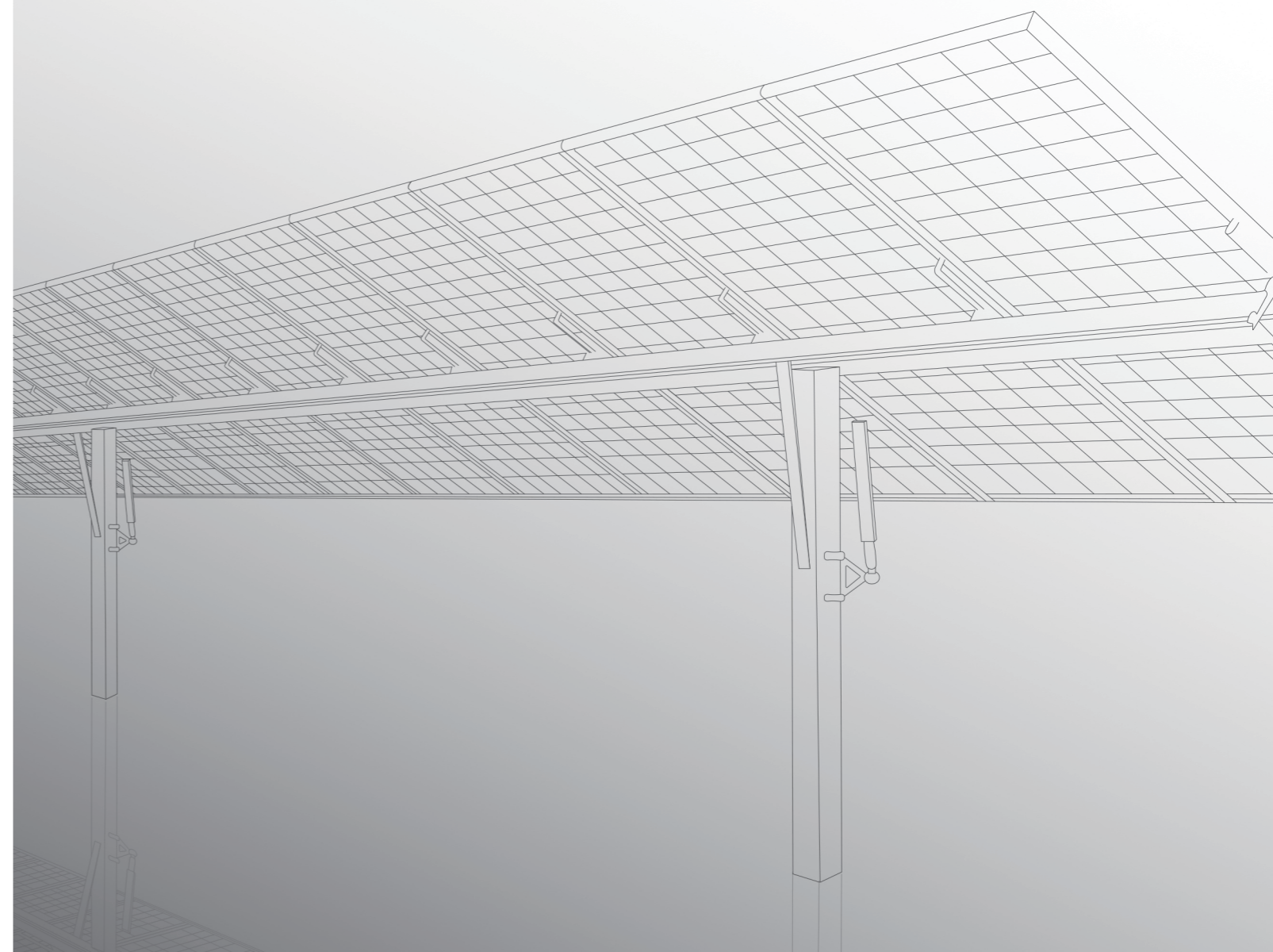


TONGWEI Solution for G12-Tracker Compatibility



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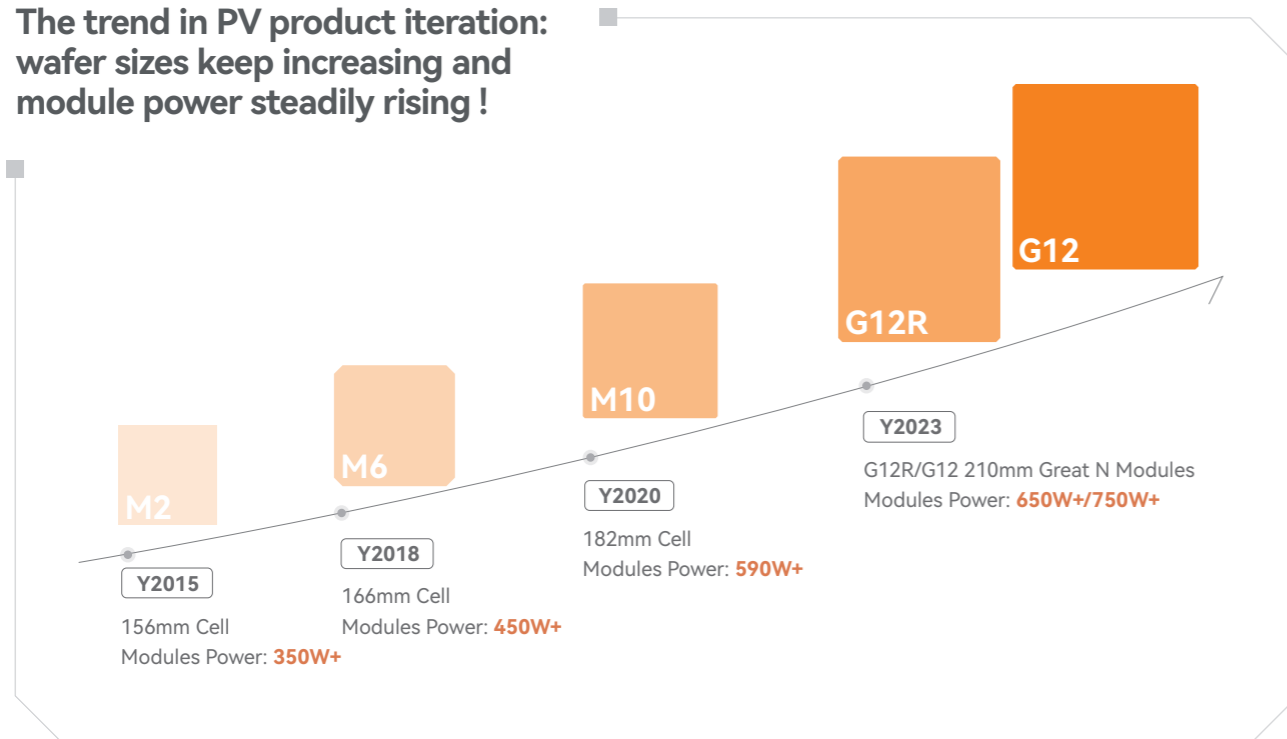
01 Introduction

1.1 "Higher Efficiency with Lower Budget" Driven Solar Market Evolution

With the acceleration of the global renewable energy transition, the PV industry has shifted from being "subsidy-dependent" to full-scale competition centered on efficiency, cost, and system value. Tongwei TNC modules (Tongwei's independently developed N-type modules) are accelerating the continuous reduction of system costs and system-level LCOE (Levelized Cost of Electricity), because of products superior properties including higher module efficiency, lower power degradation rate, greater modules bifaciality, and excellent system compatibility. "Higher Efficiency & Lower Budget" have become the key driving forces for PV industry development.

Beyond PV technological upgrades and innovation, module product iteration and upgrade base on the continuous optimization of wafer size and module dimension. Thereby continuously improving module power and product's system value. In 2023, N-type modules deployed with G12 square wafers (210mm×210mm) and G12R rectangular wafers (210mm×182mm) became a mainstream product solution in the PV industry, due to their higher module power output, higher cost advantages in manufacturing, and lower system costs and LCOE in PV power plant applications. Nowadays, these modules are gaining a strong reputation in the PV market and are driving the technological advancement of photovoltaic modules.

The trend in PV product iteration: wafer sizes keep increasing and module power steadily rising!

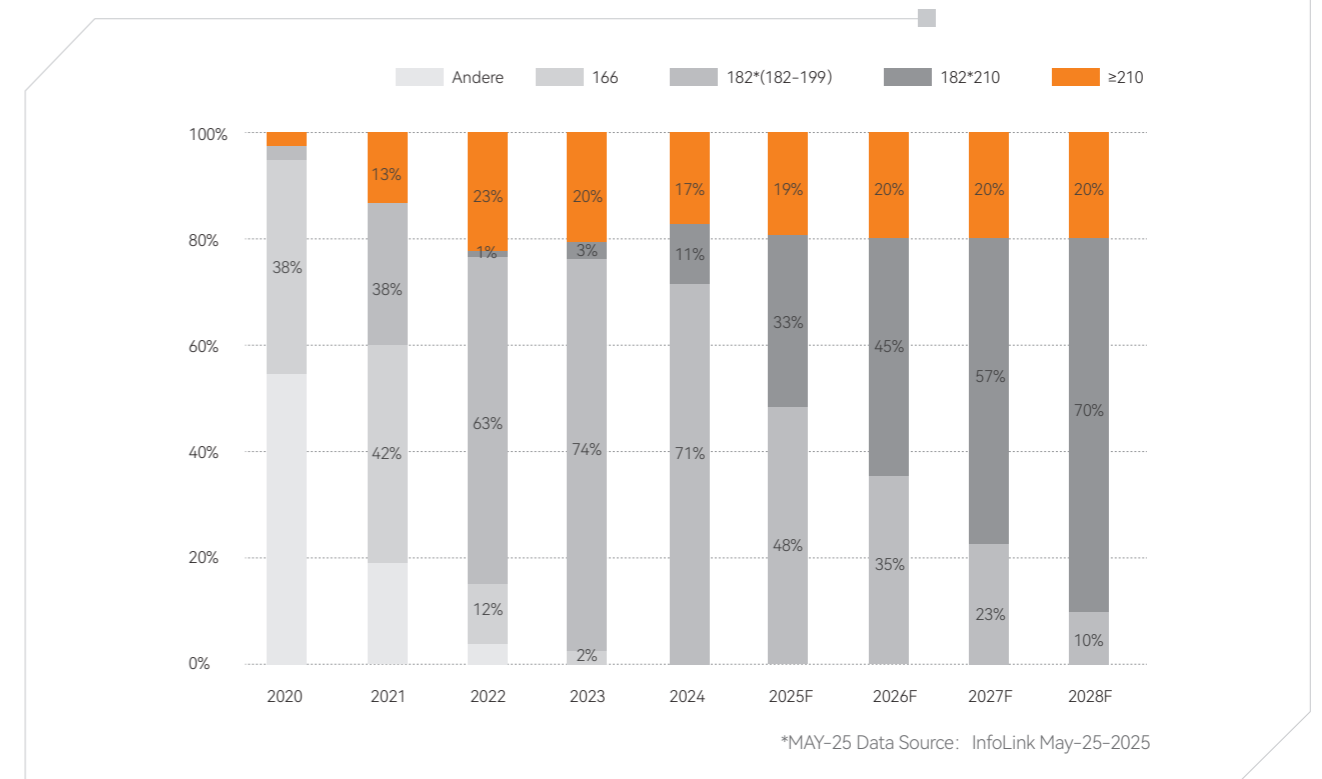


G12R modules specifically refer to standard-size modules designed with 66 pieces of rectangular G12R N-type cells (210mm × 182mm), with a module dimension of 1134mm × 2382mm. G12 modules refer to large-size photovoltaic modules designed with 66 pieces of square G12 N-type cells (210mm × 210mm), featuring a module dimension of 1303mm × 2384mm.

"G12R" Mainstream PV Modules Product: According to PV Infolink data (May 2025), the industry's production capacity for photovoltaic cells based on the G12R dimension has exceeded 300GW. All of the top 10 module manufacturers have already established G12R module production capacity. By the end of 2025, G12R modules are projected to represent 33% of the total global module produced.

Since 2022, G12 modules have consistently accounted for approximately 20% of the global annual module produced. Currently, the overall development trend of the photovoltaic industry is centered on "Higher Efficiency with Lower Budget", which continuously optimizing the project levelized cost of electricity (LCOE). Due to the lower BOS (Balance of System) costs of G12 modules and their improved compatibility with trackers and other mounting systems, along with advancements in automated installation technologies for large-scale module, G12 modules are expected to become mainstream alongside G12R modules in the future.

Modules Produced Based on Wafer Dimensions



In the China market market, G12 modules offering higher power (while maintaining an same open-circuit voltage level comparable to G12R modules), G12 module significantly reduces BOS costs for PV power plant projects with fixed track system. In overseas markets, G12R modules offer greater advantages in conventional tracker systems, primarily for three reasons:

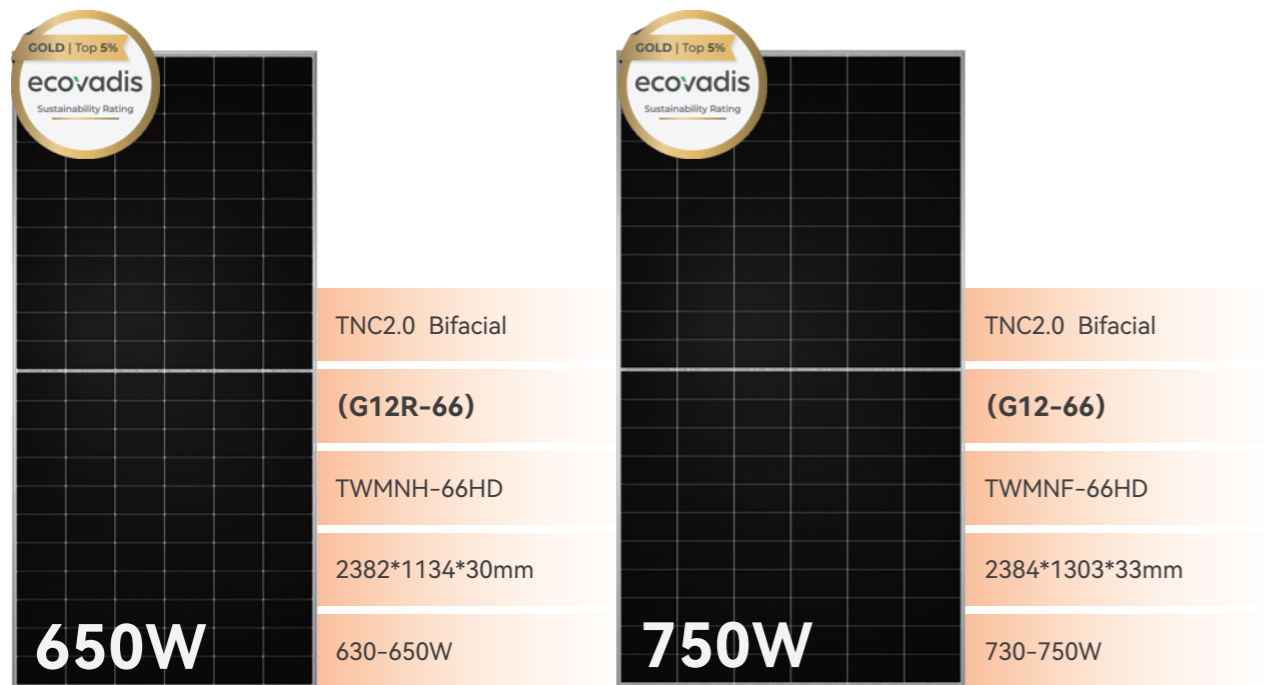
Lower overseas freight costs: Compared to G12 modules, G12R modules are a perfect fit for 40-foot high cube containers, reducing freight cost per watt by approximately 5%.

Better compatibility with tracker systems: G12R modules can be arranged in 4 strings on mainstream tracker products (In conventional tracker solutions), whereas G12 modules typically support only 3 strings, resulting in lower tracker system costs for G12R.

Lower labor costs overseas: Compared to G12 modules, G12R modules are lighter and in smaller size, making them easier to handle and install, which helps reduce labor costs in developed overseas regions.

1.2 Tongwei TNC 2.0 Modules: Superior Value for Utility PV Power Plant.

Tongwei officially entered the PV module business in 2022 and, by 2024, achieved gigawatt-scale mass production of its self-developed n-type G12 and G12R TNC modules, marking Tongwei full transition into the "Big N" era. For large-scale utility and commercial & industrial (C&I) applications, Tongwei primarily promotes two flagship products: TNC 2.0-G12R-66 and TNC 2.0-G12-66. These modules integrate several of the industry's most advanced technologies, including TPE, Poly Tech, stencil printing, and the Type-908 interconnection (Tongwei's proprietary 0BB technology). With modules maximum mass production power up to 650W and 750W respectively, and modules bifaciality reaching approximately 90%, these modules deliver greater value to utility-scale project owners.



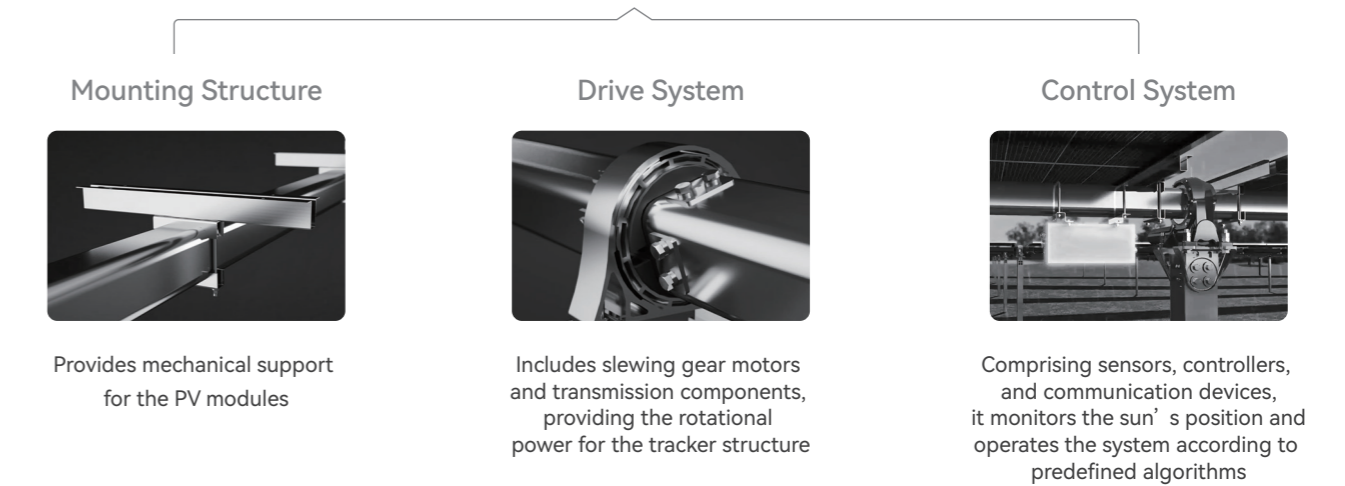
- Four Core Advanced PV Technologies:** Ultra-High Module Power and Module Efficiency.
- Superior Bifaciality:** Module bifaciality reaches approximately 90%, delivering higher energy yield from both sides.
- Greater System Value:** Ultra-low System Cost and LCOE.
- Multi-Scenario:** Suitable for Utility & C&I Projects.
- Authoritative Certification & Superior reliability:** Passed Multiple Extended Reliability Tests. Products are Proven to Withstand Harsh Environments (Desert, Snowy, Mountainous).

02 Development History of PV Trackers

2.1 How Tracker Works

Tracker is a photovoltaic mounting system equipped with an intelligent sunlight tracking system. This system uses sensors and smart controls to continuously follow the position of the sun, adjusting the tilt angle of the PV modules accordingly. As a result, the modules receive significantly more solar irradiation, effectively increasing power generation.

The tracker system is composed with following components



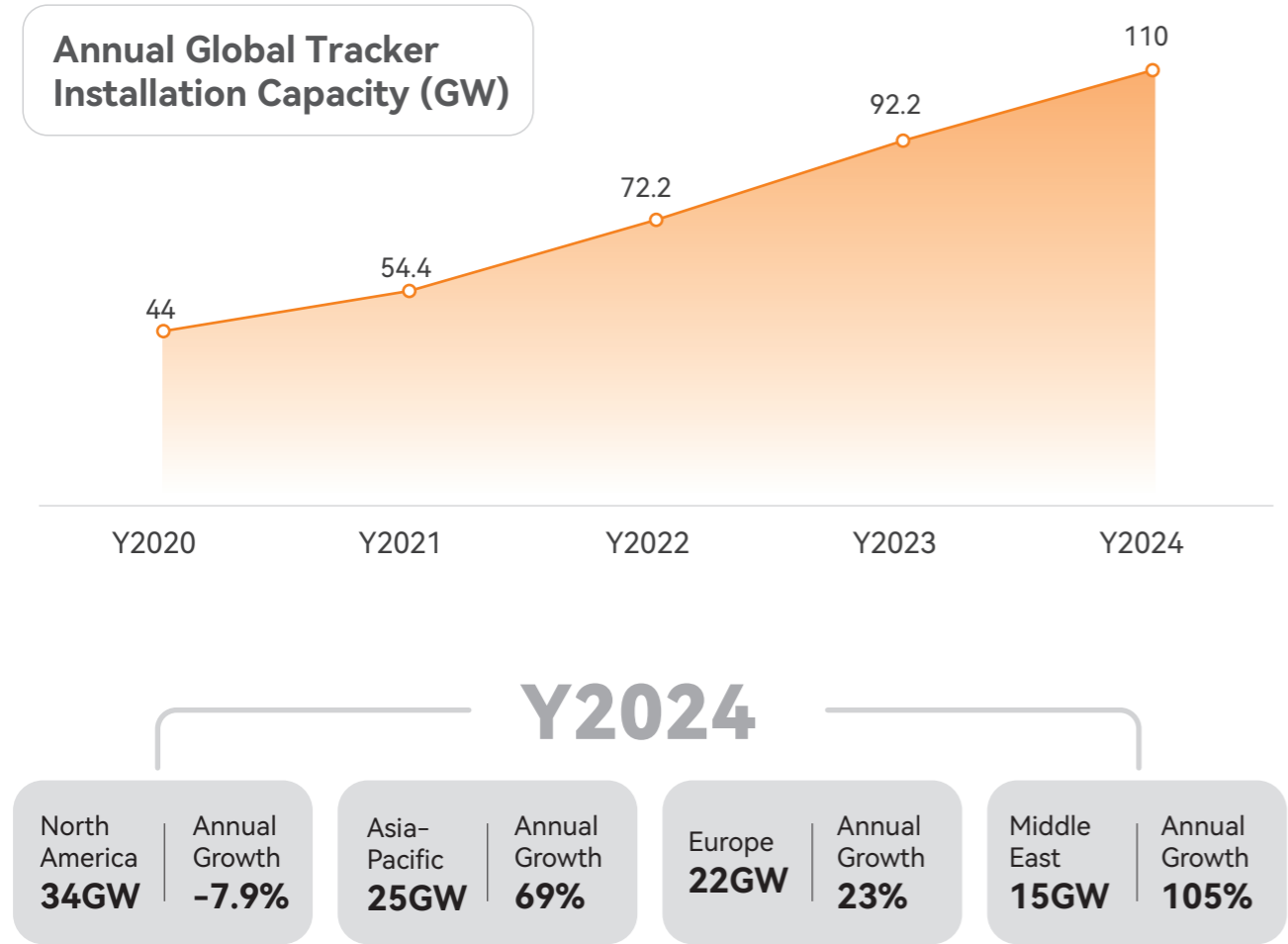
2.2 Types of Tracker

Based on the number of drive axes, tracker systems can be classified into "Single-axis Tracker" and "Dual-axis Tracker": Single-axis tracker Trackers can be categorized into horizontal axis trackers and tilted axis trackers. These systems are typically arranged in a north-south orientation and automatically track the sun's movement from east to west. Dual-axis tracker can simultaneously track both the azimuth and elevation angles of the sun, allowing the modules to maintain an optimal orientation. In theory, this enables sunlight to strike the module surface perpendicularly at all times, maximizing solar irradiance absorption. For utility PV power plant project nowadays, single-axis tracking systems deliver optimal cost-effectiveness and represent the mainstream type of tracker in the market.



2.3 Tracker Market Overview

The photovoltaic (PV) market is expanding at an unprecedented pace and scale. Against this backdrop, tracker systems, one of the key installation solutions in the PV project, have also experienced explosive growth in deployment. According to statistics, global new installations of tracker systems increased by an impressive 2.5 times between 2020 and 2024, highlighting their important position in the photovoltaic market.

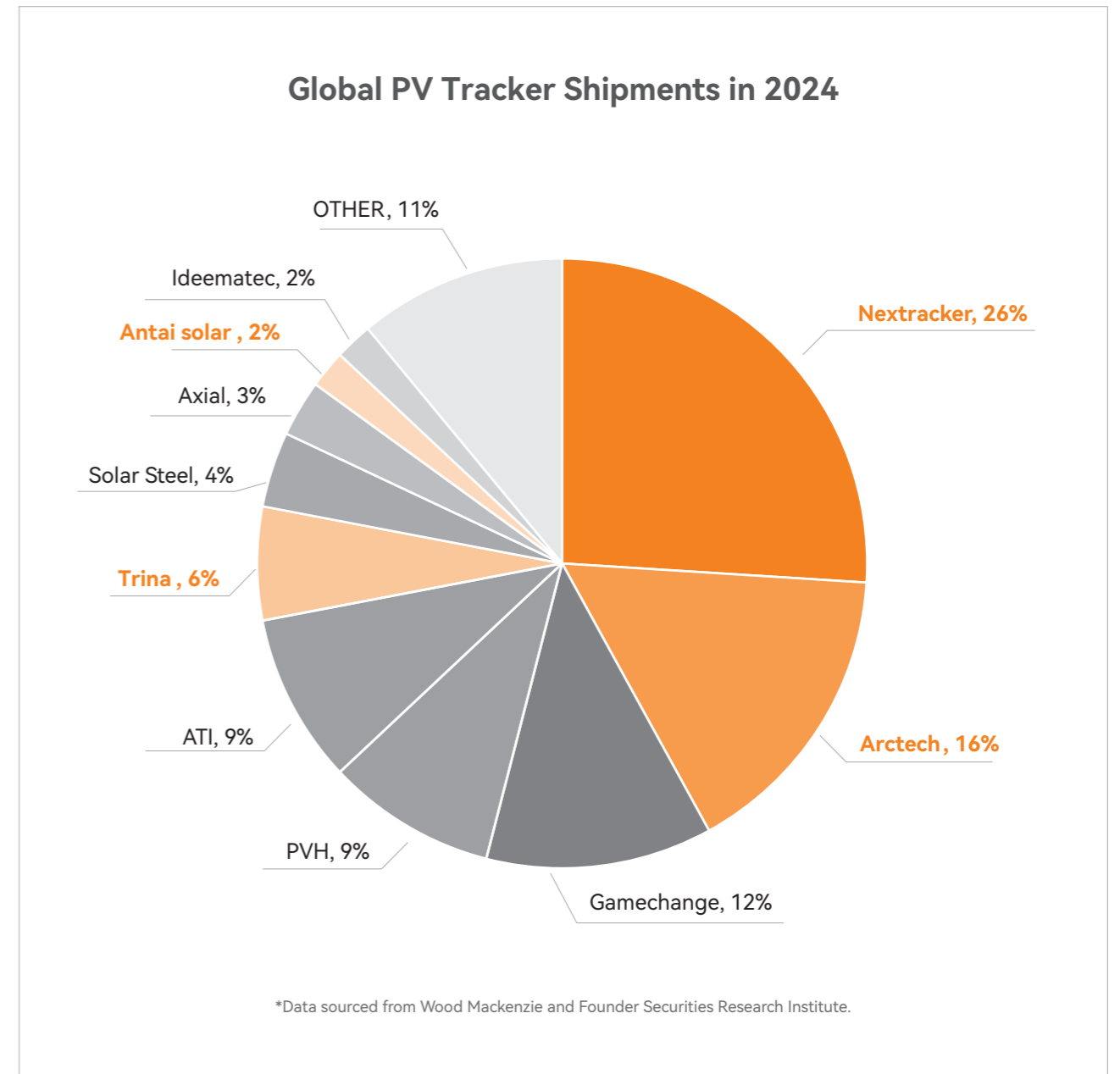


In 2024, North America, Asia-Pacific, Europe, and the Middle East remain the four major markets for tracker PV system installation.

Compared to 2023:

- The North American market saw a 7.9% decline in new tracker PV system installations compared to last year, but it still held a dominant position in the global tracker market with a market share of 30.63%.
- In the Middle East, demand for tracker systems grew rapidly, increasing by 105% compared to last year, which is the highest growth rate among whole tracker markets.
- The Asia-Pacific market has shown significant growth, primarily driven by the substantial increase in the Indian market, which surged from 5.6 GW in 2023 to 15.9 GW in 2024. (almost threefold increase)
- The European market saw a steady increase in new installations, with a 23% rise compared to the previous period.

In 2024, Chinese tracker system companies achieved a dual breakthrough in both shipment volume and global rankings. Among the top 10 tracker suppliers by shipments, three were Chinese companies. Arctech ranked second with 17.4 GW in shipments and a 16% market share, following Nexttracker's market share reaches 26%. Trina Tracker secured sixth place with a 6% market share, while Antai solar ranked in ninth.



03 Product Value Evaluation of G12 Modules

3.1 Design Methodology for Evaluation Solar System

The design methodology of a PV power plant simulated evaluation follows two major design standards: According to the Code for Design of Photovoltaic Power Station (GB 50797—2012), the calculation formula for the number of modules per string in a PV power plant is as follows:

$$N \leq \frac{V_{dcmax}}{V_{oc} * [1 + (t - 25) * K_v]} \quad (6.4.2-1)$$

$$\frac{V_{mppt\ min}}{V_{pm} * [1 + (t' - 25) * K_v']} \leq N \leq \frac{V_{mppt\ max}}{V_{pm} * [1 + (t' - 25) * K_v']} \quad (6.4.2-2)$$

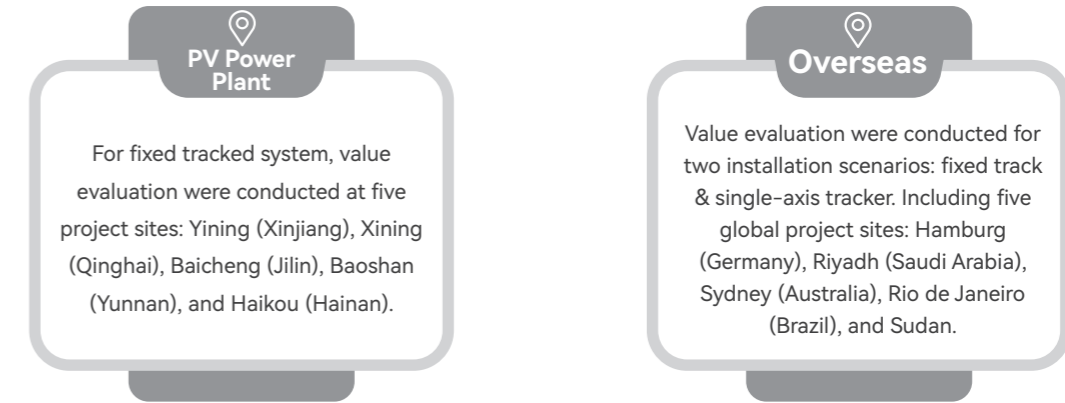
- K_v : Voc Temperature Coefficient of PV Modules
- K_v' : Temperature Coefficient of Operating Voltage of PV Modules
- N: String number of PV modules (N is an integer)
- t: Minimum Operating Temperature of PV Modules (°C)
- t': Maximum Operating Temperature of PV Modules (°C)
- V_{dcmax} : Maximum DC Input Voltage Rating of the Inverter (V)
- $V_{mpptmax}$: Maximum MPPT Voltage of the Inverter (V)
- $V_{mpptmin}$: Minimum MPPT Voltage of the Inverter (V)
- V_{oc} : Open-Circuit Voltage of PV Module (V)
- V_{pm} : Operating Voltage of PV Module (V)

According to the Code for Design of Photovoltaic Power Station (GB 50797-2012), it is required to ensure no shading between adjacent rows of arrays during the period from 9:00 to 15:00 local solar time on the winter solstice. The formula for calculating the array spacing is as follows:

- Elevation Angle: $\sin\alpha = \sin\phi * \sin\delta + \cos\phi * \cos\delta * \cos\omega$
- Azimuth Angle: $\cos\gamma = (\sin\alpha * \sin\phi - \sin\delta) / (\cos\alpha * \cos\phi)$
- Spacing Calculation: $D = H \cos\gamma / \tan\alpha$
- ϕ : Latitude; δ : Declination angle; ω : hour angle.

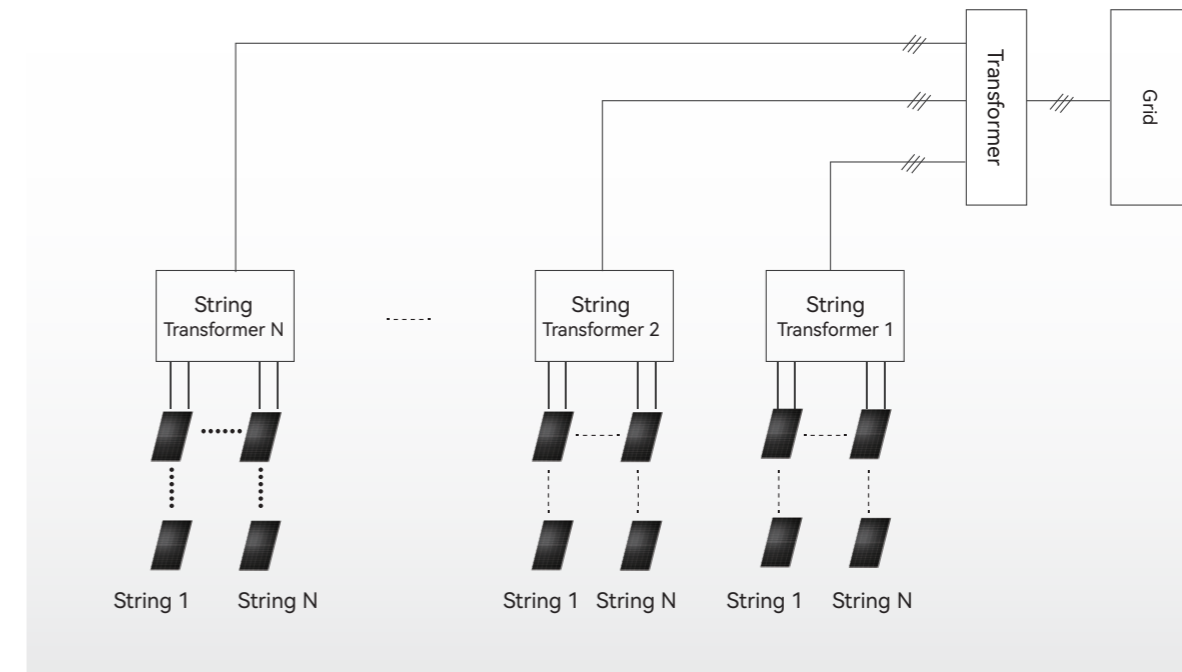
3.2 Evaluation System Design Models & Conditions

Evaluation System Site Selection Shown Below:



Evaluation System Design:

- Total Investment Cost = Modules + Logistic + BOS
- For overseas projects, Logistic costs include sea freight, exclude other charges such as taxes, handling & operation fees, and storage fees.
- AC side installed capacity: 100 MW; Set DC/AC = 1.2; Set G12R and G12 module with same price; Set G12R and G12 with same 85% bifaciality; G12R modules power 640W, G12 modules power 740W.



3.3 System Value Estimation(China)

In fixed track scenario (China), Modules G12-740W VS G12R-640W, products reduce total system costs by 0.40% to 0.92%, and lower LCOE by 0.26% to 0.56%.

G12-740 vs G12R-640: System Value Estimation(China)

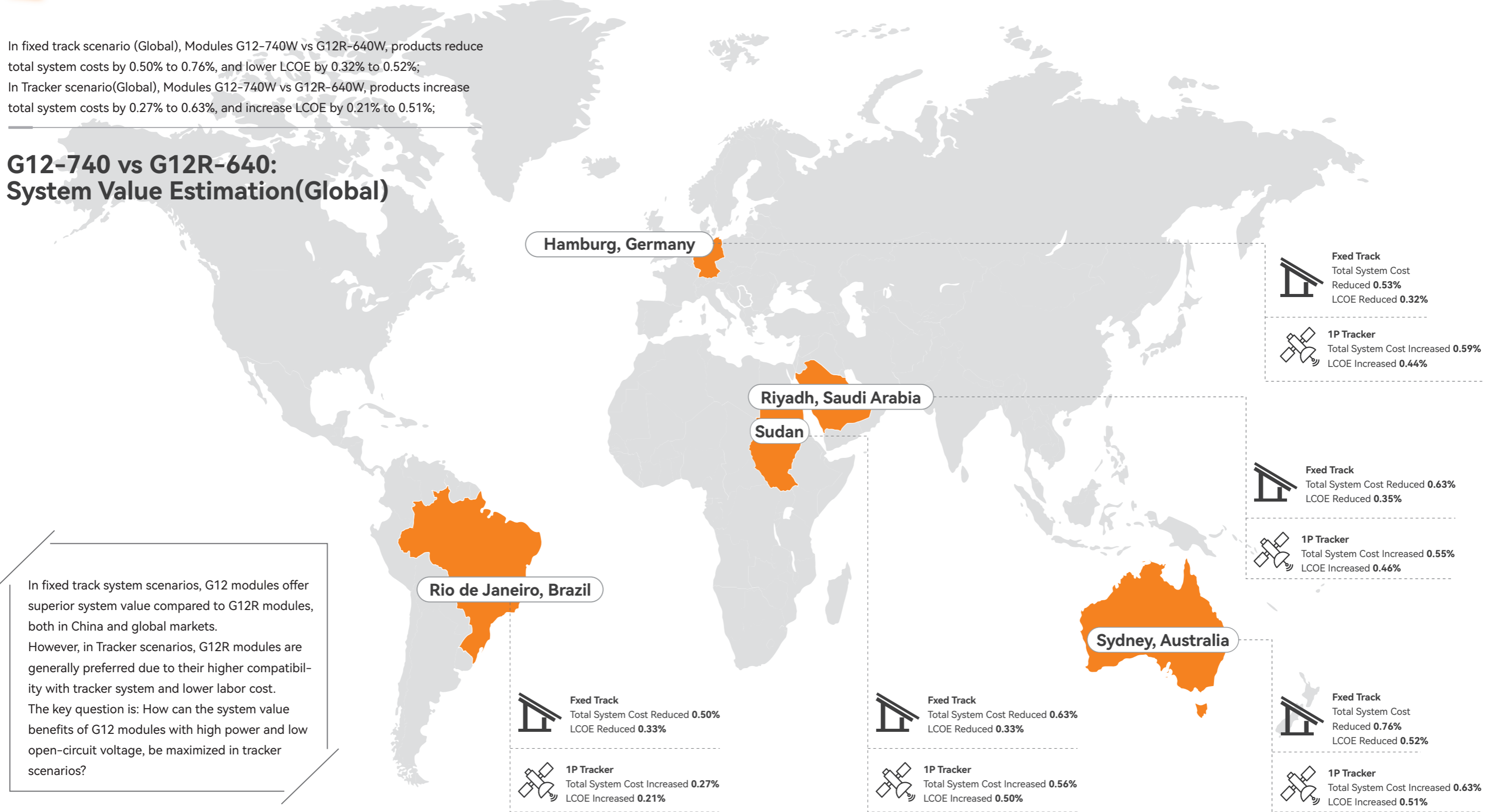


*Data from Tongwei R&D team. The selection of the price coefficient may affect the evaluation results.

3.4 System Value Estimation (Global)

In fixed track scenario (Global), Modules G12-740W vs G12R-640W, products reduce total system costs by 0.50% to 0.76%, and lower LCOE by 0.32% to 0.52%;
 In Tracker scenario(Global), Modules G12-740W vs G12R-640W, products increase total system costs by 0.27% to 0.63%, and increase LCOE by 0.21% to 0.51%;

G12-740 vs G12R-640: System Value Estimation(Global)



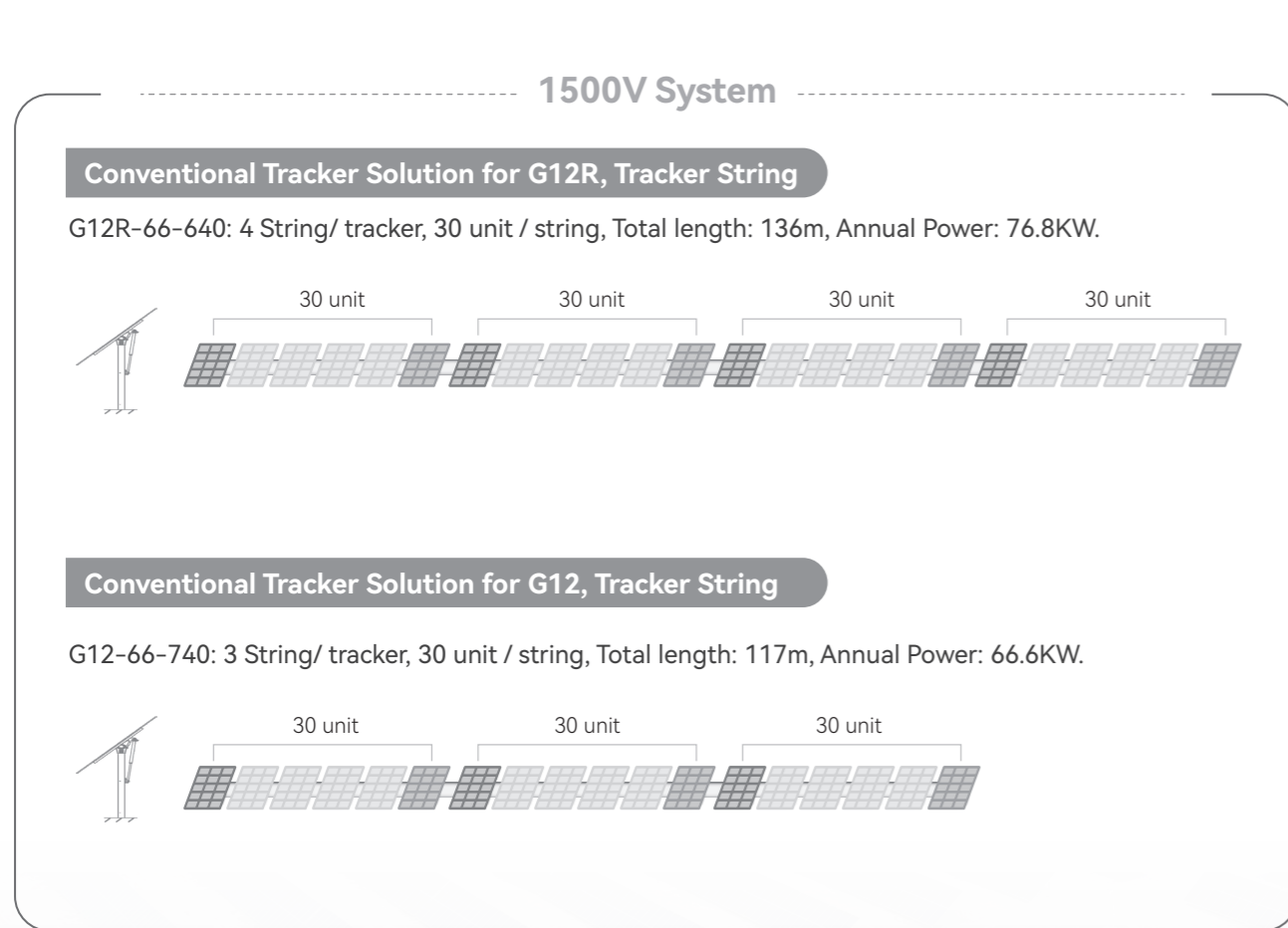
In fixed track system scenarios, G12 modules offer superior system value compared to G12R modules, both in China and global markets. However, in Tracker scenarios, G12R modules are generally preferred due to their higher compatibility with tracker system and lower labor cost. The key question is: How can the system value benefits of G12 modules with high power and low open-circuit voltage, be maximized in tracker scenarios?

*Data from Tongwei R&D team. The selection of the price coefficient may affect the evaluation results.

04 TONGWEI G12-Tracker Solution

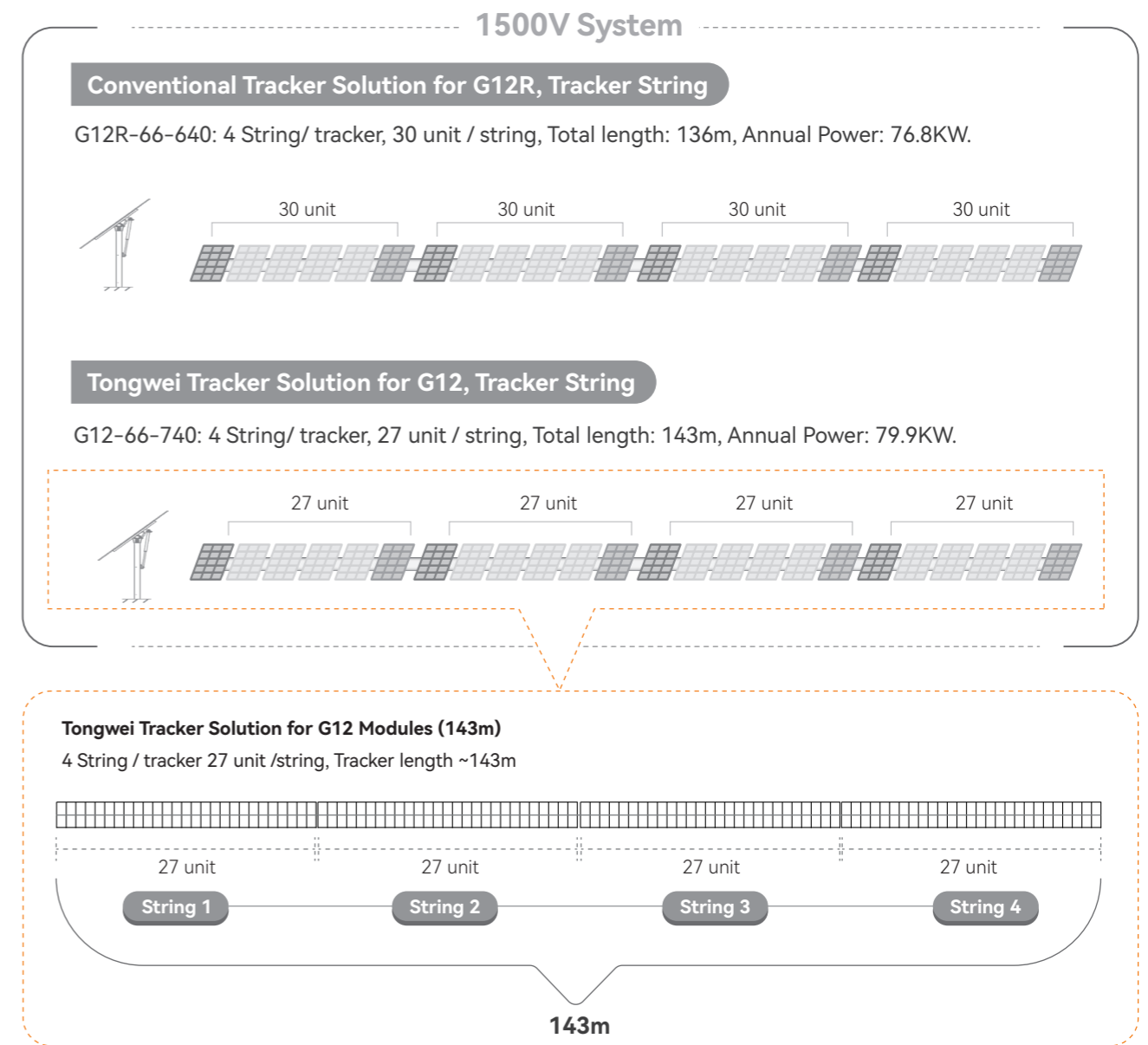
4.1 Conventional Tracker Solution: Value of G12 Modules is Limited

Currently, most tracker manufacturers design their systems based on 1134mm-wide modules, with 1P single-row multi-point drive trackers having a maximum length of up to 140 meters. According to conventional tracker string calculation logic, a single 140m tracker can equipped 3 string G12 modules or 4 string G12R modules. G12 module products (1303mm width) install one fewer string compared to G12R modules in single 140m tracker. Since trackers' costs for drives, controllers, and related components remain unchanged, the system cost of G12 modules in tracker scenarios increases significantly, severely reducing product value and competitiveness.



4.2 TONGWEI G12-Tracker Solution







Optimized layout, uncompromised energy yield, fully unlocking the BOS saving potential of high-power modules. To solve the compatibility challenges of G12 modules in tracker scenarios, Tongwei adheres to the philosophy of delivering the most cost-effective solutions to customers. Our product R&D team breaking away from conventional approaches, and innovatively introduced a proprietary tracker solution: tracker with undersized string design. (In 1500V systems, the number of G12 modules per string is reduced by 1 to 4 units) This tracker solution maximizes the effective tracker length, allowing the number of G12 strings per tracker to match G12R modules, while achieving a higher total system power output in one single tracker. At the same time, due to the higher power level of individual G12 modules, the total number of modules required is reduced. This leads to lower consumption of structural materials such as purlins and fasteners, effectively reducing the total system cost per watt in tracker scenario. As a result, the system value of G12 modules in tracker scenario shifts from disadvantage to a significant advantage compare with G12R standard modules.



05 Feasibility Study of Tongwei's Solution

5.1 Flexible Module Layout & Compatible with Mainstream Trackers

Currently, the mainstream 1P single-row multi-point drive tracker systems typically have a maximum length of 140 meters. Tongwei's solution base on undersized string design which maximizing the utilization of tracker's length and structural strength. The number of G12 modules per string on tracker can be flexibly configured as 26 or 27. Project designs to be optimized based on the tracker's maximum length and local meteorological conditions. This ensures both overall system energy yield and operational stability.

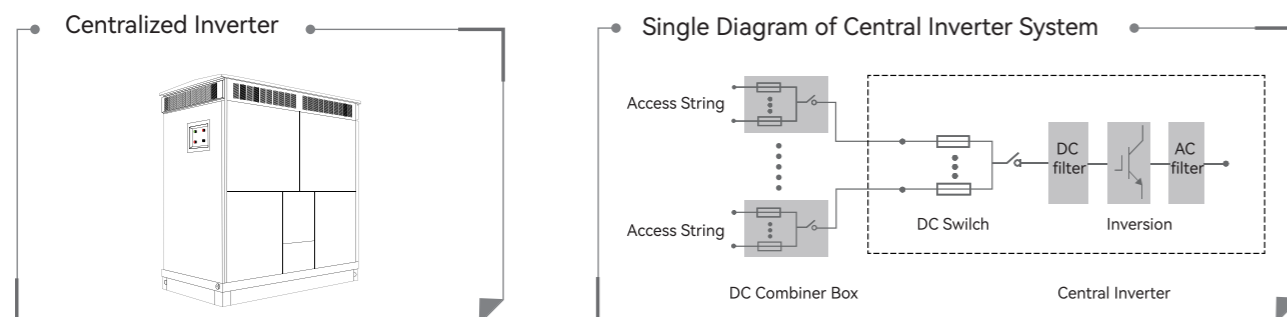
| Manufacturer | Model | Types of Tracker | Maximum length |
|--|-------------------|--------------------|----------------|
| Arctech  | Skyline II | Multi-point drive | 143m |
| Antai  | AT-Spark | Multi-point drive | 143m |
| Trina  | Vanguard | Multi-point drive | 140m |
| ATI  | DuraTrack | Single-point drive | 140m |
| PVH  | AXONEDUO INFINITY | Single-point drive | 140m |
| Nextracker  | NX Horizon | Single-point drive | 135m |

*Order does not imply any ranking. For any unlisted tracker compatibility issues, please contact Tongwei technical support.

5.2 Compatible with Mainstream Utility Inverters













5.2.1 Centralized Inverter

Central inverters could be compatible by proper selection of DC combiner box;



5.2.2 String Inverters

The operating current of the G12-66 module is approximately 17.8A, which requires string inverter with high rated input current. Tongwei's G12 module is compatible with mainstream utility inverters without increasing system costs.

| Inverter Power | Inverter Manufacturer & Model | MPPT Amount * String Amount | Maximum Input Current (A) of MPPT | Number of G12 Strings | |
|--|--|-----------------------------|-----------------------------------|-----------------------|------|
| 320KW | SG320HX-20  | 6*5 | 75 | 6*4 | |
| | SP-320K-HB  | | 75 | 6*4 | |
| | HINV360HX-G2  | | 75 | 6*4 | |
| | MAX 320K-X  | | 80 | 6*4 | |
| | ASW320K-HT  | | 75 | 6*4 | |
| | GW320KH-UT  | | 12*2 | 40 | 12*2 |
| | 320K-M12  | | | 40 | 12*2 |
| | TS320KTL-HV  | | | 48 | 12*2 |
| | KSG-320KTH  | | | 40 | 12*2 |
| | tPower-NM5.320K  | | 12(2*6+3*6) | 45 | 12*2 |
| SOFAR 320KTLX0  | 8*4 | 60 | 8*3 | | |
| 300KW | SUN2000-300KTL-H0  | 6(4*2+5*4) | 70 | 6*4 | |

*Order does not imply any ranking. For other inverter models not listed, please contact Tongwei technical support for compatibility inquiries.

100MW System Value Estimation for Middle East Project: AC capacity of 1 estimation system is 100MW, deployed with 320KW inverters, with a (DC/AC ratio) of 1.2. G12R-640 30 Pcs/String, G12-740 27 Pcs/String, Inverter compatibility information shown below:

| 100MW Tracker PV Project: Compatibility Analysis of 320KW Inverters | | | |
|---|-----------------------------|--|--|
| Inverters Amount | Module Strings per Inverter | G12R-640 | G12-740 |
| | | 30 Pcs/String, 4 String/Single Tracker | 27 Pcs/String, 4 String/Single Tracker |
| 313 | 17 | / | / |
| | 18 | / | / |
| | 19 | 10 | 254 |
| | 20 | 303 | 59 |
| Modules Annual Power per Tracker | | 76.8 | 79.92 |
| Annual Strings | | 6250 | 6006 |
| Total Capacity (MW) | | 120.00 | 120.00 |

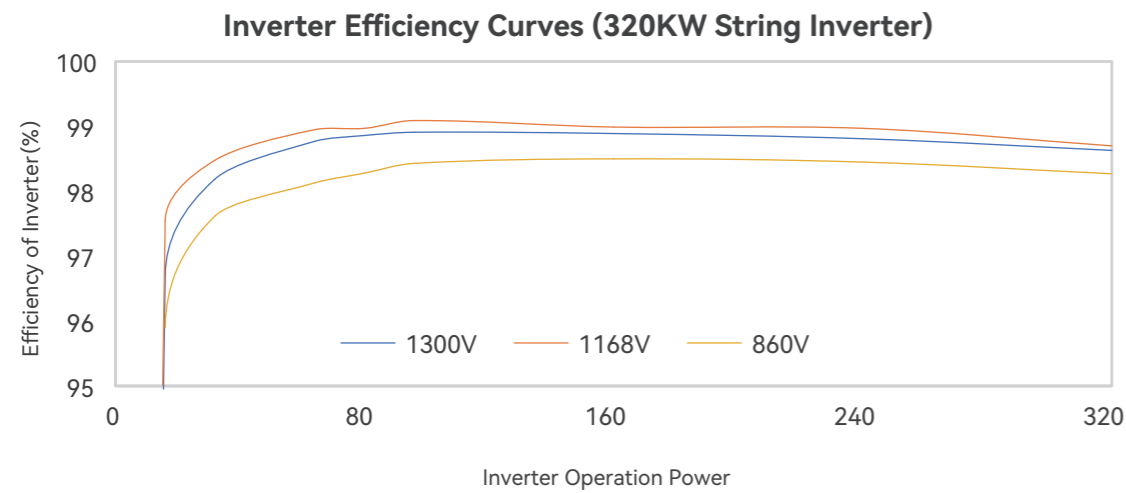
- The total module power of G12 modules per single tracker is increased by 3.1 KW, which can effectively enhance tracker utilization efficiency.
- For both two module options, the string inverter's MPPT capacity has not been fully utilized.
- By reducing 3 modules per string with the G12 modules, the installed module power capacity per single tracker is significantly increased, without changing the total number of inverters or overall cost.

5.3 Impact on Inverter Efficiency

Compared to conventional tracker solutions, G12 modules system designed by Tongwei Tracker Solution, there is virtually no difference in system efficiency between string inverter or central inverter scenarios.

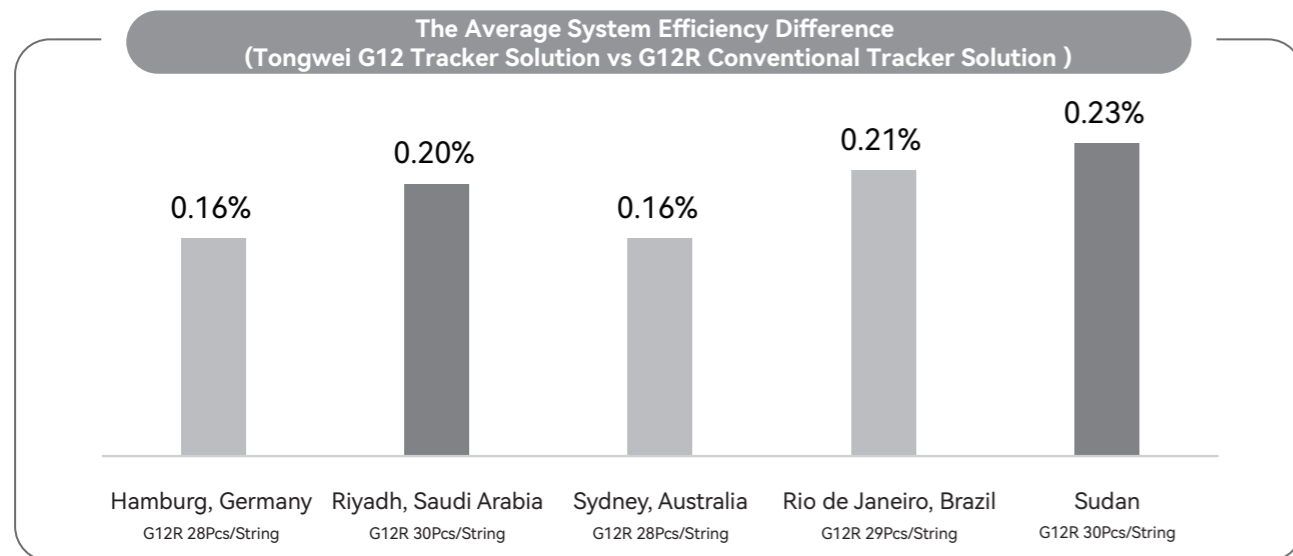
5.3.1 String Inverter

Randomly Taking a 320KW mainstream string inverter sample from market, relationship between Inverter efficiency & operating voltage is illustrated in the chart below: G12 Tongwei Tracker Solution vs G12R Conventional Tracker Solution(1500V): 120V difference in operating voltage; The inverter efficiency is approximately 0.2% lower.



Energy Yield of Evaluation System

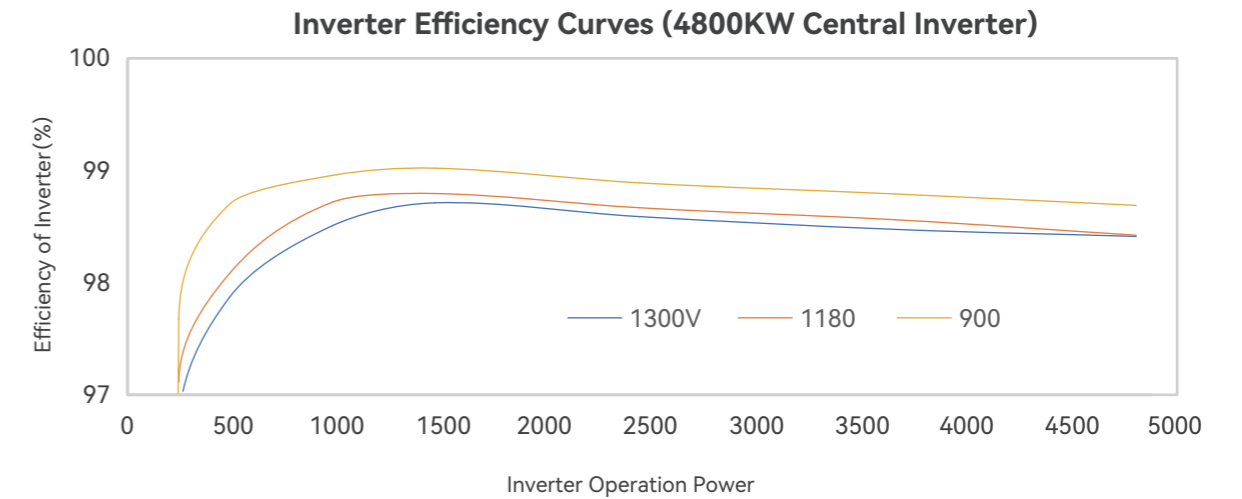
After 30-year PVSYST evaluation for 5 global tracker system site, G12 Tongwei Tracker Solution compare with G12R Conventional Tracker Solution(1500V) : The average system efficiency is approximately 0.2% lower, consistent with the difference observed in the inverter efficiency curves.



5.3.2 Central Inverter

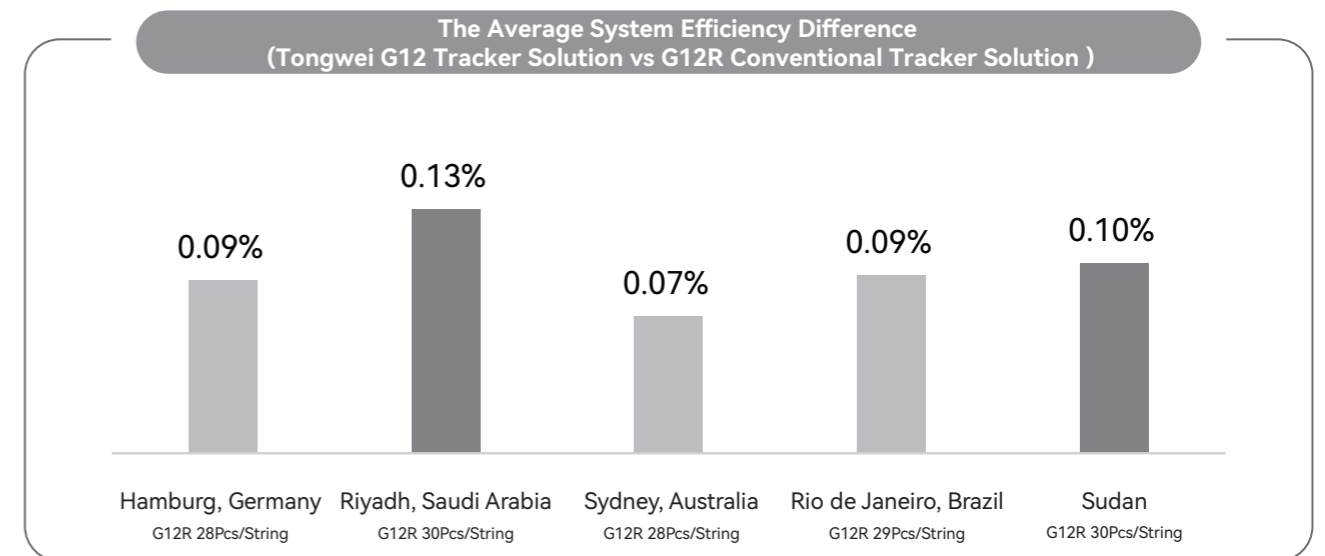
Randomly Taking a 4800KW mainstream string inverter sample from market, relationship between Inverter efficiency & operating voltage is illustrated in the chart below;

G12 Tongwei Tracker Solution vs G12R Conventional Tracker Solution(1500V): 120V difference in operating voltage; The inverter efficiency is approximately 0.1% higher.



Energy Yield of Evaluation System

After 30-year PVSYST evaluation for 5 global tracker system site, G12 Tongwei Tracker Solution compare with G12R Conventional Tracker Solution(1500V) : The average system efficiency is approximately 0.1% lower.



5.4 Field-Test for TONGWEI G12-Tracker Solution

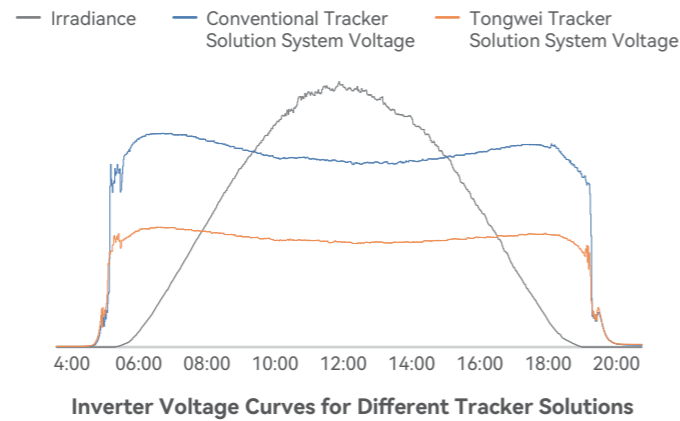
5.4.1 Tongwei Yancheng Field Test Base

During the conceptual phase of the Tongwei Tracker solution, Tongwei proactively launched the outdoor field test power plant in Yancheng base. The field test experiment connected the Tongwei Tracker Solution string and the Conventional Tracker Solution string to independent MPPTs of one specific inverter. Tongwei's R&D team deployed monitoring equipment to systematically track the following key performance indicators of the field test systems, To accurately verify the Tongwei Tracker solution's superior performance and effectiveness under real-world operating conditions:

- Inverter start-up and shut-down times
- Dynamic variations in string voltage
- Differences in AC-side energy yield

Comparison of inverter start-up and shut-down times:

Tongwei Tracker Solution string voltage is lower than Conventional Tracker Solution string. However, based on the inverter string voltage variations observed on a typical sunny day, there is no difference in inverter start-up and shut-down times, and the impact on energy yield is negligible.



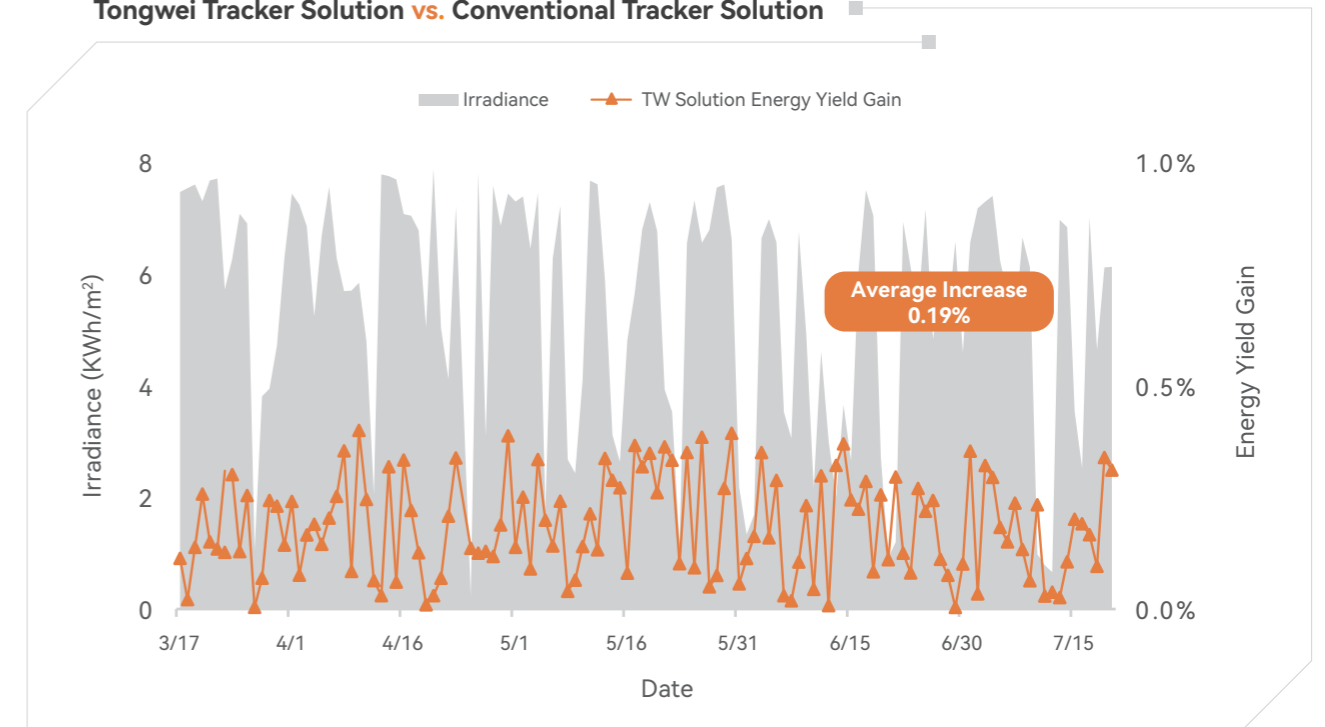
| Date | TW Solution: Start-Up | Conventional Solution: Start-Up | TW Solution: Shut-Down | Conventional Solution: Shut-Down |
|------|-----------------------|---------------------------------|------------------------|----------------------------------|
| 4/3 | 5:52 | 5:54 | 18:24 | 18:22 |
| 4/4 | 5:50 | 5:51 | 18:29 | 18:27 |
| 4/5 | 5:50 | 5:51 | 17:59 | 17:58 |
| 4/6 | 5:46 | 5:47 | 18:29 | 18:28 |

Start-Up and Shut-Down Times of Inverters

Tongwei Yancheng Field Test Results

Through 4 months energy yield monitoring, the Tongwei Tracker Solution showed an average difference of only 0.2% in energy yield per watt compared to the Conventional Tracker Solution, with negligible impact on overall system energy yield. This empirical field test data further confirms the reliability and feasibility of the Tongwei Tracker Solution.

Comparison of Energy Yield per Watt: Tongwei Tracker Solution vs. Conventional Tracker Solution



5.4.2 Pilot Project Plan

Based on the positive results achieved at the Yancheng Field Test Base, Tongwei plans to establish multiple external pilot power plant project for G12 Tongwei Tracker Solution worldwide in the future. Projects covering various PV projects scenarios including string inverters and central inverters. In collaboration with leading tracker manufacturers and power plant side customers, Tongwei and its partners have established several field test projects for the Tongwei Tracker Solution, aiming to obtain more accurate and comprehensive data support.

During the 2025 SNEC, Tongwei reached a cooperation agreement with Arctech. Two parties jointly planned two major field test bases located in Fanchang, Anhui, China, and the Middle East. Projects are equipped with Arctech's latest tracker systems, paired with 1500V string inverters. By conducting real project energy yield comparison between the Tongwei Tracker Solution and the Conventional Tracker Solution, to validating the superiority and value of Tongwei Tracker Solution for G12 Modules.

In addition, Tongwei is collaborating with power plant side customers to jointly develop central-inverter field test projects in Europe, the Middle East, and Australia. Through multi-dimensional empirical validation, the feasibility and reliability of the Tongwei solution will be further enhanced, providing the industry with more accurate and efficient solutions.

5.5 Value Evaluation for Tongwei's Tracker Solution

Through compatibility validation in tracker, inverters and field testing, the Tongwei Tracker Solution has fully demonstrated its feasibility for practical project applications. Similarly, a value evaluation assessment was conducted based on a 100MW AC-rated power plant (with DC/AC=1.2, deployed with string inverters), G12-66-740W with Tongwei Tracker Solution compare with G12R-66-640W with Conventional Tracker Solution:

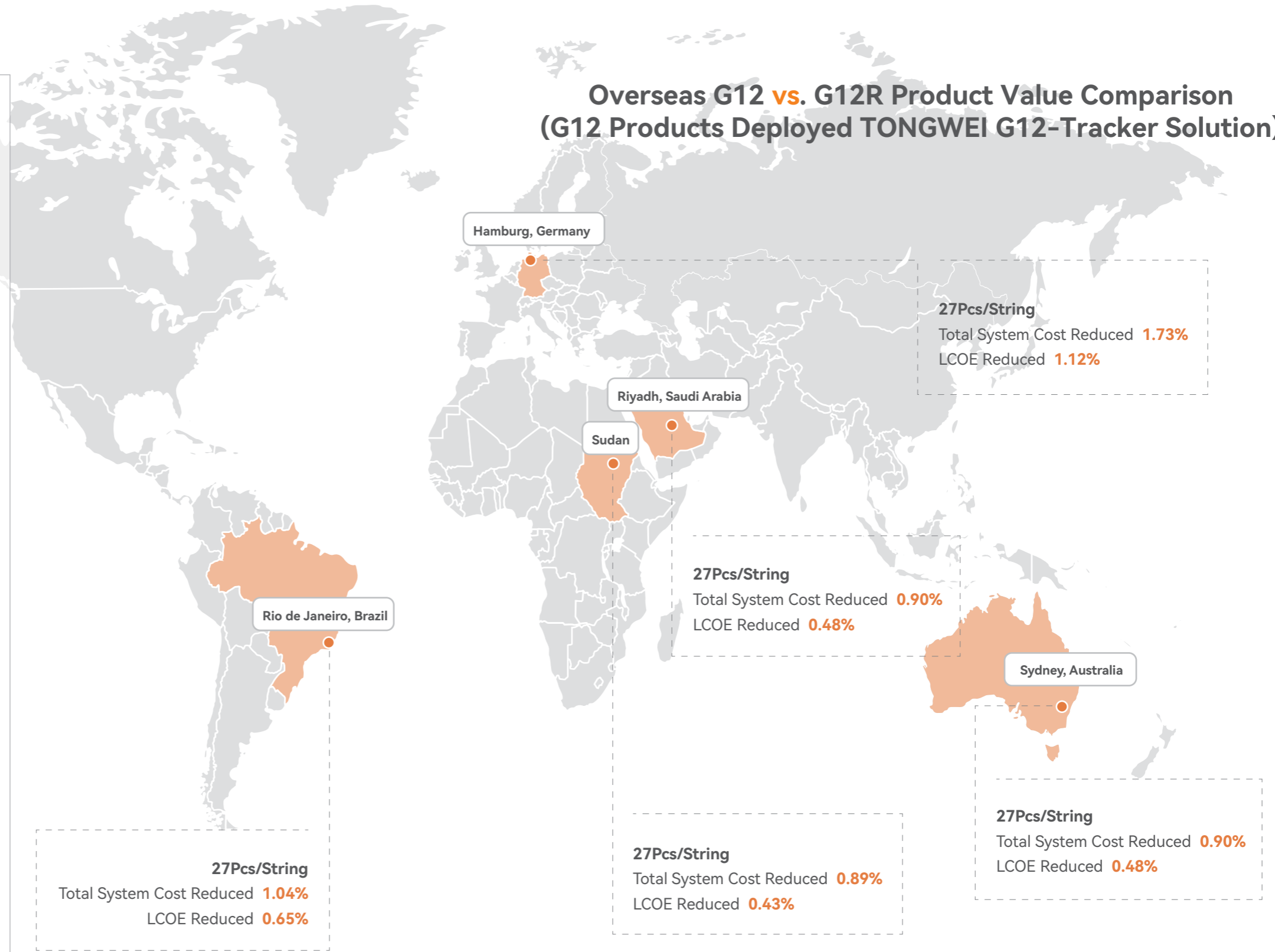
The total system cost is reduced by 0.89% to 1.73%, and the LCOE decreases by 0.43% to 1.24%.

Taking the Saudi Arabia scenario as an example, the Tongwei Tracker Solution with G12 products achieves a 0.90% reduction in total system cost and a 0.48% decrease in LCOE.

Tongwei Tracker Solution enhanced the system cost & LCOE reduction advantage of G12 products. In overseas tracker scenarios, G12 modules deliver costumers higher system value compared to G12R products.

G12 Products with Tongwei Tracker Solution is the best choice for both project owners and EPCs in the current PV market.

Overseas G12 vs. G12R Product Value Comparison (G12 Products Deployed TONGWEI G12-Tracker Solution)



*Data from Tongwei R&D team. The selection of the price coefficient may affect the evaluation results.

06 System Compatibility

6.1 Tracker Compatibility

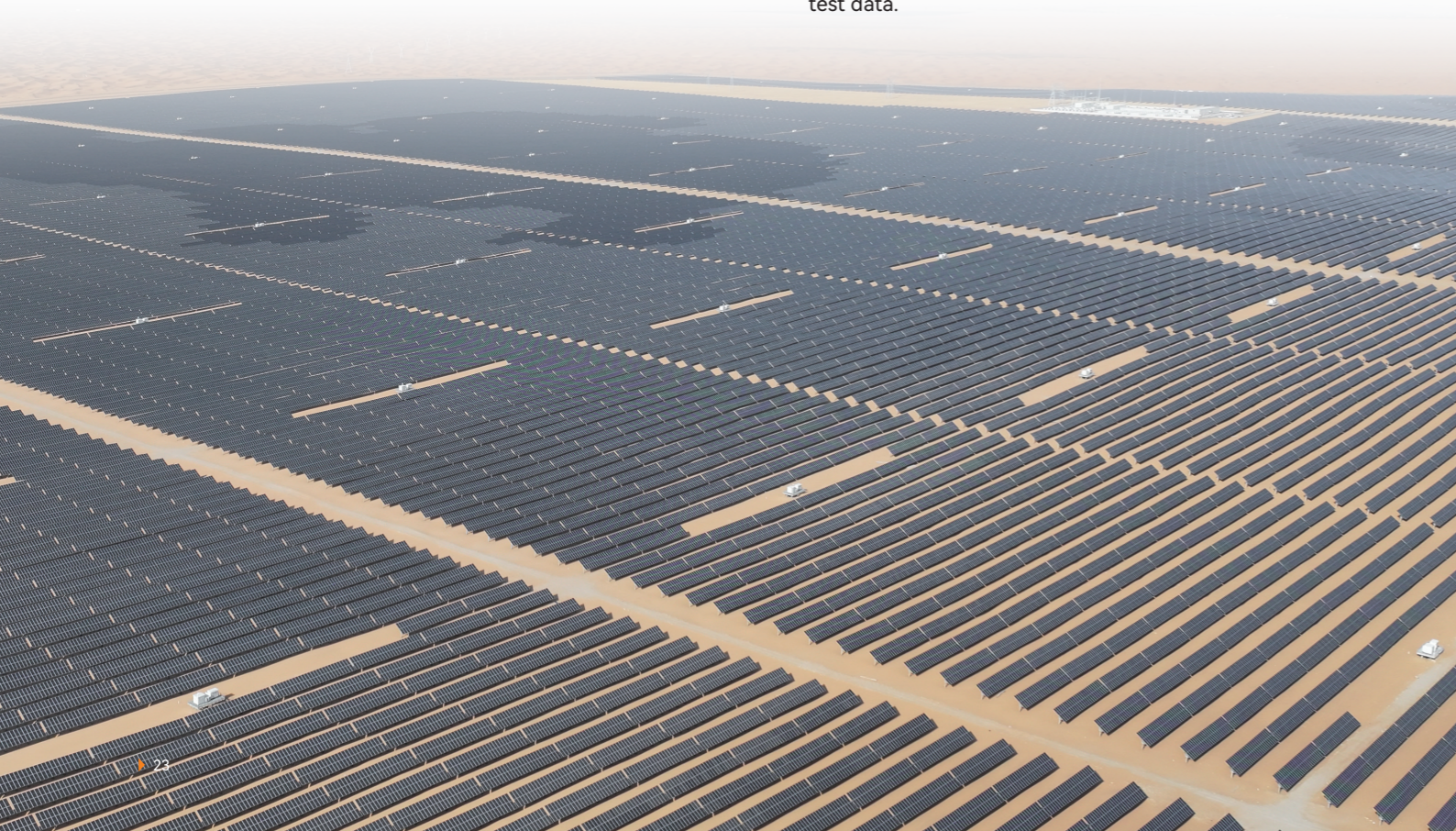
Tracker Load

With the widespread application of photovoltaic tracking systems, the reliability of module-to-tracker compatibility has become first concern for power plant side customers. The industry's standard for module-to-tracker compatibility base on IEC 61215 indoor static load assessment: testing the module's maximum static load capacity on the tracker steel structure (including main shaft, purlins, and connectors, but excluding control and drive systems), and issuing compatibility statements for client use based on the results.

To ensure data authority, Tongwei conducted systematic load testing using multiple mainstream tracker models. Diagram below illustrate the tracker load data for Tongwei's G12-66 and G12R-66 module products:

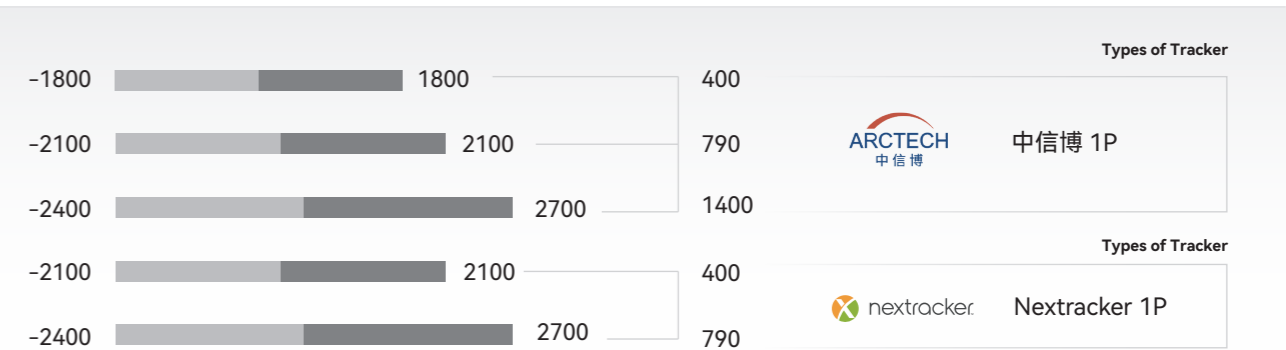
- Modules sample randomly selected from Tongwei's mass production lines.
- Tracker used in tests provided by the tracker manufacturers.
- Testing equipment was calibrated by authoritative institute.

These three factors ensure the accuracy of the load test data.

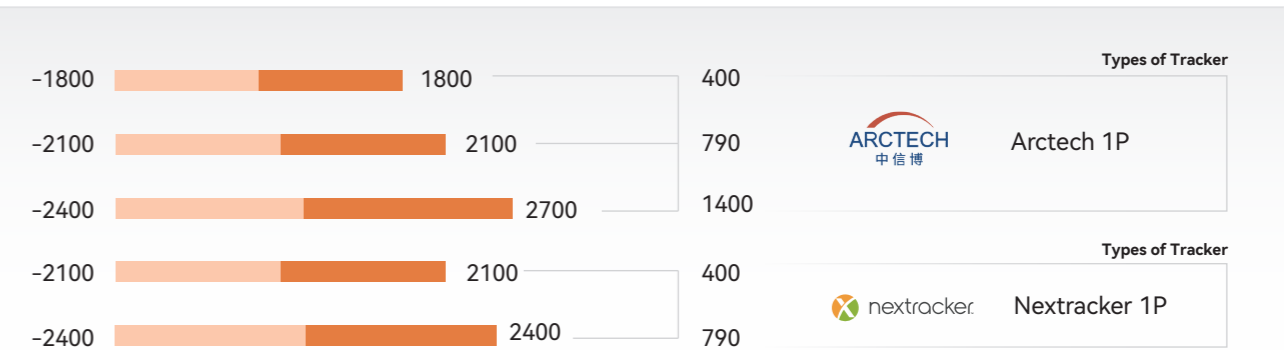


Tongwei Modules and Mainstream Tracker Load Compatibility

G12R-66



G12-66



*For detailed information on tracker compatibility and load, please contact Tongwei technical support. (Tracker compatibility statements available upon request)

As shown in the chart, the load capacity of G12-66 and G12R-66 module products is essentially the same when matched with mainstream tracking systems, and can cover the majority of tracker application scenarios.

Meanwhile, Tongwei has incorporated tracker-module compatibility as part of its quality control program for mass production, performing periodic testing to promptly and effectively maintain consistent load performance of the products in tracker scenarios.

Cost Difference

Since the load capacities of G12 and G12R modules are basically the same under the same mounting method, there is no need to choose longer purlins due to differences in module size during tracker selection. This ensures that tracker costs will not increase as a result, effectively optimizing the overall cost structure when deployed G12 modules in PV project.

6.2 Compatibility with Cleaning Robot

The issue of dust accumulation for Giga watts level utility PV power plant has become increasingly prominent. The deposition of pollutants such as dust and sand can reduce energy yield by an average of 4% to 8%, and energy yield losses can exceed 15% in arid, dusty, or coastal areas. Meanwhile, manual cleaning methods have become insufficient to meet industry demands due to rising costs and the growing scale of power plants reaching gigawatt levels. As a result, the application of photovoltaic cleaning robot systems is becoming increasingly widespread.

The mainstream cleaning robots currently are categorized into Dry-hanging, Semi-hanging, and Distributed. For large-scale utility PV power plant, Dry-hanging robot is primarily used in projects. Through compatibility testing with leading cleaning robot manufacturers, simulating 30 years of mechanical wear during cleaning, Tongwei modules maintain an average power degradation of less than 1%, significantly outperforming compare with industry standards and providing full life-cycle reliability assurance for ultra-large utility solar project.

10,000 cleaning cycles by the cleaning robot (equivalent to 30 years)

Power Degradation $\leq 1.0\%$

Data of the cleaning robot compatibility test sourced from Tongwei's internal lab.








6.3 Installation Robot Compatibility

In recent years, with the continuous expansion of individual photovoltaic project capacities, higher demands have been placed on PV manual labors' professional skills and proficiency. Projects are often constrained by tight grid-connection time limits demands. To efficiently address these project challenges, owners of utility PV power plant are increasingly inclined to use photovoltaic installation robots to replace manual labor in PV projects. Installation robots are classified into semi-automatic and fully automatic. While semi-automatic robots can reduce handling burdens of labors, they still require manual operation for positioning assistance and bolt fastening. On the other hand, fully automatic robots can operate almost autonomously, requiring human involvement only for bolt tightening, which could significantly reducing labor costs.

Tongwei Tracker Solution combined with automated installation robots, will further enhance the system value of G12 modules. Automated installation robots can achieve an installation speed of 600 to 1,000 modules per day, and 4 to 5 times that of manual labor, which demonstrating significant advantages in large-scale utility PV power plant scenarios. With the continuous advancement and maturation of AI technology, installation efficiency is expected to improve even further.


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One Installation Robot is Equivalent to Five Manual Labor



07 Future Outlook

Currently, Tongwei has introduced its innovative TONGWEI G12-Tracker Solution to the Middle East market. Through technical communication and project feasibility assessments, numerous design institutes, EPC groups, and project owners have recognized the high feasibility of Tongwei Tracker Solution. Tongwei Tracker Solution will accelerate the promotion and adoption of G12 products in global markets. As G12 gains popularity worldwide, tracker manufacturers will develop tracker products with longer maximum length to maximize G12 modules' system value performance.

For example, in a full-size string design scenario, 4 strings of G12 modules require a tracker length of approximately 160 meters. In this case, the total module power capacity within a single tracker is 12 KW higher for G12 modules compared to G12R modules. Even if G12R modules deployed with Tongwei's undersized string design, the total power capacity of G12 modules in a single tracker would still be 2.4 KW higher. Therefore, in 160-meter tracker applications, G12 modules demonstrate great system value superiority compare with G12R, and will become the mainstream product in the PV module market of the future.

| Future 160m Single-point Drive Tracker String Solution G12 Modules Deliver Significantly Higher Value Compare with G12R Modules | | | |
|--|----------------------|----------------|------------|
| Modules Samples | Modules/String | String Amounts | Power (KW) |
| G12-740 | 30(Full-size String) | 4 | 88.8 |
| G12R-640 | 30(Full-size String) | 4 | 76.8 |
| | 27(Full-size String) | 5 | 86.4 |

Attachment

Reference Table for Recommended Number of G12 Modules per String for Trackers with Different Maximum Lengths

When G12 modules system deployed the Tongwei Tracker Solution, feasibility research on project site's climatic conditions and the type of inverter used is essential.

For detailed Tongwei Tracker Solution proposal & evaluation, please contact Tongwei technical support team.

| Types of Inverter | Regions | 145m | 140m | 135m | 130 | 120m |
|-------------------|------------------------|------|------|------|------|------|
| String Inverter | Hamburg, Germany | 27*4 | 26*4 | 25*4 | 24*4 | 28*3 |
| | Riyadh, Saudi Arabia | | | | | 30*3 |
| | Sydney, Australia | | | | | 28*3 |
| | Rio de Janeiro, Brazil | | | | | 29*3 |
| | Sudan | | | | | 30*3 |
| Central Inverter | Hamburg, Germany | 27*4 | 26*4 | 28*3 | | |
| | Riyadh, Saudi Arabia | | | 30*3 | | |
| | Sydney, Australia | | | 28*3 | | |
| | Rio de Janeiro, Brazil | | | 29*3 | | |
| | Sudan | | | 30*3 | | |

Authoring Organization

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