this webinar is powered by TrinaTracker

pv magazine webinars

# Smarter trackers: Real data insights from TrinaTracker's smart control system applications

**27 November 2024**

9:00 am -10:00 am | EST, New York City
11:00 am – 12:00 pm | BRT, Sao Paolo
3:00 pm – 4:00 pm | CET, Berlin

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Leader of Technical Sales
**PVcase**

# Welcome!

pv magazine webinars

**Do you have any questions?** ❓ 🙋

Send them in via the Q&A tab. 👉 We aim to answer as many as we can today!

You can also let us know of any tech problems there.

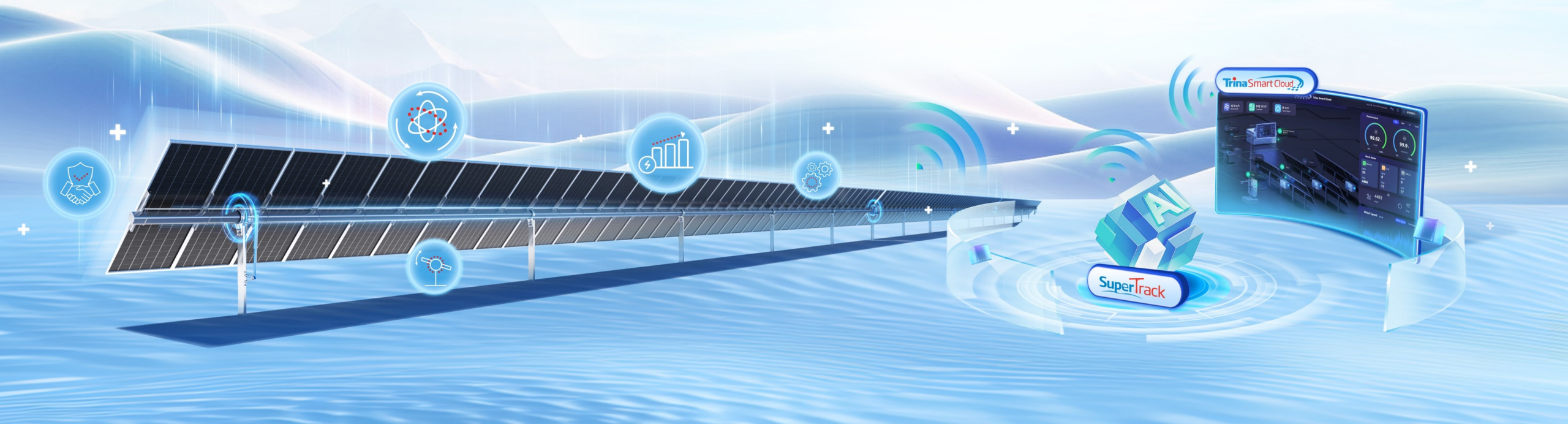
**We are recording this webinar today.** 📹

We‘ll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience. 👀 💡

# Iteration of TrinaTracker Smart Control System and Global Implementations

**Dr. Sun Kai**

Head of Smart Control System, TrinaTracker



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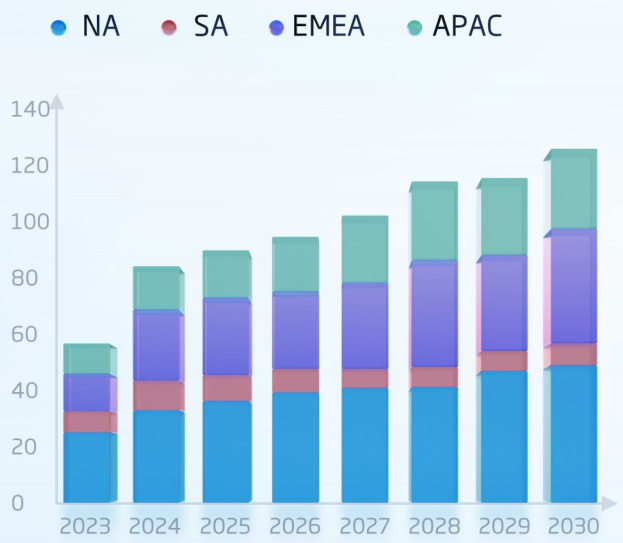
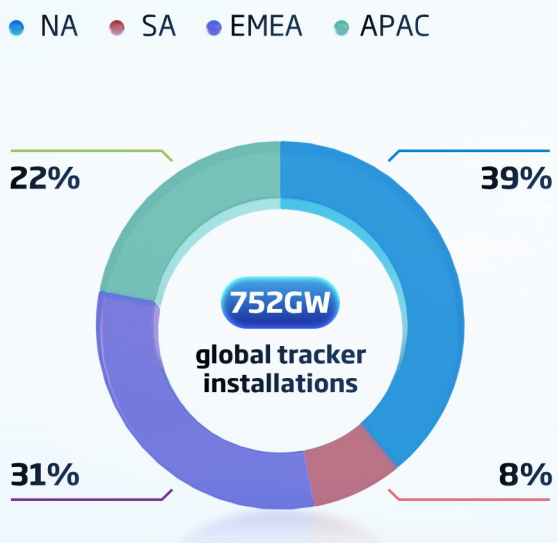
# Tracker Global Trend

## The global demand for tracker is keep increasing

**Global solar tracker annual installation forecast (GW)**




**Global solar tracker country shares by major region in forecast period (2024-2030)**




**Trackers**

**Tracker configuration**

**2P** two-in-portrait

**1P** one-in-portrait

- **Reliable tracker structure and stable operation**
- **Low failure rate**
- **Dealing with extreme weather conditions**
- **Efficient operation and maintenance**
- **Adapt to complex terrain**
- **Reduce power generation losses**

- The top 7 tracker manufacturers in the world are all developing their own smart control system, including controller, SCADA, and algorithm.
- Due to the increase in power generation, the usage of SCADA and algorithm is keep increasing.

**Advanced tracker control system**

TrinaTracker

# TrinaTracker Smart Control System

High Reliability | High Efficiency | High Performance

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TrinaTracker

# Development of TrinaTracker Smart Tracking Solution

Controller | SCADA | Algorithm

## 2020

- Self-Developed Controller
- Self-Developed Algorithm

## 2021

- 1st Generation Controller Mass Application
- Self-Developed SCADA

## 2022

- Multiple Communication Methods
- Multiple Power Supply Choices
- Dual Power Supply System
- Smart Cloud（Local Version）
- SuperTrack: STA+SBA

## 2023

- Electrical Multi-Drive Solution
- Smart Cloud Upgrade
  - Motor Diagnostic Pre-warning
  - Multi-Role Permission Management
  - 3D Digital Map
- Algorithm Upgrade
  - New SBA Deployment Method
  - Self-Recognition
  - Self-Optimization
  - Self-Training

## 2024-11

- Smart Control System New Upgrade

**Pain points**

| 2020 | 2021 | 2022 | 2023 | 2024-11 |
|---|---|---|---|---|
| Third party controllers' slow responses to fulfillment and after-sales requests.<br><br>Maximize the efficiency of bifacial modules.<br><br>Complex weather conditions and terrain can cause power generation losses. | The station level SCADA cannot monitor the operation status of tracker.<br><br>On-site operation and maintenance rely on manual inspection with low efficiency. | Frequent rain and cloudy weather lead to an unstable power supply for trackers.<br><br>Customers have different requirements and preferences for communication and power supply modes. | Need for more precise and stable tracker control. | Photovoltaic power stations require greater power generation, better protection, and lower operation and maintenance costs. |

# Latest Pain Points of Photovoltaic Power Plant

## SCADA
Flexible login

## Controller
Better communication applicability, faster response to extreme weather conditions

## Algorithm
More refined shadow optimization

Latest Upgrade Release in 2024

Customers' requirements for trackers have changed.

Power station development is now mostly in remote areas, with a shortage of flat terrain, which leads to small, scattered project sites.

The shading situation may vary in different seasons.

Various extreme weather conditions require prevention of tracker damage.

Project site has a large area or complex terrain, making operation difficult.

Multiple small capacity stations require centralized management.

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# TrinaTracker Smart Control System New Upgrade

## TrinaTracker Boosting Power Beyond the Horizon
## Smart Controllers

Auto Hail Protection

High Power Output

Electrical Multi-drive for Precise Control

## TrinaSmart Cloud
## Tracker Level SCADA

### Local Version

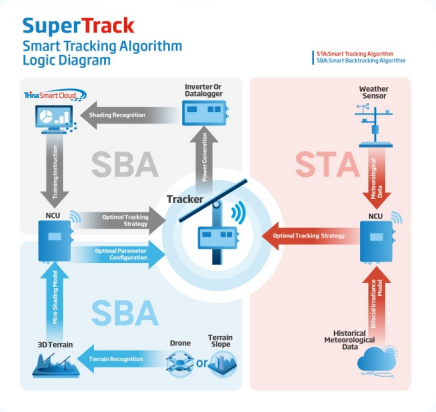
Deployment in the central control room with private domain storage on site.

### Cloud Version

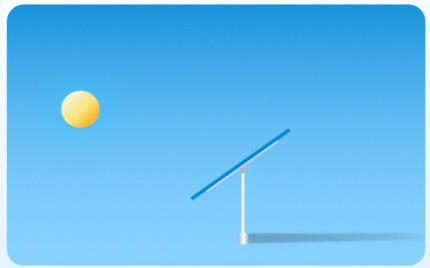
Login without limitation, and the operation status of the tracker can be monitored at any time. Multiple station monitoring and management can be performed with one account.

- Real Time Monitoring on PC
- Remote Parameter modification
- Multiple Station Management
- Motor Diagnostic Pre-warning

## SuperTrack
## Smart Tracking Algorithm




STA+SBA



Seasonal Optimization

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# Future of the Smart Control System

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# Global Applications

## La Dorada

Colombia • 2023

**108MW**

**Highly recognized the Smart Control System**

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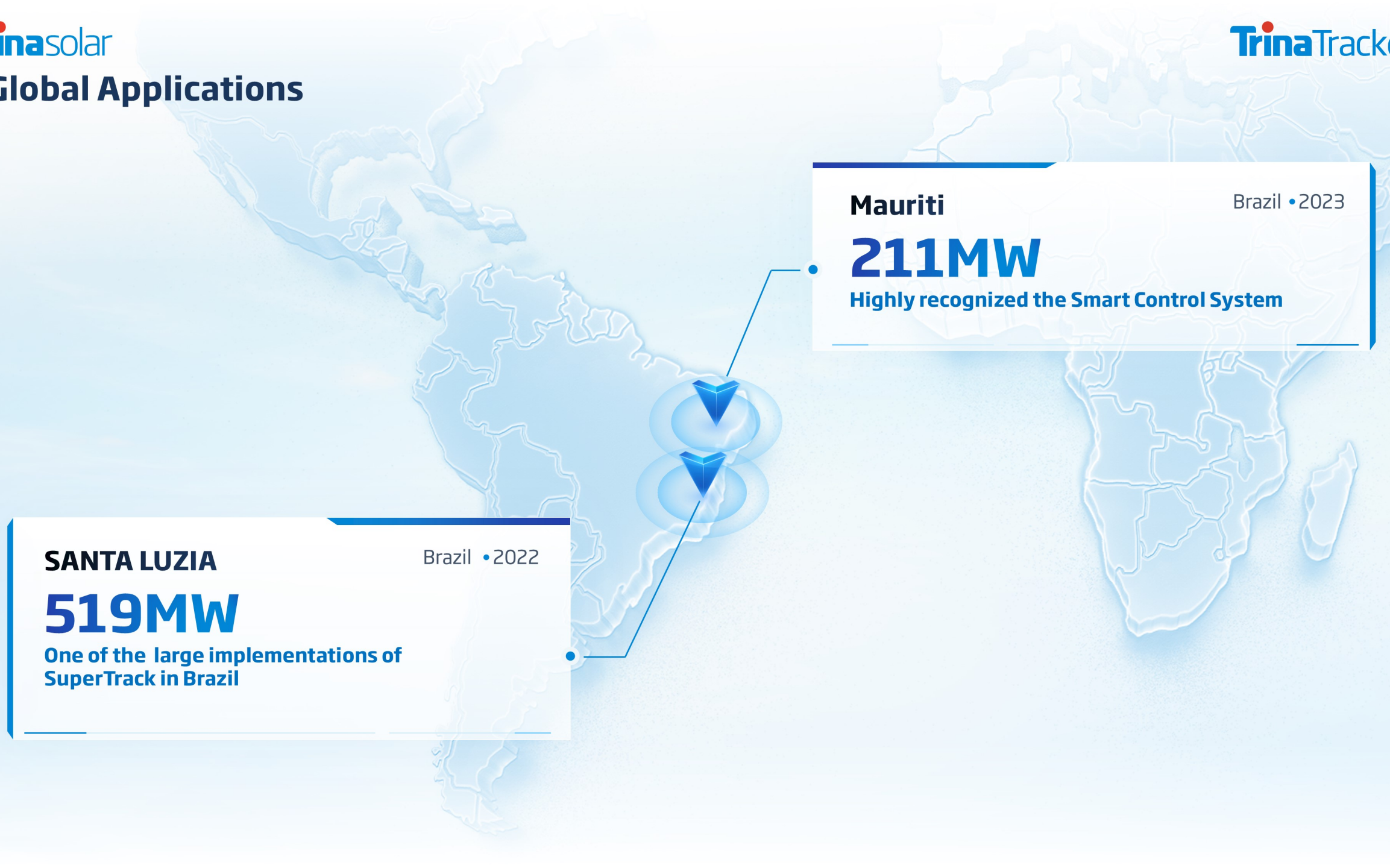
# Global Applications



**Mauriti**

Brazil • 2023

**211MW**

**Highly recognized the Smart Control System**

**SANTA LUZIA**

Brazil • 2022

**519MW**

**One of the large implementations of SuperTrack in Brazil**

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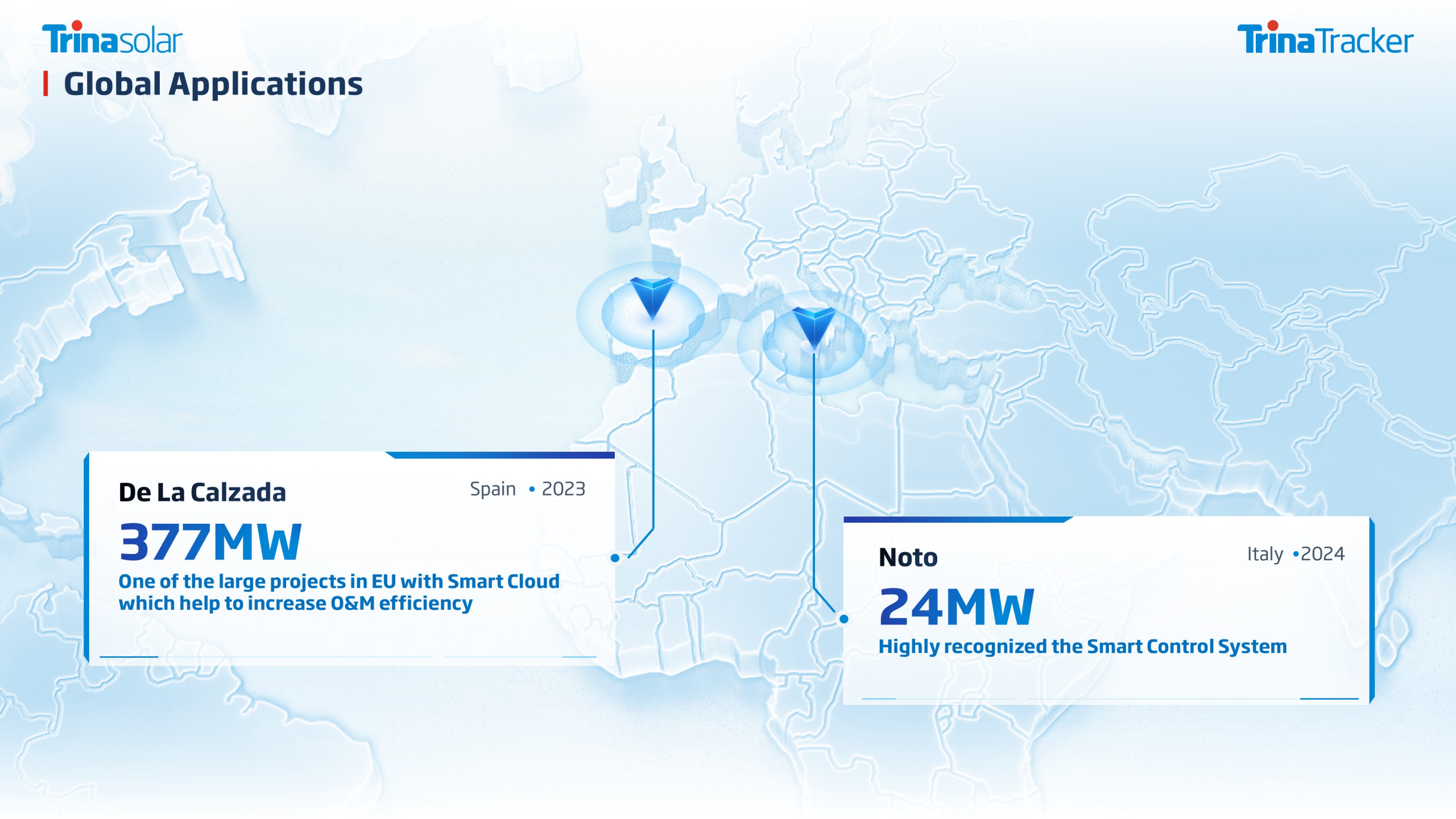
# Global Applications



## De La Calzada

Spain • 2023

**377MW**

**One of the large projects in EU with Smart Cloud which help to increase O&M efficiency**

## Noto

Italy • 2024

**24MW**

**Highly recognized the Smart Control System**

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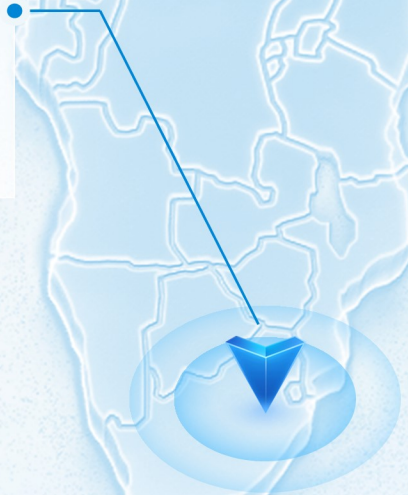
# Global Applications

## Polokwane Outlying

South Africa • 2023

**148MW**

**Customers emphasize the energy efficiency of power generation and choose to use Trina's innovative SuperTrack**



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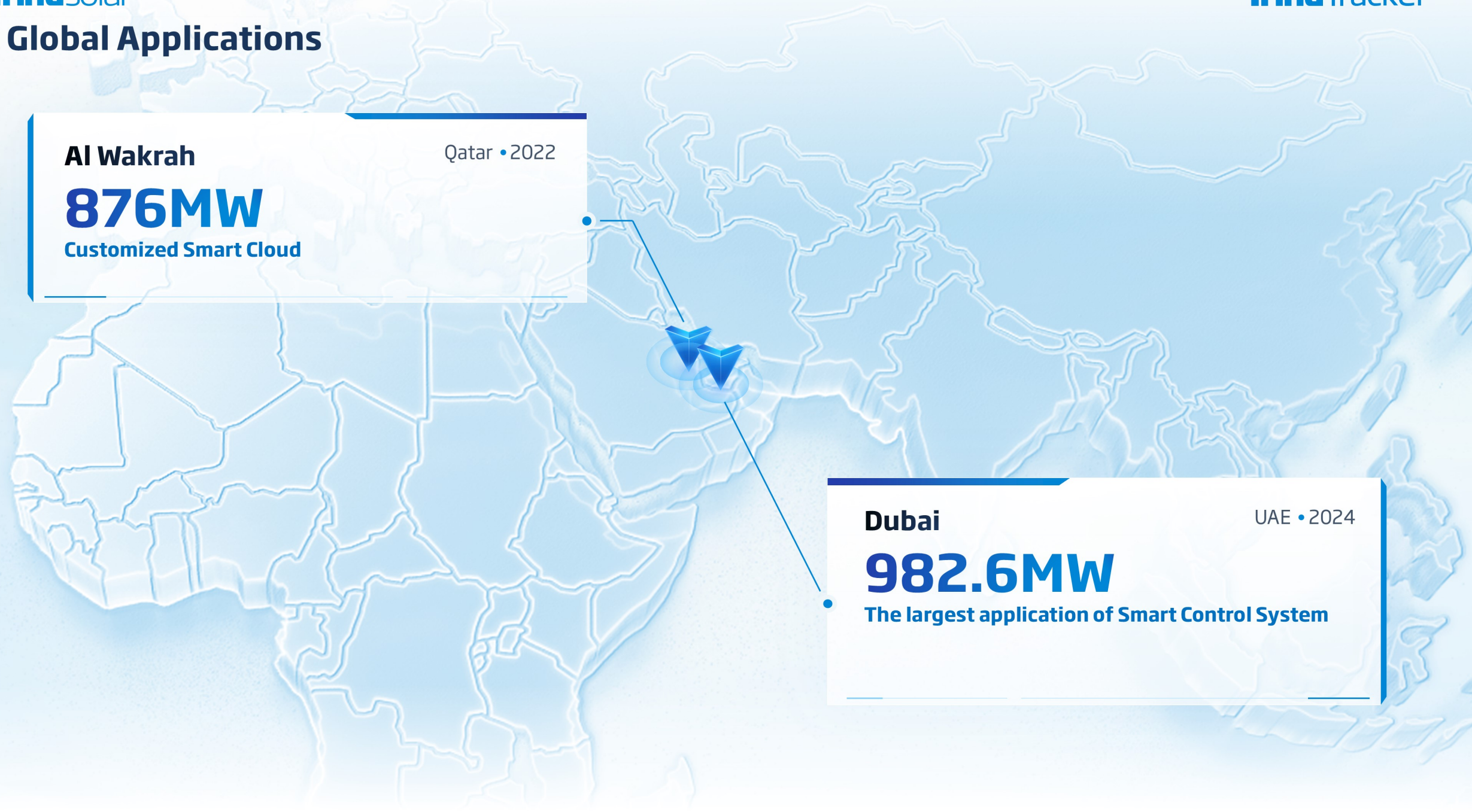
# Global Applications



## Al Wakrah

Qatar • 2022

**876MW**

**Customized Smart Cloud**

## Dubai

UAE • 2024

**982.6MW**

**The largest application of Smart Control System**

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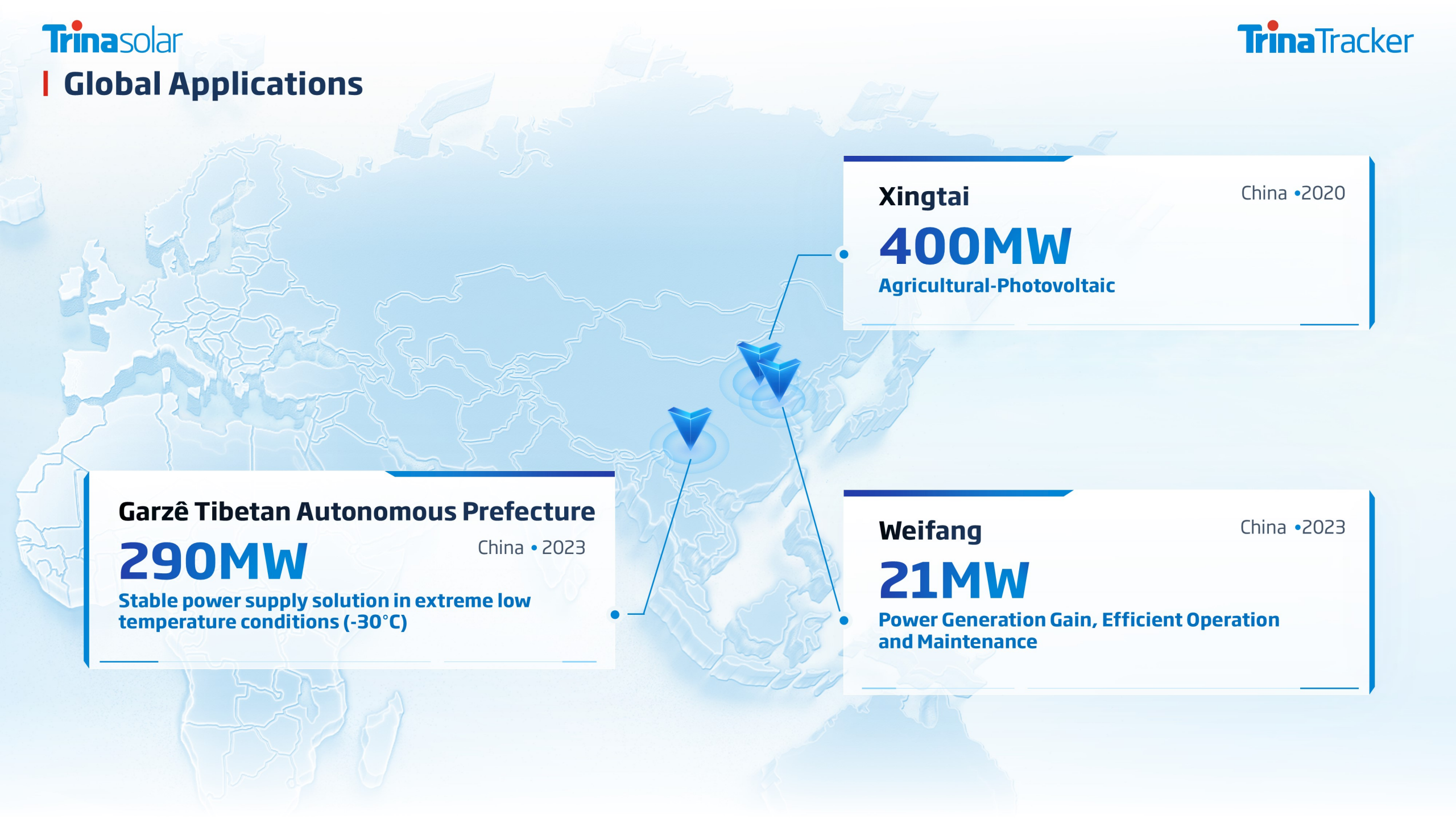
# Global Applications



## Xingtai

China •2020

**400MW**

**Agricultural-Photovoltaic**

## Garzê Tibetan Autonomous Prefecture

China • 2023

**290MW**

**Stable power supply solution in extreme low temperature conditions (-30°C)**

## Weifang

China •2023

**21MW**

**Power Generation Gain, Efficient Operation and Maintenance**

# Smart Tracking Solution - High Operation Efficiency Case

## We have applied Smart Control System to Shandong retrofit project, which has sufficiently improved the efficiency of power generation and operation.

**Extremely Inconvenient Transportation**
Located in the midst of mountainous terrain, with a radius of 20 km of barren land

**Frequent Accidents**
Only one non-paved path to the site, and there are often cars broken-down on the road.

**Extremely Difficult Operation and Maintenance**
Extremely difficult for operation and maintenance, requiring Smart Control System to monitor the real-time status and improve operation efficiency.

**After providing technical retrofit services for one year, Trina conducted a follow-up visit with the customer and collaborated with SGS to validate the actual power generation gain. Let's take a look at the final results together.**

**Weifang**

China • 2023

# 21MW

**Power Generation Gain, Efficient Operation and Maintenance**

| Product | Feature |
| --- | --- |
| Smart Control System | Technical Retrofit Project |

# Case Study - Shandong Retrofit

Shandong, China

## Retrofit

Capacity
**21MW**

Test Period
**Nov 2023-Oct 2024**

Energy Generation Overall Gain
**3.24%**

**Equipment Failures Led to Communication Interruptions**

**Manual Inspections is Time Consuming**

**Complex Terrain**

**Smart Control System**

**Run Normally for 1 Year**

**Digital O&M Platform**

**3.24% Energy Gain**

*"We choose our tracker partner based on three **KEY CONSIDERATIONS**"*

**01**
*the partner's strength and ability to provide stable after-sales service for years*

**02**
*their R&D excellence and ability to improve the overall energy yield of the power station*

**03**
*the capability to offer remote real-time monitoring and reduce our overall O&M costs*

*––Engineer, Power Station O&M Co. Ltd.*

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# Effective Operation and Maintenance

## Before

**Problem Occurred** — Labor (Person): 2-3

Visual Inspection
**2 Times/Day**

Decreased Power Generation
**2-3 Days to Discover**

**Problem Positioning** — Labor (Person): 2-3

Inspecting issues on site for each row
**Around 1 Day**

**Problem Solving**

Detecting and Repairing Faults
**Around 1 Day**

## Now

**Problem Occurred** — Labor (Person): 1

Fault Warning
**Minute Level**

Error Reporting
**Minute Level**

**Problem Positioning** — Labor (Person): 1

Maintenance in advance to prevent malfunctions
No inspection required, directly identify problem points
**Hour Level**

**Problem Solving**

Repair directly according to the reported information
**In Half Day**

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# Operation Contrast

## Labor (Person)

Before **2-3**

Now **1**

**60%**
Labor reduce

## Time

Before **Around 5 days**

Now **In 1 day**

**80%**
O&M efficiency increase

# Case Study - Campiña

Campiña, Spain

## Campiña

Capacity
**11.65MW**

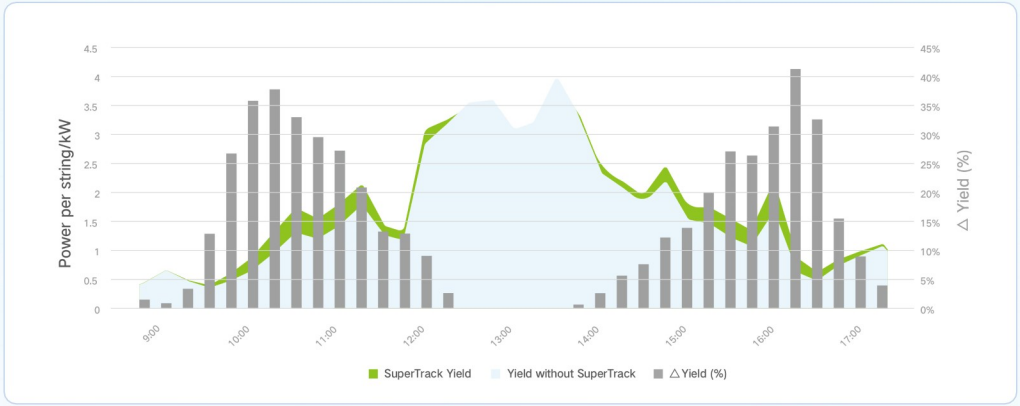
Test Period
**May 2023-March2024**

Typical Cloudy Day
**9.15%**

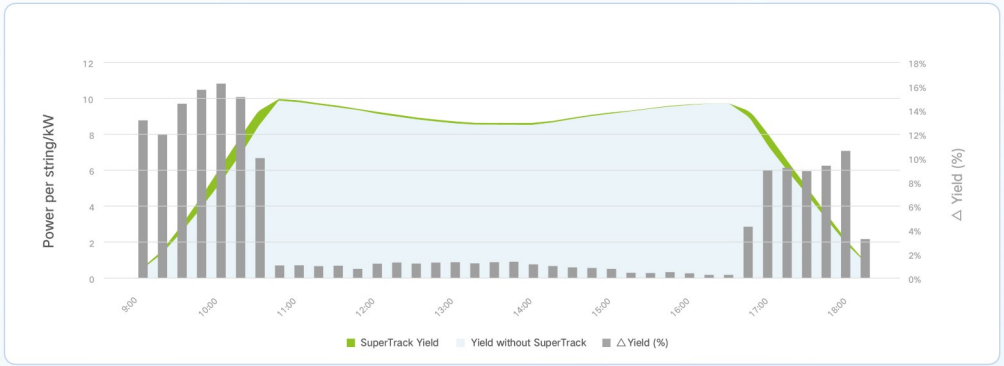
Typical Sunny Day
**2.87%**

Energy Generation Overall Gain
**2.21%**

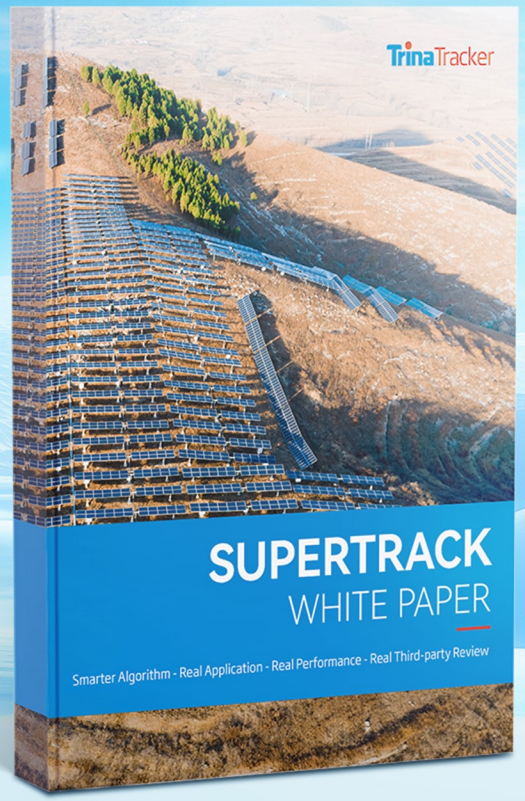
## Power Generation of Typical Cloudy Day

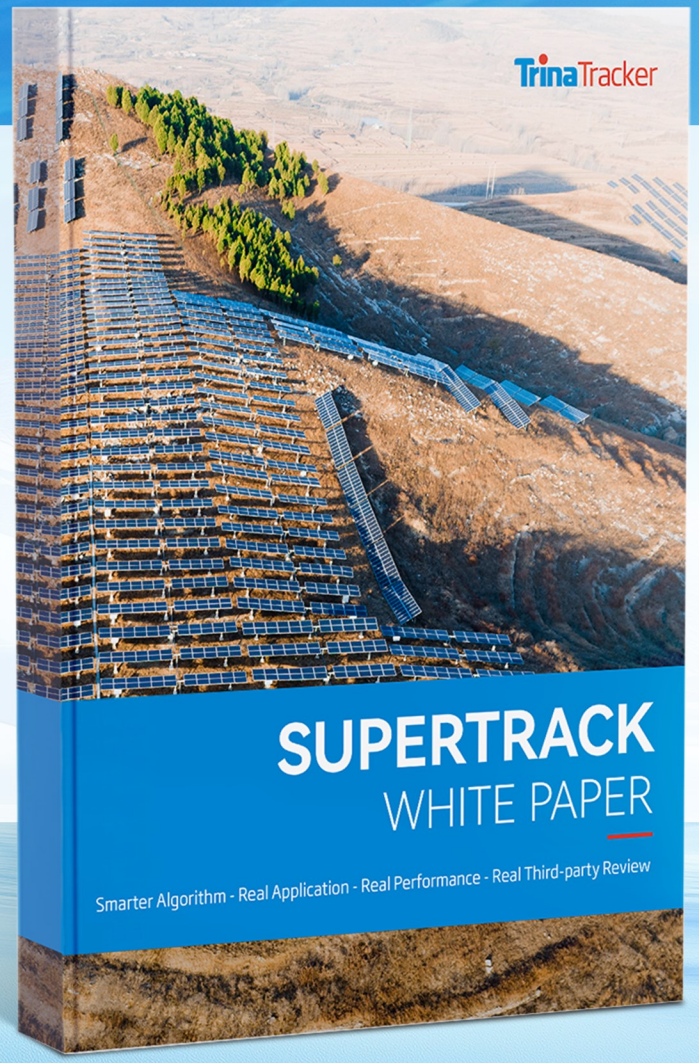



## Power Generation of Typical Sunny Day



# TrinaTracker New Updated SuperTrack White Paper Global Launch






# Directory

01 Optimization for complex terrain

02 Optimization for diffused irradiance

03 Third-party review

04 Case study

# Thank You!

Get in touch with:

**Sun Kai**
Head of Smart Control System

# PV tracker market trends and smart tracker controls

Joe Shangraw
Research Associate, Wood Mackenzie

joseph.shangraw@woodmac.com

November 27, 2024

# Global PV market trends

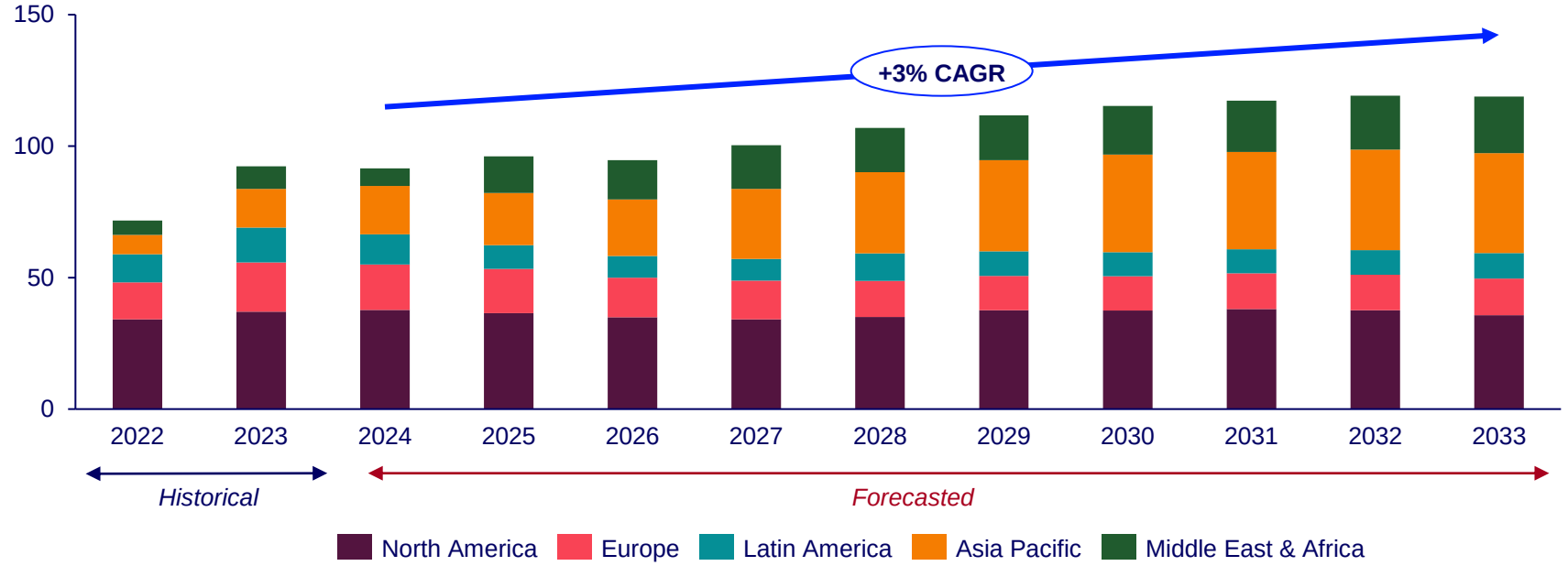
From Wood Mackenzie's 2024 Global solar tracker landscape report

Wood Mackenzie

# Cumulative global PV tracker shipments will surpass 1000 $GW_{dc}$ over the next decade

The global market will average 3% growth from 2024-2033, led by demand in Asia Pacific and the Middle East

**Annual PV tracker shipments by region, 2022-2033 ($GW_{dc}$)**

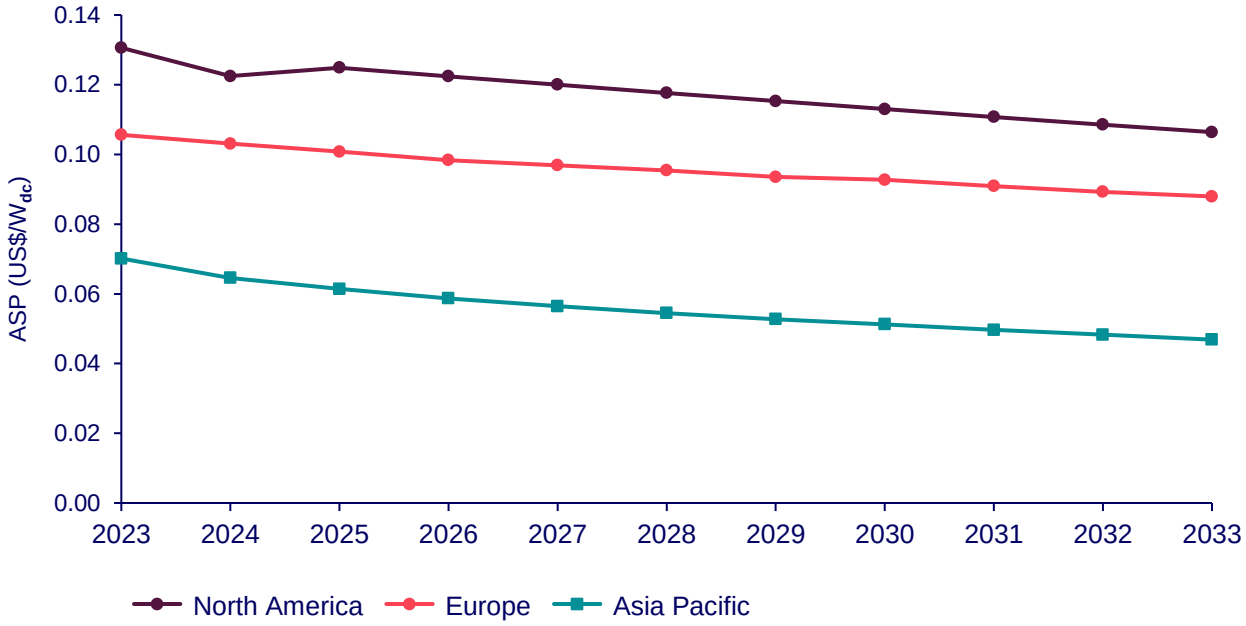



Source: Wood Mackenzie 2024 global solar tracker landscape. CAGR: Compound annual growth rate

# Global ASP for trackers expected to decline by more than 20% over the next decade

Factors include the globalization of the supply chain, larger modules per tracker, and stabilizing steel prices

**PV tracker average selling price (ASP) by region, 2022-2033 (US$/$W_{dc}$)**




**Downward cost drivers**

- Globalization of manufacturing
- High competition
- Larger and better modules (improves watts/area)

**Neutral cost drivers**

- Commodity prices (e.g. steel)
- Drive-train technology

**Upward cost drivers**

- Increasingly complex terrain/soil
- Labor-saving joints, foundations, and pre-assembly

Source: Wood Mackenzie 2024 global solar tracker landscape

# Industry developments in smart tracker systems

Wood Mackenzie

# Industry trends in smart tracking algorithms

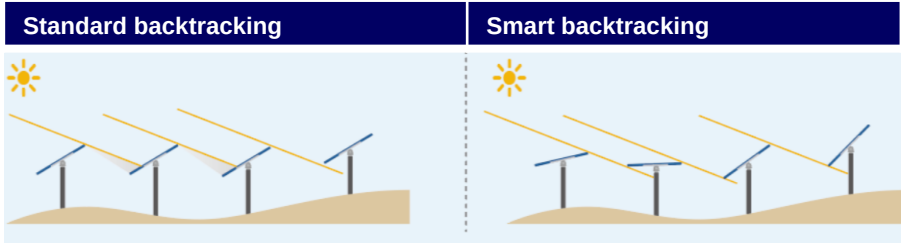
## Several features have become widely available since the rise of advanced control systems

### Advanced backtracking

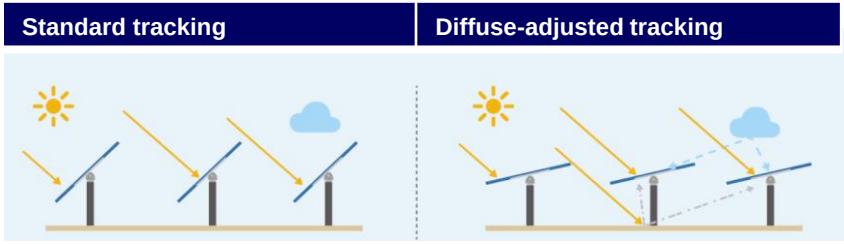
- Traditional backtracking **avoids row-to-row shading during low sun-angle hours,** based on date and time
- Advanced algorithms learn from sloped terrain and partial shading
- Optimization depends on how many rows each motor controls

### Diffuse generation

- Considers reflected sunlight from the clouds and ground
- Learns from each site's terrain and albedo (for bifacial modules)
- Responsive tilt adjustments based on real-time weather updates




Source: TrinaTracker Smart Backtracking Algorithm: SuperTrack Whitepaper




Source: TrinaTracker Smart Tracking Algorithm: SuperTrack Whitepaper

### Safety and maintenance communications capabilities:

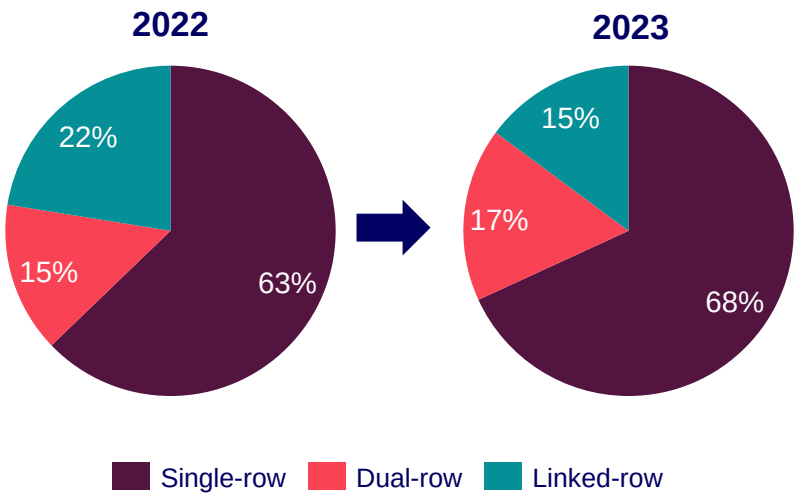
- Automatic wind and hail stow
- Real-time visibility into row-level performance
- **Pinpoint and alert equipment failures** to speed up inspection and maintenance time

# Differentiating between modern tracking control systems

## Tracker architecture and model design can influence potential gains in solar production

- **Single-row drive trackers** provide the highest degree of row-to-row optimization compared to dual-row or centralized trackers.
- On-site weather equipment and pyranometers allow **for faster response times** to changes in irradiance and wind speeds.
- Closed-loop control systems that **autonomously and continuously optimize production** will usually outperform similar systems that operate on fixed inputs.

**Global tracker architecture breakdown by shipped capacity**




Source: Wood Mackenzie

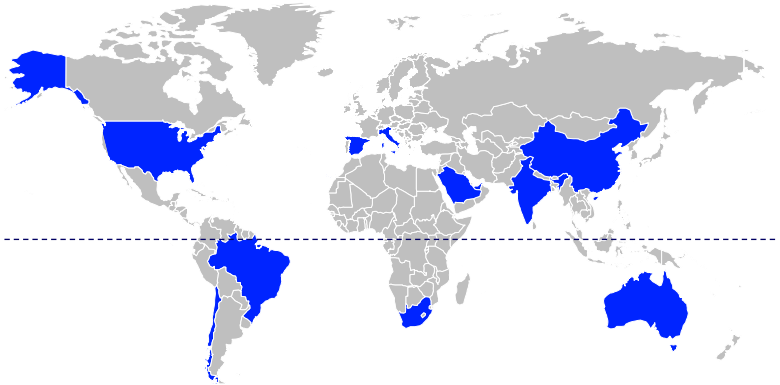
# Where can smart tracking systems bring maximum value?

Location and market conditions will affect the demand for smart tracking systems

## Geography considerations

- Backtracking can be more effective **in mid/high-latitude regions** with more low sun-angle hours
- Helps justify non-graded projects on **complex terrain**
- Boosts production in regions with more **clouds/rain**

**Top 10 global PV tracker markets (2024-2033)**



## Market considerations

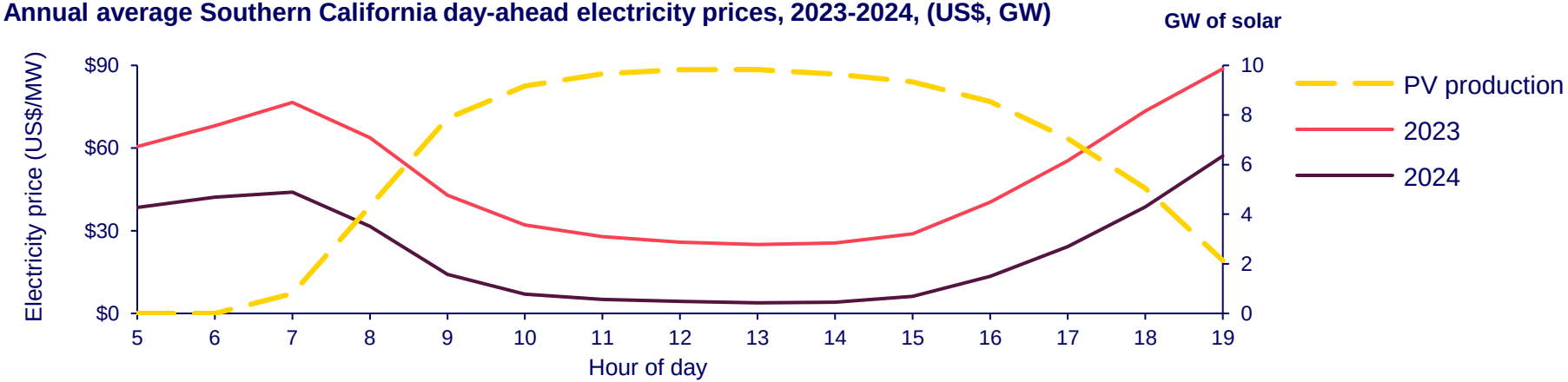
- Does the market favor low CAPEX or low LCOE?
  - Low-CAPEX markets may prefer fixed-tilt or linked-row trackers
- Will improved off-peak generation translate to greater revenue?
  - In high solar penetration areas**, are energy prices more favorable in cloudy and evening hours?**
- **Insurance costs** (Hail and wind-prone regions)

Wood Mackenzie

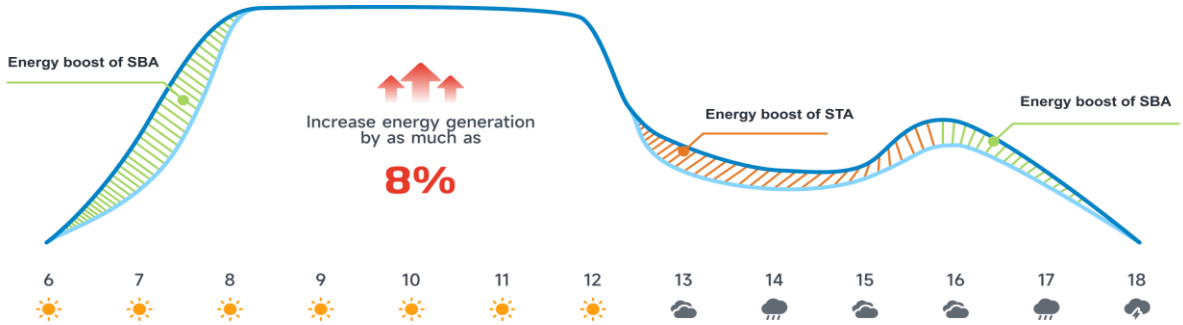
Source: Wood Mackenzie, Trina Solar

# Extra value at off-peak hours: Looking at California as high PV penetration example

## Annual average Southern California day-ahead electricity prices, 2023-2024, (US$, GW)




## SuperTrack vs conventional tracker: Example production curve (with a cloudy afternoon)




Source: Wood Mackenzie, Trina Solar, EIA's CAISO Hourly Day-Ahead Locational Marginal Prices 2022-2024

# Q&A

Please send additional questions to
joseph.shangraw@woodmac.com

# About Wood Mackenzie

Wood Mackenzie is the global insight business for renewables, energy and natural resources. Together, we deliver the insight needed to separate risk from opportunity and make bold decisions when it matters most. **Driven by data. Powered by people.**

- We provide **commercial insight** and access to our experts, leveraging our integrated **proprietary data and analytics**.
- **2,000 employees** across **30 locations**, close to customers and industry contacts
- Over **700 sector-dedicated analysts and consultants** globally
- **Leaders in the energy transition** and cross-commodities

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PVcase

# Digitalization of tracker industry

## Unlocking synergies across the value chain

November 2024

## About PVcase

PVcase creates advanced software to break logjams in the engineering and construction of renewable energy projects, making them less labor-intensive, time-consuming, and complicated. **Our technology enables developers to complete projects faster, more efficiently, and precisely – accelerating the global transition to clean energy.**

PVcase is particularly focused on **tackling the problem of "data risk"** caused by data degradation throughout a project. Discrepancies in data from dozens of sources can hamstring a project and cause it to underperform its expected energy output. PVcase ends clunky processes and corrupted data and clears our path to a net-zero economy.

## Vision

Accelerate the renewable energy transition by developing the industry's leading software ecosystem that helps design, analyze, and optimize renewable energy assets globally.

## Mission

Fight climate change through software.

FT FINANCIAL TIMES
statista
WE ARE #104
AMONG 1000 EUROPE'S FASTEST GROWING COMPANIES 2024

BNEF Pioneers
2024 Winner

LAZARD
T100
2024

# Trusted by customers worldwide

PVcase

edp Renewables

maxsolar energy concepts

nexamp

ib vogt

RWE

OHLA Progress Enablers

Iberdrola

aes

Trinasolar

voltalia

Statkraft

new leaf energy

**1500+**
Customers

**1 TW+**
Projects designed per quarter

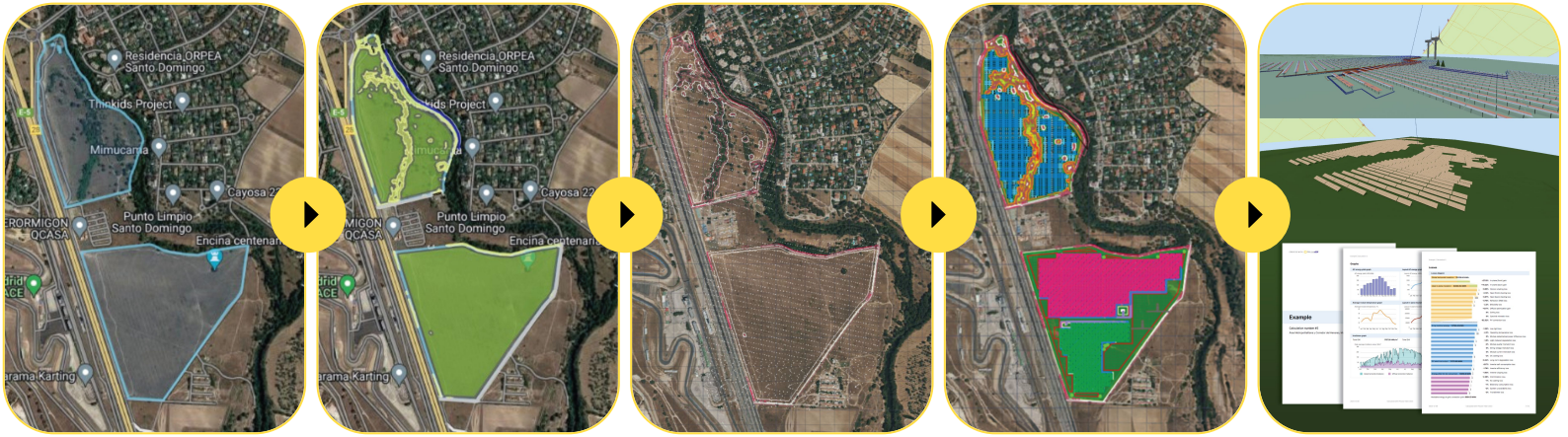
**75+**
Countries

# Project phases of PVcase Integrated Product Suite

PVcase PROSPECT

PVcase GROUND MOUNT

PVcase YIELD




SITE SELECTION AND ANALYSIS

PROJECT DESIGN STAGES

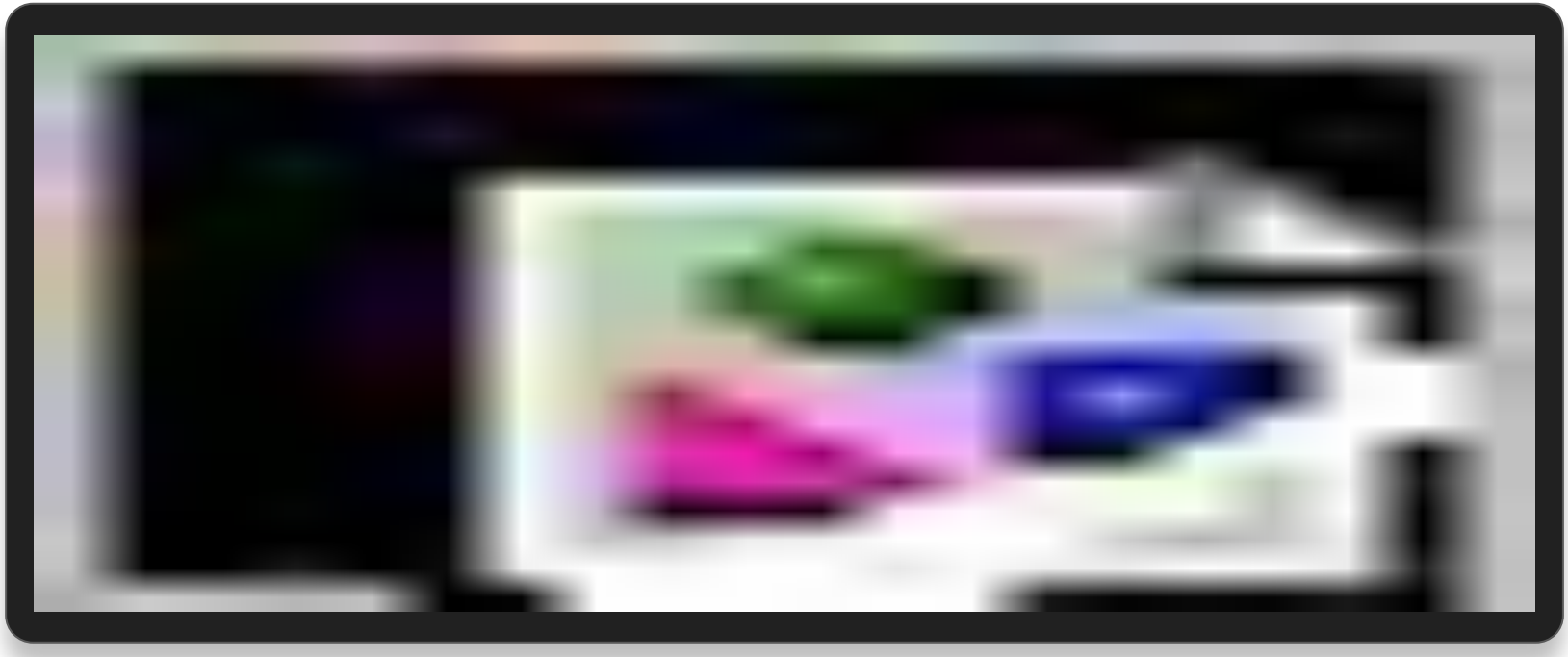
ENERGY PRODUCTION ESTIMATES

✅ Simplified **Site Selection**

✅ Automated **Design**

✅ Maximized **Performance**

# PVcase Ground Mount and Yield integration enables users to more efficiently assess multiple layouts and deep dive when needed



# Trackers Industry Synergies

# Identifying synergies to address key industry trends

PVcase

**Trackers for complex terrains**

- PVcase GM **integration of new product features that are cost-cutting** for shared customers, in a context where cost for EPC is typically 15% higher due to higher labor cost for grading.

**Agrivoltaic tailored products**

- Developing **tailored product solutions** for agro-projects with dedicated features **to unlock the potential of trackers** in both energy and agro yields improvement

**Advanced Tracking Algorithms & AI**

- Collaboration between R&D dept. can **speed up innovation roadmap, reduce costs and create a market leading products**

**Bundled and software solutions**

- Bundle software solutions, trackers product and after sales services to **provide an integrated service to Developers and EPCs**

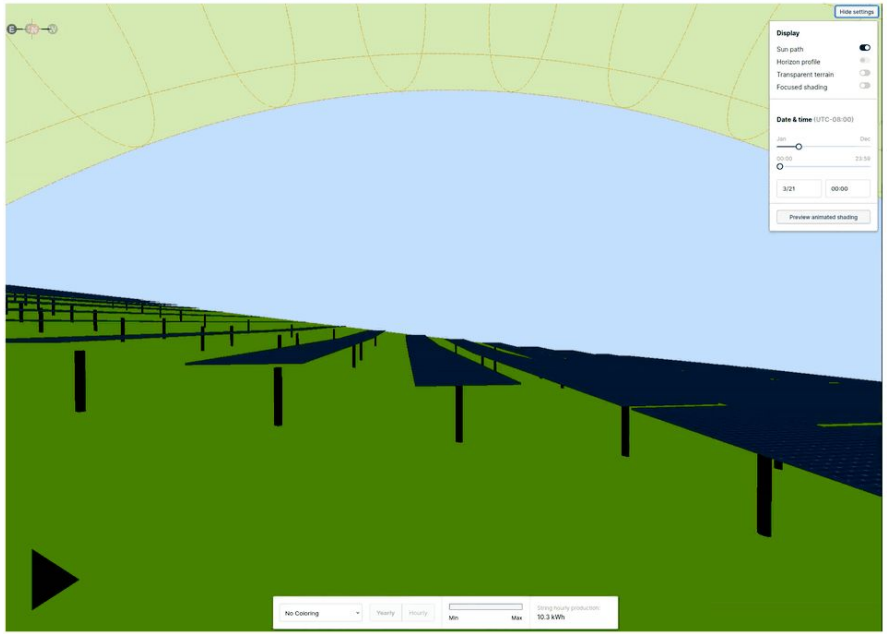
PVcase GROUND MOUNT

PVcase YIELD

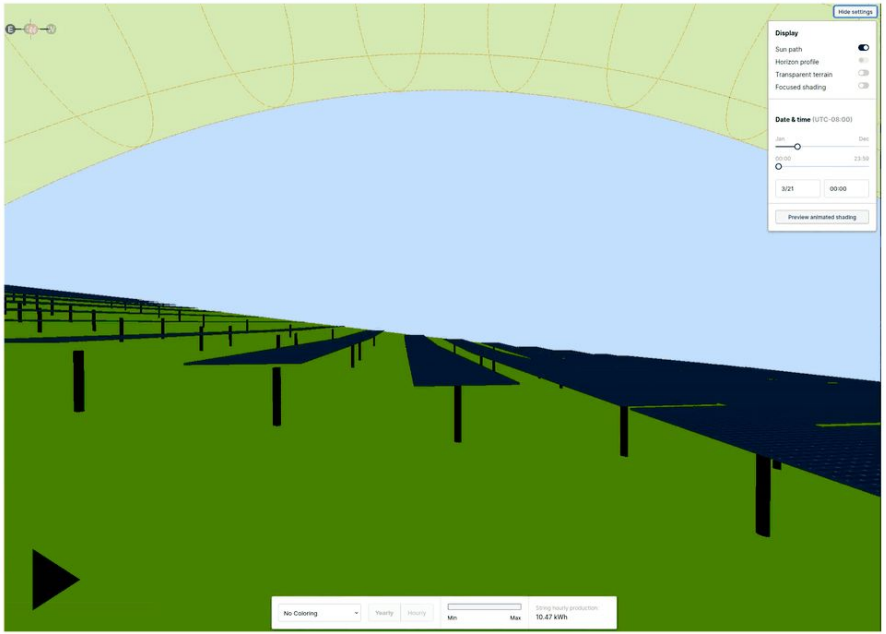
**In an increasingly complex industry scenario, it's key to align software and hardware development to deliver a complete solutions to the final users**

# Trina Tracker & PVcase joint efforts

## Conventional backtracking




## Terrain-aware backtracking




**TrinaTracker and PVcase have engaged in a collaborative effort to conduct an independent comparison of their respective tracking algorithms for complex terrains.**

# Value creation for the Industry

## TODAY

We can expect software to manufacturer collaborations to:

- Increase accuracy of the algorithms developed by both parties.
- Allow the final users to run consistent iterations across the possible tool and platforms during different stages of the asset lifecycle

## TOMORROW

Broadening the collaboration efforts to include final users:

- Develop tailored solutions based on existing software environments and unique processes
- Increasingly reduce the time to market and bankability of new innovative solutions

PVcase

# Thank you!


## Joaquin Fontanet

**Technical Sales Team Leader**

**joaquin@pvcase.com**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# Smarter trackers: Real data insights from TrinaTracker's smart control system applications

## Q&A

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11:00 am – 12:00 pm | BRT, Sao Paolo
3:00 pm – 4:00 pm | CET, Berlin

**Matthew Lynas**
Editor
**pv magazine**

**Sun Kai**
Head of Smart Control System
**TrinaTracker**

**Joe Shangraw**
Research Associate
**Wood Mackenzie**

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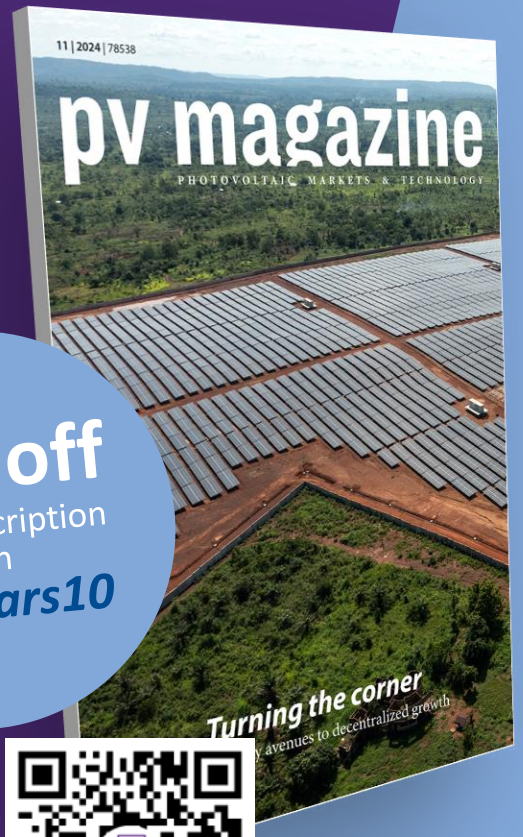


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**Matthew Lynas**
Editor
**pv magazine**

# Thank you for joining today!