Blueshift RESEARCH REPORT

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Solar Tracker Industry Leaders Poised for Continued Growth

Companies: ARRY, BME.SOL, FLEX, FTCI, ROCK

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Report Type: ☑ Initial Coverage ☐ Previously Covered ☑ Full Report ☐ Update Ratings: **ARRY** 4/5, **FLEX** 4/5, **FTCI** 3.5/5

Research Question:

Which company has the best solar panel tracking technology and is best positioned in the market?

Summary of Findings

- Despite challenges from supply shortages due to COVID-19-related issues and a crowded and competitive market, the leading solar tracking companies are well positioned for meaningful and continued growth.
- Growth will be driven by demand from utility companies, municipal governments, school districts, energy co-ops, and investors all looking to generate, use, and sell solar energy. Solar trackers are becoming a standard on ground mount large-scale and even mid-scale projects because of the significant efficiency improvement they offer. Sources said currently 70% of all new ground mount projects call for using solar trackers and that is expected to grow rapidly to 75% or 80%.
- Sources expect the market to easily support the major players in the space, as well as a dozen or more smaller companies that offer quality trackers at competitive pricing.
- The leaders in the solar tracking industry include:
  - Array Technologies Inc. (ARRY), which has an excellent reputation and is expected to dominate the large, flat site 100 MW projects. Its advantages include the ability to use one motor for 18 rows of panels. Its primary weakness is a lack of flexibility for hilly sites.
  - Flex Ltd.'s (FLEX) Nextracker and FTC Solar Inc. (FTCI) are also well regarded and considered leaders in natural terrain solar installations and projects from 2 MW to 20 MW.
- The solar tracker competitive landscape is crowded, with several competent and innovative companies that bring similar products and technology to the market. Fourteen companies were discussed by sources, with each mentioning Soltec Power Holdings S.A. (BME.SOL), GameChange Solar, RBI Solar (a Gibraltar Industries Inc./ROCK company), PVHardware, Nevados Engineering, Solar FlexRack, Schletter Solar, and Ideematec.
- Sunfolding and Jurchen Technology were discussed as innovative companies with new technology that could gain share if they can establish bankability and a positive reputation.
- Challenges facing the solar tracking industry include margin and pricing pressure due to supply price increases and shortages, shipping delays due to port backlogs, rising interest rates and inflation, and—although not expected—regulatory and tax incentive changes that could negatively impact the industry.

Silo Summaries

1) Energy EPCs and Solar Company Executives

Three solar company executives all expect the solar tracker market to experience increased demand driven by increased solar energy requirements from utility companies, municipalities, school districts, and energy co-ops. They do not expect one solar tracking company to dominate the market as it is highly competitive and at least a dozen companies are expected to secure share in the space. **Array Technologies is considered an excellent company whose strength is with large 100+ MW flat and open types of sites. Nextracker and FTC Solar are more flexible than Array and excel in natural terrain environments and, according to one source, will dominate the 2 to 20 MW projects.**

2) IPPs (Independent Power Companies)

Array, FTC Solar, and Nextracker are well known in the solar industry—but even more important than choosing a company for its name is the initial study of the geometric aspects of a project to determine which supplier's product meets the requirements. The solar tracking market is growing because utility scale solar is growing. Solar tracking technology helps achieve 30% more yield than static systems. **This source guesses the tracking market could see an annual growth rate of 40% to 50% in the next two to four years.**

3) Solar Tracker Competitors

These two solar tracker manufacturers expect significant growth and demand for solar trackers. One said the market is mature but will grow above the 75% share level for new utility sized projects especially in the Midwest and on the East coast. **The other said it anticipates 'huge' growth** which has motivated his company to add production capacity on a yearly basis.

4) Solar Tracker Component Suppliers

Two suppliers to the solar tracking industry foresee continued and escalating growth for the industry, however one source highlighted a steel shortage that could slow growth until it is resolved. Nextracker, Soltec, and FTC Solar all have solid technology and are in the best position to succeed. The other source said Array Technologies has set itself apart because of its recent technology upgrade and product flexibility.

5) Industry Specialists

An energy performance testing executive and an academic heading a solar lab both think the use of solar trackers will continue to grow. One predicts growth will be fast. The other source expects growth but suggested that there are limiting factors.

	Solar Tracker Growth	ARRY and FLEX Positioned for Growth
Energy EPCs and Solar Company Executives	↑	↑
IPPs (Independent Power Companies)	↑	↑
Solar Tracker Competitors	↑	→
Solar Tracker Component Suppliers	↑	↑
Industry Specialists	↑	→

Background

Blueshift Research's initial research found the solar tracking market experiencing a whirlwind of IPOs and spinoff speculation for some of its leading companies. Solar trackers direct solar panels toward the sun, changing their orientation throughout the day to follow the sun's path to maximize energy capture. With the green energy market projected to experience significant growth over the next several years as corporations and governments worldwide make decarbonization commitments, these companies that dramatically improve the efficiency of solar panels seem positioned for tremendous expansion. What remains to be seen is whether all of the solar tracking market leaders benefit from the anticipated market expansion or if one company has superior technology or processes that will set it apart.

With strong demand from Wall Street for clean energy stocks, IPO activity and spinoff speculation has dominated the solar tracking industry, leading to heightened expectations for future growth and success.

- Array Technologies, the world's second-largest supplier of solar tracking systems, went public in October 2020, raising $1.05 billion.
- Soltec Power Holdings, a solar tracking company based in Spain, followed Array with its IPO in late October 2020, raising $175.8 million.
- These IPOs led the Street to speculate that Flex would spin off its market leading solar tracking division, Nextracker. In Flex's January 2021 fiscal Q3 earnings report, the company acknowledged it was actively pursuing alternatives for its Nextracker business that might include a full or partial separation of the business through an IPO, a sale, a spin-off, or other transaction possibilities.
- This month, Texas-based FTC Solar filed an S-1 to launch its IPO with a goal of raising $423 million at $18 to $20 per share. The company now lists on the Nasdaq Global Market under the symbol FTCI and completed its IPO on April 28, raising $258 million at $13 per share, well below its goal.

Market conditions for renewable energy are trending toward what could be a robust recovery from raw material and labor shortages brought on by the COVID-19 crisis that negatively impacted the entire green energy industry. Driving the recovery is the December passage of a two-year extension of the Investment Tax Credit for solar and a global trend of corporations committing to decarbonize by purchasing renewable energy. Also, the Biden administration recently signed executive orders to rejoin the Paris Climate Accord and require federal agencies to procure 100% renewable energy. The administration also announced a clean energy plan to reduce greenhouse gas emissions by 50% by 2030. According to a 2020 market research report by Fortune Business Insights, the global market for solar trackers was an estimated $9.3 billion in 2019 and is expected to exceed $22 billion by 2027.

Four solar tracking companies control the vast majority of the market and each claim to be the best.

- Flex's Nextracker started in 2013 and has been the solar tracker market leader for the past five years. Its affiliation with Flex provides unparalleled scalability and bankability, with 100 manufacturing sites in 30 countries and a worldwide supply chain and distribution network.
- Array Technologies has 17% share and 30 years of a successful track record, as well as an ISO 9001:2015 Certification and a 2021 Manufacturing Leadership Award.
- Soltec Power Holdings claims 11% market share, has been in business 16 years, operates in 20 countries, and has 35 international patents. It has installed 270,000 trackers supporting 19 million modules.
- FTC Solar has 10% share and has been in business since 2017. It is headquartered in Austin, TX, with sales and support in Australia, India, the Middle East, and Southeast Asia. It has ISO 9001:2015 and ISO 14001:2015 certifications and is UL certified, as well.

The primary headwinds facing the solar tracking industry are the continued disruption of the raw material supply chain and labor shortage due to COVID-19. The heavy capital investments required for installing solar trackers can drive up the initial cost of a project, which has the potential to curtail the growth trend if customers opt for lower cost but less efficient fixed solar installations.

Current Research

Blueshift Research assessed which company has the best solar panel tracking technology and is best positioned in the market. We employed our pattern mining approach to establish six independent silos, comprising 10 primary sources and five secondary sources focused on the solar tracking industry. Interviews were conducted April 26–May 14.

1) Energy EPCs and solar company executives (3)
2) IPPs (Independent Power Companies) (1)
3) Solar tracker competitors (2)
4) Solar tracker component suppliers (2)
5) Industry specialists (2)
6) Secondary sources (5)

Next Steps

Blueshift Research will continue to research the growth rate of the solar tracking industry. We will also focus on some of the new companies in the space to determine if any of them will take share from the industry leaders.

Silos

1) Energy EPCs and Solar Company Executives

These three solar company executives all expect the solar tracker market to experience increased demand driven by increased solar energy requirements from utility companies, municipalities, school districts, and energy co-ops. One source said the growth will be fast and sustained for years to come, another said growth will be by geographic region based on solar goals and availability of sufficient sunshine, and the third said the current growth is just the tip of the iceberg. He expects the tracker utilization rate to escalate from 70% to 75% to 80% of all ground mount solar projects. Sources do not expect just one solar tracking company to dominate the entire market as it is highly competitive and at least a dozen companies are expected to secure share in the space. Array Technologies is considered an excellent company whose strength is with large 100+ MW flat and open types of sites. Nextracker and FTC Solar are more flexible than Array and excel in natural terrain environments and, according to one source, will dominate the 2 to 20 MW projects. Solar FlexRack, GameChange, RBI Solar, Schletter, Sunfolding, and Ideematec were all discussed as offering solar tracker technology that will likely compete. Sunfolding was singled out as offering a unique hybrid design and solution that could gain meaningful share.

Key Silo Findings

Background

- 1 source is the president and managing director of Solar Operations Solutions, LLC.

- 1 source is a supply chain executive for an EPC.
- 1 source is a senior vice president at Blue Oak Energy.

Solar Tracker Market Potential

- 3 said the solar tracker market is poised for significant growth.
  - 1 said the current market is just the tip of the iceberg. He predicts the use of solar trackers will increase from 70% of all new ground mount projects to 75% to 80%.
  - 1 said growth will be by locality where solar mandates are a driver and where sun is prevalent.
  - 1 said growth will be fast and for years to come.

Solar Tracker Company Strengths/Weaknesses

- Array Technologies is considered the leader in large 100+ MW projects. Its one-motor tracker for up to 18 solar rows is a strength but it does not configure well for natural terrain projects and smaller installations.
- Nextracker and FTC Solar are expected to be the dominant trackers in the 2 to 20 MW and natural terrain solar arrays.
- Solar FlexRack, GameChange, RBI Solar, Schletter, and Ideematec were also discussed as competitors that can successfully compete for some share of the market.
- Sunfolding was singled out as having a unique hybrid design and power source that should make it successful.

Miscellaneous

- 1 said the use of bifacial solar modules in combination with solar trackers is a growing trend.
- 1 said the next major disruption of the energy industry is the creation of virtual power plants utilizing both traditional generators and renewable energy assets.

1) Brad Micallef, managing director and president of Solar Operations Solutions, LLC

The solar tracker market is big enough and still growing rapidly, so there will not necessarily be only one winning supplier and one winning technology. While Array (ATI) is very competitive in the large 100+ MW flat and open types of sites, other players such as Nextracker and FTC have advantages, such as independent row-driven tracker systems, which have more flexibility, as opposed to ATI's mechanically ganged row tracking system that uses a single motor to move several rows of solar modules at the same time. Nextracker and FTC will dominate the market in utility scale types of projects ranging from 2 to 20 MW but there will be dozens of other players who will pick up projects here and there. The industry trend is toward increased module energy density while other system costs keep going down. Solar industry growth is at the tip of the iceberg, with not just large utilities but schools, municipalities, and co-ops starting solar projects. Solar trackers will increase proportionately, with trackers being adopted in 75% to 80% of ground mount projects. Last year, new U.S. trade policy incentivized the import of bifacial solar modules. Combining the use of solar trackers with bifacial panels is showing higher yields in projects and the trend to use that combination is continuing this year.

Background

- Solar Operations Solutions is a technology solutions company and utility scale PV solar operations and maintenance (O&M) services provider.
- "[I have been] in utility scale PV Solar industry for over 13 years."
- "[I] have used Array and Nextracker in projects. I've known Array for 10 years and Nextracker for seven or eight years."

Solar Tracker Market Potential

- "This industry has not felt the impact of COVID-19 as much as other industries such as retail or in-dining food service. There were some construction delays and there were some material issues with steel but I haven't heard of any large industry-wide delays caused by the pandemic."
- "I'm surprised at the rapid and widespread adoption trackers have received in the last five years. As an operations and maintenance provider, I thought that most of our developer customers would stay with standard fixed-tilt systems which are easier to model and maintain because there are no moving parts. The market has proved me wrong."
- "70% of the projects that we see have trackers specified. Last year, newly imposed U.S. trade policies incentivized the import of bifacial solar modules. Trackers and bifacial panels are a great combination and projects with both have measurably higher yields. We ended up seeing a large increase in systems with both tracker and bifacial modules last year because of the change in U.S. trade policies."

- "This year, as well, we are seeing a lot of systems with a combination of bifacial modules and trackers."
- "I expect the growth of the solar tracker market to increase proportionally with the growth of solar projects, with trackers being adopted for 75% to 80% of ground mount projects."
- "As a private company, we are doing 50% more business this year compared to last year because of more customers bringing projects to the market. In the 13 years I've been in the utility scale solar industry, we are seeing more tracker adoption and more bifacial module adoption and we now also see schools, municipalities, and co-ops adopting projects, too. The latter all seem to have recently become aware that solar technology works and makes good financial sense. It is not just large utilities and investors anymore. We expect to see strong capital expenditure in both the utility and public sector."
- "I believe that the last 10 years of solar industry growth is just at the tip of the iceberg. The real market is just beginning to open up now. Long-term trends in energy policy and a shift in capital expenditure away from fossil fuels, toward renewables, is already underway as evidenced in utility integrated resource plans and state-level carbon reduction mandates."
- "The solar market has really just stepped onto the launching pad, following a decade of successful test flights."

Solar Tracker Company Strengths/Weaknesses

- "Array Technology has been around for a long time and they have a product line that performs very well, especially for large, flat ground mounted projects in desert and flatland deployments. Using a mechanically ganged-row tracking system, the ATI system uses a single motor to move multiple rows of solar modules at the same time. This is both mechanically and cost efficient. The ganged-row design introduces challenges for projects that have too much roll to the land, are irregularly shaped (not rectangular), or have features that require dividing the solar plant (e.g., wetlands, roads, patches of trees). Additionally, the ganged-row design can create an impediment to equipment and land access for equipment such as trucks and mowers during long-term commercial operations."
- "Nextracker takes a different approach. Instead of using a single motor and mechanism to link several rows together, they have a motor on each row. The motors are self-powered, drawing power from a small solar module that includes an integrated power supply and battery for 24/7 operation, eliminating the need for auxiliary power sources and additional field wiring. Independently powered rows don't have the same long-term impediments for service equipment and provide greater flexibility for terrain topology, as well as land features and irregular array arrangements. The adoption of independently actuated and self-powered row tracking systems is a trend that many companies have adopted."
- "The ability to position rows independently has also enabled Nextracker to develop and deploy TrueCapture, a layer of optimization that alters the standard east to west tracking algorithm to adjust changes in diffuse light caused by clouds. We can see a measurable increase on the site where we are running these algorithms. This type of optimization is not available on a mechanically ganged system."
- "With the exception of ATI, I cannot name a single mainstream supplier of ganged-row trackers. Most tracker companies are now supplying some form of independent row-driven tracker system."
- "FTC is an evolution of two different ideas: independent row tracking and larger format module tables. FTC's tracker is much taller than standard trackers, allowing more modules to be mounted east-to-west in what we call a table. The wider the table, the taller the tracker needs to be to achieve ground clearance, as the tracker rotates to its for east or west position. A taller tracker means larger steel beams are required for support; however, a wider module table means more energy density of the row and, hence, a lower cost per watt."
- "We've seen FTC trackers in the current fiscal year deployed by several clients along with bifacial modules where we have supplied monitoring and control software. We haven't installed or used them in projects we've been responsible for providing O&M services for, though, so I can't speak to their reliability in commercial operation. My initial impression is that they are a real contender in the tracker space and I expect to see more of them."

> Array Technology is very competitive in the large 100+ MW flat rectangular sites. … For that type of project in that segment, Array is the leader. … Utility scale type projects of 2 to 20 MW are going to be where companies like Nextracker and FTC dominate the market. But there will be a dozen other companies that will pick up portfolios of projects, too.
>
> *Brad Micallef, managing director and president of Solar Operations Solutions, LLC*

- "In my opinion, the market is large enough, and still growing, so that there is not necessarily going to be only one tracker supplier or one preferred technology. The market is also still seeing innovations. Sunfolding, for example, is

an interesting hybrid of ganged-row cost efficiency while also providing many of the benefits of an independent row system. Sunfolding uses a centralized air compressor to power a large array of module rows but still eliminates the drive bars, adapts to extreme terrain topology, and has a vastly simplified mounting system that reduces installation time. There will always be a few companies at the top hedging for market share but each with unique benefits for projects with specific requirements. Array Technology is very competitive in the large 100+ MW flat rectangular sites. I don't think they are going anywhere. For that type of project in that segment, Array is the leader. For smaller projects or projects where you don't have flat or open land, there are myriads of players like Nextracker, Solar FlexRack, GameChange, RBI Solar, Schletter, Sunfolding, Ideematec, FTC, and still others. Utility scale type projects of 2 to 20 MW are going to be where companies like Nextracker and FTC dominate the market. But there will be a dozen other companies that will pick up portfolios of projects, too."

- "As far as technology disruptions, the trends have been consistent. As module energy density increases, the balance of system costs are driven down; fewer parts, less material, less labor. As tracker row energy density increases you see the same reductions in parts, material, and labor, too."
- "Aside from trackers and bifacial modules, I believe the major disruption in our industry is the creation of virtual power plants through widespread utility coordination of both traditional generators and renewable energy assets. The ability to pull these generation sources together where you can forecast, firm, and provide reliable ancillary services to the energy trading market will be a game changing event for renewables that are currently classified as intermittent generators. The technology to support this exists today and I believe we will start to see pilot projects deployed relatively soon that support wider adoption in the next two or three years."

2) Supply chain executive for a full-service solar solution provider

Array and Nextracker are recognized in the industry as tier one suppliers. ATI is well suited for desert-type terrain because it is powered by a central motor while other suppliers such as FTC Solar and Nextracker have solutions with self-powered trackers that are used in mountainous topographies that are more flexible. Pricing is competitive but smaller companies such as RBI Solar and GameChange can sometimes be cheaper. Pricing is based on the site and the project. However, CapEx is not the only consideration when choosing. Maintenance is likely to be more expensive with ATI's solution that limits the free movement of trucks and mowers between rows. The most important consideration when choosing a supplier for a project design is the cost per watt outcome.

Background

- Source has used RBI Solar and other solar tracker products.

Solar Tracker Market Potential

- "The solar tracking industry is growing incredibly fast. It varies state by state but, overall, in the U.S. it is growing and will continue to grow in coming years. The utilities are motivated to have more and more renewables connected to their grids. We have a very optimistic outlook."

Solar Tracker Company Strengths/Weaknesses

- "The first and most important consideration is what the site of the project looks like. For any project, you need to have site studies that make recommendations of the type of technology you can use. There are many other systems than ATI, FTC Solar, Nextracker, and Soltec that are less expensive and just as efficient."
- "If the site is flat and there are no difficulties leveling and preparing the site, you can easily use whichever company you want."
- "Specifically, ATI is known to be used for desert types of terrains that are flat— Texas, for example. In mountainous regions in California or North Carolina where the topography is more challenging, you need to select another vendor that has self-powered trackers."
- "If the topography is flat, ATI's solution has trackers where the central beam is powered by a central motor, powered by the auxiliary transformer, that you need to design and integrate at the inverter station level. The trackers will always be moving and there are no installation issues."

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Supply chain executive for a full-service solar solution provider

- "With a more difficult topography, you need to be more creative and this means using self-powered trackers. This type of technology is very popular. This is what Nextracker and FTC Solar have. They produce very good and well-known tracker systems for an affordable price."
- "Major EPC companies will recognize both ATI and Nextracker as the top two. They are considered tier one suppliers."
- "Just because they are the top two doesn't mean they are the most expensive. Smaller companies like GameChange Solar and RBI Solar, though, might be cheaper but they all try to be aggressive on price. CapEx, however, is not the only thing you need to consider.
- "Consultants model the project with whatever product the customer wants but getting to the optimum power output is, of course, the most important."
- "For example, Nextracker, with their TrueCapture technology, claim to capture more sun. It's a backtracking function which avoids shadowing from the front rows when the sun goes further down."
- "Another important consideration is maintenance because you need mowers or trucks to access the rows. With self-powered trackers, this is not a problem. With ATI, the mowers need to go halfway down the row, make a U-turn and return, because there is a beam at the center of the row. This becomes a more serious issue maybe 20 years after the site is commissioned as more growth covers the terrain. A project using ATI is priced higher compared to self-powered trackers, which allow grounds maintenance to have easy access."
- "Once you have your study, you can submit it to the tracker companies and they suggest ways to adjust their technology to the landscape of the site."
- "There are other differences as well in achieving east/west position. We use RBI trackers that have a fairly complicated solution in the most difficult types of terrains in mountainous regions."
- "If I had the option to select a site, I would choose a flat site. But if I can't choose, I can use RBI's solar trackers. But unless it's a very crazy and challenging terrain, Nextracker, GameChange, Soltec, are all good for this and they fit sites well with minimal site preparation."
- "Pricing very much depends on the project and the site. The comparison criteria ends up being the cost per watt. For current projects in Texas, we are working on we are looking at RBI and Nextracker as our top suppliers. In other states, we are looking at other solutions."

3) Danny Lee, Ph.D., senior vice president at Blue Oak Energy

Nextracker and ATI are both very good products. ATI is often chosen for sites that can fit 18 contiguous rows that can be powered by a single motor and Nextracker is used for smaller, more jagged sites because of its flexibility. Projects where people prefer to have products with fewer motors would choose ATI. FTC has a smaller footprint and is also more adaptable. Prices for both ATI and Nextracker are competitive and purchases are often decided according to volume and purchasing agreements. The solar industry generally and single-axis trackers specifically are growing but growth is likely to vary by locality because of different renewable energy goals and because not every area has that much sun. The advancement of solar storage solutions would be a positive disruption to the industry.

Background

- Blue Oak Energy is a full-service engineering and consulting company.
- It has supported more than 2.4 GW of operating solar facilities.
- It has largely used Nextracker and ATI in projects.

Solar Tracker Market Potential

- "There were some supply chain issues due to COVID-19 around dock workers getting ill. I think it's been mostly corrected and I don't think there are any supply chain issues anymore. Around December there was somewhat of a bottleneck."
- "The industry is growing. The cost of solar is continuing to go down. The retirement of coal plants and the advancement of storage are driving growth."
- "Forecasted growth is going to vary by region. Some states have mandates to be carbon neutral by a certain year. Growth is going to be market by market."
- "I wouldn't necessarily consider it rapid growth. There will be localized growth in certain areas where you have the right conditions to do solar. Further out, in three to five years, it will still be localized because you don't have sun

everywhere. Solar has become very economical and now must compete directly with other energy sources. That said, there are some markets where it's tough to beat the cost of wind, natural gas, or fossil fuels."

- "Single-axis trackers typically bring the highest yield [in terms of kWh generated per kW installed] as opposed to fixed tilt or dual axis trackers. I think there will be some reduction in solar projects in states that are saturated, like California, where solar is producing more energy than the state can use. This is where storage will be critical."
- "Disruption in a good direction would be the advancement of storage solutions—using renewable energy outside of the sunny part of the day. That's critical for the success of the industry."

Solar Tracker Company Strengths/Weaknesses

- "Both Nextracker and ATI are great products and we don't have any issues with either of them. Nextracker is independent in the sense that they don't have a central drive axis like ATI. That's a differentiator for certain topographies that have constraints."
- "On sites that are not very good, Nextracker gives you more flexibility with layout."
- "There's an inherent problem with trackers in general that motors and bearings do wear out. They are not zero maintenance but that's an issue for both products."
- "Nextracker's self-powered trackers simplify wiring vs. ATI's active power supply—but not enough to change potential buyers' minds. We use both extensively. People will choose based on the form factor of the site. If you can't have 18 contiguous rows for the use of the single motor [ATI] then you would instead use Nextracker. For smaller, jagged sites, Nextracker is more suited. For large sites, it doesn't matter which you use."
- "Both ATI and Nextracker are fairly competitive. Procurement in this area is very complex in terms of supply agreements and volume. We see both prevalently on projects. Supply agreements could cause some people to buy more of one than the other."
- "I've heard that some people prefer to have fewer motors and that would push them to select ATI. There are less points of failure. I've learned over the years that people have different opinions and preferences that are not necessarily bulletproof."
- "We've only used FTC once, on one of our first projects, so I don't have much experience to share. They have a smaller footprint so they can be more adaptable when you don't have big, flat, contiguous land. Their form factor is smaller than the other two."
- "Nextracker is more flexible than ATI because ATI has 18 rows that are connected. For Nextracker, each row is independent. FTC is independent also but is smaller as they have less modules per rack."
- "I don't think there are necessarily disruptions on the horizon. Module manufacturers are going to larger format modules, not more efficient, but bigger. This is good for trackers because there are fewer parts. You're bolting together less modules. This is a positive for the industry. It would bring down costs in the sense of decreasing the number of times someone has to pick up the module."

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> *Danny Lee, Ph.D., senior vice president at Blue Oak Energy*

2) IPPs (Independent Power Companies)

Array Technologies, FTC Solar, and Nextracker are well known tracker companies in the solar industry—but even more important than choosing a company for its name is the initial study of the geometric aspects of a project to determine which supplier's product meets the requirements. The geometry of the project determines decisions about whether the EPC or IPP will want to use a single module in a row in portrait format, or very large modules, or two modules in parallel per row. Ease of installation is another factor. Prices tend to be competitive but involve negotiations and could, therefore, affect choice. New companies have a hard time breaking through because the AHJ (authority having jurisdiction) can require additional testing if they are not familiar with a product. The IPP might be reluctant to risk delays and extra costs. The solar tracking market is growing because utility scale solar is growing. Solar tracking technology helps achieve 30% more yield than static systems. This source guesses the tracking market could see an annual growth rate of 40% to 50% in the next two to four years. Increased trade tariffs could curtail growth.

Key Silo Findings

Background

- This source is a recent former IPP engineer with experience using Array and FTC Solar trackers.

Solar Tracker Market Potential

- 1 said barring any additional trade tariffs, the solar tracker market could experience 40% to 50% growth.
- Decision making on which solar tracker to use on a project is based on initial study of the geometric aspects of a project and price negotiations. New companies in the market face significant challenges is securing projects as they are untested and risk causing delays and additional costs.

Solar Tracker Company Strengths/Weaknesses

- 1 said Array, FTC Solar, and Nextracker are all well-known and well regarded in the solar tracker industry. However, he had heard of some tech issues with Nextracker and FTC Solar had a situation where they had to provide testing to prove they could meet the job requirements.
- Soltec and PVH were also discussed as strong companies and Sunfolding and Jurchen Technology were highlighted as new companies with potentially disruptive technology.

1) Project manager at IPP until recently

Background

- "[I am an] independent engineer. I worked for an IPP until earlier this year [and] had several projects using solar trackers for up to 200 MW AC power."
- "[My projects] predominantly used ATI and FTC Solar."

Solar Tracker Market Potential

- "The solar tracking industry is growing because utility scale solar is growing. This will benefit single-axis trackers. The trackers are designed to be simple and to not require much maintenance. The solar tracker technology makes it possible to achieve around 30% more yield compared to static systems."
- "In the U.S., more and more states that previously weren't interested in renewable energy are now bringing in solar, joining Texas, Virginia, and the Carolinas, so there's no longer such a big red/blue divide. This means the number and size of projects are growing. It is difficult to quantify growth. As a guess, I'll venture an annual growth rate of 40% to 50% in the next two to four years."
- "Further out, growth will depend on whether the industry can keep showing the value of solar. In combination with storage, solar is the cheapest energy. Even if there are political changes in the future, I doubt there would be a way to turn back the wheel to keep fossil fuel industries alive, which are more expensive anyway. It would be hard to reverse the growth trend. The pace of growth might not be as great but the [solar tracker] industry will keep growing."
- "Increased trade tariffs could, to an extent, curtail growth but not in the next three or four years. It did to some degree in the past but the politics are different now."

Solar Tracker Company Strengths/Weaknesses

- "Decisions about which trackers are used are made by purchasing. The criteria can be very technical but they can also be political."
- "Cost is a factor, so is ease of installation."
- "The main companies in the market are ATI, FTC Solar, and Nextracker, Soltec, and PVH. There are a lot of players to choose from in this market. Most of the ones who have been in the market for long are big enough and bankable, even if some of the names are more dominant."
- "You hear the most about Nextracker, they have the term tracker in their name. FTC and ATI are also well known in the solar industry."
- "ATI is definitely a company that's well liked in the industry. I've seen it used and the experience was very good."

> The solar tracking industry is growing because utility scale solar is growing. This will benefit single-axis trackers. The trackers are designed to be simple and to not require much maintenance. The solar tracker technology makes it possible to achieve around 30% more yield compared to static systems. … This means the number and size of projects are growing. It is difficult to quantify growth. As a guess, I'll venture an annual growth rate of 40% to 50% in the next two to four years.
>
> *Project manager at IPP until recently*

- "I worked on a project where the AHJ questioned the materials and welds of FTC trackers and requested tests. The system had not been used within the territory of this AHJ before. This does not mean their quality was bad but there was a problem and FTC was willing to work on a solution. The incident made us reluctant to work with new suppliers where the AHJs tend to be challenging [rather working with known and tested suppliers]."
- "I've heard of issues that Nextracker also had, meeting technical requirements for the AHJ on a project in the past, but I didn't work on that."
- "Sunfolding is a newer company and less well known and probably still working on the bankability issue."
- "The geometric aspects are important to consider when choosing solar trackers. Some have a single module in a row in portrait format. Others use very large modules or two modules in parallel per row. The geometry determines the best fit to cover the area. Even just a few additional feet might lead to using a completely different system to get the best coverage. The main consideration is how far apart the rows need to be to avoid shading. It's similar to installing solar panels on a roof: first look for the best fit, then for all other aspects."
- "After the initial design process, you look at which companies provide that geometry."
- "50% of the time it's the IPP that chooses a product because they've had a positive experience. In other situations, it's the EPC that suggests a product in their design."
- "The price points end up being comparable. Each company has specific sales points to justify their price. The purchasing department negotiates the prices. Prices will depend on the size of the project and the negotiations. Tracker costs are budgeted within a narrow dollar/cents per kw range."
- "They will look for the company that provides the right geometry and where the cost fits the model."
- "There could be a technology that could take market share away from single-axis trackers. Jurchen Technology uses an east/west system. There are no mechanics and that makes it inexpensive. You also get high density, low cost, and a very high yield per square foot of surfaces. I haven't seen them used on a project yet because they are new and there's always hesitation in using new systems in areas where there might be problems with the AHJ. Each AHJ has different requirements."
- "Bringing something new in might not always be a good idea, depending on the AHJ. Once a product has been tried and you see it working, it becomes easier to choose it."

3) Solar Tracker Competitors

These two solar tracker manufacturers expect significant growth and demand for solar trackers. One said the market is mature but will grow above the 75% share level for new utility sized projects, especially in the Midwest and on the East Coast. The other said he anticipates "huge" growth, which has motivated his company to add production capacity on a yearly basis. One source noted supply constraints due to a shipping container shortage that could slow growth. He said an increase in steel or solar module tariffs could also negatively impact the market, although with the current administration no increases are imminent. He added that tax incentives are also still important, however, not critical in promoting the continued growth of solar energy. As expected, each source was partial to their own company's solar tracker products as offering strong, innovative technology and flexibility. One source noted that conventional trackers from Array, Nextracker, and FTC Solar are challenged on natural terrain installations where his company's products excel. The other source said there are pros and cons to each company's products, suggesting that Array and Nextracker only offering one tracker solution makes them less adaptable but provides supply and manufacturing efficiency. The same holds true with motor configurations—a single motor moving several rows of modules keeps up-front cost and maintenance expense lower but is less adaptable than multiple-motor trackers.

Key Silo Findings

Background

- 1 source represents a seven-year-old company making solar trackers suitable for large scale natural land projects.
- 1 source represents a company based in Europe with an 11+ GW pipeline.

Solar Tracker Market Potential

- 1 said although the market is mature, solar energy is the lowest cost energy generation option for around 90% of the world and will grow significantly above the 75% penetration in new, large scale projects. He added that supply is constrained due to shipping container shortages and increased tariffs on steel and modules could slow growth.

- 1 said the growth potential for solar trackers is huge and that his plant is adding production capacity every year to meet the anticipated demand.

Solar Tracker Company Strengths/Weaknesses

- 2 said their company's products offered strong and flexible solutions.
  - 1 said the conventional trackers from Array, Nextracker, and FTC Solar are challenged on natural terrain installations.
  - 1 said there are pros and cons to each company's trackers.

1) Yezin Taha, founder, Nevados Engineering

The use of solar trackers will increase beyond the current 75% share in new utility scale construction. Though the solar market is becoming mature, there are still many areas in the U.S.—like the East Coast and the Midwest—that are seeing rapid growth. However, there are not enough flat lands to install trackers on every project, as the trackers of the leading companies including Array, Nextracker, and FTC Solar are not cost-effective and have limitations for use in all terrains. Their products require expensive flattening of rolling terrains. Nevados Engineering's all-terrain tracker works on flat land, slopes, and rolling terrains and, therefore, provides a cost-effective solution. COVID-19 has presented a challenge to the supply chain, as U.S. ports were affected. Though this has somewhat resolved, a shortage of shipping containers is causing higher prices internationally.

Background

- "Our company is focused on solar trackers for flat lands, slopes, and rolling terrains. The tracker can work for all terrains."
- "Solar equipment is easy to install on flat land. If the land isn't flat, the preparation is very expensive. We developed a tracker that can fit the flat land and the same tracker can be used on sloped and rolling terrain without land grading or changes in the operation of the tracker, except for changing the tilt angle [backtracking]. Other trackers have limitations for rolling terrains."
- "We've been around for seven years."

Solar Tracker Market Potential

- "COVID-19 challenged the supply chain because of ports in the U.S. being affected. This is only somewhat resolved now. Internationally, there is a shortage of shipping containers. Where you might have paid $2,000 to $2,500 for a container now you are paying $5,000 to $7,000 per container. However, the value of the goods inside those containers is quite high and even if you double the cost of shipping it doesn't erode the financial viability of the project. It just adds a little cost."
- "The solar market is mature now. The question of whether it can compete with other generation assets has been answered positively. In fact, solar is a preferred generation source for many utilities. It is the lowest cost energy generation option for around 90% of the world. It is the future of the energy generation industry. Having said that, it will be a long time before solar fully replaces all generation assets, if it ever does."
- "There are still large solar power plants going in the ground but there are also smaller ones for smaller distributed generation installations. In the U.S., the East Coast is growing at a rapid rate. We're also seeing high growth rates in the Midwest, in states like Illinois, Michigan, and Minnesota, places where five years ago we weren't expecting that much growth."
- "As solar grows, I don't think there will be a major shift away from solar trackers in the U.S."
- "Instead of conventional trackers where companies like Array, Nextracker, and FTC Solar cannot cost-effectively fit the natural terrain, in the past, they would have used fixed tilt systems. But now we [our company] have solutions where we can install solar trackers cost-effectively and that yields a better levelized cost of energy and lets us continue to grow the tracker market."

> **I think the tracker market is poised to grow to a larger share of the overall solar market for new construction in the coming years for commercial, industrial, and utility. Around 75% of new utility scale construction is with trackers and I expect that percentage to continue to increase.**
>
> *Yezin Taha, founder, Nevados Engineering*

- "I think the tracker market is poised to grow to a larger share of the overall solar market for new construction in the coming years for commercial, industrial, and utility. Around 75% of new utility scale construction is with trackers and I expect that percentage to continue to increase."
- "If steel and solar module tariffs were to increase dramatically, they could curtail the growth. It doesn't look though as if it will happen anytime soon. I don't expect this administration to drive those tariffs up any higher than the last administration."
- "Tax incentives for solar are still important for many developers but not critical for all solar power developers. The market is slowly becoming independent of the need for incentives."

Solar Tracker Company Strengths/Weaknesses

- "There is a need in the industry for a strong and large company that provides an all-terrain tracker."
- "There isn't enough flat land to support the solar industry. In Virginia for example, their mandate is to put in 750 MW of solar a year but they don't have anywhere near enough flat land for that. The products of the large tracking companies require flat land or flattening rolling terrain. This is expensive and there are limitations on flattening land. Developers don't want to deal with the environmental mitigation problems of scraping off the flora and the topsoil because they'll have to get new grasses planted to hold the soil in place so that rain won't wash the equipment away. If a utility wants to install solar on farmland, the farmer can require that the land be returned in usable form when the lease expires in 30 years so you can't scrape off all the topsoil."
- "It is a major need in the industry to have an alternate tracker that does not need to have land graded. It needs to be a simple tracker, not like some of the very complex ones that already exist, which are challenging for operations and maintenance."
- "Without good all-terrain trackers, the tracker market could slow down in some areas or might not grow as expected and could be replaced by other generation assets."
- "The focus on technology these days is on energy storage and that helps solar. Any new ideas of alternate energy solutions would take decades to grow and to take over. I don't see solar being replaced any time soon by anything that is out there."

2) Engineering executive and customer service manager at a major European solar tracker manufacturer

Many of the manufacturers in the solar tracking market have only one product. The advantage is that they can standardize their product and their manufacturing process and aim to have fewer supply chain issues. This manufacturer has several configurations that allows it to adapt to different client requirements. The company expects there will be a huge increase in the solar tracker market and is increasing production capacity yearly to meet anticipated demand.

Background

- This source represents a European manufacturer with an 11+ GW pipeline.

Solar Tracker Market Potential

- "I believe there will be a huge increase in this market. We now have a pipeline of about 11+ GW but we are expecting an exponential rise in the coming years. For this reason, we are increasing our production capacity every year."

Solar Tracker Company Strengths/Weaknesses

- "Some of the players in the solar tracker market have one main product and other companies sell several configurations—portrait/landscape/two-module-in-portrait, etc. … Companies that have a large portfolio can adapt better to different clients' needs."
- "In the U.S., the main configuration is one-module-in-portrait. This is because it is easy to install and installation costs are relatively high compared to the Middle East, South America or Australia."
- "Having a portfolio of trackers of several heights can be an advantage, or not. Companies like ATI and Nextracker only have one main product. This means they can standardize their product as well as the manufacturing process. Having many products with many components can lead to more issues in supply."
- "Another differentiation in the types of trackers is whether they have a single motor per row or where several rows are moved by the same motor.

"I believe there will be a huge increase in this market. We now have a pipeline of about 11+ GW but we are expecting an exponential rise in the coming years. For this reason, we are increasing our production capacity every year."

Engineering executive and customer service manager at a major European solar tracker manufacturer

If there's one motor per row, the positive is you can move each row independently so that each row is in the best optimized position at each moment and you can obtain maximum production. It's more easily adaptable to the terrain. The negative is that you have a higher number of motors compared to the solution where you use let's say one motor to move 20 rows. You have fewer motors but you can't optimize the production as much as when you have one motor per row. That's the case with ATI compared with Nextracker and our company's solution."

- "Another differentiation is the stow positions [the position of the tracker against the windows] where you have a system to avoid damage to the tracker because of wind. There are two systems to protect against wind; one is active and the other is passive. ATI for example uses a passive system where they don't have anemometers nor wind sensors. They instead have a mechanical controller that can make the row move to a stow position. Others like Nextracker and PVHardware use active systems. Some use anemometers and when the wind speed is high, the tracker moves to the stow position. These different solutions have pros and cons. The con in the passive system [like ATI has] is that after the tracker has moved to the stow position where it is safe from the wind, it takes at least 12 to 24 hours to return to the optimum position for production. A pro is that this setup is more robust because it is mechanical and does not depend on any electronic parts. The active systems like PVH's and Nextracker's have an anemometer to read when the wind is high. The tracker moves to stow. The positive is that when there is no wind, it goes back immediately into working position and you have optimum production right away. The con is that the electronic controls can have some redundancy in terms of safety measurements."
- "Others have only one main product—one module in portrait. PVH is the leader in the Middle East, Australia and Europe because of its height portfolio—one-module-in-portrait, two-modules-in-portrait, three-modules-in-landscape, a product with one motor per two rows, a product with one motor per row—in other words several configurations which allow it to adapt to the various client requirements."
- "The manufacturers all look at and use similar criteria: the robustness of the product and in terms of production, optimized backtracking so the product is configured to do the tracking without generating shadows on the other rows. I'm not sure if others have that because they move a lot of rows with one motor so they are less adaptable than the rest. The others are similar."

4) Solar Tracker Component Suppliers

Two suppliers to the solar tracking industry foresee continued and escalating growth for the industry; however, one source highlighted a steel shortage that could slow growth until it is resolved. He anticipated that the shortage will not be resolved until the fourth quarter of 2021 and, until then, the tracker industry is being margin and price squeezed. According to one source, there are few differences between solar tracker products and the bigger companies—including Array Technologies, Nextracker, Soltec, and FTC Solar—all have solid technology and are in the best position to succeed. The other source said Array Technologies has set itself apart because of its recent technology upgrade and product flexibility. The industry is highly competitive. One source noted that whenever a new feature or improvement is introduced by one company, within a short period of time all the main companies offer something similar. Price is also a key decision element for IPP solar projects which, unfortunately, has negatively impacted the supplier of drive devices. He said his company's solar business is declining because a new, lower-cost technology has garnered the favor of the main manufacturers and reduced his business to only maintenance and repair of past installations.

Key Silo Findings

Background

- 1 source is a manufacturer of solar components used in the installation and operation of utility scale projects. .
- 1 source represents a manufacture of drive motors for solar trackers.

Solar Tracker Market Potential

- 2 said they expect continued and significant demand and growth for the solar tracker industry.
  - 1 qualified his growth response by saying a steel shortage could slow growth until it is resolved by Q4. Until then, solar tracker manufacturers face a margin and pricing squeeze.
  - 1 said demand for solar tracking on utility scale projects is increasing because of significant efficiency gain provided by its use.

Solar Tracker Company Strengths/Weaknesses

- 1 said the larger companies in the solar tracker industry all have solid technology and are best positioned to succeed, including Array, Nextracker, and FTC Solar.
- 1 said they have worked with Nextracker, Array, FTC Solar, and Soltec in the past and they all have solid products and good people. He added that Array Technology's upgrade and flexibility has set it apart, to some degree.

1) CEO of a supplier to solar tracker players

Soaring steel prices and shipping disruptions are roiling the industry and creating short-term challenges. However, growth looks to be strong once the current supply chain issues abate. The big players (Array, Nextracker, and FTC Solar) are well-positioned to capitalize on future growth, although no company has an obvious advantage in terms of technological prowess.

Background

- This supplier counts many of the major solar tracker companies as customers of its utility scale installation and operation components.

Solar Tracker Market Potential

- "It's a great market from a growth and a top line standpoint. It's a brutal market from the margin and profitability standpoint. The tracker guys are under a massive price squeeze. They've made major commitments six to 12 months out for steel and shipping, and the price of steel and shipping has soared."
- "That'll come around. This is so tied to everything that is happening in steel and other commodities, and everything that is tied to shipping. Until Maersk gets more capacity online, until the Port of LA declogs their port, we're going to have this problem. We're backed up. We've got customers screaming at us. Steel is going through the roof. We can't even get steel in certain instances. You come back to the fundamental economics, and it should cost $4,000 to get a container from India or China to the States. It'll all come back."
- "It's taking longer than anyone expected. It ain't going to get worked out in three months or six months. It's going to be nine months before we get back to normal."
- "Look at solar overall and the growth in solar overall. The growth in trackers is going to be greater than overall solar. It's really the utility-scale projects that are booming. People are putting in trackers in Canada, for God's sake. If you can afford to put in a tracker that far north, you can put them in anywhere. In my opinion, trackers are going to take over the entire industry."
- "Commodity cost are a challenge, and that could slow things down. Something's gotta give. Prices have to come back down or you have to get better PPAs [power purchase agreements]."

Solar Tracker Company Strengths/Weaknesses

- "There's not a heck of a lot of differentiation. They have fundamentally different designs but it's not like wind. A wind turbine is a monster; it's an engineering feat. These designs ain't that difficult. The barriers to entry ain't that big. The moat ain't that deep and it ain't that wide."
- "Clearly, the big players out there have great technology. Array, Nextracker—they have great technology. But does anyone stand out far and away for dominant technology? No."
- "Some of the guys are good on even ground. Others are good in certain weather zones. They have strengths and weaknesses in certain niches. But I don't see that one company that has far and away better technology."
- "I don't really see the differentiation between them."
- "The big guys are big because they're better able to weather the storm. Nextracker, Array, FTC are well-positioned. They have the balance sheets. The smaller guys are going to have a tougher time."

> **Clearly, the big players out there have great technology. Array, Nextracker—they have great technology. But does anyone stand out far and away for dominant technology? No.**
>
> *CEO of a supplier to solar tracker players*

2) Sales representative for a manufacturer of solar tracker drive devices

Although this source's business with solar tracking companies is declining because of his competitors offering lower pricing and improved technology, he sees demand for solar power and solar trackers increasing. He said Array has

recently differentiated itself with improved technology and more flexibility that makes it the current market leader. However, he noted that in his experience the advancement will be quickly reverse engineered and offered—often at a lower cost—by the competition. Price is the primary driver in the solar tracker industry.

Background

- This source's company's solar business is declining because tracking companies now favor sleeve drives vs. its screw jack design.
- He remains in contact with all of the major solar tracker companies because his company is called on for repair and upgrade work on past projects.

Solar Tracker Market Potential

- "Although our business in the solar tracker space has declined, the market is expanding."
- "Demand for utility and commercial scale solar is strong and trackers are in increasing demand because they make the project much more efficient than a fixed panel installation."

Solar Tracker Company Strengths/Weaknesses

- "I worked with all of the companies you are asking about (Nextracker, Array, FTC Solar, and Soltec) in the past and they all have quality products and the people deal with are great."
- "Array seems to have set itself apart recently with its improved technology and flexibility but all the companies are solid."
- "One thing I've learned is that when one company develops something that sets it apart, within a year or two all of the major companies wind up offering something similar and often at a lower cost."
- "What really drives the solar tracking industry and for that matter the solar industry overall is price. That's why our business is declining and being limited to the repair and upkeep of past installations, our customers found a lower-cost solution."

> **Array seems to have set itself apart recently with its improved technology and flexibility but all the companies are solid.**
>
> *Sales representative for a manufacturer of solar tracker drive devices*

5) Industry Specialists

A third-party energy performance testing executive and an academic heading a solar lab both think the use of solar trackers will continue to grow. One predicts growth will be fast, as predictive maintenance and real-time field data improves production optimization. The other source expects growth but suggested there are limiting factors, including the cost and competition for battery storage and competition from other renewable energy sources and fossil fuels. Also, the cost of maintaining solar installations could be a growth impediment. One source acknowledged FTC Solar, Array, Nextracker, Soltec, and PVHardware as some of the major solar tracker providers, but neither source knew specifics regarding their products or market potential. The third-party testing executive did single out Nevados Engineering as offering a solar tracking system that is flexible for use in natural terrain projects and helps reduce engineering costs.

Key Silo Findings

Background

- 1 source is an executive for a third-party energy performance testing company.
- 1 source is an academic and director of a solar lab.

Solar Tracker Market Potential

- 2 said the growth of solar trackers will increase.
  - One said the growth will be fast and driven by predictive maintenance and remote field data that will improve energy production.
  - 1 said growth will continue but factors like legislation, competition cost, and competition will all impact the rate of growth.

Solar Tracker Company Strengths/Weaknesses

- Neither source was knowledgeable about the major solar tracking companies.
- 1 source did highlight Nevados Engineering as offering an innovative, flexible tracker system suitable for natural terrain projects that reduces site engineering costs.

1) Development executive for an independent energy performance service company

FTC Solar, Array, Nextracker, Soltec, and PVHardware are some of the big players in solar tracking. Every penny matters, especially in very large projects, so the differences in the trackers are considered along those lines. Building and insuring for extreme weather has also become an important consideration. Independent third-party lab testing is becoming more common. The industry is expected to grow rapidly due to improvements in predictive maintenance and real-time feedback from the field that will improve production optimization. There could be disruptions to growth because of factors like supply chain issues and economics but solar will continue to grow.

Background

- This source is a downstream testing executive.

Solar Tracker Market Potential

- "I expect the use of solar tracking to grow rapidly. As modules change and the industry/power electronics/software gets better, so will predictive maintenance and real-time feedback from the field for production optimization—trackers that can be remotely adjusted anytime based on localized site conditions, e.g., extreme weather."
- "There have been supply chain disruptions. The shipping industry has been impacted heavily by congestion at the ports. This has impacted delivery of solar equipment to projects, delaying completion. Force labor within the PV module manufacturing industry could shift how and where structural components are made, where the material (polysilicon, steel, aluminum, etc.) is mined. There will probably be more consolidations in the near future, or companies involved in SPACs/IPOs to raise additional capital. Growth might slow for economic reasons, supply chain or perhaps tax equity shortages, but the train has left the station. Solar will only continue to grow."
- "From a reliability/performance testing perspective, the rapid changes in designs and shifts in material used within the supply chain, means modules, inverters, trackers and ESS [energy storage systems] very much need third party testing or bankability studies to validate claims manufacturers are making, ideally before technology is deployed to a solar site and especially if a system is expected to last 30 to 40 years."

I expect the use of solar tracking to grow rapidly. As modules change and the industry/power electronics/ software gets better, so will predictive maintenance and real-time feedback from the field for production optimization—trackers that can be remotely adjusted anytime based on localized site conditions, e.g., extreme weather.

Development executive for an independent energy performance service company

Solar Tracker Company Strengths/Weaknesses

- "A few of the big players in solar tracking are FTC, ATI, Nextracker, Soltec, and PV Hardware. I don't know enough to say which company has the best technology."
- "There is much debate about how rear side shading and bifaciality are influenced by the total ecosystem of physical parts on the back of a module, one-in-portrait versus two-in-portrait, torque tube dimensions, wire management, caps, struts/braces, gears, etc. … All contribute to some amount of micro production loss. Special ray tracing tools and models are used to capture all of those parts."
- "On small systems, the losses are probably negligible. On multi-hundred MW, multi-hundred-acre sites, those losses can compound and are meaningful to investors and asset owners when production estimates don't align with actuals. PPA rates are paid out on a cents per watt basis, so every penny matters."
- "Extreme weather is now an important consideration. Two years ago in Midlands, Texas, there was a hailstorm that caused $75 million in damage. That has fundamentally changed how solar projects are insured and what is insurable in the U.S. Tracker companies have since invested a lot of R&D in developing smart trackers, with special algorithms, connected to live weather data that can automatically put an entire system or parts of a system in a vertical stow position if for example hail is in the forecast or extreme winds."
- "Finally, wafer formats in modules are getting larger, going from 156mm (most common today) to 182mm to 210mm. This matters as the modules get bigger—more material, i.e., glass, aluminum, polysilicon, silver, and more weight and surface area on the racking and trackers. There is more engineering and potential cost unless the net benefit of having larger wafers, and cells, truly equates to more longer-term production."
- "It is a balance of structural and system costs. I know some developers who are sticking with fixed tilt systems because it is easier to model and more predictable. And more cost efficient."

- "Third-party or independent lab testing on trackers and racking systems is important. That will become more common. [Our company] reviews wind tunnel reports and studies but we don't have a wind tunnel to test the technology or load thresholds."
- "In terms of technical enhancements, examples exist of flexible systems that match the natural terrain such as Nevados Engineering. Flexible solutions for complicated sites will eliminate or reduce other civil engineering costs."

Miscellaneous

- "I'd think about the macroeconomic influences. At least for utility scale solar. Policy implications with China on trade. Import tariffs. Commodity prices or demand for iron ore and Chinese steel could have short/long-term pricing implications or create uncertainty. The global shortage in semiconductor chips may also play a role. Especially in "smart" systems. The U.S. doesn't have a strong presence in chip manufacturing. I don't know how all of these impact pricing exactly—but I'm sure they do."

2) Academic solar specialist at a major university in the Pacific Northwest

Growth of solar tracker use will continue; however, the rate of growth may be impacted by several factors. Storage technology costs, competition from other renewable energy sources and fossil fuels, chip shortages, and the high cost of solar module and tracker maintenance are all factors that could affect the rate of growth experienced in the tracker space.

Background

- This source is director of a solar lab whose data is used to help establish a sound infrastructure needed to integrate solar energy into the regional energy mix.

Solar Tracker Market Potential

- "The growth in the United States will be affected by legislation. I see continued growth but the rate of growth depends on dependable and inexpensive storage technologies. There will be competition with the electric car industry for these batteries."
- "[What could curtail growth includes] competition for battery storage with the electric car industry. Competition with other renewables, especially wind. Trade war with China. Competition for the established utility industry that has money invested in non-renewable technologies. Fight to use existing fossil fuels."
- "Chips may be a problem until the supply lines improve."
- "[In terms of growth potential,] maintenance is the main drawback to tracking systems. It is likely that solar electric facilities will be overbuilt and charge storage or put to other use when the load capability is achieved. This will affect the capital cost equation."
- "Overall, the main problem is maintenance and the ease to replace worn parts. With the 2AP [two-axis] trackers, we have had to replace the tracking motors from the use of wear and tear. This only happens once every seven to 10 years, but the bearings and parts must be lubricated. For a large solar electric facility, this maintenance must be quick and easy. Power to the motors is important as well as power to the computer chips. Batteries wear out over time and they have to be replaced. Again, this is done on a five to seven year time basis. Also, be sure that wiring coming into the boxes have drip loops. These systems will usually be in hot, dry, areas and far from service centers. Simplicity, durability, and maintainability are crucial factors."

Solar Tracker Company Strengths/Weaknesses

- "The trackers I am familiar with are the two-axis trackers from Kipp & Zonen and the EKO STR-32G (by EKO Instruments B.V.) LI-Cor also has a solar tracker but it is antiquated and no longer produced. We also use the Eppley manually adjusted solar tracker but they are not suitable for any use except solar monitoring. I do not use the single-axis trackers."
- "For our use, the 2AP is the most sturdy tracker. We have used them since 1997."
- "The most commonly used solar PV trackers are one-axis trackers. For smaller systems, the east-west trackers may be tilted along the axis to the equator."

Secondary Sources

These five secondary sources focus on Array withdrawing guidance due to increased material and shipping costs, Nextracker's planned IPO, the solar tracker market's growth potential, and Array's and Nextracker's recent contract success.

May 12 PVTECH article

Array Technologies withdraws 2021 guidance amidst "unprecedented" rise in materials, logistics costs.

- "Shares in Array Technologies have continued to fall in early morning trading, slumping more than 33% to US$16.50 at the time of writing."
- "Array Technologies has withdrawn its guidance for 2021 after experiencing 'unprecedented' increases in material and logistics costs which severely impacted earnings in the first quarter."
- "Reporting its Q1 2021 results yesterday, Array revealed lower than expected adjusted earnings of US$34.5 million for the reporting period, a 69% drop year-on-year, on the back of headwinds caused by spiraling costs of steel and logistics constraints."
- "Revenue fell by around 44% year-on-year to US$245.9 million, attributed by Array to unseasonably high revenues recorded in Q1 2020 as developers procured components for safe harboring ahead of the step-down in investment tax credit levels."
- "Speaking yesterday, Array Technologies chief executive Jim Fusaro said that higher than anticipated logistics costs weighed heavily on its Q1 2021 earnings, contributing to the missed guidance for the period, but also warned of increases in steel and shipping costs that are 'unprecedented both in their magnitude and rate of change.'"
- "Fusaro noted that between the first quarters of 2020 and 2021, spot prices of hot rolled coil steel used in Array's tracker products more than doubled, and have continued to increase since, rising a further 10% since 1 April 2021. Array does not hold large inventories of steel, meaning the company is more exposed to price fluctuations. '…A significant increase in the price of steel over a short period of time can negatively impact our results,' Fusaro added."
- "This volatility is anticipated to continue. Fusaro said that increases in steel and freight costs will impact Array's margins at least in the second quarter and potentially later in the year if prices do not normalize. The company is taking 'several actions to mitigate' on the potential impact of these on 2021's full-year results, including passing some of these costs onto its customers and negotiating long-term contracts with freight providers, and other initiatives."
- "Full guidance for the year will be reinstated once the company has completed a review of open purchase orders and prices have stabilized, allowing it to develop a more stable forecast."
- "Fusaro was also, however, keen to stress the potential upside of price pressures from a competitive point of view."
- " 'Importantly, we believe our competitors are being impacted by the same cost increases that we are experiencing and, in certain cases, much more significantly because their smaller size gives them less buying power with suppliers.'"
- " 'We believe the near-term pressure that is being created by the current environment may enable us to accelerate our market share gains because some of our competitors may not be able to deliver on customer commitments given their inability to procure raw materials at a competitive price or at all,' he said."
- "Array also noted that its quoting activity had risen to the highest levels seen in the company's history, with Fusaro specifically mentioning the up to 4GW contract sealed with leading US-based EPC Primoris Services late last month."

April 29 PVTECH article

Nextracker progresses with its planned initial public offering.

- "California-headquartered solar tracker manufacturer Nextracker is moving forward with a proposed initial public offering (IPO) of the company."
- "The firm, which was acquired by electronics manufacturer Flex for US$330 million in 2015, said it has confidentially filed a draft registration statement on Form S-1 with the US Securities and Exchange Commission relating to the transaction."
- "Flex said in a press release that the IPO and its timing 'are subject to market and other conditions and the SEC's review process.'"

- "Flex revealed in its third-quarter results statement in January 2021 that it was actively pursuing alternatives for the Nextracker business, considering options such as a full or partial separation of the unit through an IPO, sale, spin-off or other transaction."
- "PV Tech has reached out to both Nextracker and Flex for comment on the story, however neither had responded at the time of writing."
- "Founded in 2013, Nextracker has to date provided 50GW of trackers to solar projects that are operational or under construction. Last month, it secured a deal to provide 125MW of its single-axis NX Horizon trackers to Spanish developer Solaria, adding to another recent deal for what will be Australia's largest PV project.
- "The IPO news comes as Nextracker competitor FTC Solar saw its stock begin trading on Nasdaq yesterday (Wednesday), with its shares rising from the initial listing price of US$13 to a high of US$15.28, before closing at US$14.26. FTC Solar, which makes Voyager trackers, previously said it was aiming to raise as much as US$423.6 million from the listing."
- "Another US tracker manufacturer, Array Technologies, completed its own IPO last year, as the company ramps up efforts to expand its presence internationally. It expects 2021 revenues to be 23% higher year-on-year, reaching as much as US$1,125 million."

April 28 WBOC article

WBOC published the availability of a Fortune Business Insights report, titled "Solar Tracker: Global Market Analysis, Insights, and Forecast, 2018-2026." The report predicts a CAGR of 12.6% during the period.

- "The global solar tracker market is projected to gain impetus from the increasing demand for green energy across the globe. According to a report published by Fortune Business Insights, titled 'Solar Tracker: Global Market Analysis, Insights, and Forecast, 2018-2026,' the overall solar tracker market is expected to grow from USD 8 Billion in 2018 to USD 18.5 Billion by 2026 at a CAGR of 11.09% during the forecast period."
- "The global solar tracker market size was valued at USD 9.30 billion in 2019 and is projected to reach USD 22.33 billion by 2027, exhibiting a CAGR of 12.6% during the forecast period."
- "The report suggests that the governments of numerous countries have been creating awareness regarding the benefits and requirements of green energy in order to reduce the emission of carbon. This is anticipated to be one of the major drivers that are likely to increase the global solar tracker market sales. Also, small and big key market players have begun to invest huge sums of money in this industry. This will also put a positive impact on the global market."

April 22 Solar Industry article

Array secured a contract for 4 GW of solar trackers from Primoris Services Corp.

- "Array Technologies, a manufacturer of ground-mounted systems used in solar energy projects, has been awarded a contract for up to 4 GW of trackers from Primoris Services Corp., a provider of specialty contracting services."
- "'We are pleased to expand our relationship with Primoris Renewable Energy,' says Jeff Krantz, CCO of Array Technologies. 'This agreement builds on the 2 GW that Primoris Renewable Energy has already purchased from Array and underscores the edge our system provides in installation efficiency. Through innovations, including single-bolt module clamps and the toolless assembly of certain components, we are helping our EPC customers reduce their labor costs and complete projects on time and under budget.'"
- "The contract includes a commitment to purchase 2.5 GW of DuraTrack HZ v3 single-axis solar trackers that are scheduled to be used in more than 10 projects across North America and an option to purchase an additional 1.5 GW for other projects."

March 3 Power Technology article

Nextracker has secured a contract to supply its products to an 830 MW solar photovoltaic plant in Brazil.

- "Solar tracker supplier Nextracker has secured a contract to supply its products to an 830MW solar photovoltaic plant in Brazil."
- "Engineering, procurement, and construction firm Andrade Gutierrez and developer Elera Renováveis issued the contract for phase one of the Janaúba PV plant. The solar complex lies near the city of Janaúba, Minas Gerais in Brazil."

- "Under the agreement, Nextracker will supply its single-axis NX Horizon solar tracker technology, optimised for bifacial panels. Nextracker chief commercial officer Marco Garcia said: 'We are honoured to work side by side with our partners, Elera and Andrade Gutierrez to deploy Brazil's largest solar tracker project.'"
- "Nextracker's expert local staff combined with our company's cutting-edge solar tracker and software technologies will ensure that this historic project will perform to its full potential."
- "The company claims that the NX Horizon tracker will help Elera Renováveis to maximise Janaúba plant's performance while minimising operational costs."
- "Through its regional office in Brazil, Nextracker will offer engineering advisory, commissioning, asset management and advanced data analytics services for preventive maintenance. The company will also train installers in best practice at its Sao Paulo training centre."
- "Once operational next year, the solar complex will become the largest of its kind in South America."
- "Andrade Gutierrez Renewables general manager Patricio Pavez said: 'We are delighted to be working with Nextracker on the Janaúba solar plant. Nextracker's extensive expertise in wind design research, development, and engineering and proven bifacial gains were ultimately what led us to select the NX Horizon smart solar tracker.'"

Additional research by Eva Cahen and Jeff Ostrowski.