



ANTAISOLAR SOLAR TRACKING SYSTEM 3.0

ONE-STOP SOLUTION **WHITE PAPER**

2024/6

ANTAISOLAR

PREFACE

ANT, as its name suggests, it builds strong and well organized community, the most moderate believers of hardworking.

TAI, is a symbol of quintessence of universe from Sino language, it provides diversity during our development of product and services.

The fusion of two of the greatest strengths of diversity and community made the brand of ANTAI.

As a diligent group of "ants," we have been chasing the direction of light since 2006, hoping to contribute to the development of a greener world. Continuously exploring on this beautiful planet, we, along with our solar tracking systems, seek the mysteries of human civilization.

Along this journey, we have witnessed the wisdom and courage of our team members. They have conducted countless experiments and attempts, constantly optimizing and improving our technology solutions, leading our intelligent tracking systems into the era of 3.0.

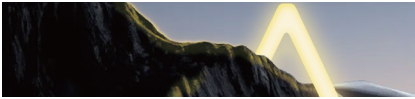
However, these descriptions are not just about the exploration and innovation of technology. Behind the team, there is a firm belief in environmental protection and sustainable development. This is just the beginning of our journey. In the future, we believe there will be more wonderful stories to be written together with all of you.

Gabriel W. Wong

Vice President of Antaisolar

1st, Jun, 2024

Antaisolar Madrid Service center



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1 / FINANCING SERVICES & DNV BANKABILITY

With the expansion of solar energy around the world and the constant construction of solar plants with increasingly greater generation capacity and consequently high investment values, national or international financing has become a mandatory condition for investors to invest their money in this business, which at its root is a financial operation.

Therefore, due to the constant increase in the construction of solar plants, suppliers like Antaisolar that offer the possibility of financing with bankability stand out in this segment, even more so when they integrate the ease of obtaining money for investors with refined logistics for greater speed of sending material for all countries in the world.

1.1 CAPABILITY TO PROVIDE FINANCING SERVICES DURING CONSTRUCTION

Our company has the capability to offer financing solutions during the construction period. Through our strategic alliances with highly rated financing banks and the China Export & Credit Insurance Corporation (Sinasure), we provide precise and efficient financing solutions. These are not only limited to prudently extending grace periods for payments up to two years but also include tailor-made settlements based on the specific circumstances of each project.

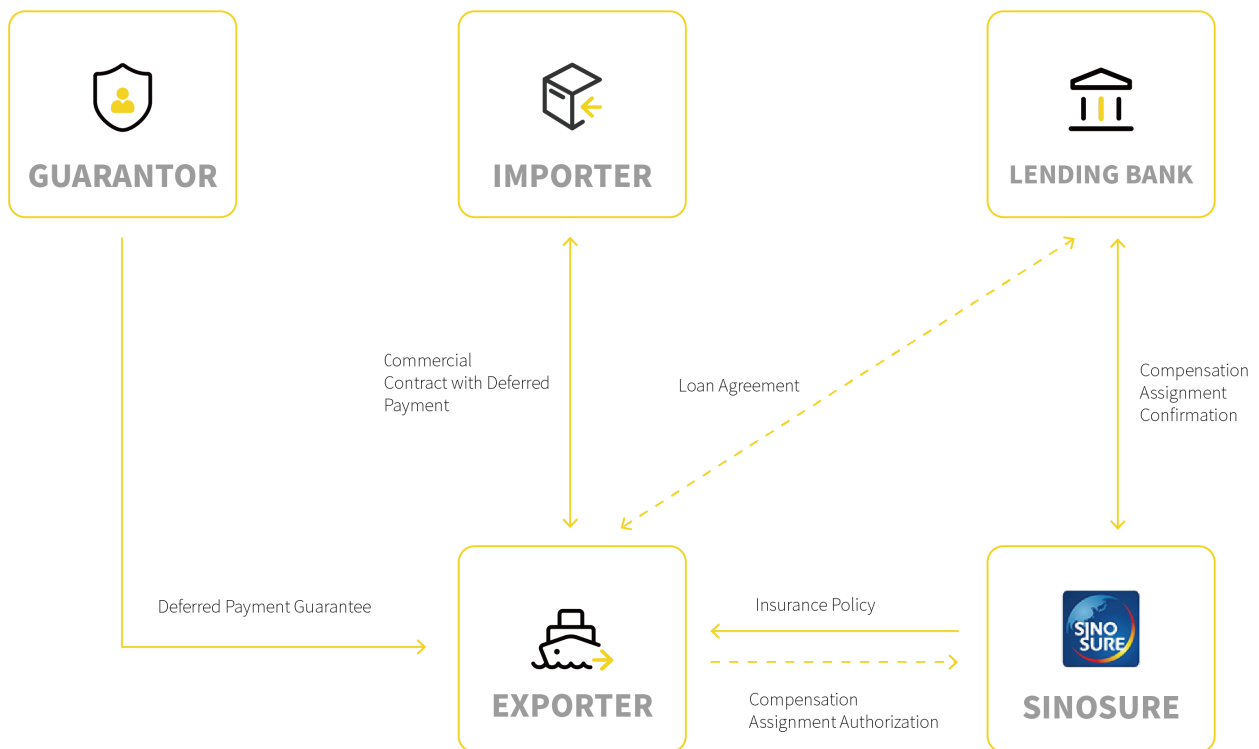


Figure 1 : Export Supplier's Credit Insurance

In collaboration with banks, we will disburse payments in alignment with our progress in fulfilling commitments. Clients have the option to settle their payments with us either quarterly or semi-annually, effectively mitigating financial pressures during the construction phase. Furthermore, the involvement of Sinasure ensures rigorous risk management throughout the process of contract fulfillment, thereby enhancing the security of both commercial transactions and contract execution.

MAIN ELIGIBILITIES	
EXPORTER	A legal entity registered in mainland China, and licensed to conduct foreign trade and international economic cooperation, with no deficient record in previous collaborations with SINOSURE.
CHINESE CONTENT	For export of large-scale machine or complete sets of equipment, at least 60% of commercial contract value (CCV); for high-tech and high-value-added ships or marine engineering projects, at least 40% of CCV; for EPC projects, at least 35% of CCV.
DEFERRED PAYMENT RATIO	Normally, the deferred payment should not exceed 85% of CCV.
CURRENCY	USD, RMB, EUR or other currencies acceptable to SINOSURE
MAIN TERMS & CONDITIONS	
INSURED AMOUNT	Deferred payment amount plus related interest.
PREMIUM RATE	To be decided on a case-by-case basis. Factors affecting premium rate include country risk, tenor, borrower/guarantor credit risks etc.
SECURITY	In addition to the borrower/guarantor credit, additional security arrangements, including but not limited to escrow accounts, pledge, mortgage, and collateral may be required.
DEFERRED PAYMENT INTEREST RATE	To be discussed and agreed by the exporter and the importer.
COVERAGE PERCENTAGE	Up to 90% for both political and commercial risks.

Table1: Qualification Criteria For Importers

1.2 LTA TRACKER – TECHNICAL BANKABILITY REPORT

In June 2024, TAI (a certain product series) was awarded the Technical Feasibility Report issued by Solida. Solida carried out extensive work in analyzing the overall situation and technical feasibility of TAI and, after diligent study and field visits to its photovoltaic projects in Spain, releasing the following in its report:

- Antaisolar's substantial track record since 2006, with 33.2 GW of signed capacity, has been a testament to its remarkable reputation in the market;
- 'TAI Simple' 1P trackers that meet industry standards are recognized as a comprehensive, user-friendly, and cost-effective photovoltaic panel tracking system solution;



- The technical specifications of the tracker are aligned with industry standards, and its length has the potential to surpass that of competitors, offering greater flexibility in design;
- The tracker possesses all the required certifications, and its structural and foundational design methodology adheres to industry standards. TAI's warranties are better than those of its competitors, demonstrating a strong commitment to quality and performance. The spare parts list, both in terms of specific components and suggested usage, is also in line with market standards;
- The report also recommends the tracker's simple and efficient design, which is expected to facilitate the assembly process, leading to shorter construction time and less project costs.



Figure 2 : LTA Tracker –Lender Technical Advisory

About Solida:

Solida is a technology advisory firm for lenders, providing insights and advice on the technology risk posture of borrowers. It utilizes proprietary technology to analyze a borrower's technology stack, security practices, and overall IT risk posture.

1.3 DNV BANKABILITY REPORT

In November 2023, Antaisolar launched the third phase of a bankability services capability report issued by DNV. The review focused on the generic methodologies employed in Antaisolar's design, manufacturing, and business systems. The report conclusively demonstrates that:

- The ANT and TAI series trackers are integral to Antai's photovoltaic tracker solution development programme and have been commercially deployed in multiple projects across China and other markets.

- DNV found that the tracker concept and development strategy align generally with common tracking solutions in the market.

Antaisolar's extensive experience in manufacturing and producing solar PV mounting systems, DNV recognizes the company as highly skilled in its product development process.

The report serves to underscore Antaisolar's capability in bankability services related to the design, manufacturing, and business systems of its solar tracking solutions. This confirms that Antaisolar's products and processes meet industry-recognized standards and are considered bankable.

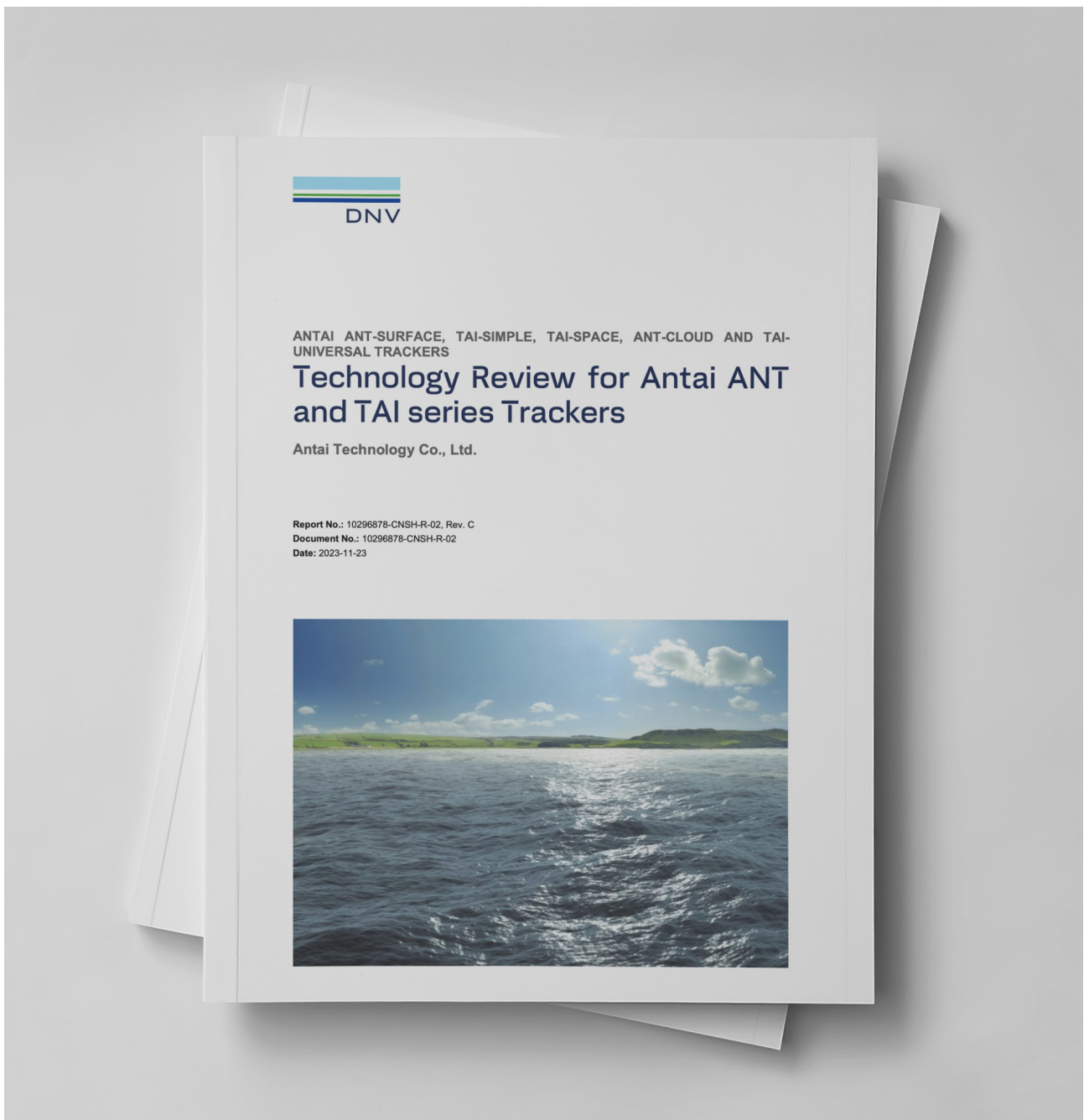


Figure 3 : DNV-Bankability Report



AUTHOR

- Responsible for the research and development of new products and solutions.
- Responsible for R&D process and platform.
- Over 15 years of R&D experience in smart device and control system.
- Global working experience in electrification and automation.
- Master's degree in Control Science and Engineering, Harbin Institute of Technology, China

R&D DIRECTOR AT ANTAISOLAR



ABU YANG

2 / SMART TRACKING SOLUTION

The current challenge of optimizing and managing solar plants with greater efficiencies, less losses, with greater generations and mainly lower installation and operation costs, involves the use of very advanced control technologies with on-board intelligence, mainly in plants.

In this article we will demonstrate Antaisolar's optimization for installation, control and intelligent protection, often autonomous, aiming, together with bifacial solar panel technologies, to increase production gains with lower costs.

Antaisolar's smart tracking solution that consists of 3 parts, smart control system, smart protection strategies and smart tracking algorithm is designed for single axis tracker including 1P and 2P.

2.1 SMART CONTROL SYSTEM

Antaisolar's smart control system comprises hardware devices and software applications. Besides the sensors, the main hardware devices are NCU (Network Control Unit) and TCU (Tracker Control Unit), whose communication relies on Zigbee. TCU is the device controlling the tracker's movement to follow the path of the sun while NCU acts as the control center for Zigbee sub-network, and gateway to interact with site network for local and remote software service.

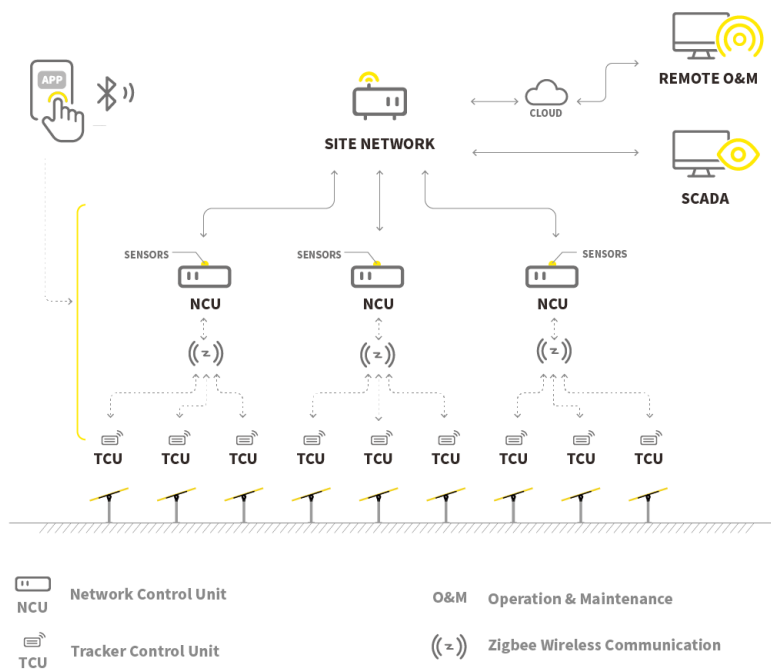


Figure 4 : Smart Control System Architecture

There are three types of software application, Mobile App, SCADA (Supervisory Control and Data Acquisition) and Remote O&M (Operation & Maintenance). Mobile App is used for easy commissioning and installation via Bluetooth. SCADA is used for local monitoring, management and maintenance. Remote O&M is used for remote monitoring, management and maintenance.

2.2 SMART PROTECTION STRATEGIES

The smart protection strategies are designed to mitigate extreme weather risks to protect the tracker structures and modules. There are four types of stow management strategies that can be configured based on the tracker structure, location and meteorological conditions of the site.

WIND STOW



Move trackers to the defensive stow position as configured on site, when the wind alarm is activated, and return to normal mode after the wind alarm is deactivated.

SNOW STOW



Move all trackers to maximum tilt angle to dump snow, when the snow alarm is activated, and return to normal mode after the snow alarm is deactivated.

FLOOD STOW



Move trackers in flood zones to 0° tilt angle (flat position), when the flood alarm is activated, and return to normal mode after the flood alarm is deactivated.

HAIL STOW



Move all trackers to maximum tilt angle to minimize hail impact force, when the hail alarm is activated, and return to normal mode after the hail alarm is deactivated.

Figure 5 : Extreme Weather Protection Strategies

2.3 SMART TRACKING ALGORITHM

Conventional tracking algorithm limitations

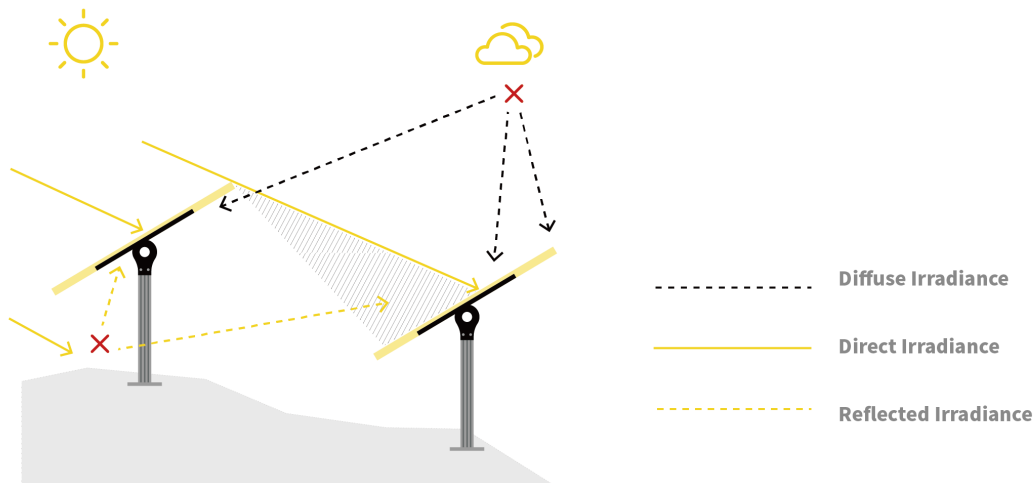


Figure 6 :Conventional Tracking Algorithm Limitations



Conventional tracking algorithm consists of astronomical algorithm and backtracking algorithm, which only consider direct irradiance, flat terrain, monofacial module. But it is not the optimal solution for bifacial module, high diffuse irradiance weather and irregular terrain.

Smart tracking algorithm to boost the power generation

The smart tracking algorithm considers direct, diffuse and reflected irradiance to adapt to bifacial module and various weather conditions.

Bifacial module converts irradiance captured on both front and rear sides of photovoltaic panels into power, and it is widely used in real projects nowadays. This algorithm can adjust the tracker to optimal tracking angle to boost the power generation, based on the comprehensive irradiance calculation of both sides of bifacial module.

In high diffuse irradiance condition like overcast or cloudy weather, and low irradiance condition like rainy weather, for optimal power generation, this tracking algorithm controls the tracker to switch to a more horizontal position and reduce the rotation of the tracker.

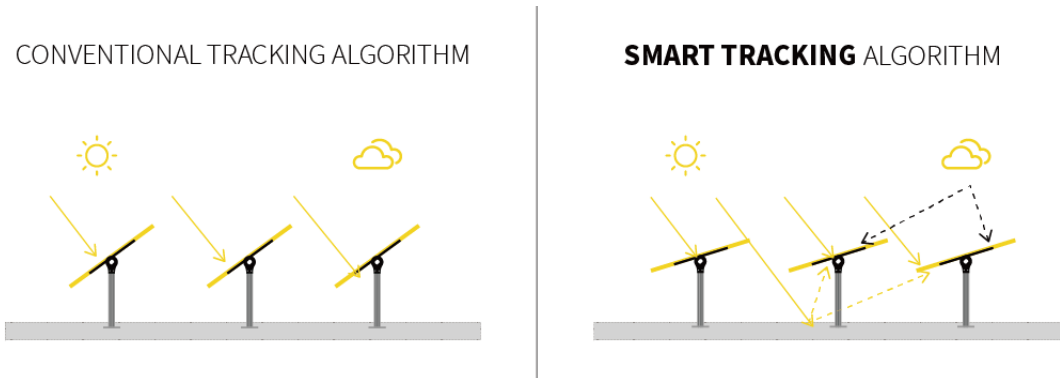


Figure 7 : Comparison Diagram of Tracking Angle in High Diffuse Weather

This smart algorithm also takes the terrain variance into consideration to solve the shade problem caused by irregular terrain during backtracking.

Conventional backtracking algorithm, which only focuses on sun position and tracker structures, can't solve inter-row shading problem caused by irregular terrains. However, Antaisolar's smart tracking algorithm, whose basis is 3D modeling and efficient optimization algorithm, can minimize the inter-row shading and lift power generation of irregular terrain.

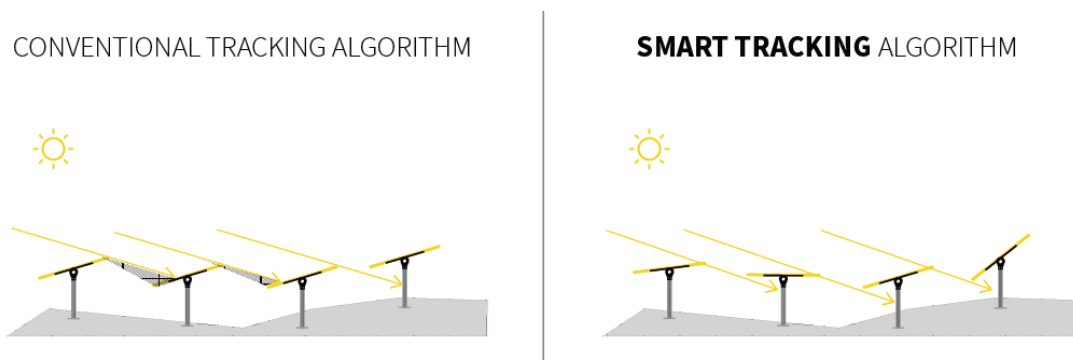
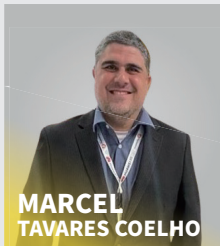


Figure 8 : Comparison Diagram of Backtracking Angle under Irregular Terrain

AUTHORS

- Cooperation with Harvard University Extension School – Solar Energy
- 12 years of experience in energy systems
- Experience in both centralized and distributed solar projects
- Oversees Antaisolar's engineering and project support in Latin America and Europe
- Master in Renewable Energy and Tracking Systems, Federal University of Brazil

**SENIOR TECHNICAL ENGINEER
AT ANTAISOLAR**



**MARCEL
TAVARES COELHO**

- Customer-facing technical lead with owners, investors, and EPC
- Responsible for the design and engineering of over thousands of utility-scale PV projects
- Cooperate with the R&D engineers in China and overseas to work with wind tunnel facility, 3rd party review engineering company, and lender technical advisory
- B.S. in Civil Engineering from Lawrence Technical University, Michigan, USA.

**DIRECTOR OF TECHNICAL
AT ANTAISOLAR**



**FRNAK
WANG**

3 / PEOPLE-ORIENTED, INNOVATIVE INSTALLATION + O&M SOLUTIONS



Figure 9 : Antai Ningxia Delivered Project Site

3.1 PEOPLE-ORIENTED, ANTAI 'S PRE-ASSEMBLY SOLUTIONS

The pre-assembly solutions offer the following advantages:

Modular Design:

Simplifies installation steps, reduces the number of workers, and lowers on-site management complexity.

Quality Consistency:

Factory pre-assembly ensures high quality, reducing on-site errors.

Cost Efficiency:

Shortens project duration, reduces faults and rework, and lowers construction costs.

Safety and Efficiency:

Simplifies construction, reduces risks, and enhances safety.

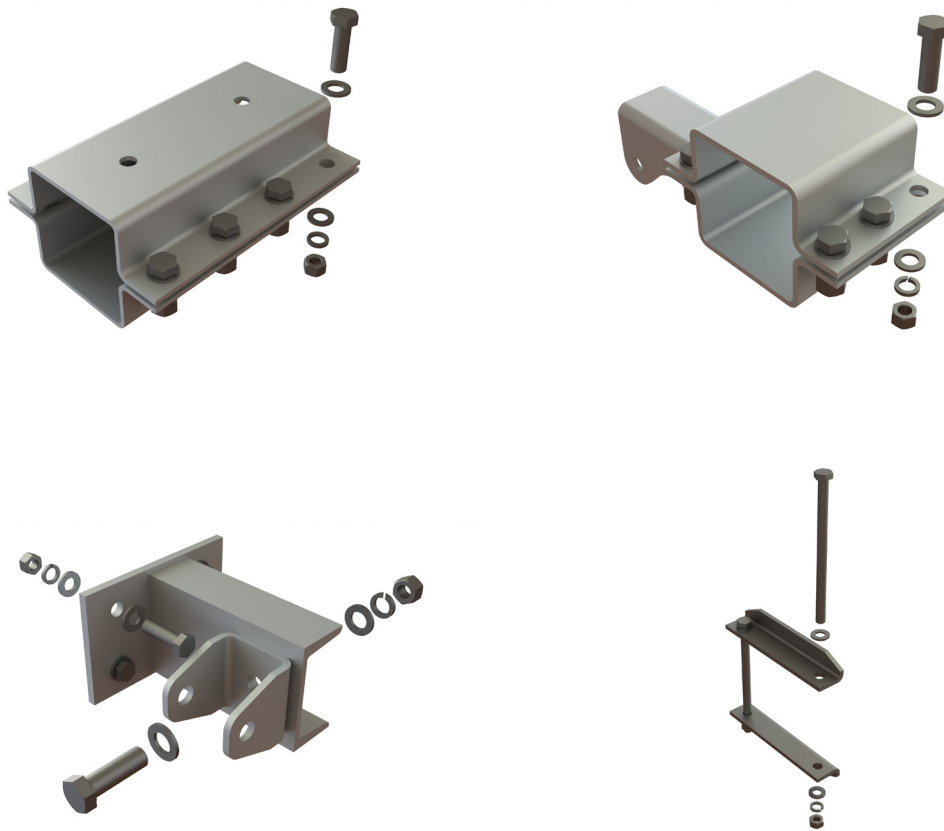


Figure 10 : Preassembled Torque Tube Connector / Preassembled Damper Arm /
Preassembled Damper Seat /Preassembled Bearing Baffle

Summary

Antaisolar's pre-assembly solutions offer significant advantages in enhancing installation efficiency, reducing costs, improving quality control, and ensuring safety. These solutions are adaptable to projects of various scales and standards. By completing complex assembly and commissioning work in the factory, pre-assembled components substantially reduce on-site construction time and complexity, lessen the need for highly skilled labor, enhance construction safety, and optimize project management processes. In summary, pre-assembled components provide robust support for the efficient, economical, and high-quality execution of projects.

3.2 EFFICIENT, FAST, HIGH-QUALITY, AND SUPERIOR: ANTAISOLAR'S SUPPORT FOR ON-SITE O&M

Antaisolar selects superior materials, and reduces inspection frequency to achieve rapid verification. This approach reduces O&M time and costs, ensuring efficient project delivery and fulfilling commitments to customers.

Implementing Maintenance-Free

- Double-Sealed Structure : Ensures internal cleanliness for slewing driver
- Self-Lubricating Bearings and Coating Technology : Key components require no regular lubrication
- Pre-Filled High-Durability Grease : Enables long-term stable operation without the need for replacement.

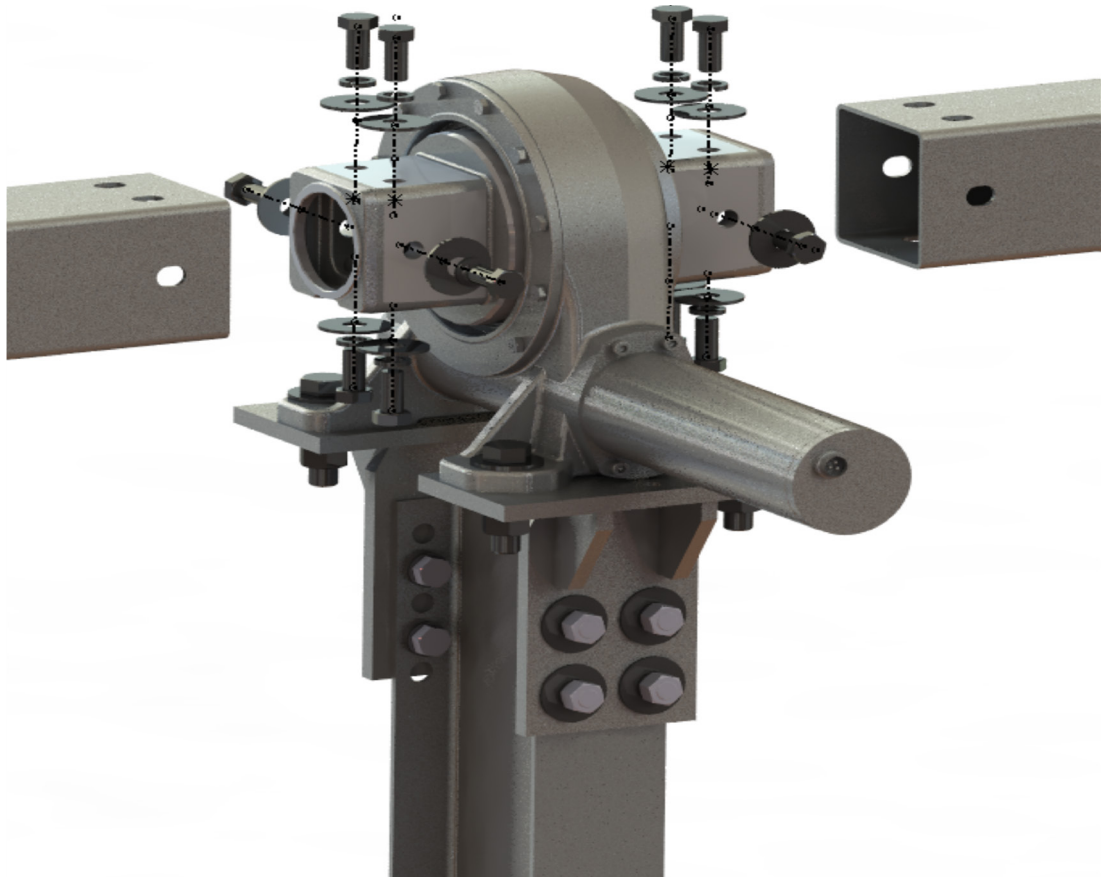


Figure 11 : Slew Drive Installation Demonstration

Advantages of Maintenance-Free

- Reduced Operating Costs : Minimizes maintenance work and lowers labor and material costs.
- Minimized Downtime Losses : Less downtime due to maintenance increases power generation efficiency.
- Improved Reliability and Stability : Reduces wear and failures, enhancing system reliability and ensuring long-term stable operation.

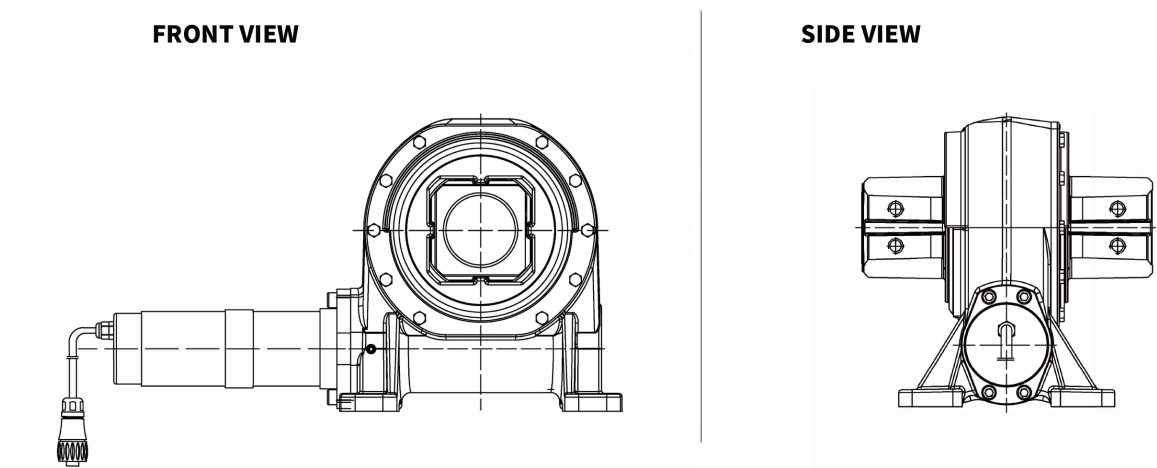


Figure 12 : Slew Drive Front View & Slew Drive Side View



Utilization of Advanced Algorithms and Large-Span Column Design to Reduce Column Quantity by Approximately 16% in Photovoltaic Support Systems

Structural Optimization

Optimizing column layout through advanced algorithms and employing large-span columns reduces the number of columns required while maintaining system stability and wind resistance.

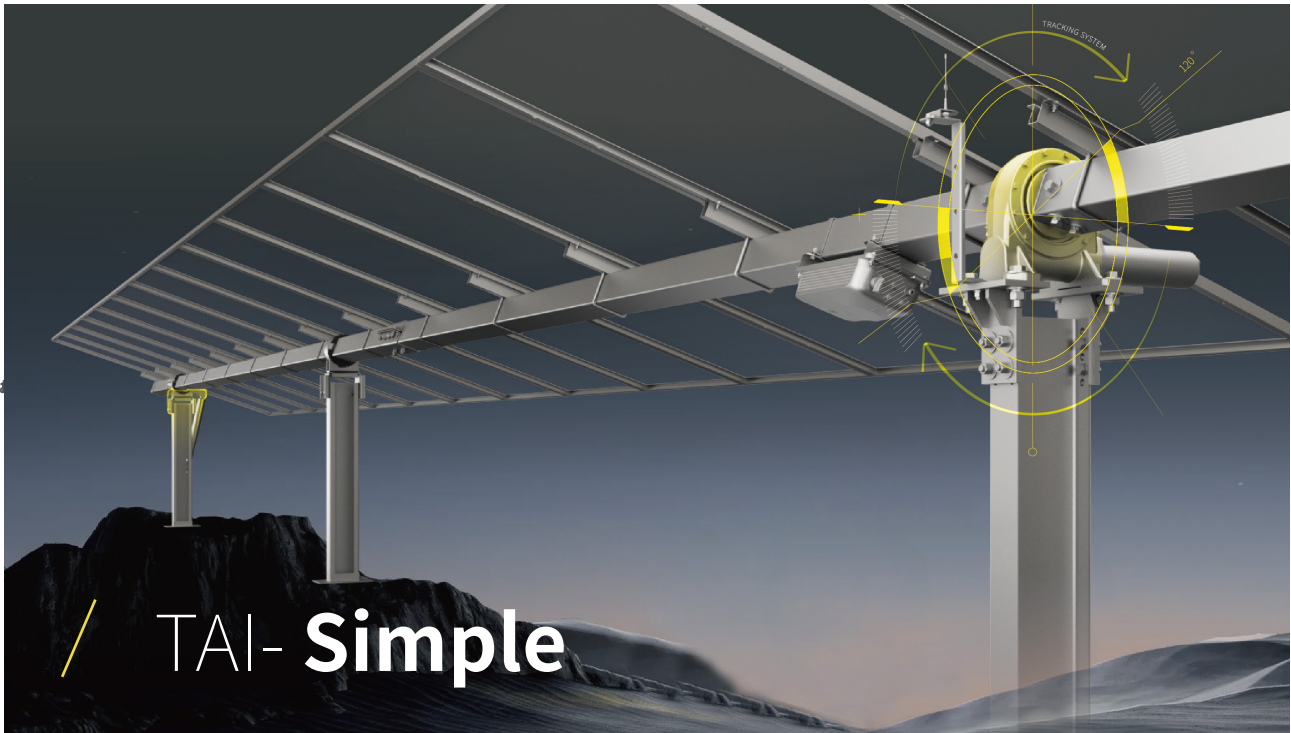


Figure 13: Antai's Single Axis Tracker (Tai-Simple)

Cost Savings

- Reduced Material Costs : Decreasing the quantity of structural components lowers procurement expenses.
- Lowered Construction Costs : Reducing excavation and concrete pouring requirements cuts foundational work costs, leading to overall cost reductions.

Simplified Installation and Maintenance

- Reduced Maintenance and Inspection Workload: Saves on long-term operational and maintenance costs.

Use of Zinc-Aluminum-Magnesium Coating for Enhanced Corrosion Resistance, Cost Reduction, and Extended Support Structure Lifespan

Corrosion Resistance

Zinc-aluminum-magnesium materials are applied to key components, such as torque tube and purlins, reducing maintenance costs and downtime while extending their lifespan.



Figure 14 : Tracker Post Ramming Site

Advantages of Zinc-Aluminum-Magnesium Coating (AZM)

- Smoother Surface : Less prone to contamination
- Higher Surface Hardness : Superior wear resistance, with the coating less likely to peel off, thereby reducing cleaning time
- Excellent Corrosion Resistance : Provides superior protection against corrosion.

Cut Edge Corrosion Resistance

The coating containing magnesium and aluminum forms a dense protective film at the cut edges, significantly enhancing corrosion resistance.



Figure 15 : Zinc-Aluminum-Magnesium Coating



Figure 16 : Traditional Pure Zinc Coating

Coating Adhesion

The zinc layer in zinc-aluminum-magnesium materials adheres better than that in hot-dip galvanized (HDG) coatings, and the zinc shedding is significantly less compared to pure zinc hot-dip coatings.

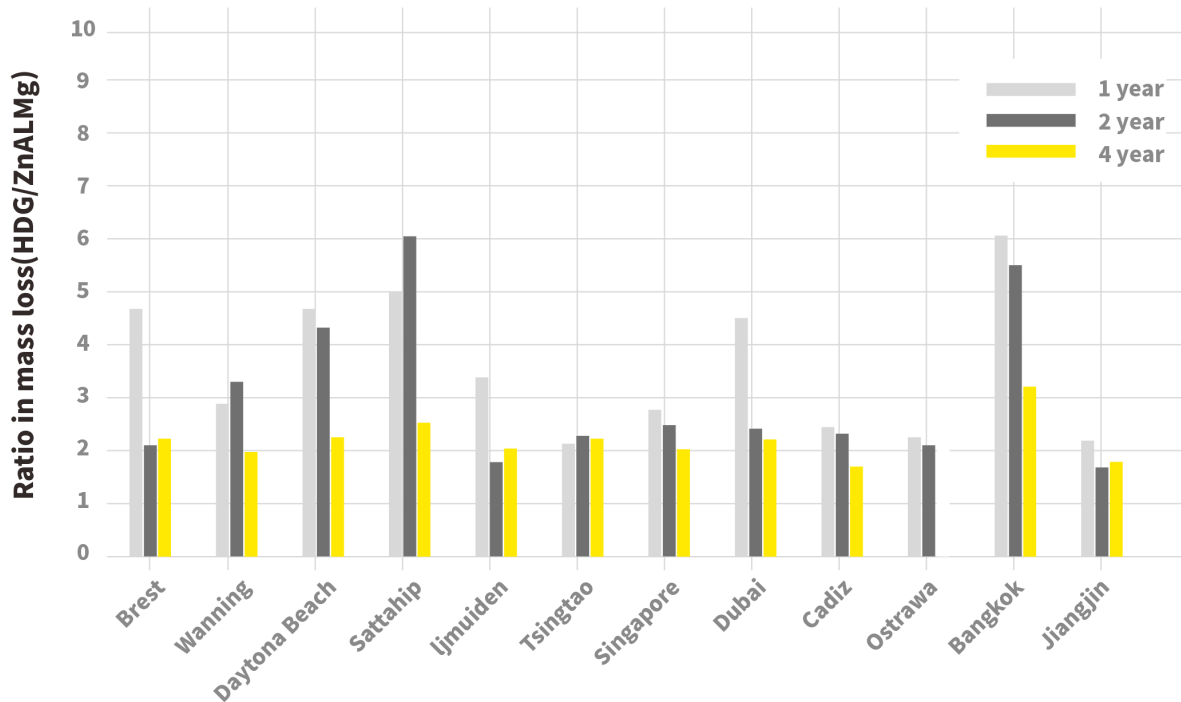
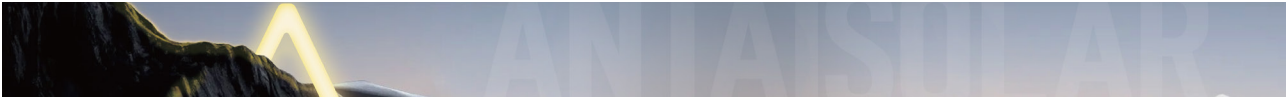


Table 2 : Ratio Between The Mass Loss For Hdg And Zn2%Al2%Mg Coated Steel After 1, 2 And 4 Years Exposure



AUTHORS

- Expertise in Direction and Project Management
- Proficient in technical, administrative, and economic control of projects
- Skilled in job planning and payment tracking
- Experienced in structural design of renewable industry
- National and international work experience

DIRECTOR OF GLOBAL PROJECT DELIVERY AND SERVICE AT ANTAISOLAR



- Certified Plant Consulting Engineer
- Over 10 years' experience in EPC project management and consultant of solar power plant, coal-fired power plant and telecom
- Master degree of Tongji University holder

DIRECTOR OF GLOBAL PROJECT DELIVERY AND SERVICES AT ANTAISOLAR



4 / FIRST-CLASS GLOBAL PROJECT DELIVERY SERVICES

Depending on high-quality overseas localized production, exceptional supply chain capabilities, convenient collaborative platforms, and advanced digital tools, Antai has developed the "1+2+3+4" comprehensive delivery service system which is competitive in the world.

1 OBJECTIVE

To establish a comprehensive global delivery service system.

2 CORES

Customer synchronisation and internal resonance.

3 METHODS

Onshore, nearshore, and offshore delivery services.

4 STRATEGIES

Optimisation of production and storage facilities, enhancement of operational systems, improvement of management skills, and digital empowerment.



Figure 17 : 6 Global Production Bases of Antaisolar

The system identifies the "three" main components of project contracts, which include: Products (delivery timelines, quantities, quality, adjustments), Documents (drawings, manufacturing processes, customs clearance, manuals), and Services (technical support, customs clearance, onsite assistance).

Antaisolar innovates delivery management through the "Five-one" mechanism, which includes: Establishing "one" comprehensive system, constructing "one" resource pool, compiling "one" manual, utilizing "one" ruler, thus leading to "one" detailed ledger. This mechanism can rank projects according to their priorities, share transported materials information timely and consider shipping arrangements according to onsite construction sequences. Thus, we can lower the support costs and enhance on-site construction efficiency so that the management of contract delivery which is complete and visual can be achieved.

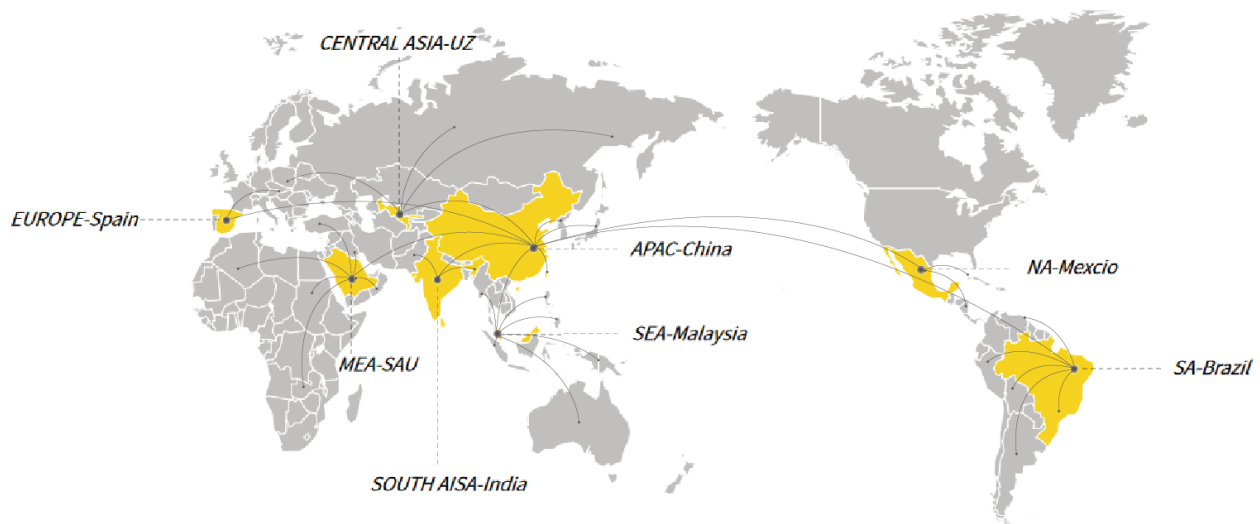


Figure 18 : 8 Global Delivery Service Centers of Antaisolar

Optimizing coverage system for global projects, Antaisolar has established 8 global delivery service centers and each center employs experts of Research&Development, sales and delivery service, forming Antaisolar's international service center which has functions such as selling, providing and serving. These centers are located in Asia-Pacific (China), Europe (Spain), South America (Brazil), South Asia (India), North America (Mexico), Central Asia (Uzbekistan), Southeast Asia (Malaysia), and the Middle East & Africa (Saudi Arabia). By making use of digital tools to build collaborative working platforms, each center can depend on each other to finally realize cross-border cooperation and efficient project management, which can provide overall delivery service of 24*7 high quality.



AUTHOR

- Over 16 years of experience in the renewable energy sector, specializing in solar and wind energy
- Responsible for strategic technical and economic decisions
- Manages international teams in LATAM, India, and Spain
- Collaborates with the China R&D center on full-cycle engineering tasks
- Involvement in technical documentation analysis, project product design, technical support, and product optimization

**GLOBAL ENGINEERING
DIRECTOR AT ANTAISOLAR**



**EMMANUELE
CHIAPPORI**

5 / RELIABLE LOW-CARBON PRODUCT SOLUTIONS

ESG, an assessment criterion and investment philosophy which measures a company's non-financial performance related to environmental, social, and corporate management, aligns intrinsically with carbon neutrality and sustainable development goals. Antaisolar has proposed low-carbon solutions for tracker products in raw material design, material transportation, onsite construction, and O&M, so that the solid foundation for Antaisolar's sustainable development is established.

5.1 CHOOSING COATED ZINC-ALUMINIUM-MAGNESIUM ALLOY IN RAW MATERIAL DESIGN

Traditionally, galvanized steel has been the main structural material in bracket design. After processed into shaped-steel, steel will also undergo hot-dip galvanizing (HDG) which is characterized by high energy-consumption and emission, producing substantial toxic gases and waste by-products that bring significant health risks to workers involved in production. However, the production of Zinc-Aluminium-Magnesium Alloy brackets eliminates hot-dip galvanizing and surface treatments so that the production corporation can produce and shape trackers needed by customers directly, reducing carbon emissions by 168 kg per ton compared to galvanized steel.

In the light of this, Antaisolar employs a new type of high-corrosion-resistant coating material—Zinc-Aluminium-Magnesium (AZM) alloy—in choosing raw material for Antaisolar's trackers, significantly contributing to energy saving and emission reduction. Besides, this alloy not only offers excellent corrosion resistance but also superior processing, forming, welding, and aesthetic qualities, effectively addressing most environmental problems in project construction.

Historically, standard materials were transported by using traditional wooden pallets, which led to low space utilization in containers and potential damage in transportation, affecting the stability and safety of the goods. However, Antaisolar has transformed the package of materials to recyclable wooden crates, increasing packing efficiency from 65% to 90% while reducing product damage.

5.2 POST RAMMING—MINIMIZE LAND DISTURBANCE

Considering different soil and terrain conditions, the foundation forms for solar mounting systems vary greatly. Based on environmental considerations, Antaisolar prioritizes the "post ramming" foundation solutions. From the perspective of long-term benefits for solar power projects, post ramming foundations can offer greater adaptability, higher cost-effectiveness, and are less restricted by seasonal temperature variations. Additionally, by reducing the use of concrete in the construction process, this scheme can reduce soil corrosion and also the difficulty of soil restoration after the completion of projects, thus avoiding irreversible damage to the environment.

5.3 UTILIZING RECYCLABLE MATERIALS IN O&M

Bearing is a crucial component of trackers. Recently, with the development of material science and the spread of sustainable development, Ultra-high molecular weight polyethylene (UHMWPE) has been widely used in Antaisolar's trackers, which can not only enhance its bearings' performance but also correspond to Antaisolar's strategic objective of promoting environmental, social and governance (ESG).

UHMWPE, a material with an extremely high molecular weight, very low friction coefficient, and outstanding wear resistance, offers multiple advantages: enhanced durability, reduced friction, and improved impact resistance. Recyclable UHMWPE also reduces system energy consumption and extends usage lifespan, supporting carbon emission reduction, resource waste, and environmental protection.

In the future, Antaisolar will continue the principles of ESG, constantly exploring and innovating to provide our clients with higher quality and more environment-friendly products and services. Meanwhile, Antaisolar looks forward to working hand in hand with more partners to jointly promote the sustainable development of PV industry.

Disclaimer /

All information contained in this white paper is for reference only and does not constitute any offer or commitment. Although Antaisolar has endeavored to update the information and to keep the product and company information current, the design of product solutions must take into full consideration specific geographic conditions, temperature, geological characteristics, environment, wind speed, and climate temperature differences, and be combined with the type of support product required by the customer in order to be fully developed. Therefore, we make this disclaimer to ensure that you fully receive the following advisory information: All information in this white paper is for reference only, and Antaisolar makes no express or implies representations or warranties of any kind regarding the completeness, accuracy, timeliness, reliability, suitability, or effectiveness of any information, products, services, or other related content in this white paper, nor does it represent the company's position or judgment. If you use or rely on any information or data in the white paper on your own and any loss is caused or resulted, you shall bear the risk yourself, and we shall not assume any form of responsibility.

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