markets where the regulators have enabled them. The past 12 months have seen a number of utility-scale projects in Europe, the US and Australia demonstrate the value that can be added under the correct conditions.

Making predictions is difficult, especially when they are about the future, to paraphrase the physicist Niels Bohr. With that in mind we have steered clear of issuing forecasts and instead present the key issues that will set the agenda for the year ahead.

John Parnell

CONTENTS	Module technology: The agony of choice	18	Post-subsidy Europe: MIP ending and grid parity promise	24
	Mounting: Trackers go to the poles	21	make European solar a 'sleeping giant'	
	Storage: Several steps closer to ubiquity	22	USA: The uniting states of solar	26
	India: Solar tender flurry overshadowed by policy hiatus	23	China: If the cap fits	26
			Global markets: Where's hot and where's not	28

MODULE TECHNOLOGY The agony of choice

Choices, choices and more choices; this is the reality facing anyone hoping to procure solar modules in 2019 and subsequent years as the PV industry looks beyond its traditional trappings of 60- or 72-cell aluminium back-surface field (Al-BSF) based cell technologies. As if the array of new module offerings were not already bewildering to developers, EPCs and investors, the chances are it will be even more so in 12 months' time as yet more innovations are presented to the sector, according to Finlay Colville, head of research at PV Tech and Solar Media. That is unless independent engineers (IEs) and third-party labs manage to reach consensus quickly not just on how to evaluate the latest technologies, such as bifacial or half-cut cells, PERC, HJT and n-type, to name a few, but also how they perform in specific conditions and on different mounting systems such as trackers.

It was with this atmosphere of excite-

ment mixed with uncertainty that PV ModuleTech kicked off for its second year, this time in Penang, Malaysia, with the whole value chain of the industry trying to come to terms with the newest module products. Traditional technologies look set to stay in play for a while longer, however, wherever cost or wafer supply remain constrictive to the spread of newer modules. Moreover, one key question was whether a standard 72-cell p-type multi-crystalline module is at present the only truly bankable module in the world, being the only relevant product to have had 20-plus years in the field.

Nonetheless, it wasn't all rosy for the tried and tested technologies, with some shocking statistics presented about variability in solar panel supply. For example, Michelle McCann, partner at test lab, PV-Lab Australia, showed that when manufacturers knew their product coming into Australia would be examined, tests showed modules performing

generally at or above nameplate power. However, when manufacturers did not know their product would be tested, deviation from nameplate power was far more variable, with up to 12% less power than billed in the worst case.

"We do get good product in Australia; we just don't always," added McCann. "Manufacturers can and do choose where to ship certain product."

It seems the trick is no longer just about what you buy, but also the way you buy.

Indeed, Lawrence McIntosh, another partner at PV-Lab Australia, showed evidence that product from the same tier-one supplier going to two different customers in the same country can often have significant variation in performance tests. The findings harked back to this time last year when we covered the inaugural PV ModuleTech 2017 conference in Kuala Lumpur; from which the takeaway phrase was 'all modules are not created equal'.



A bewildering array of new module technologies is available to project developers and EPCs

Credit: WuxiSuntuh

Scrutinising bifacial

However, the overriding focus of this year's event was on how to grapple with the whirlwind of new technologies going into 2019 and beyond. One of the major questions facing the industry is how, when and whether to adopt bifacial modules, because if bifacial were to become the industry norm it would force all EPCs and plant designers to completely rework their assumptions about how to optimise site yields over 20-30 years. Many procedures that are standard to monofacial module installations are turned upside down by the bifacial concept, given its ability to generate power from albedo on the ground on the backside of a sun-facing module. A whole new game in terms of balance of system (BOS) would need to be played.

IEs and certification bodies all showed their work on bifacial testing so far, but it seems that a benchmark test for bifacial has eluded the industry and as one delegate put it "the industry is really excited but confused about bifacial technology". While there is puzzlement and risk aversion, there are also early adopters taking the sector into uncharted territory. Offering one of the more bullish forecasts on where bifacial will

be in 12 months' time, Paul Wormser, VP of Clean Energy Associates, reminded us in the final panel session that some players are starting to invest in and install hundreds of megawatts of bifacial modules already.

"We are going to see not just the data coming from the test labs and the pilot sites, but we're going to empirically see really big projects going in the ground now," said Wormser. "It's going to accelerate and so we're at the tipping point and I think when we come back here next year it's going to be the normal thing to do."

This suggests that some players have done their due diligence and fully trust this technology, having moved on from the pilot phase. Of course, only time will tell us how performance will be out in the field.

Colville noted a tendency in the solar industry for innovations to either vanish or become almost universal very quickly and this is why everyone in the sector needs to watch closely to see if bifacial starts catching on.

Another suggestion that bifacial technology simply cannot be ignored came from Helen Zhou, module technical director at China-headquartered manufacturer JA Solar, who said the firm

would soon start only producing bifacial cells and even putting them in monofacial modules due to the prices coming down so far on bifacial cells.

Ralph Romero, senior managing director, Black & Veatch Management Consulting, which plans to introduce the industry's first bifacial module rankings through tests in the Nevada desert, said: "In the US, there is a lot of excitement about bifacial modules, but the reality is there is still a lot of uncertainty with regards to module availability and module quality and first and foremost is the lack of a widely accepted energy forecasting tool for bifacial module performance. That's probably the single most significant limitation today that I see in the US market for deployment of bifacial technology. There are still hurdles to be overcome – it's not that everybody is now going crazy about bifacial modules; there's still a lot of hesitation."

Romero said that B&V's bifacial tests show on average a 5% module efficiency gain over mono, which is significantly less gain than the 15%+ gains that many manufacturers have touted. He added that the large variability in bifacial forecasts across the industry means that they need to be taken with a grain of

salt. Regardless of that, the conference still heard of some developers considering sites of up to 300MW capacity using bifacial modules.

Nonetheless, Romero added: "The reality is that most manufacturers have bifacial products, but not very many actually have high volume commercial production of them."

Multi not dead...yet

The issue of multi versus mono is still a huge question given that these technologies account for roughly 90% of the market still.

The rise of mono-PERC modules has been undeniable, perhaps symbolised by some players in the aggressively price-obsessed Indian market starting to come to terms with it.

For Colville the global market is utterly dependent on wafer supply now and he went as far as to suggest that if there was enough mono wafer availability to supply the whole market today, then "multi is dead". However, wafer supply constraints mean multi should still be supplying multiple-gigawatts over the next three years and can still utterly dominate specific markets, with some Indian players, for example, likely to be procuring multi right up until the last standard polycrystalline module comes off the production line for an extremely low price in a few years' time.

In his analysis of the event, Vinay Rustagi, managing director of consultancy firm Bridge to India, aptly wrote: "There has been a common perception in India that the solar industry is highly commoditised, with multi-crystalline modules accounting for over 98% market share. But these modules are turning obsolete – worldwide share has already fallen from over 70% in 2015 to less than 50% now.

"As for the developers, there seemed to be a feeling that their job is becoming difficult in trying to evaluate different technologies and picking the right one. Some developers mentioned that they have to run as many as 30 different project design combinations before settling on a final plan."

What and when to pick

Indeed, Frank Faller, VP technology at 8Minutenergy Renewables, one of the largest solar IPPs in the US, said that not only is p-type multi "disappearing" but there are easily 15-plus technology options for modules and the trend is

increasing. This dramatically increases the number of modelling iterations the company has to run to optimise its projects. This has made predicting the LCOE of a project more complicated and performing due diligence both more difficult and strenuous.

Faller also said that from a general developers' point of view, degradation modes on panels are still not fully understood, particularly as "degradation modes depend on the BOM [bill of materials] and components, and are unique for each single PV module brand and mode". He also described the finding that quality varies even between different workshops of the same manufacturer as "quite disturbing".

A major difficulty is how to instil confidence in developers that in six months' time the frontrunner technology won't completely change again, added Colville. The speed of technological progress means a newer, better module could be around the corner just three months into a project that takes 18 months to build, so how does one factor that into LCOE calculations?

"Everyone thinks it's great that there are all these higher performing modules and all this extra capability, but actually that's a problem if you are trying to develop something and have a fixed plan that you are giving to investors and demonstrating what the returns are going to be for 20 years," he said.

Besides the wafer supply issue, downstream growth will also play a key role in deciding the future of p-type multicrystalline. Colville said that if the market suddenly needed an extra 40GW next year, it is multi that would supply that demand, simply because there is not enough mono.

However, he added the caveat: "In a world of low-cost mono you have got the sky in terms of what might happen next. You have to deal with change quickly because in 12 months' time or in 18 months or two years there could be a rapid transition to tens of gigawatts of heterojunction (n-type) and then everything changes again. So maybe this is actually a warning time in the industry that it's just different now, that the industry and the cell processing have moved and we've got low-cost, high-purity wafers coming through for the first time."

Bouncing back from 531

China's policy upheaval in May this year,

which significantly cut the leading solar market's projected growth, sent shockwaves through the industry; however, early November saw news emerge that the Asian giant may be considering enlarging its overall solar target to a huge 250-270GW by 2022. This will be sure to affect the rising demand from the rest of the world across Southeast Asia, Latin America and the Middle East, which have been absorbing the surplus capacity in China caused by the 531 announcement.

The resulting decline in ASPs has caused the whole industry to squeeze. Colville said this decline is entirely due to the supply of polysilicon and wafers, which is controlling both technology and pricing – adding: "The pricing of modules in the last few years has been held relatively high, you'll be disappointed to hear if you're a manufacturer."

Price and quality

Declining ASPs of course puts pressure on manufacturers to increase energy yield while also decreasing costs.

"The gap between the ASP and module cost is quite small and this is a huge pain for all of us in the industry, which means nobody is really earning money," said Mirko Meyer, head of product management at major equipment supplier Meyer Burger. "So then the question is how can we overcome this? Of course we can reduce module costs but this is hard without suffering on quality. The whole industry is squeezing and quality becomes a pain."

To make matters harder, Colville also added that a rebound on prices is very unlikely anytime soon.

"There's not a lot of margin in module manufacturing especially after China 531," said Tristan Erion-Lorico, head of PV module business, laboratory services, at quality assurance and risk management company, DNV-GL. "People are getting squeezed, but for the most part they are surviving. But if they are not getting a healthy margin to survive then cutting corners is an inevitable thing to turn to rather than closing the company down."

Quality was indeed a major feature of PV ModuleTech and we heard throughout the conference a long list of problems including underperforming modules, poor quality backsheet choices, replacement of modules after only a few years, and micro-cracks, to name a few.

For example, due to many first-time Indian developers entering the market

during the “gold rush” of 2014/15, Vinay Rustagi said: “There is a big problem in India that many projects don’t have the necessary amount of quality focus that they should have had. Many projects we know are underperforming very badly. There is high module degradation, there are warranty problems being reported etc.”

However, besides emphasis on price,

many delegates noted the importance of third-party labs and IEs having a strong voice for the industry to rely on.

Lou Trippel, vice president of product management at US-based thin-film solar manufacturer and developer, First Solar, said: “In terms of energy prediction – these things are hard enough without even considering some of the biases that may

be present. We end up with a bit of an arm wrestling match here and we luckily have some referees that can jump in. As an industry we need to recognise the importance that these independent roles play in trying to drive toward that level of unbiased and absolute correctness.”

Tom Kenning

MOUNTING Trackers go to the poles

The tracker market’s progress can be plotted on a map emanating from the equator and spreading towards the poles. Barring a few outliers (a double-axis tracker was fitted at 65°N by a Swedish energy company in 2011) the mass markets for solar trackers have been rooted in hot desert-like environments. As with so much progress in the industry, the double win of improved technology and better project economics has opened the door for a host of new markets.

Steve Daniel is the VP of sales at Solar FlexRack, which makes both fixed and tracker mounting systems. He says the shift to trackers is exemplified by his company’s own sales record: from selling next to no trackers two years ago the company is now approaching a 50:50 split.

“We’re seeing a lot of fixed-tilt in the Midwest and Northeast (of the US) and we’re seeing a lot of trackers in the south west and south east but it is creeping up the eastern border. We’re going further

and further north,” he says. “It’s all in the economics. We’ve got some good proof points that we’ve done in Montana, Minnesota, Ohio, Michigan and Oregon, which are showing that trackers are viable in cold weather climates in general; it’s been a very positive year for us.”

In the US, as markets develop beyond the deserts of the south, so too will the opportunities for trackers.

That level of ubiquity that has been achieved in California and other states could be repeated elsewhere. Trina Solar is providing its TrinaPro system to one of the new wave of subsidy-free projects in Spain. The package includes a tracker and it seems hard to believe that Europe won’t repeat the same ‘creep’ northwards that has been experienced in the US.

As bifacial modules find bankability the argument for trackers will be bolstered further, blowing open the door to markets like India where the economics have not been favourable.

Jim Fusaro, CEO of Array Technologies,

is eyeing strong growth in the market but not at any cost, leaving some markets such as India out of reach.

“We’re certainly looking at all opportunities. The market is going to continue to grow, we’re looking at more than 10% growth in the tracker industry over five years and there is scope for more than that. There is business out there that will be good for our competitors. We just simply won’t take it at those margins,” he adds.

Maturity is not only improving the end product it is also increasing competition and creating consolidation in the tracker market. This healthy fat trimming is only likely to improve the cost per extra kWh that trackers can deliver for the market. New opportunities, a healthier ecosystem, more complementary module technology and an ever stronger economic case suggest the poleward march of the tracker shall continue in 2019.

John Parnell



The market for trackers is maturing, technology is improving and the addressable market is growing.

Credit: Array Technologies

STORAGE Several steps closer to ubiquity

Like water slowly filling a maze, energy storage is spreading through the power and energy sector via niches and targeted opportunities, until the levee breaks and batteries and other storage media play a ubiquitous and integral role in managing power and energy flows all over the world.

That is to say, analysis of the sector is not taking in the whole picture if we are to narrow our focus too much. While front-of-meter, grid-scale storage deployment may have levelled off in Western Europe and parts of the US, the fact that last year saw record-breaking deployments in the behind-the-meter (BTM) segment in both territories shows that where one avenue in the maze begins to fill up, the market travels in new directions. The BTM segment is likely to grow further this year in many territories, not just in Australia or the southern US where the economics of solar self-consumption make a compelling case for batteries, but also through changes in market design in regions including the US and Europe. These changes will enable or encourage increased participation of aggregated distributed resources such as behind-the-meter energy storage in wholesale markets or to provide grid services, meaning that the lines between the transmission & distribution (T&D) and customer sides of the meter will begin to blur.

The biggest macro trend we are likely to see is the push further away from long-term contracts, particularly for grid services provided by front-of-meter energy storage. Again, the good news behind that trend appears to be that in addition to the increased value of BTM storage,

high commercial electricity costs and corporate decarbonisation goals will be a contributing factor to total deployments in 2019. Peak demand reduction will be a big market driver, but in a broader sense so will the aspect of "merchant risk" involved in energy storage projects at the bigger end of the scale.

Fair market design and stable policy conditions will be important to success and there will also be regulatory and policy developments to follow closely throughout the year, providing many unknowns. If one could be crass enough to draw a general trend, it appears that as network operators begin to understand the value of storage, so too do policy makers and regulators, and we can only hope that this is how things will play out in general in 2019. This year we saw California elect to introduce a 100% renewable retail electricity by 2045 target and again we can only hope that other governments, be they state or national, will follow.

Of course, those are the 'saturated' or 'mature' markets. Other countries and their grid operators are still in the process of deploying large-scale storage and many of those, which include Italy, much of Asia and Latin America, can learn from those early adopters. While mentioning Asia, it cannot be denied that of course South Korea, Japan and most significantly China will continue to exert influence on global markets as well as shaping their own. All three are home to leading technology providers and manufacturers, and China and Korea are deploying huge projects including solar-plus-storage and energy storage in combination with other technologies over the next few years. South Korea

is incentivising solar-plus-storage with Renewable Energy Credit certificates, while China has created a National Energy Storage Mission which includes plans for flow batteries of multiple hundreds of megawatt-hours.

Microgrids will continue to grow in both individual project size and relevance to the overall market. While a vast amount of that will be in emerging markets such as rural parts of Africa, Southeast Asia and India, bringing energy access to remote communities or islands, the very definition of microgrid is ever-evolving. In 2019 we are likely to see big megawatt-scale systems for communities and industries, including remote mining operations and instances where the microgrid is even in a grid-connected area, it just doesn't need to run from the grid.

We can also expect further exploration of technologies besides lithium-ion. It still reigns supreme, but 2018 was also quietly a good year for flow batteries and to a lesser extent for ultracapacitors not to mention even earlier stage technologies such as liquid air energy storage (LAES) and various combinations of hybrid systems.

We will also see energy storage in competition with natural gas, whether that will mean the retirement of existing peaker plants as batteries take their place, or even cases where energy storage is deployed at natural gas plants to increase their efficiency and reduce their carbon footprint. The relationship between batteries and natural gas is being very closely looked at.

Andy Colthorpe

Storage is making headway towards becoming an indispensable part of the modern energy system

INDIA Solar tender flurry overshadowed by policy hiatus

Indian solar is facing its toughest period so far since the launch of its 100GW solar target and its current slowdown has the potential to turn sourer if a major tax issue is not resolved. Despite the government's best attempts to issue innovative tenders and then shape them to the desires of developers, recent tenders have also persistently been undersubscribed or not subscribed to at all. While hybrid wind and solar, and manufacturing-linked tenders both come with their own set of concerns, the sentiment is that several wider market factors mean that the tariffs that the government is looking for are not viable at the present time.

"There are a huge amount of tenders coming out, but because of the ceiling cap on the tenders people are not bidding for them," says Anmol Singh Jaggi, co-founder of India-based solar advisory, EPC and O&M firm Gensol Group, which has provided services on multiple gigawatts of projects across India.

For Singh Jaggi, there are four factors that are holding back the sector right now, and it's not just the two-year safeguard duty imposed on cell and module imports from China, Malaysia and developed countries.

"One is of course the safeguard duty," he says. "But the other is the Goods and Services Tax (GST), which lacks clarity on whether it is at 5% or 18% for solar.

That's a big overhang. It's an even bigger issue than the safeguard duty today. The third is the Indian currency has gone from 68 rupees per dollar to 74. Of course it's now come back to about 71, but still it has increased the project costs. Fourthly, interest rates over the globe have hardened by about 150 basis points in the last six months."

As a result of these factors, tariffs of 2.50-2.60 rupees per unit are no longer viable, adds Singh Jaggi, who does not expect interest rates to soften in the next year or so.

More importantly the Ministry of Finance needs to come out with a paper clarifying the GST rate for solar, because if it comes out at 18%, the industry can be expected to slow down "much more significantly," says Singh Jaggi.

To make matters trickier, 2019 is an election year, so with just six months to go before people hit the polls, the GST rate for solar is not expected to be the top priority of any politician. Moreover, investments in



Credit: Welspun

A policy hiatus in the run-up to elections could slow down solar deployment in India in 2019

India tend to stall two months either side of an election.

However, Vinay Rustagi, managing director of consultancy firm Bridge to India, expects a big pick up in 2019 for solar deployment because of the various tender timelines from 2017, with 10.9-11GW of projects due to come online. Rustagi agrees there will most probably be a hiatus on the policy front, particularly either side of the election, but also notes that a council meeting on the GST is due to be held shortly where there are expectations that the issue could finally be resolved.

Ups and downs of 2019

Expecting 2019 to be anything but a peak year for Indian solar, Singh Jaggi says he would be happy if the market hits 7-7.5GW, a far cry for the more than 10GW of capacity installed back in 2017 or what may well be achieved in 2018.

On the flip side, rooftop solar is the main success story in India right now and Jaggi expects this segment to see 1GW+ installations in 2019. Bridge to India also expects rooftop to grow very robustly by adding 1.5-2GW every year mainly driven by the commercial and industrial segment.

On another positive note for PV, Jaggi believes that next year individual states will start realising that they will be facing a power deficit in 2021 and 2022, given that India is growing at 7% GDP per year, and will need roughly 14-15GW of new capacity added each year. That comes on top of the fact that almost no new major coal plants have been added in India in the last two years. Solar has the advantage of being installed in just over a year, unlike

coal, hydro and nuclear, which can take 3-10 years, so he expects states to come out with lots of tenders in the second half of 2019 or in early 2020.

"Power demand has definitely picked up in 2018 especially in the last six months faster than anytime in last three to four years," adds Rustagi – noting that exchange power prices have increased due to some hydro plants running at much lower plant load factors (PLFs) and poor availability of coal and railway links for thermal power plants.

On the other hand, India still has excess installed thermal capacity and some plants will be coming online again soon after resolving bankruptcy proceedings, which could absorb some the need for more solar generation.

Nonetheless if the manufacturing-linked solar tenders do not work out, there will be renewed impetus on the issuance of pure solar tenders, says Rustagi, since government is under pressure to take some positive steps. The Ministry of New and Renewable Energy (MNRE), for example, has already directed the Solar Energy Corporation of India (SECI) to issue a 1GW tender every month for four months up to March 2019.

There is also talk of the government reviving plans for 12GW of solar capacity for public bodies (PSUs) with a mandate to use domestically produced modules, given that both the safeguard duty and the manufacturing-linked tender have so far failed to encourage expansion of PV manufacturing capacity in India in the manner envisaged.

Tom Kenning

POST-SUBSIDY EUROPE MIP ending and grid parity promise make European solar a 'sleeping giant'

The lifting of political and cost-based brakes on European solar in 2018 is set to awaken a sleeping giant, with subsidy-free solar projects potentially the norm all across Europe in just a few years.

A combination of more and more countries hitting grid parity, the ending of the Minimum Import Price (MIP) on Chinese imports as well as a temporary Chinese module oversupply means that the European solar market is on the cusp of booming, according to several developers and module suppliers.

"The MIP ending has led to a huge IRR boost for investors and developers since it has allowed global market module prices to be used in Europe," says Frank Niendorf, general manager Europe, at China-based manufacturer, JinkoSolar.

Lily Coles, commercial operations director at UK-based developer Anesco, which has already built a subsidy-free solar-plus-storage plant in England, agrees: "Coming out of MIP then opens up a huge door for us and the panels have always been the most expensive part of it. We've spent a lot of time whittling down the other components and being cost competitive while maintaining the quality on the inverters, the cabling, the ground-mount system and everything else, but the panels have been sort of out of our control, so it's going to make a massive difference and we can now see that pipeline really growing."

Other developers have also celebrated the effects of the MIP ending combined with China's subsidy removals. Dale Barnard, senior project engineer at Denmark-based developer, European Energy, cites an IHS Markit report on

prices dropping 30% across the board, with panels in Europe bottoming out at €0.20/W.

He describes these as "insanely cheap prices" that could only have been dreamed of last year – adding: "It almost opens up the entire European market for subsidy-free, perhaps with exceptions for some of the very northernmost countries."

When the MIP ended the prices dropped overnight, adds Andrew Witkin, sales director at module manufacturer Seraphim Solar System. Manufacturers had huge amounts of stock and the prices have carried on dropping to point where there are rumours of stock nearly running out in Europe, with potentially even a shortage from now into Q1 2019. Witkin also believes that much of the highest efficiency stock such as bifacial and mono PERC modules is being soaked up by China's Top Runner programme, leaving less for Europe. Thus availability of product could be an issue at a time when Germany is increasing deployment, Italy is rebounding and the US market is growing again.

In any case, Niendorf cites several countries where post-subsidy projects are already proliferating or are set to kick-start merchant PV in the coming year, including Spain, Portugal, Italy, the UK and the Netherlands.

"From 2020/21 onwards it will be all over the place," he adds. "No matter which country and we will have reached a system cost level that will allow the installation of projects without any kind of support."

In the short-term, Niendorf stresses that while he expects prices to come down further to some extent, the overcapacity

in China is a temporary phenomenon, and prices coming down 30% in such a short period of time raises questions over how sustainable those levels are. However, an industry that is not dictated by the politics of feed-in tariff (FIT) support also means that future module price fluctuations will be far less severe than in the past.

"Becoming independent from those subsidies will actually lead to a more stable supply and demand, which we have in other industries as well, so PV will get there," he says.

Furthermore, both developers agree that post-subsidy solar will drive both better quality and competition in projects. Investors become far more interested in technology when project margins and returns are predicated on the performance of the technology used rather than the comfort of a FIT subsidy. Anesco's Coles says this means developers have to demonstrate their technology's capabilities far more to investors whilst also focusing heavily on re-engineering plant designs.

European solar has faced a tough five years held back by what Niendorf describes as "artificial brakes" while other geographies boomed. Now most of those brakes have disappeared, but there is the major looming problem of grid integration.

Nevertheless, he adds: "I think this parity is a sleeping giant, and most players are not aware of what potential also in Europe that parity has."

"We can see so much development activity all across Europe, which scares the commercial conservative utilities like hell. It's a great chance for Europe as well to become finally more [energy] independent, so we are extremely bullish

THE EUROPEAN MARKETS HUNGRY FOR MODULES

Frank Niendorf, general manager Europe at manufacturer JinkoSolar, gives his forecasts for European market demand

"For sure Spain will become the biggest European PV market again in 2019 and probably also 2020/21, for the next three years (see separate box).

There is a lot of activity developing projects on a pure merchant basis and that's a pretty impressive development. At some point in time, in particular in Spain, probably 2-3 years we will reach a point when there are so many more installations and gigawatts that actually the spot market price level will come down and then it might become an interesting question what parity finally is.

"Italy is showing very interesting signs now on parity projects. France is now starting with its first parity projects to be installed at the end of next year as well and in Germany there are activities from big utilities who are

starting to acquire big lands because they plan to do projects on a pure merchant/parity basis. In the UK we think we will see the first 200MW of installations during next year without any kind of subsidies.

"The Netherlands – you still have a certain regulation which makes PV installations extremely attractive but then I would say from 2020/21 onwards it will be all over the place, no matter which country and we will have reached a system cost level that will allow the installation of projects without any kind [of support]. Portugal also has a reasonably hospitable regulatory environment with great irradiation."





Credit: Anesco

Clay Hill Solar Farm in the UK is one of a growing number of unsubsidised solar plants emerging in Europe

for the European market and in general as well because this momentum cannot be stopped now.

"We have reached a cost level which is unbeatable. It's the cheapest electricity energy source in the world and we have not finished that yet – it's going down further."

European Energy's Barnard agrees: "Solar has got a raft of positives from ease of installation to low cost to low maintenance. [...] The only thing that was holding it back was the high cost of procurement versus the power prices that you can achieve and once we hit parity that problem disappears, you're no longer tied to political issues, you're completely divorced from that process and you can rely on the market to drive things forward, so it's incredibly exciting."

The industry is equally excited by the new technologies and efficiencies as they are about low prices with module power ratings now in the range of 270-400Wp after significant R&D efforts by the upstream sector. Moreover, Coles says that even high street banks are beginning to see revenue streams in solar and investors are becoming more comfortable with the words "merchant risk".

Tom Kenning

NEW ROUTES TO MARKET

As Europe's solar markets move into a post-subsidy scenario, two new business models – merchant solar and corporate PPAs – are coming to the fore as key routes to market. Merchant power plants sell power on the wholesale spot market, while under private PPAs, developers sell power directly to off-takers as a means for the latter to hedge against rising energy bills and cut emissions.

Spain's solar resurgence is a prime example of this new world, driven as it is by a huge merchant and power purchase agreement opportunity that far outstrips the size of recent government tenders. The country now has a pipeline of 29GW, according to the national solar trade group, UNEF, of which only 3.9GW has been tendered by the government.

"The market has realised that they can expect very little from the government and they aren't going to wait around for a new support scheme," says Jose Donoso, the head of UNEF. "With the degree of competitiveness that solar has, we can go straight to the market on a merchant basis or we can look for PPAs, without any need for input from the government.

"At this moment in Spain, there are 29GW of solar projects in the planning process. One year ago we had no PPAs and now we have a PPA signed every week with big companies. All the major off-takers are in talks with different developers," added Donoso.

Trade body SolarPower Europe acknowledged the growing importance of the merchant and PPA markets in its most recent 'Global Solar Outlook' report.

According to recent SPE figures, corporate solar accounted for 1.7GW of new capacity in 2017, while a further 2GW has been contracted this year.

SPE's deputy CEO, Bruce Douglas, highlights the recent financial close by developer Baywa of the 174MWp Don Rodrigo PV power plant near Seville, Spain, as a sign of things to come. The plant is unsubsidised, instead trading off a 15-year PPA with the Norwegian energy group Statkraft. "That's an example of what's coming, and coming fast," Douglas says.

SPE is more circumspect about the growth of the merchant power market for solar, as this comes with considerable price risks for developers. According to SPE's head of market intelligence, Michael Schmela, although some companies are trying merchant projects "here and there", financing such projects remains a barrier. As such, Schmela says the full adoption of the European Commission's so-called clean energy package, which sets the EU's legislative framework for clean energy going forward, will be a key step forward for growth in the merchant market.

"We have to wait – the market design of the clean energy package is in its final stages, and it's really still here the questions around balancing responsibilities, on priority dispatch... [that] need to be clarified to make sure what you can do and what you can't do so that the financing institutions will be able to make decisions on [financing projects]."

John Parnell and Ben Willis

USA The uniting states of solar



Credit: Contri Solar

California has long been the 800lb gorilla of the US solar market. According to data from the Solar Energy Industries Association and Wood Mackenzie, it has installed more solar than the next largest eight states combined. It's clearly a special case. Of those next eight, only Arizona and North Carolina have installed more than 3GW. If you move further down the rankings it becomes quite thin indeed. For that reason, even modest improvements across the board could yield a fairly positive result for overall US deployment. The good news is that appears to be

very much the case.

Looking ahead into 2019, there is scope for progress in a huge variety of US states. Despite this, the industry is understandably wary about making predictions.

"The only that has ever been true is that whatever we expect to happen, will definitely not happen," says Joe Song, vice president of project operations, Sol Systems. "We went into 2017 thinking all these projects were going to happen and then [Section] 201 [solar tariffs] came around and it paralysed the industry. Everyone went into this year thinking no projects

New state markets are beginning to open up in the US, driven by new policy and financing developments

were going to happen and then come July the China market pivoted and it opened up a whole lot of opportunities.

"In terms of where I believe we are now, excluding any disruptive events, we, like most other developers, are heavy in Massachusetts, and so is everyone else, we've also been paralysed there waiting to see if we have a good or a bad project," Song says. Massachusetts launched its new 1.6GW solar programme which will see projects of up to 5MW entered into an online approval process. Developers that have invested time and effort into predevelopment work

CHINA If the cap fits

If 2018 taught us anything about the Chinese market it was to expect the unexpected. May's cap on solar deployment caught many cold. The scale and swiftness of the actions were indeed a surprise but runaway manufacturing expansions and a desire to avoid a severe overcapacity issue might have been a warning sign that something had to change.

At the time of writing, Beijing was still planning for 2019. A meeting in early November with a variety of stakeholders offered no definitive answers. What we do know is that the National Energy Administration (NEA) is well aware that some of the same companies working

on FiT dependent projects are delivering eye-wateringly low-cost subsidy free projects in other parts of the world. We also know that grid issues that have plagued renewable plants in recent years are receiving renewed attention. The NEA has said it will support local governments who wish to offer their own incentives to plants on the proviso that they make sense, that is to say, that the grid will not curtail the electricity at some of the painfully high rates seen in China's North West.

At the meeting in November, the idea of ramping up the country's solar target was floated. A figure of 200GW by 2020 was circulated but PV Tech Power understands

that one major module supplier is pushing for a higher figure of as much as 270GW. Current installed capacity is 165GW.

A willingness to press ahead with that higher goal may be as dependent on grid improvements as it is on Chinese module manufacturers' ability to prove there is sufficient global demand for the product of new factories.

Five years ago this latter objective was a harder task. California and a volatile European market were the only multi-gigawatt games in town. Today India, a more predictable Europe, a patchwork of US states plus South East Asia and Latin America offer outlets. The diversity of the global solar industry is broadening and

on parcels of 5MW, have no idea how much capacity they will ultimately build.

"Illinois is similar with a lot of community energy as well as adjacent markets to Illinois, where again, people are waiting until they can enter the block programme. We're tracking policy changes that are in the works whether it's in New Jersey, Maryland or DC that will enable the incentives to be better or at least longer term. We're also keeping an eye on emerging markets like Idaho, we've been doing a project in Nebraska for a couple of years. Some people view Alabama and Kentucky as being the next Georgia so we'll keep working down there buying land and putting in interconnections."

EPC and developer Conti Solar has a similar outlook with Illinois ranking high but not alone in offering fresh opportunities.

"Broadly, the entire south east region is largely an untapped market," says Eric Millard, CCO, Conti Solar. "We're starting to see some indicative feelers from developers in Alabama and Kentucky looking for pricing guidance. The Carolinas – I know North Carolina is already a prevalent market – and Virginia will see a lot more activity from the Duke and Dominion procurement rounds. Dominion is aggressively building out and will do so for a while."

In October 2018, Virginia issued a mandate for 3GW of solar and wind.

"Then there are states like Florida, Tennessee and Midwest states like Indiana and Ohio which are on our watch list as well. Historically there has not been a lot of build

but now, on the utility-scale side of things, there is a bit of a queue," says Millard.

The policy challenge

For a lot of states, large and small, the issue is one of unpicking incumbent legislation that chokes solar deployment. James Owen is executive director of the advocacy group Renew Missouri, which has been advocating for all renewables since 2006. Missouri recently passed Senate Bill 564, which as Owen explains, is often referred to as the grid modernisation bill. Solar forms a key component. In the case of Missouri, coal remains a dominant force and part of Renew's work, in conjunction with the Natural Resources Defence Council, is to find affordable ways to retire coal plants early.

"We're working with the NRDC on legislation to promote the concept of securitisation, which would open a market place for those depreciated assets which would allow the utilities to shut down those coal assets early and we think that will contribute to the concerns about solar adding to that bottleneck," says Owen. "Michigan has done this with a lot of success. Consumer groups like it, the utilities like it and environmental groups very much like it. We can close down plants with 10-15 years left in them."

The refinancing uses bonds with interest rates in the order of 3% versus the project finance rate, which could easily be double. The savings can allow the plant to be mothballed early without creating

a stranded asset. The technique was also used when Florida's Crystal River nuclear plant closed after it was found to have structural problems.

Missouri's largest utility, Ameren, is targeting emissions reductions of 80% by 2050.

"By 2025 they want to add 50MW of solar generation and plan to add 100MW by 2027. This is nine years but I would expect this to be frontloaded because we have the tax incentives expiring in 2021. I suspect that will come sooner," says Owen. New legislation will also clear the path for microgrid developments such as those favoured by military bases.

The emergence of new solar markets across the breadth of the US means even new entrants have to look beyond California and New Jersey.

Dutch mounting manufacturer Esdec, which specialises in rooftop systems, launched its US operations in September. Its approach signals the growth of non-utility solar beyond the usual suspects.

"If you look at the research reports the top 10 are in the south west and north east but we need to be aware of what is going on in the other states," says Esdec CEO, Stijn Vos. "We want to make sure we are present there as well. "We are building a team of solar veterans to cover the established states but we need to be able to cover the up and coming solar states as well."

John Parnell

just as in nature's ecosystems, everybody wins in that scenario, barring any external interference.

If China is to decouple deployment from centralised support schemes and devolve this to local governments, then the Chinese market is only going to be more complicated in 2019. The diversity of creating 34 provincial Chinese solar markets could well see it evolve into something more sustainable.

John Parnell

Some in the industry want to see annual deployment remain at similar levels as we have seen recently



Credit: United PV

Global markets: where's hot and where's not

Interview | Vikas Bansal, head of business development, solar international, at one of the world's largest solar EPC firms, Sterling & Wilson, talks to Tom Kenning about which geographies show the most promise for solar development going into 2019 and beyond. India, Western Europe and China are covered separately in this feature

Asia

"This year Vietnam has been a fantastic market. We were all expecting last year that Vietnam would open up but finally, it has. We are constructing roughly 300MW of plants in Vietnam and even next year Vietnam is going to remain very active in PV (see p.30 for separate analysis of Vietnam). Bangladesh will pick up. This market has been dormant for the last three years. There have been lots of things happening at the government level, but finally this year they will be able to roll out a few solar PV plants on the ground and next year will even be bigger for this market so we are very focused on Bangladesh.

Markets like Malaysia are doing lower volumes, but they seem to be doing a small volume every year so they are more consistent.

Indonesia has been one market which personally for me has been a bit of a disappointment. Two years back when we started getting into Indonesia, we invested, we had people and offices there and we all thought that Indonesia would finally open up, but unfortunately, it didn't happen. There are a lot of grey areas in terms of local content requirements, and in terms of feed-in tariff (FiT) applicability, so that is one market which has been a dampener to say the least.

There are other sporadic markets like Myanmar, Cambodia, where action will happen but as of now we don't see them as long-term markets because they do not have long-term policies to promote renewable energy.

Australia

Australia has been one market which has absolutely boomed in the last two years and we feel the market will continue to boom although there are some policy-level issues which have been happening in the past few months, for example, The National Energy Guarantee (NEG).

Nevertheless, the way we see the market is that in Australia the merchant power plants are still making sense. We are also working on several large opportunities there including some of the large plants which are going under construction in the next three to six months.

So overall, from our perspective, even though the policies are a bit fuzzy as of now we still feel the market has all the right macro indicators and will continue to grow for the next three to five years.

Central Asia and Eastern Europe

Kazakhstan has shown some signs of movement. That is one market which we think this year will be small – they really want to take a step-by-step approach, which we appreciate, but the overall

long-term plan seems to be there so that is a market to watch out for. If not this year, next year that market is going to open up for large-scale investment on the PV side.

There are markets like Ukraine which have been dormant for the last many years. Even now we do not have much visibility on the way the market will shape up, although there were a few issues on the bankability of the PPA, which have been partially addressed. We still feel the market will take another six to nine months more for things to become clearer.

Middle East

The Middle East is like one large tender driven market. You've had tender announcements in almost all the major countries in the gulf, while Abu Dhabi has indicated that it will come out again for another 1.5GW tender for solar PV. They want to bring about 5-6GW in the next two to five years so there is a high possibility that they will come out with a large tender in the next six to nine months, but obviously, that still remains a possibility. These UAE programmes are all evolving.

In Saudi Arabia, where things have still not gone the way they were planned, finally, they were able to come out with more structured and long-term solar programmes. It's another country where we all know it has a lot of potential when the macros are all in place. It's a matter of [the] right policies and right implementation.

They have taken the first step with the execution of the 300MW Sakaka plant and we are very confident that moving forward they will come out with more structured RfPs for the solar PV domain. Sterling & Wilson invested in that market many years back. We have a full-fledged presence in Saudi Arabia and that speaks volumes about our focus and interest in this market.

Egypt has done a lot of megawatts and they have been able to allocate more megawatts recently, but moving forward after this year we have little visibility about Egypt for 2019.

We are not clear whether they will be looking for more capacity but overall we always evaluate the market from a very macro level perspective. We still feel Egypt is a large country with large requirements and they can still absorb power [on] their grid. However, the policies are still as of now not clear in terms of implementation and what kind of targets they are aiming at.

Other markets in the Middle East are more sporadic. Some countries will come out with a tender, but will they go through it in a long-term process? Countries like Oman are now very active in solar after a three-year break, but strategically planning for such countries can be difficult.



Credit: Wisol

Australia is among the global solar markets S&W's Vikas Bansal expects to continue growing

Africa

A few pick countries are likely to be very active. One would be Kenya, which we feel has finally woken up to the fact that some amount of solar on their grid would be useful. It will help them in creating more jobs and Kenya has already allocated a few PPAs and as per our understanding they will be allocating more PPAs in the next 3-6 months, so that's one market which is going to be important.

Then everybody knows South Africa has made a comeback. It took a break for two years and now it's suddenly coming back on the block.

A lot of other markets have [the IFC's] Scaling Solar programmes, but from a strategic level these markets will remain sporadic. They will come out with a few tenders and then they will go back to their normal route.

Even if you look at some of the countries which adopted the Scaling Solar programme things have been rather slow. They have been able to implement only a few hundred megawatts under the programme and the programme started almost two years ago. These countries obviously need a lot of baseload generation but they do not have any solar on the grid so all of these countries can very easily absorb a few hundred megawatts of solar in their grids and they can kick-start their industry.

In the last four to five years a lot of countries have done one or two projects, for example Mozambique, around 50-100MW, Zambia around 100MW, Namibia around 50MW, and Kenya till now not much, 20-50MW. So they have done one or two projects but the large-scale adoption has not happened and from our perspective we don't think a lot of African countries will adopt large-scale solar at least this year, but maybe next year once the prices of solar further go down they may again start looking at solar in a more active way.

But all these countries have the right intent and I'm very sure it's only a matter of time before they start adopting solar on a larger scale.

Latin America

Latin America has been very active. Although Argentina has had some issues on the banking and credit side of the market, we feel it will become an important player moving forward.

Chile has traditionally been a very proactive solar market, but it had a break in the last couple of years. However, now that the north and south parts of the country are linked with transmission lines, it will again see a third wave of solarisation and 2019 and 2020 are going to be important for the Chile market.

Mexico is another country that started solar about 3-3.5 years back and is again keen to do around 1-2GW every year and they will continue to play an important role.

Colombia has had a government policy announced and although there are a lot of regulatory challenges in the market, we think in the next one to two years Colombia will become an important market from a scale perspective. We think even their solar programme will be 500MW-1GW, which is a good enough scale for anybody to start investing and thinking seriously about any country.

Brazil has been an on and off market. They have done more than 1GW to date. Even now we are not very clear which way the market will go, so from a strategic perspective we are not sure whether we should focus on Brazil now or wait and watch.

North America

We very strongly feel that the US will remain an important market despite the tariff imposition on modules. We still feel the market will remain healthy although the volumes have gone down. But even at a level of 5-7GW it's a big enough market. The policies are very structured and a lot of states are still interested to go for solar.

We also feel that US is one market wherein you will see a lot of integration of solar and storage because it's a developed market. There are a lot of possibilities of combining storage and solar and then offering more dispatchable power to grid operators. Sterling & Wilson understood this a couple of years back and we are right now implementing a 30MW solar project in US and very soon we will be starting a 70-80MW construction.