Solar Mounting Systems Explained

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SolarPower Europe Briefing Paper

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Contents

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K2 at a glance

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Locations on different continents

>36 GW
Total capacity of installed K2 systems

>130
Countries with K2 systems

3 million
Projects completed worldwide (in the last 5 years)

The Strong Foundation for Commercial Installations

- Over 20 years of experience in the PV industry
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  Pitched roof **Flat roof** **Facade**

  Ground mounted **Carport**

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After solar modules and inverters, solar mounting systems are the third key building-block of the solar PV system. More than the 'frames' of the solar installation, mounting systems represent 10-20% of upfront project costs and directly impact solar projects' performance, durability and stability, as well as upfront, operational and maintenance costs. Crucially, through intelligent design and use of innovative technologies, mounting systems can actively contribute to increasing flexibility in the EU electricity system. The right choice of mounting system can significantly help to flatten solar generation profiles and increase PV production in the morning and evening hours, when electricity prices are higher, thus improving the business case for large-scale developers in a context of high cannibalisation and curtailment rates.

The mounting structures and trackers' segment is one of the few solar segments that is dominated by western, and often even local players in Europe. The EU is home to a large ecosystem of mounting system providers: upwards of 40 companies in the EU develop mounting solutions across the rooftop, ground-mount segments, as well as façade, agri-PV, solar carports, and all kinds of PV applications. This includes recognised global market leaders for trackers, fixed ground-mount and rooftop mounting.

Largely made of steel and aluminium, mounting systems value chains are well developed in Europe, from material production to installation in PV projects. However, in a context of decreasing solar component prices across the value chain and growing economies of scale, the sector is concerned by the impact of imports of cheaper components or products into the EU market, incurring risks for quality and resilience. Clear and transparent analysis of solar mounting structures in international trade is challenged by the lack of available customs data.


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In light of this, SolarPower Europe proposes three policy recommendations to help support this crucial segment within the EU solar value chain:

1. **Implement mounting structures more widely on the National level in the context of the EU Net-Zero Industry Act (NZIA).** The NZIA Secondary Legislation, which was adopted by the European Commission in May 2025, includes in its Annex the list of net-zero technology final products and their main specific components for the purposes of assessing the contribution to resilience. Considering solar mounting systems, it mentions 'PV trackers and their specific mounting structures'. Given that **fixed mounting structure solutions are used in around 50% of annual utility solar projects in Europe, according to research by WoodMackenzie, and therefore around three quarters of overall annual solar deployment in 2024 (including rooftop solar**), their exclusion from this list does not reflect the reality of the solar industry today. **Therefore, in the implementation of NZIA at national level, SolarPower Europe recommends including mounting structures more widely.**

2. **Develop specific HS code/customs codes for both solar mounting structures and trackers** that can help track and identify the shipments of these components in international trade, as is done for solar inverters and modules (Harmonized System Codes (HS Code) Commodity Classification - Foreign Trade Online).

3. **Develop harmonised and robust quality standards** across three key areas: structural integrity, transparency, and warranties, in order to support the development of a single market for quality mounting structures.

SolarPower Europe extends a special thank you to **K2 Systems, Nextracker, GSE Integration, enson** and **Allimex**, whose Case Studies are featured here to shine a light on Europe's enduring expertise in the mounting systems segment, showcasing a range of mounting solutions, from fixed rooftop and ground-mount mounting structures, to tracker systems and building-integrated (BIPV) solutions.

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01

Introduction

What are solar mounting systems?

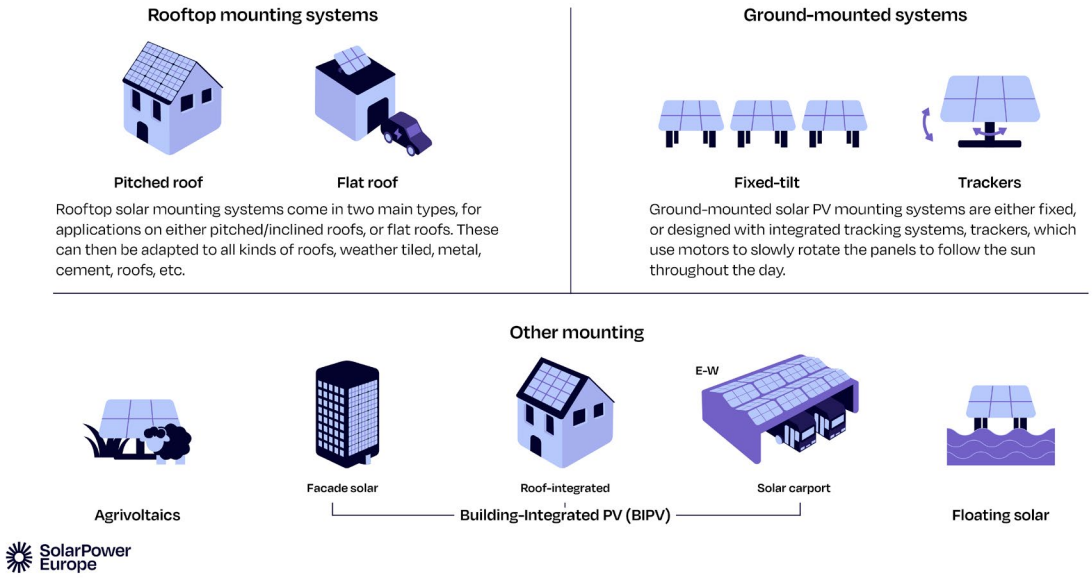
What are solar mounting systems?

After solar modules and inverters, solar mounting systems are the third key building block of solar photovoltaic (PV) installations, ensuring the stability and durability of solar PV projects over their use-phase lifetime and beyond. PV mounting systems are Balance of Systems (BoS) components largely made of steel, or aluminium, which hold solar panels in place and secure the solar installation against wind and weather, such as to maximise safety and structural stability. They determine the angle, orientation, and durability of the installation, and are essential components for optimising solar PV production and efficiency.

As the global solar market continues its rapid expansion, growing by 33% to a new record of 597 GW of PV capacity installed in 2024 (65 GW in the EU), mounting and racking technologies are evolving rapidly to keep pace. Today, a wide variety of mounting solutions are available to accommodate different project needs – including ground-mount fixed systems and trackers, various devices on buildings, primarily on rooftop but also on facades, and more recent applications such as agrisolar, floating, carport systems, etc.

Figure 1

Solar Mounting Systems - an essential part of solar PV applications



Rooftop PV installations in both the residential and commercial & industrial (C&I) segments[2] made up 64% of the EU's entire installed solar fleet by end of 2024. Solar rooftop mounting systems are designed either for pitched (inclined) roofs or flat roofs, and are either integrated in the roof structure ("penetrating"), secured to the roof using clamps ("non-penetrating") or weighed down ("ballasted") using concrete blocks or ballast trays. Large flat roofs of C&I buildings often use ballasted flat roof products, whereas pitched roof mounting systems are more common in the residential segment.

[1] SolarPower Europe (2025): Global Market Outlook for Solar Power 2025 - 2029

Ground-mounted solar PV mostly refers to the large-scale utility segment for solar projects in the MW capacity scale[3], which made up 36% of all solar PV installed in the EU by the end of 2024. Mounting systems in this segment come in two main types: **fixed** structures, or **trackers.** Across the residential, C&I or utility segments, fixed-tilt systems are often directly referenced using the overarching term "**mounting structures.**" They are designed and installed at an optimal orientation and inclination to maximise solar energy production, and are commonly used in smaller or central/northern European PV power plants. **Trackers**, on the other hand, are mounting systems exclusively used in ground-mounted utility scale projects, which use integrated tracking technology to slowly rotate the PV modules to follow the sun's movement during the day.

This results in more solar energy produced compared with fixed-tilt systems, including in morning and evening hours. Single axis tracking systems can rotate either horizontally or vertically, and dual axis tracking systems (although less common) can effectively follow the sun's circular motion across the sky, across two axes. Historically, trackers are mostly used in geographies with high irradiation in southern regions.

Mounting systems are also developed for **all other PV applications:** façade installations, building-integrated PV applications (BIPV), agrivoltaics (agri-PV), floating PV, solar carports, and even plug-in solar PV (also known as "balcony" solar).

Why are they important?

The solar PV value chain can be segmented into upstream and downstream sectors:

1. Upstream

Polysilicon, ingots/wafer, cells and modules, inverters, mounting systems and electrical Balance of System (BoS).

The upstream sector covers the module value chain, from production of raw materials to manufacturing of solar cells and modules. It also includes the assembly of solar panels and the development of BoS components like mounting systems.

2. Downstream

EPC, (engineering, procurement, construction), Project Development, O&M (Operation & Maintenance).

The downstream sector includes the installation, operation and maintenance of solar systems, and end of life treatment.

[2] Segmentation is based on the following system size: Residential (<10 kW); Commercial (<250 kW); Industrial (<1000 kW); Utility-scale (>1000 kW, ground-mounted). SolarPower Europe's methodology includes only grid-connected systems. Installed capacity is always expressed in DC, unless otherwise stated.

[3] Although smaller ground-mount solar installations also exist in the C&I segment (10 kW-1 MW).

Mounting systems fit in the upstream phase, bridging generation technology (PV modules) with the site infrastructure, and enabling project developers and EPCs to efficiently deliver operational systems.

More than just the "frames" of the PV system, **mounting systems directly impact PV installations' stability, reliability and operational lifespan, PV performance, upfront and maintenance costs, and even contribute to the flexibility of EU's electricity system.**

Reliability: structural stability, quality and longevity

Fundamentally, mounting systems physically secure PV modules against environmental factors: wind, snow, seismic events, etc. They must last for the entire lifetime of the PV system in outdoor conditions – between 25–30 years, and must adhere to **international, regional, and national industry standards,** depending on the market, covering areas like **structural design**[4] **, material durability, corrosion protection, and wind/snow load resistance,** even resistance to turbulence or seismic events where applicable. Poor mounting solutions can cause damage to modules, system failures, or even safety hazards.

Certifications according to relevant standards are therefore essential for quality and safety assurance, whether through optimal module clamping or corrosion protection through **galvanising**[5] for steel structures.[6] The drive to reduce costs in solar projects can be a risk and lead to compromises in the quality of solar mounting structures.

PV performance: maximising energy generation

Mounting systems for both rooftop and ground-mounted solar applications are designed and engineered such as to determine the optimal tilt and orientation for **maximising PV production.** A well-engineered mounting system also **reduces module shading, soiling risk, and temperature-related losses.**

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[4] For example in Europe, the EN 1991 (Eurocode 1): Actions on structures includes specifications for wind loads, snow loads, self-weight, and other actions.

[5] Galvanising is the application of a thin layer of Zinc, or Zinc, Aluminium, Magnesium alloyed coating on steel or iron to prevent rusting. For more information see the European General Galvanisers Association's website.

[6] International standard ISO 1461 covers Hot-dip galvanised coatings on fabricated iron and steel articles, **ISO 14713** tackles Guidelines on corrosion protection for zinc coatings, and the European norm **EN 10346** refers to continuously hot dip coatd steel flat products made of low carbon steels for cold farming.

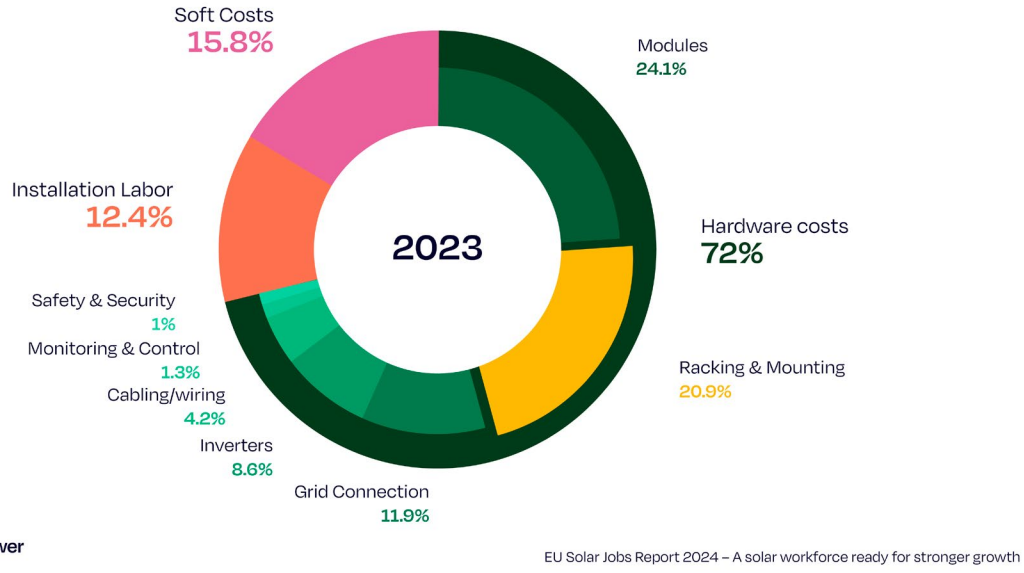
Tracker systems in particular, applied widely for large-scale utility PV projects globally, and increasingly used in the agri-PV sector, further increase solar energy production. **Single axis tracker generation yields of 15-20% compared to fixed-tilt installations,[7] and reduce Levelised Cost of Energy (LCOE), driving the products' popularity.**

Costs: optimising CAPEX, installation and O&M costs

Mounting systems represent an important investment for the project developer or consumer, representing around **10-20% of PV project's capital expenditure (CAPEX) costs.** While this varies greatly depending on the size, location and type of PV project, this share is expected to rise as module prices have decreased significantly in recent years. In the ground-mounted utility-scale PV segment, racking and mounting represents around 20% of overall project costs (see Fig. 2). After PV modules, they were the second largest single hardware cost for the entire installation, higher than solar inverters or grid-connection.

Figure 2

Mounting structure cost as share of total utility PV project cost, 2023



EU Solar Jobs Report 2024 – A solar workforce ready for stronger growth.

For solar rooftop installations, since soft costs, installation labour and inverters represent a larger share of the overall nvestment, racking/mounting structures tend to have a smaller share in project costs. Depending on the market, location (higher building heights will affect wind loads), type of roof and building (pitched or ballasted - ballast roof mounting is generally more complex and expensive than pitched roof mounting; steel or tiled, etc), costs will vary, as highlighted in Table 1.

[7] IEA PVPS (2024): Best Practices for the Optimization of Bifacial Photovoltaic Tracking Systems.

Table 1

Average share of mounting/racking in PV installation costs, by market and rooftop segment

Pitched residential	Flat residential	Commercial flat
5-15%	10-20%	15-20%

Lower limits refer to simple, roof-parallel systems, and upper limits mainly apply to more complex roofs, either tilted systems, or with higher load or demanding situations (snow, wind).

Additionally, most of the labour spent installing PV systems, especially at utility-scale, involves assembling mounting systems. Pre-engineered and modular mounting solutions can significantly **reduce installation time and labour costs.** Faster installations shorten project timelines, reducing financing costs and accelerating time-to-revenue.

Finally, the proper specification of mounting systems during the design stage ensures that they offer maintenance-free support for the initial project lifespan and throughout subsequent repowering phases. **Qualitative and reliable systems thus minimise operation and maintenance (O&M) costs** by reducing risks of mechanical failure or module misalignment.

The right choice of mounting system therefore impacts system cost, durability, and performance gain, directly influencing the Levelised Cost of Energy (LCOE).

Adaptability: solar for all sites and applications

Ground conditions (rocky, sloped, sandy, agricultural) and rooftop types (metal, tile, flat concrete) of solar PV installations vary greatly: **flexible and customisable** mounting systems allow projects to be built efficiently across diverse terrains and infrastructures. Especially in the utility ground-mount segment, PV mounting solutions are often tailor-made to the site's specific needs, since solar projects increasingly encounter **complex terrain** as flat land becomes less easy to access and more expensive in mature markets.

For the rooftop segment, there is a wide **variety** and abundance of fixed mounting products for different rooftops across different countries and regions. Mounting systems are also increasingly able to **adapt to challenging weather conditions:** for example, trackers are able to preventatively respond to high wind or hail conditions and automatically rotate panels to an optimal angle to protect them from damage. Finally, mounting solutions exist for all kinds of PV applications, including agrisolar, floating solar, and more niche applications like carports, BIPV, etc. See the Case Studies from page 28 onwards for some examples.

Sustainability: mounting for sustainable solar

Mounting systems can considerably improve PV systems' **sustainability performance,** from metal production to PV end-of life stages. While a majority of rooftop mounting structures are made of aluminium, ground-mounted fixed structures and trackers are mainly made of galvanised steel. Manufacturers like **K2 Systems** promote low-carbon solutions, sourcing metals through local suppliers working to reduce the carbon intensity of their primary production, or using recycled metals with lower embedded emissions. For example, imported aluminium into Europe has an

average 30% higher carbon footprint than aluminium produced in the EU.[8]

In the use-phase, steel structures can last several decades, increasing their potential for reuse, notably in the case of retrofitting or repowering PV parks. If galvanised with a thick layer of zinc, steel structures can maintain structural integrity for up to 60 years [9], outlasting PV module operational lifetimes, and can be repeatedly reused or re-galvanised. Developers like **BayWa.r.e.** have already "retro-fitted" some PV projects, only adapting the existing mounting structures to new modules, when necessary.[10] However, the repowering market is still small, hindered by several factors. For rooftop/racking systems, namely for aluminium products, lifespan & warranty periods are usually 20-30 years, similar to the lifetime of the PV module, limiting the potential for re-powering. Then, PV module sizes have increased substantially in recent years, which means that older racking, especially for flat roof systems, are in many cases not suitable for bigger modules. Finally, more than dimensionally mal-adapted, older mounting systems can be technologically outdated, given the increased awareness of wind and snow effects on mounting structures, compounded with the scale-up of the mounting structures industry which has led to improved systems and layout plans.

Finally, not only should mounting systems be manufactured with robust, durable, and reusable materials, but it is also essential to make them fully recyclable. If reuse is not feasible, structures can be dismantled, with the steel or aluminium redirected to standard steel recycling routes. In the EU, 90% of steel is currently recycled,[12] and aluminium can be recycled endlessly without losing its initial properties. In 2023, 39% of Europe's aluminium production came from secondary production from recycled scrap aluminium[13]. For further details on sustainable practices for mounting systems, please refer to SolarPower Europe's Sustainable Solar report.[14]

Flexibility: mounting has a role to play for a flexible energy system

Mounting systems can also play a key part towards **increasing flexibility in our electricity systems.** The design of solar mounting systems can contribute to flexibility by increasing PV production outside of peak noon times, where price cannibalisation can bring solar electricity down to zero or even negative prices. "Flattening" the production curve and generating more solar electricity in the adjacent 'shoulders' of the solar PV production profile, in the morning and evening, when both demand and capture prices are higher, improves the business case for project developers. Moreover, **tracking systems** often use 'backtracking' or 'diffuse response' technology, which use advanced AI algorithms to determine the optimal tilt of panels once the sun is lower in the sky, to prevent shading from other panels, or when there is cloud cover. These have the effect of optimising the already beneficial tracker generation profile. According to a simulation from leading tracker manufacturer Nextracker (US) (Fig. 3), in 2024 such a tracker system with optimised back-tracking software can provide more than 30% more value (in €/MWh) annually than an equivalent fixed-tilt system.[15]

[8] SolarPower Europe analysis based on figures from European Aluminium's Science-Based Decarbonisation Pathways for the European Aluminium Industry (2023)

[9] Products that have been batch galvanised according to the EN ISO 1461 standard. Source: European General Galvanisers Association (EGGA) (2021), Galvanised Steel and Sustainable Construction: Solutions for a circular economy

[10] 5.4 MW Saint Martin Lalande solar plant, by Sonnedix, Aude department, France. Link

[11] Aluminium forms a natural oxide layer on its surface when exposed to air, providing inherent corrosion resistance.

[12] Steel Construction Institute: The recycling and reuse survey

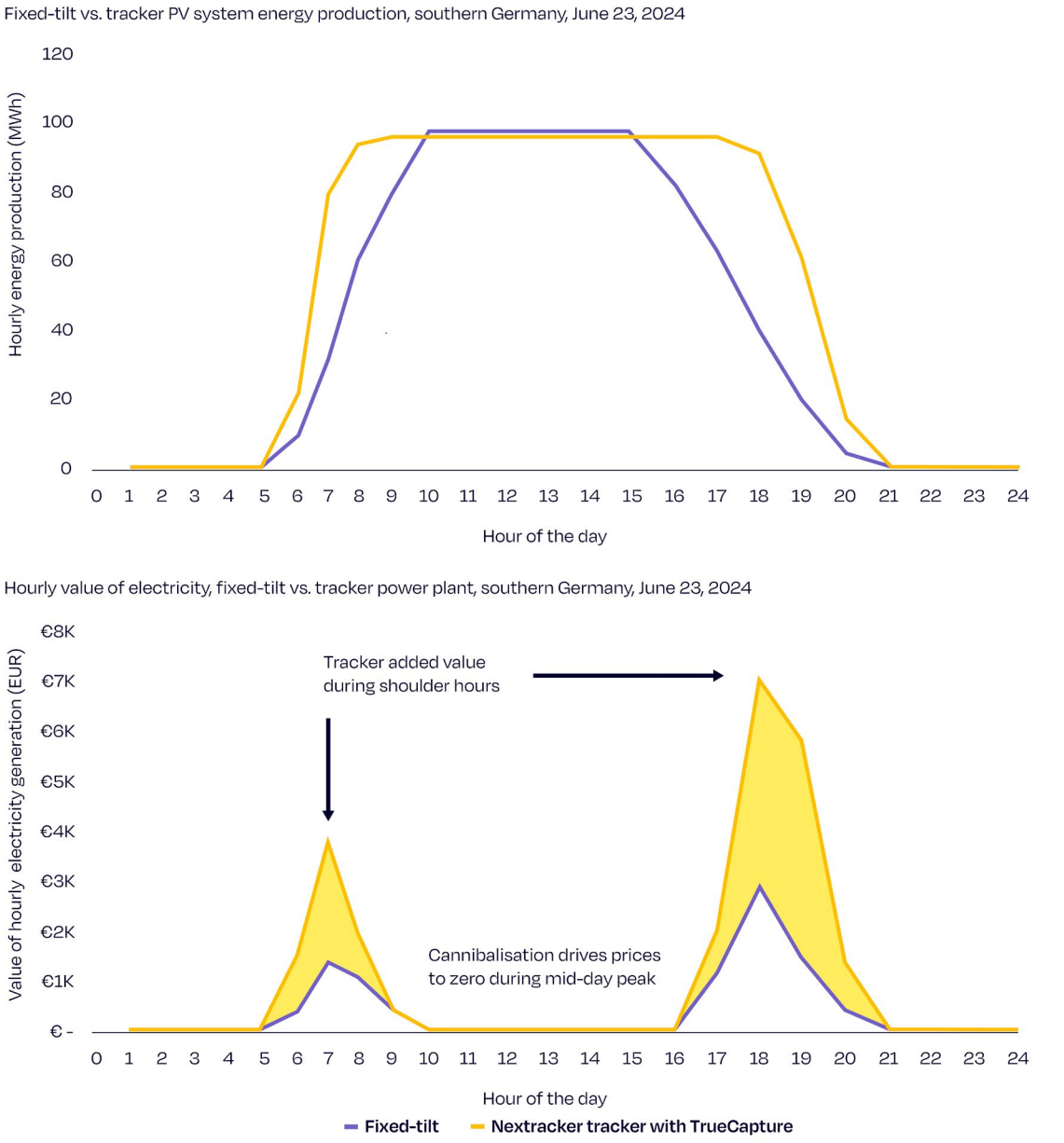
[13] 7% from primary production, and 54% from imports. See European aluminium supply by source (European Aluminium, 2025)

[14] SolarPower Europe (2024), Sustainable Solar. Environmental, social, and governance actions along the value chain.

[15] As shared in a corporate presentation by Nextracker (May 2025).

Figure 3

Solar & flexibility: energy production and solar value for tracker vs fixed-tilt system, Southern Germany, 2024



As shared in a corporate presentation by Nextracker. "Tracker Systems vs Fixed Tilt Performance – Independent Technical Validation", Enertis Applus+, May 2025; Nextracker analysis.

Fixed mounting structures can also help to shave the solar mid-day peak generated by south-facing solar systems. For example, **east-west (E-W) mounting configurations,** with panels alternatingly facing east and west, provide a more balanced energy generation profile by generating more energy in the morning and evening hours, which helps to offset peak electricity costs and enhance overall system efficiency. While south-oriented profiles provide higher production over the whole day, several studies have demonstrated the benefits of E-W orientations for overall self-consumption

rates, optimising electricity costs or the space required to install PV systems, and generally better matching electricity consumption profiles, including for vertical configurations and in Nordic countries. [16] [17]

In conclusion, mounting systems are an operational, financial, and performance-critical element in solar project delivery and long-term success. Mounting systems are therefore a crucial segment of the solar value chain, with its own part to play in creating a flexible electricity system, as well as within the EU's solar industrial ecosystem.

Solar mounting systems in the EU

The EU hosts many manufacturers of both mounting structures and tracking systems (see Fig.4 map).

Compared to other solar PV components like modules or inverters, where large shares of solar products are imported from outside the EU onto the EU market, local mounting systems providers generally have a competitive advantage in domestic markets. Mounting structures are mainly composed of heavy, lowcost steel / aluminium components, and international shipping of these components represents a significant fraction of their cost. All else being equal, this provides an inherent preference for domestic production relative to imports. Shorter delivery times for providing solar projects is another key advantage for local producers.

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While this advantage is progressively being challenged by competitors' economies of scale, solar mounting system producers are still numerous and well distributed across the top EU solar markets. Upwards of **40 different European companies** are active in the segment today, with Spain and Germany together hosting 60% of the EU's solar mounting system providers.

[16] Mubarak et. al (2019), "Why PV Modules Should Preferably No Longer Be Oriented to the South in the Near Future." Energies, 12(23), 4528. https://doi.org/10.3390/en12234528

[17] Øgaard et al. (2024), "Vertical bifacial PV systems: irradiance modeling and performance analysis of a lightweight system for flat roofs." EPJ Photovolt, 15 13 (2024). DOI: https://doi.org/10.1051/epjpv/2024012

Figure 4

EU Map of major solar mounting systems manufacturers

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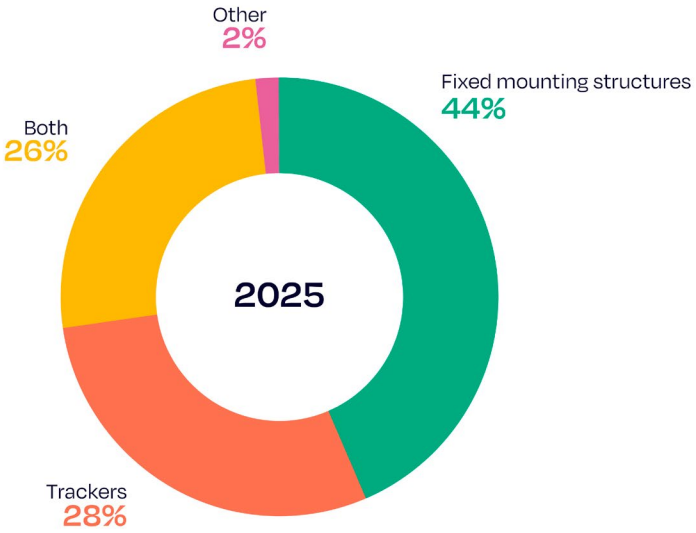
EU company headquarters are represented. Companies shown here are those known to SolarPower Europe at the time of publishing. Missing providers and updates can be notified to the report authors.

Figure 5

Solar mounting system companies in the EU, by activity, 2025



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Mounting structure providers

Mounting structures (non-tracker/fixed systems, across all segments) are used in around 50% of utility projects in Europe, according to research by WoodMackenzie,[18] and therefore make up three quarters of the PV market in 2024, by installed capacity, compared to tracker systems which then make up a quarter of the EU solar market. It's therefore unsurprising that the large majority of mounting system manufacturers in Europe provide fixed mounting structure solutions, for either the rooftop or ground-mount solar segments, or both, with some also specialising in BIPV, agrivoltaics, solar carports, or other fixed PV applications. Some 44% of mounting system providers in the EU specialise in fixed structures only, with another 26% providing both tracker and fixed solutions, usually specialising in the ground-mount segment, while 28% of companies provide tracker solutions only (Fig. 5). Some providers specialise in specific niche applications such as BIPV mounting.

K2 Systems (DE) and **Enstall** (NL) are market leaders for fixed-tilt mounting systems in the EU. The **Enstall group**, via its multiple European subsidiaries (**Schletter, Esdec**, Sunfer, and PanelClaw) is a global leading provider of rooftop solar mounting systems. Enstall specialises in rooftop mounting systems without tracker technology, providing solutions across the Dutch, Spanish, German, and international markets for the residential and commercial/industrial (C&I) sector. These include mounting systems for the installation of solar on pitched/inclined roofs, flat roofs, carports, with available products for façade/wall installation, and some ground-mounted applications. **Schletter** (DE), recently acquired by the **Enstall** group, is another market leader, with global presence and providing all types of mounting systems (including fixed ground-mount and trackers).

K2 Systems is a full-solution provider of fixed-tilt systems, across all segments, including utility-scale ground mounted PV. With currently 10-18 GW of manufacturing capacity in the EU, and

[18] WoodMackenzie (2025), Global solar PV tracker market share report 2025 | Wood Mackenzie

85% of their products produced within the EU, **K2 Systems** also also has a global presence, and established production value chains in international markets – in the US, existing production capacities in Mexico have been expanded by domestic sourcing in the US since 2024 (see Case Study page 49). Outside of these market leaders, the EU is also host to an ecosystem of many smaller producers delivering solar PV mounting solutions across European solar markets, such as **Enson** (PO), a Polish start-up developing fixed mounting structures for ground-mounted PV (see Case Study page 46).

Allimex (BE) is another player established in rooftop and small ground-mount segments (see Case Study page 56). Then, in other niches of PV applications, some manufacturers like **GSE Integration** (FR) specialise in mounting solutions for roof-integrated solar PV (see Case Study page 42). In the rest of Europe, companies like UK-based **Solarport** (UK) also deliver fixed mounting solutions in major EU solar markets.

Additionally, fixed mounting structures in the EU are also developed by stakeholders whose main activity is not manufacturing. There are larger solar distributors, like **IBC Solar** (DE), develop in-house mounting structures for rooftop PV. A leading European EPC contractor and project developer, **SUNOTEC** (BU) has recently started developing their own mounting systems, with the first **SUNOTEC** mounting structure produced in Bulgaria in 2023

Tracker companies

Historically, solar trackers have been less favoured in EU ground-mounted solar markets, for several reasons. Tracking systems are most common in lower latitudes with high irradiation, and trackers' marginal increase in energy yield in Europe has not always outweighed their higher CAPEX cost,

compared with applications in markets like the United States, where trackers are used in 90% of utility solar projects[19] .

Additionally, tracking systems require more space between panels to avoid shading as they rotate. Since land is usually rather expensive and subject to competing uses in Europe, fixed-tilt mounting has been the more common option for large-scale PV, until recently. However, in today's context of record-low prices for solar system components, trackers are becoming cheaper and more innovative, and are now increasingly used in utility solar projects across Europe, particularly in southern Europe.

Spain is the centre of both tracker manufacturing and demand in Europe: the majority of solar tracker manufacturers in Europe are based in Spain, with some companies also producing in Italy, Germany and France. The EU is host to 5 of the top 10 global market leaders for tracker shipments in 2023[20]: PV Hardware (ES), **Soltec** (ES), Ideematec (DE), Solar Steel (ES) and Axial Structural Solutions (ES). Together they held a quarter of the annual global market, amounting to around 23 GW of global tracker shipments, capitalising on both domestic and international demand, particularly in the rest of Europe and Latin America. While these market leaders specialise in tracking solutions, other EU companies like **Zimmerman PV** (DE) provide both tracker solutions and fixed-tilt systems for ground-mounted solar projects, as well as mounting solutions for agrivoltaics or floating PV.


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[19] Taiyang News (2024), Solar Trackers Market Survey 2024

[20] WoodMackenzie (2024), Global Solar PV tracker market share report

Meanwhile, companies headquartered outside of Europe also produce mounting structures and/or tracking systems in the EU. **Nextracker** (US) is the global and European market leader for tracker systems; with 100 employees in Europe and 9 GW of trackers delivered to EU solar projects to date, the company plans to start shipping 100% made-in-EU trackers from 2026 (see full Case Study page 53). **Trina Tracker** (China), the tracker division of the leading integrated cell and module maker Trina Solar, also has a tracker production site in Spain. Although rather new compared to established tracker players, in 2018 TrinaTracker acquired Nclave, a Spanish mounting systems producer, and relies on local know-how as a means of growing in this dynamic segment.

Other

Aside from manufacturers, other stakeholders in the solar mounting systems space in the EU include materials providers for aluminium or steel, such as **Metlen Energy & Metals** (GR), a raw materials (bauxite, alumina) supplier and aluminium producer and recycler, and steel provider **ArcelorMittal** (LUX). **Arcelor Mittal** also produces mounting structures and trackers via the ArcelorMittal Projects Energy division. Steel galvanisers are represented by the **European General Galvanizers Association EGGA**, and the aluminium industry is represented by the European Aluminium association.

Further down the value chain, testing and certification bodies such as **TÜV Rheinland** also develop services to qualify solar mounting solutions to ensure they meet requirements, both for ease of operation, such as worker safety or replaceability of individual modules, and suitability of materials or properties of the mounting system, notably for corrosion resistance, wind tunnel testing, fire safety, etc.[21] Notably, companies like **IQAS -Inter Q&A services** (PT) also have a role to play specifically in the PV tracker industry: in order to distribute products worldwide, tracker companies will often rely on local third-party suppliers, mills and manufacturers, both for sourcing raw materials and for producing parts, based on the products' specifications. Third party suppliers must therefore be assessed to meet the quality and safety standards set by the parent company. Portuguese start-up **IQAS – Inter Q&A services** (PT) provides such services and works with leading EU tracker providers to inspect the global distribution of their products.

The EU is therefore host to a rich industrial network of suppliers of solar mounting systems, distributing products and supporting solar projects at home and globally.

[21] TÜV Rheinland, Flyer – Qualification of solar mounting systems

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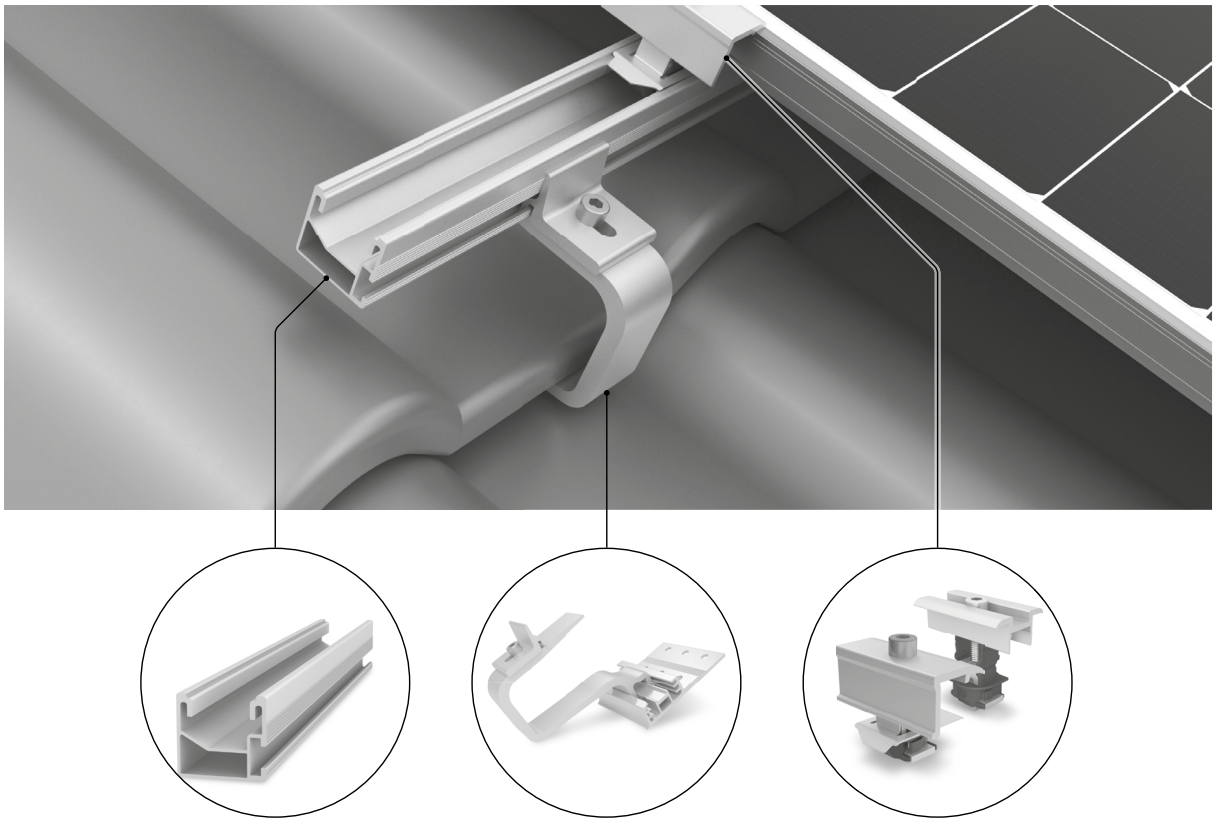
02

Market and technology brief

Technology brief

Mounting systems are largely made of steel or aluminium components, sometimes cement, used for ballasting, with additional electronic components needed for trackers.

Rooftop systems



K2 SingleRail 36

K2 SingleHook 3S Light

K2 Clamp EC/MC 25 - 40 mm

©K2 Systems

Rooftop mounting components usually consist of:

- **Mounting rails, or racks** – to support the panels,

- **Clamps** - to secure the panels to the rails,

- **Rail connectors or splices/splice plates** to connect rails,

- **Brackets/hooks/clamps** – to secure the rails to the roof; these can vary depending on the type of roof and choice of **foundation,**

- **Foundations** - either

    - For inclined roofs:

        Penetrating roof mount, which secures the system by drilling brackets/hooks directly into the roof. These require additional **flashings** and/or **sealants** to provide either physical or chemical waterproofing, to protect the roof from leaks over time.

Non-penetrating mounts, such as clamp systems, usually favoured for metal roofs to prevent potential leaks. These mounts attach directly to the roof seams, offering a secure installation without the need for drilling into the roof.

- For flat roofs: a **ballasted foundation**, where either concrete or metal ballast trays are used as weights to secure the PV installation (also used for some ground-mount systems).

Rooftop mounting rails are either made of galvanised steel or aluminium (stainless steel is also used, mostly for screws, nuts and bolts, etc). While aluminium has historically been the material of choice in this segment, due to its lighter weight and naturally corrosion resistant properties, some rooftop mounting structure manufacturers are seeing a shift from aluminium to steel, especially for C&I and even residential flat roof applications. Just as steel components have gradually replaced aluminium in openarea installations due to their structural properties and cost, the same question arises for rooftop solar mounting. Here, it remains to be seen whether the advantages of aluminium over steel – such as durability and ease of processing – will continue to prevail in the market despite price pressures.

Several PV mounting companies like **K2 Systems** now provide steel solutions for the rooftop segment. Aluminium is expected to retain a share of the market in the long term, namely due to its aesthetic quality; industry leaders estimate that aluminium holds around 60% share in the rooftop segment today.

Ground-mounted systems: fixed tilt

Fixed-tilt ground-mounting structures typically made of steel and consist of both 'aerial' components for the supporting **structure** – i.e. rails connected together to support the modules, connected to rear and front legs (or a single leg, or pole), with clamps holding the modules in place – and a **foundation or substructure** – the "legs" are typically either driven into the ground (using posts/piles, anchors, screws), or held in place with concrete ballasting.

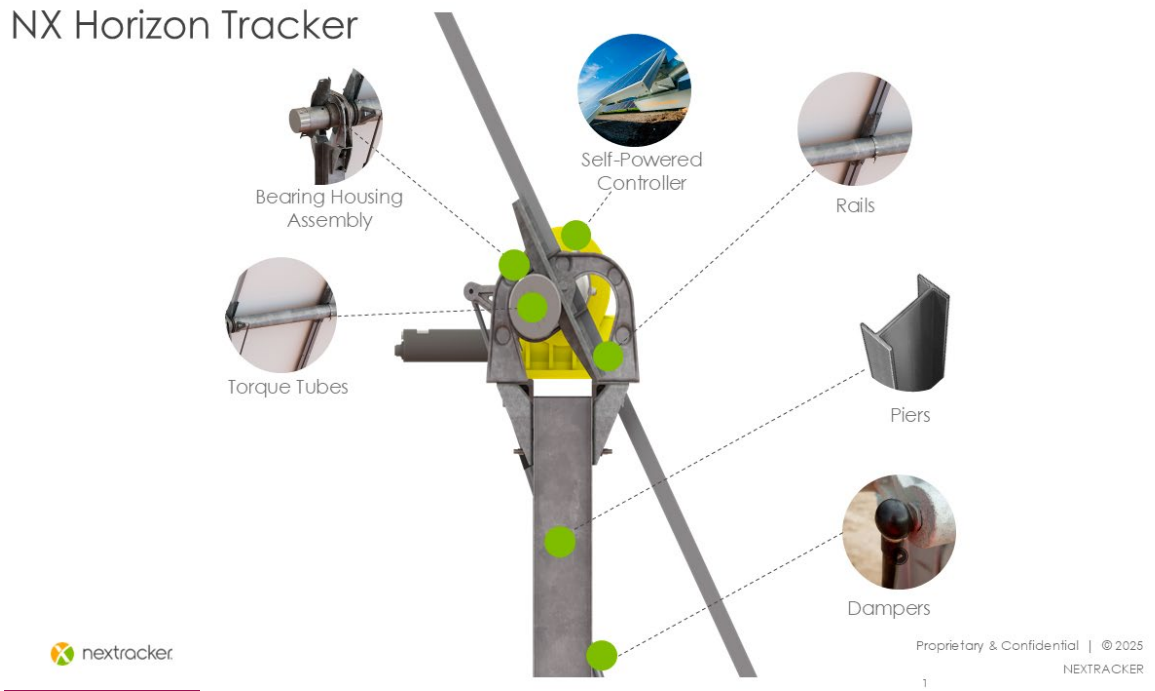
While most fixed structures are oriented **south** (in the northern hemisphere), one specific type of fixed ground-mounting architecture is **East-West (E-W)**, whereby panels are mounted facing both east and west, typically in a back-to-back (butterfly wing) configuration: half are tilted East (to capture morning sunlight), and the other half are tilted West (to capture afternoon sunlight).

(Left image) in-ground anchoring ; (Right image) concrete ballasting anchoring

Ground-mounted systems: trackers

Trackers, whether single axis, or dual axis, have different architectures to fixed-tilt structures, as well as requiring additional electronic components. Single axis tracking systems (SAT) are the most common tracker technology: they can rotate horizontally or vertically, in East-West (E-W) (most widespread) or North-South (N-S) directions. Trackers will usually be oriented on a north-south axis that rotates the modules from east-facing in the morning to west-facing in the evening (E-W). While this configuration is most common due to their higher energy yield, N-S configurations are less favoured as they limit solar panel rotation.

Dual axis tracking systems (DAT) can effectively follow the sun's circular motion across the sky, across two axes – although increasing energy yield by up to 45%, their higher complexity, CAPEX and O&M costs puts their LCOE at a premium compared to their single-axis peers.[22] Additionally, its complex technology has not been able to evolve and adapt to rapid market changes: popular at times of very high feed-in tariffs in Spain, they are hardly used in utility projects today.



© Nextracker

The main components of a single-axis tracking system also include both general **structure or 'aerial'** components, including rails and fasteners (nuts, bolts, etc), and **foundations** which connect the installation firmly to the ground. Other important tracker components are the electromechanical parts, such as drive motors and controllers, as well as the connection elements such as fasteners.

The torque is a galvanised steel tube connected to the rails holding the modules. It is rotated by the **drive motor,** so the PV panels rotate. The bearings connect the torque tube to the support columns, while the **drive train** (transmission system) consisting of a gearbox, or slew drive on or near the pier, allows the torque tube to rotate. Hydraulic dampers work as shock absorbers, ensuring the structure's stability. Finally, the tracker controller comprises all the electronics required to perform the tracking algorithm and exchange data with the network controller units and weather stations.

[22] Taiyang News (2024), Solar Trackers Market Survey 2024

Weather stations are also necessary to measure windspeed and direction and safely stow trackers in cases of high wind or hail events. Overall, for each solar plant there are over 500 major components per MW of project, with thousands of minor components (e.g., nuts, bolts).[23] The performance of a specific tracker design is not only defined by its adaptability to specific terrain and engineering, but also by its efficiency during installation.

Because trackers represent moving machinery and require much more material than fixed-tilt racking systems, as well as more land-use and higher operation and maintenance (O&M) costs – they typically represent a cost premium. However, this premium is often outweighed by the increase in energy production. In its early days, single-axis trackers used to be exclusively located in sunny areas, where the performance gain was more substantial. However, since 2013, through optimisations in design and cost, single-axis trackers have also been deployed in less sunny locations, though its share is still much smaller there.

Global and EU markets for mounting structures

Ground-mounted PV: fixed tilt vs trackers

Deployment

Industry insights indicate that globally, fixed mounting structures and trackers both had somewhat equal market share for utility projects today.[24] However, this split varies across markets – for example the Indian and Chinese markets are known to prioritise fixed-tilt structures, likely due to due to their lower price, faster installation, lower O&M costs, and the overall strong competitiveness on installation costs for large Chinese and Indian utility projects: based on industry data from **PV Case**, the average Indian ground mount project size is over 140 MW, 7 times larger than the global average. Still according to PV Case, fixed-tilt mounting make up 87% of all ground-mount projects in the Indian pipeline today (Fig. 6).[25]

This skew also explains that the Asia Pacific region only installed 26% of the world's solar trackers in 2023,[26] despite the region's dominance in the global solar market, with a 67% share of the world's solar capacity in 2023.[27] Particularly, China alone accounted for almost half of all utility scale solar installations in 2023, amounting to 255 GW. Meanwhile, the same year, the America and Caribbean region, led by the United States, held almost half the global tracker market at 46%.[28]

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[23] US Department of Energy (2022), Solar Photovoltaics: Supply Chain Deep-Dive Assessment

[24] TaiyangNews (2024), Solar Trackers Market Survey 2024

[25] PV Case (2025), data as presented in the Global Market Outlook 2025-2029 webinar launch.

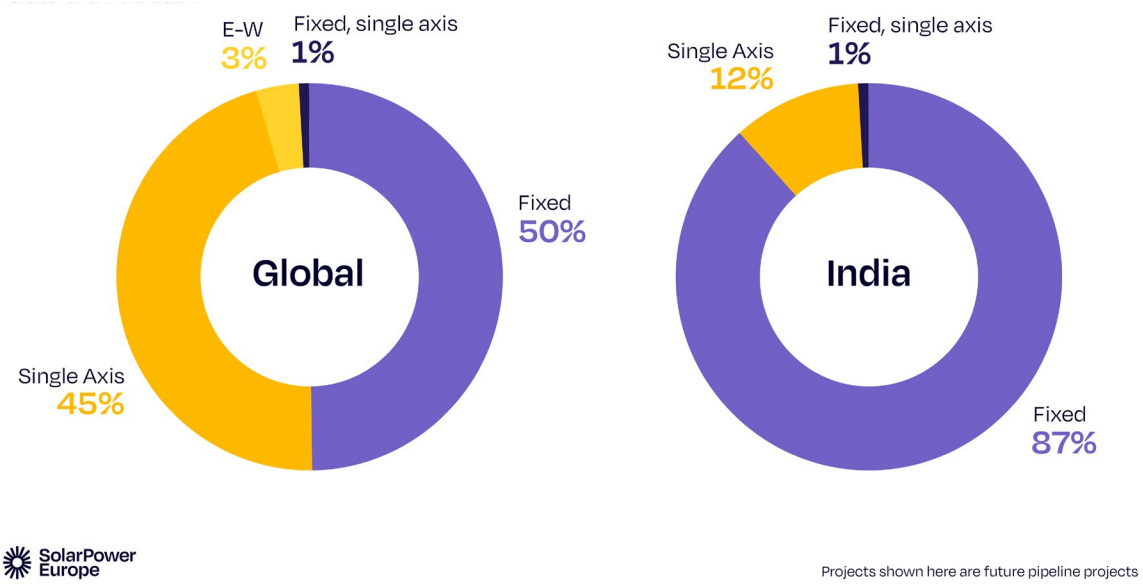
[26] Kumba et. al. (2024) Solar tracking systems: Advancements, challenges, and future directions: A review - ScienceDirect

[27] SolarPower Europe (2025): Global Market Outlook for Solar Power 2025-2029

[28] Kumba et. al. (2024) Solar tracking systems: Advancements, challenges, and future directions: A review - ScienceDirect

Figure 6

Share of mounting structures in PVcase GM pipeline projects, Global and India, 2024



SolarPower Europe

Projects shown here are future pipeline projects

In Europe, the penetration of trackers in utility projects is difficult to estimate. Their share varies across markets, and most central European countries have historically favoured fixed mounting. According to WoodMackenzie's latest Global Solar PV tracker market share report 2025, Spain holds 50% of the continent's tracker demand in 2024, where trackers have 90% penetration in utility projects. Meanwhile, top fixed-tilt markets include Germany, with over 95% of solar parks using fixed-mounting, followed by France and Poland.[29] While southern markets like Spain, Italy, and Portugal have historically held the most market share for trackers, industry sources report tracker deployment now also in other European solar markets like Denmark, the Baltics, the UK, and even in Germany. On average, WoodMackenzie considers an average 50-55% share of trackers in European utility projects in 2024, while industry experts consulted in the Taiyang News Tracker Market Survey 2024 estimated a similar 50% share.

What are the drivers for the tracker market?

The global tracker market saw strong growth in the last three years, especially in the US and Europe, and a few emerging markets in Asia-Pacific and Brazil. According to Wood Mackenzie, in 2023, global solar tracker market shipments surged between 28% year-on-year to 92 GW, and in 2024, shipments reached 111 GW for another 20% market growth. This reflects the increasing importance of this technology, even in regions that historically favoured fixed systems, such as India, parts of Europe, and South America.

Key drivers for the deployment of tracking systems include their **increased yield**, especially combined with **bifacial modules**, their **decreasing price premium** compared to fixed-tilt mounting systems, and their applications in the **agri-PV** sector and for **complex terrains**. Crucially, tracker systems can also **contribute to system flexibility** through the intelligent management of panel

[29] WoodMackenzie (2025), Global solar PV tracker market share report 2025 | Wood Mackenzie

inclination at peak production times, and increasing production in the morning and the evening, at times of higher electricity demand – an increasingly important topic in mature markets, and a major reason why developers in central Europe are now also closely looking into trackers as a means to deal with curtailments and decreasing solar capture prices.

Single axis trackers **can increase solar PV production up to 20% compared to fixed-tilt installations.** While trackers were in high demand during times of high module prices, since they help meet a project's target power with fewer modules compared to fixed-tilt mounting, they are still finding a business case in the current market conditions of rock-bottom prices for modules and inverters, despite their higher upfront cost compared to fixed-tilt structures.

With that said, single-axis trackers have gained significant market share in ground-mounted projects in large part because of their **relative price decrease as compared to fixed-tilt systems.** According to one report, over the last 10 years, prices have decreased 47% from USD 0.17/W in 2015 to now stagnate at around USD 0.09/W, **still on average 10% costlier than fixed-tilt systems in 2024.** Costs range from around €0.07/W for single-axis trackers in Europe to USD 0.15/W in the US, with additional foundation expenses driven by local regulations.[30]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Then, the combined use of trackers with **bifacial modules**, which make up the majority of commercially produced solar cells today, have a **compounded and multiplied effect on PV production and project returns**, making trackers are a logical choice for large-scale solar projects. Indeed, scientific publications such as the one from Solar Energy Research Institute of Singapore (SERIS), Global Techno-Economic Performance of Bifacial and Tracking Photovoltaic Systems by Carlos D. Rodríguez Gallegos et al, show that **bifacial modules with single-axis trackers achieve 16% lower LCOE than a conventional system**, in most locations, by significantly **boosting energy production by more than 35%.**[31] Additionally, investors and developers are now more informed about the feasibility and effectiveness of trackers, and larger developers are pushing for trackers in more and more markets.

The tracker segment is also exploring new applications, for instance with agrivoltaics – the colocation of solar panels and agriculture – one of the most common dual uses of bifacial PV and trackers (Fig 7). Trackers for agrivoltaic applications can expand the areas possible for PV installation, and often provide extra value for farmers, potential crop yield increases, among other tangible benefits.[32] Fixed mounting structures are also widely used in agrisolar and floating PV projects.

[30] TaiyangNews (2024), Solar Trackers Market Survey 2024

[31] Rodríguez Gallegos et al. (2020), "Global Techno-Economic Performance of Bifacial and Tracking Photovoltaic Systems, Joule, Volume 4, Issue 7, DOI: https://doi.org/10.1016/j.joule.2020.05.005

[32] IEA PVPS (2024): Best Practices for the Optimization of Bifacial Photovoltaic Tracking Systems.


© Soltec

Finally, trackers' **high-tech features** provide **innovative ways to improve performance and durability** of PV projects. Outside of simply tracking the sun, they also increase resilience by managing harsh weather conditions or diAicult terrain. Today's trackers are embracing cutting-edge technologies, with **AI-powered controllers** and sophisticated algorithms to optimise tracking performance. The major emphasis in this field is on maximising sunlight absorption by positioning the modules at an optimal angle and avoiding shading to get the best out of the shading situation (**'back-tracking'**). Another innovation is **diffuse-response** and involves optimising panel positioning in diAused light conditions, such as cloudy days. **Self-cleaning** algorithms also tilt the modules during precipitation events or when conditions will lead to dew formation to allow water to flow easily oA the modules and wash away dirt or snow. Hail-response and wind-response algorithms place the rows in orientations to protect the modules from damage (e.g., tortional galloping). Trackers are also handy to mitigate noon peaks effectively by adjusting the modules' optimal position.

Market leaders

Mounting structures

Compared to solar modules or inverters, local mounting systems providers in different solar markets generally have an advantage over international competitors, due to the added cost of international shipping of heavy metal components, and the strategic importance of short delivery times and of mobilising local skilled workers. Consequently, in Europe, the field for mounting systems is one of the few solar segments that has been dominated by European players. One analysis from Future Market Insights (FMI) indicates that the top 4 companies in the European Market for solar mounting are based in Germany and hold more than half, 51-63% market share.[33]

However, some European manufacturers are concerned that this advantage is progressively being challenged by international competitors' ability to mobilise their economies of scale. There are large installers sourcing lower-cost mounting products from outside the EU, while large Chinese vertically integrated PV manufacturers are also turning into full-solution providers, often using domestic mounting equipment to serve European markets.

[33] Future Market Insights (2025), Europe Photovoltaic Mounting System Market

Trackers

For the tracker segment, specifically, according to Wood Mackenzie's Global PV tracker market share report 2024[34], the top 3 leading global tracker providers in 2023 were US companies: Nextracker, Array Technologies, and Game Change, making up over 50% of global shipments in 2023. This is unsurprising given the US is the largest global market for trackers. Together they combined around 100 GW manufacturing capacity in the US, as well as a global production footprint in Brazil, Malaysia, Spain and China, with plans to expand manufacturing activities to Australia or Saudi Arabia. **Five EU companies were in the global top 10 market leaders for solar trackers in 2023:** PV Hardware (ES), Soltec (ES), Ideematec (DE), Solar Steel (ES) and Axial Structural Solutions (ES). Together they **made up a quarter of global tracker shipments in 2023**, mostly from Spanish companies, which capitalised on both domestic and international demand, particularly in the rest of Europe and Latin America. With 4 companies in the top 10, Chinese companies provided 19% of global tracker shipments in 2023.

However, according to the recent update to this report, this picture is shifting in 2024 with Chinese supplier Arctech now in 2nd place globally with 16% market share, overtaking Array (US), while Nextracker increased its global market share to 26%. Meanwhile, one EU company (PV Hardware) is still in the global top 5 in 2024. [35,36]

Specifically on the European market, while US-based **Nextracker** emerged as the #1 market leader for trackers in 2024, EU headquartered tracker manufacturers still make up the majority of the EU's PV tracker market. However, **EU tracker companies' market share is shrinking, from 67% in 2023 to 55% in 2024,** namely due to the rise in market share from companies from 10% in 2023 to 23% in 2024.

550 MW Ptolemaida solar park, Greece

[34] WoodMackenzie (2024): Global PV tracker market share report 2024

[35] Global solar tracker shipments reach 111 GW in 2024 – pv magazine Australia

[36] Arctech ranks world's No.2 in solar tracker market – pv magazine Australia

This recent shift points to increased competition from non-EU players on the European solar market, including in the solar tracker space, which also translates in global market dynamics.

Fixed-tilt and rooftop solar mounting structures

Outside of tracker market dynamics, key trends across the mounting systems segment in general include the **rapid innovation in materials** for **increasing durability** and allowing for **faster assembly and installation times.** These are mutually beneficial to both manufacturers and developers, with major players concentrating on lightweight aluminium alloys and corrosion-resistant coatings.

Additional value propositions are also being offered by some mounting solutions providers through installation services and structural engineering support. Ground-mount and **carport systems** are driving market growth due to strategic partnerships with utility-scale developers and **urban planners.** Additionally, the EU's focus on carbon-neutral infrastructure is creating new opportunities for recyclable, **low-carbon mounting materials.**

Moreover, while there is a significant and growing body of market and technology research dedicated to the deployment of solar trackers, there is comparatively little literature available describing the fixed-tilt or rooftop mounting structures market, on either the global or European scale. This can be linked in part to the overall lack of transparency for tracing global shipments of fixed mounting structures, as they do not have their own international customs code, as modules or solar inverters do. Given fixed-tilt mounting structures' key role in solar value chains, and that they make up two-thirds of the EU's annual solar market, this is a challenge for evaluating the EU's resilience in this specific segment.

03

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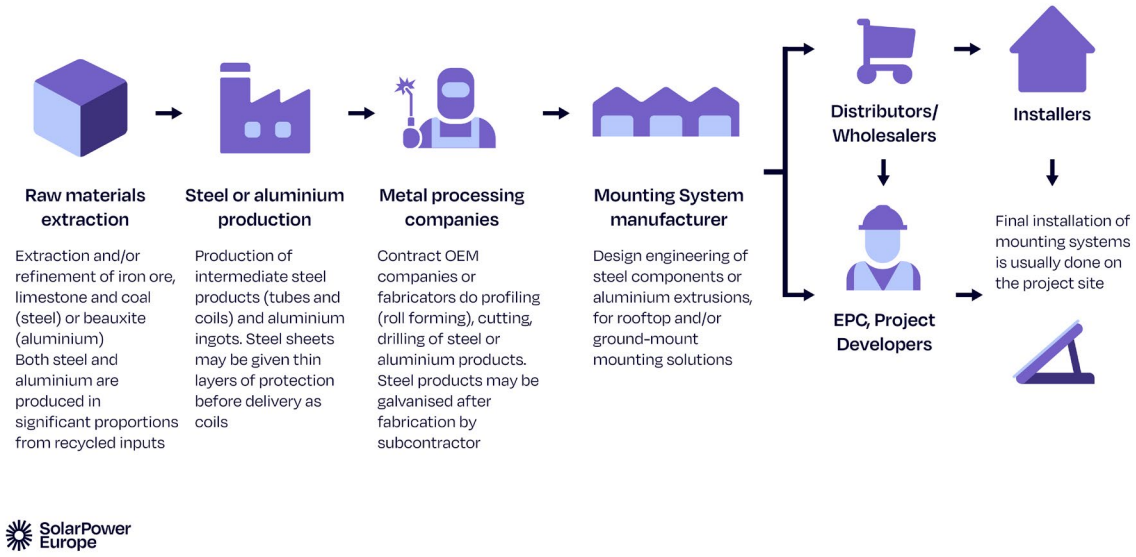
Solar mounting systems' supply chains

Production value chain for solar mounting systems

The solar mounting systems value chain is largely organised as follows:

Figure 7

Solar Mounting Systems value chain



Mounting system manufacturers collaborate with **steel or aluminium suppliers** to source materials for the design and/or production of solar mounting components across all PV segments. The above picture will vary somewhat across the rooftop mounting segment, ground mount fixed-tilt or tracking systems. For large scale projects, in fact, **mounting structure and tracker companies** spend a significant portion of their developing intellectual property for the design of structures and trackers, and managing logistics to bring the pieces of equipment to the PV system site. In particular, tracker manufacturing will often collaborate with local mills and metal processing companies to produce the company's parts based on the product's specifications. While there is some manufacturing performed by the companies themselves, a significant portion is made by third-party OEM suppliers. For example, Zimmerman PV Steel group specialises in the design of mounting solutions, and outsources the production itself.

For steel specifically, **galvanising** is done either before the part is manufactured, by the steel producer, directly on the steel coils (continuous metallic coating, e.g. EN 10346) or afterwards, at which point the produced component is fully immersed in zinc (batch galvanizing to EN ISOI 1461). The mounting solutions are then delivered, to the required design specification, to PV distributors, wholesalers, or directly to EPC or developers for large scale projects.

Much of the time, a significant portion of tracker or mounting structure assembly occurs at the PV installation site. While some preassembly of components does occur, it is weighed against the

additional costs of shipping a bigger piece of equipment to the PV project. Tracking and mounting structure companies do not do the installation themselves, but rather provide training and field services to EPCs or installers.

Companies look to produce mounting systems at the lowest cost to the PV site (including shipping), balancing this with the competitive advantage of short lead times (getting the equipment to the PV site in a timely manner). Therefore, a company may opt for manufacturing locations that are somewhat more expensive but closer to demand. This allows companies to deliver products faster than their competitors and provide a quicker turnaround time if there is an error and a part needs to be replaced.

During the lifetime of the PV plant, **O&M** for mounting structures, and trackers especially, is key to ensure the continuous quality and performance of mounting or tracker systems. Towards the end of life, mounting structures can also be reused in situ during repowering or recycled and contribute to a circular solar ecosystem.

EU Resilience for solar mounting systems

Steel and aluminium in the EU

Galvanised steel and aluminium are the key materials used for the racking, structure and sub-structure components of solar mounting systems. Due to its characteristic durability in harsh outdoor environments and corrosion resistance, galvanised steel is used in most ground-mounted PV projects and large parts of the rooftop solar segment. Aluminium, given its properties as a lightweight and corrosion-resistant material, is often used for mounting in rooftop residential and commercial systems. Outside of mounting systems, aluminium is also a key material in the PV module value chain, used to make solar module frames. Steel represents a major expense for mounting systems: for tracking systems, they constitute about 70% of total product costs,[36] with additional costs for motors, control systems, and software.

Steel and aluminium are of key strategic importance for ensuring European resilience across many industrial segments. Steel production in the EU starts high in the value chain, from the primary production of steel slabs using raw materials (iron ore, coal and limestone), or recycled scrap steel. Primary production is followed by the 'finishing' stage, in which steel slabs are flattened and rolled into large coils, ready for use in various industries. While EU production is still able to cover most of the EU's domestic demand in steel (90%),[37] the picture is slightly different for aluminium, where Europe depends increasingly on imports for aluminium: according to **European Aluminium**, in 2023, primary production of aluminium in Europe contributed 7% of European supply, and 39% was met by domestic secondary production, from recycled aluminium, compared to **54% of net imports.**[38]

[36] TaiyangNews (2024), Solar Trackers Market Survey 2024

[37] European Commission (March 2025), A European Steel and Metals Action Plan

[38] European Aluminium (consulted June 2025)

In response to growing concerns from the steel and metals industry, in a context of rising trade tensions and increased competition from Asia, the European Commission has recently tightened safeguard measures, including import quotas, to protect its steel and aluminium industries from market distortions caused by global overcapacity. In March 2025, the European Commission published a Steel and Metals Action Plan[39], announcing plans to reduce steel imports by 15% starting April 1, 2025, aiming to shield EU producers from unfair foreign competition, particularly from Asia.[40]

Moreover, steel and aluminium fall under the scope of the Carbon Border Adjustment Mechanism (CBAM), currently in its transitional phase until end of 2025: importers of carbon-intensive goods like steel and aluminium **currently have only reporting obligations, without the need to buy and surrender CBAM certificates.** From 2026-onwards, with the definitive regime of CBAM, importers of steel and aluminium will need to purchase CBAM certificates for covered goods from February 2027 for imports made in 2026. **This means that from 2026-2027, EU steel and aluminium are likely to experience a boost, as competing, carbon-intensive, imports will come with new financial consequences.**

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None of these measures would appear to address rising concerns, at the high level, of imports of steel solar mounting structures from China and other third countries. Quotas do not apply to such final end products, whilst quotas can limit the competitiveness of European solar structure manufacturers who may need to import, for example steel coils, to remain competitive.

Manufacturing of solar mounting systems in the EU

In the strict context of solar mounting systems, generally speaking, local manufacturing is competitive given the advantages for meeting shorter delivery times, lower shipping costs of heavy steel/

[39] European Commission (March 2025), A European Steel and Metals Action Plan

[40] Euronews (March, 2025), EU plans to reduce steel imports by 15%

aluminium components, and the availability of a skilled engineering workforce. This is exemplified by the large EU ecosystem of mounting and tracking providers shown in Fig. 4, and by the fact that several global market leaders develop local production of mounting systems, close to key markets, notably in Brazil or in Spain in addition to domestic manufacturing. However, in a context of decreasing solar component prices across the value chain and growing economies of scale, the sector is impacted by the imports of cheaper products on the EU market.

The European General Galvanisers Association estimates, based on anecdotal evidence from installers' data and site visits, that an increasing share of steel components for the production of mounting systems, up to more than 50% of the supply, now originate from China.[41]

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The NZIA implementing act includes trackers and their specific mounting structures in the list of specific components for the purposes of assessing the contribution to resilience. Given that fixed-mount PV systems made up over two thirds (78%) of the EU solar market in 2024, auction authorities, contracting authorities and contracting entities should be encouraged to apply resilience criteria in public procurement and auctions for these components. It may be possible to extend this action to fixed-tilt mounting structures through national implementation.

Moreover, solar mounting structures do not have a specific customs code, and therefore the transparent analysis of international trade for solar mounting structures is made impossible by the lack of official import data.

[41] EGGA (2025), EGGA's position: Implementing legislation for the NZIA

04

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Policy Recommendations

In light of these considerations, SolarPower Europe presents the three following policy recommendations:

Add Mounting Structures to the implementation of Net-Zero Industry Act on the National Level

SolarPower Europe suggest amending the Annex to the Implementing Act of the list of net-zero technology final products and their main specific components for the purposes of assessing the contribution to resilience to add the mounting structures in the same entry of the trackers as follows: "PV trackers and their specific mounting structures". The objective is to ensure that both ground-mounted solar structures and trackers, which are alternatively used in the utility-scale segment, are considered for resilience purposes. The current narrower definition implies that only tracker-based mounting components count toward the resilience non-price criteria, potentially excluding large volumes of fixed-mount PV systems, which represent around three quarters of the EU solar market in 2024.

Develop specific HS code/customs code for mounting structures and trackers

that can help track and identify the shipments of these components in international trade, as is done for solar inverters and modules (Harmonized System Codes (HS Code) Commodity Classification - Foreign Trade Online). The EU customs code, or Harmonized System (HS) code, is a standardised international system for classifying traded products. It is used for customs declarations, statistical tracking, and trade policy measures. Having a specific HS/customs code for mounting structures and trackers is essential to accurately track and identify shipments of these systems in international trade, much like existing codes for solar inverters and modules.

- Currently, mounting structures fall under broad and non-specific categories. If made of iron or **steel**, they are typically classified under **7308** - Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridgesections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel. If made of **aluminium**, they are often classified under **7610** - Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel.

- Solar trackers also fall under broad and non-specific categories. In some cases, they fall under the same general codes used for mounting structures, which also cover a wide range of steel fabrication items. Alternatively, they may be classified under general codes that encompass various electronic components. These general categories are **not solar specific** and can apply to a wide range of non-solar components, making it difficult to gather precise trade data or assess the resilience of the solar value chain. **Therefore, developing dedicated HS/customs codes for both solar mounting structures and trackers would support better data collection, enable informed policy-making, and align with industrial policy objectives under instruments like the Net-Zero Industry Act, where customs tracking is linked to measuring supply chain resilience via the non-price criteria for resilience.**

Develop harmonised and robust quality standards.

We need a single market for mounting quality structures. To address the current inconsistencies and lack of clarity in the racking and tracker segment of the solar industry, we recommend the development of harmonised policy standards across three key areas: structural integrity, transparency, and warranties. Structural standards should align with internationally recognised benchmarks, such as the Eurocode, to ensure safety and comparability – regardless of origin. Transparency requirements must mandate that racking manufacturers provide publicly accessible, comprehensive technical documentation equivalent to what is standard for modules and inverters. Lastly, warranty terms must be standardised in both format and terminology to enable meaningful comparisons and ensure procurement clarity. These steps will strengthen trust, improve product quality, and reduce procurement risk across global solar supply chains.

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05

Case Studies

GSE Intégration

European manufacturer of **mounting systems** for **standard photovoltaic modules**

www.gseintegration.com

GSE Integration

Advancing solar roofing in Europe

GSE Integration, a subsidiary of Wienerberger, is a European leader in roof-integrated photovoltaic (BIPV) systems. Founded in 2008 and headquartered in France, GSE Integration manufactures building-integrated mounting systems compatible with most standard PV modules. With over 7 million m² installed in Europe and a growing production footprint across five EU sites, GSE Integration offers innovative, lightweight, and aesthetic solar roofing solutions — ideal for new builds and major renovations.

793 kW roof-integrated PV, 228 houses in a zero-carbon Eco-Town, Bicester, Oxfordshire, United Kingdom

Importantly, all components of the GSE IN-ROOF SYSTEM are made in Europe, supporting local industry and ensuring high-quality standards across the supply chain. By replacing traditional tiles with sleek, integrated PV modules with GSE IN-ROOF SYSTEM simultaneously serve as roof and solar power generator — making it a preferred solution for urban environments, residential developments, and municipal projects under Europe's revised Energy Performance of Buildings Directive (EPBD). With over 300 solar roofs installed daily in 2024, GSE Integration has scaled production and logistics, including a new 6,000 m² logistics platform in Normandy, to meet growing EU-wide demand.

Offering

GSE Integration's IN-ROOF SYSTEM offers a lightweight, cost-effective, aesthetic and universal solution that is compatible with almost all framed PV modules. At 16 kg/m² compared to 60 kg/m² for conventional on-roof systems, and up to 40% cheaper for new roofs or full renovations, the IN-ROOF system blends into rooftops, is approved by many EU city planning bodies and is certified across Europe, including MCS 012 (UK), ETN and ATec (Avis Technique) (France), ABZ (Germany), SPA (Netherlands).

220 kW roof-integrated PV on 29 new-build energy-neutral homes, Dronten, The Netherlands

GSE Integration distinguishes itself not only through its products, but also through comprehensive support before, during, and after installation. First, GSE installers receive hands-on training in training centres or on-site for first installations. Installers then use the GSE Connector planning tool to simplify system configuration and produce a full materials list, and develop customised plans and calculations for complex rooftops. Finally, GSE provides digital services in the form of online configurators, webinars and live Q&A with engineers for ongoing project support.

This customer-centred approach and service ecosystem empowers professionals at all project stages, ensuring optimal performance and smooth deployment.

Project Spotlight: Public and Residential Solarisation

Public Sector Projects

In collaboration with regional energy agencies and municipal governments, GSE Integration has deployed thousands of square meters of in-roof PV systems on public buildings such as schools, administrative centres, and sports facilities. These projects are central to achieving local sustainability goals under new EU mandates.

Residential retrofits and new builds

GSE Integration's roof-integrated systems are used in large-scale residential retrofits and housing developments. The aesthetic appeal and structural lightness allow homeowners and developers to meet solar obligations without compromising on design or roof integrity.

Europe-wide deployment

GSE Integration collaborates with partners across Europe to scale installations on both single-family homes and multi-residence projects. Their GSE Connector planner simplifies roof system configuration, easing large rollouts.

Industry challenges

Challenges to solar deployment for the in-roof solar mounting segment include regulatory complexity across EU member states, the shortage of skilled installers, aesthetic constraints in urban and heritage zones, and logistics and supply chain pressures. GSE Integration has found innovative ways to respond to each of these challenges.

First, GSE maintains a robust certification portfolio (e.g., MCS 012 for the UK, ETN and ATec (Avis Technique) in France, ABZ for Germany, SPA in The Netherland) and supports customers in navigating national standards. GSE also offers training centres, webinars, and first-installation support to professionals across Europe. Fundamentally, the GSE IN-ROOF SYSTEM offers a discrete, flush design approved by city planners and heritage boards. Finally, to ensure a resilient supply-chain, GSE doubled production capacity in 2024 and launched a modern warehouse in Normandy to streamline distribution across Europe.

© GSE Intégration

Outlook and contribution

With its "Made in Europe" philosophy, tailored training, and certified technology, GSE Integration contributes to the EU's solar mandates and industrial strategy. By partnering with roof window leaders like VELUX, FAKRO, and ROTO, it continues to innovate for integrated building aesthetics and performance.

GSE Integration is not just a system provider — it is a partner in the energy transition, transforming rooftops into assets of climate resilience.

enson

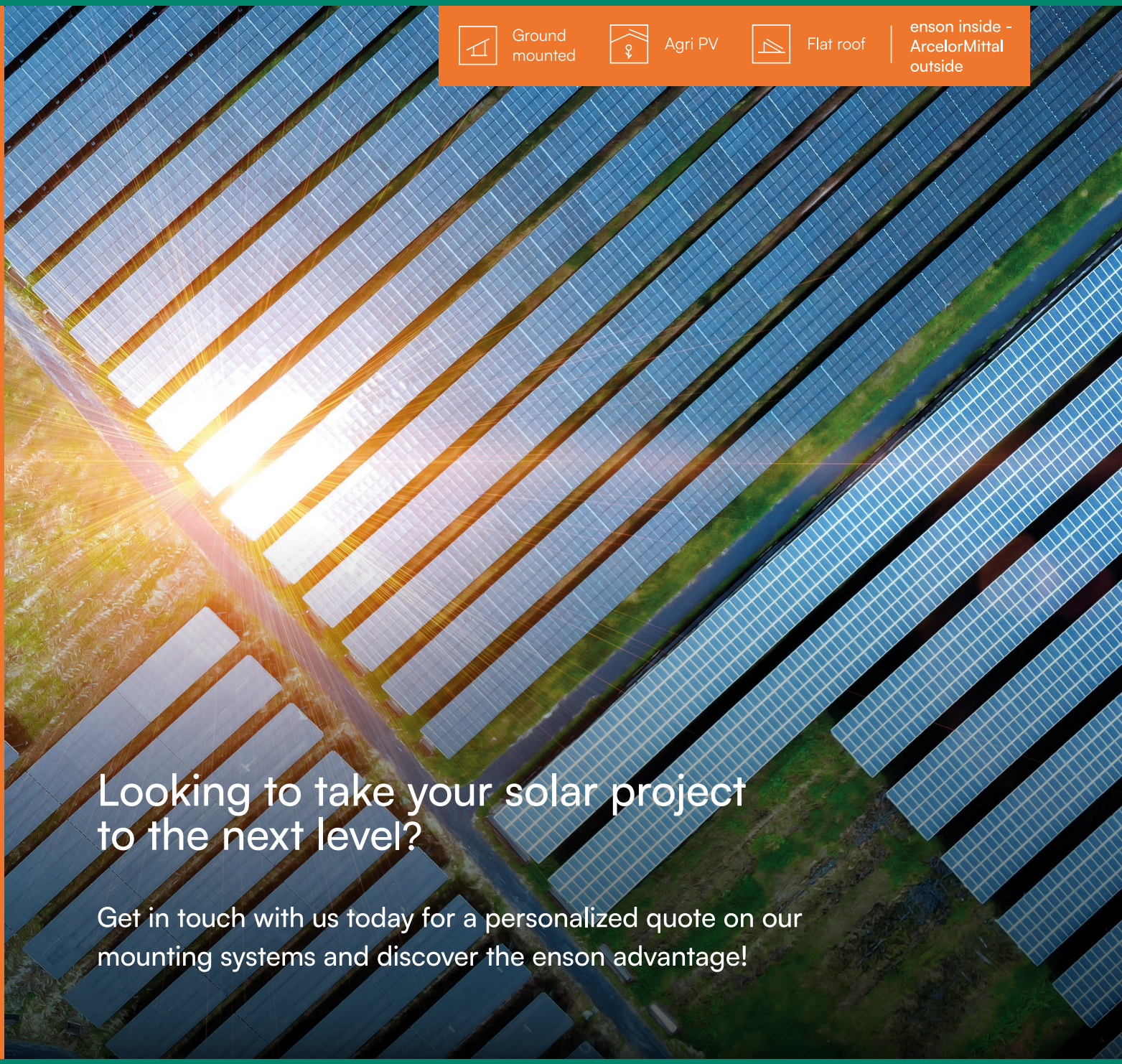
EUROPEAN PV MOUNTING SYSTEM MANUFACTURER

+ 1.5 GW
In-house annual production capacity

+ 3 GW
Planned projects in the pipeline

ISO

TÜV



Looking to take your solar project to the next level?

Get in touch with us today for a personalized quote on our mounting systems and discover the enson advantage!

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enson is a European manufacturer of PV mounting systems, combining technology and creativity to deliver innovative, safe, and functional solutions. Using a proactive approach, enson supports installers and focuses on smart investment optimisation using wind tunnel testing, AI, and R&D. Thanks to its in-house production facility, enson develops unique products, such as advanced connectors and mounting systems tailored to individual customer needs, ensuring flexibility and consistently high quality.

With over 3 GW of designed projects in development and 1.5 GW annual production capacity, enson exports its PV mounting systems to 7 countries, supplying more than 600 MW to the EU market.

Engineering challenge and innovation in practice – 117 MW Konyavo project, Bulgaria

The 117 MW Konyavo project in Bulgaria presented a major engineering challenge that required enson to develop entirely new structural solutions. The project site was an abandoned orchard with leftover tree roots and irregular land features. This unusual terrain made it impossible to use standard support layouts. However, enson was able to precisely adapt its design to complex geotechnical and load conditions.

793 kW roof-integrated PV, 228 houses in a zero-carbon Eco-Town, Bicester, Oxfordshire, United Kingdom

Additionally, the project had to meet extreme wind and snow load requirements. enson therefore introduced special reinforcement solutions and conducted detailed collision analysis of all structural elements. A project of this complexity required close cooperation between design and production teams, as well as ongoing technical dialogue with the client to ensure stability, safety, and efficiency in one of the most demanding locations enson worked on in 2024.

Key challenges arose in the completion of the project, and enson developed solutions to answer each one.

Firstly, large parts of the site made it **impossible to install standard double pile structures,** requiring the startup to develop a one-row post design, along with a new static analysis and careful component selection.

117 MW Konyavo project, Bulgaria

The next challenge was to **ensure stability under extreme loads** and adapt to the site's harsh snow and wind conditions. To ensure structural durability, enson implemented additional bracing elements and found the best place within the structure.

Then, due to the compact layout and single-row design, special attention was given to collision modelling, adjusting horizontal elements and optimising mounting points accordingly for full compatibility with the PV modules.

For the single-row post structure, **selecting the right beam and bracing layout** was crucial. Different configurations were tested for stiffness and ease of installation. The final solution was confirmed through load testing on a prototype.

Before implementation, a **full-size prototype was built and tested** at enson's production facility. The load tests confirmed the design assumptions and informed the final adjustments. The results and the stiffness of the structure fulfilled all the requirements.

117 MW Konyavo project, Bulgaria

Finally, the project involved the use of **mixed structure types**, both south-facing and east–west structures, **to cover flat zones**. Structures were adjusted to site-specific needs and investor requirements, allowing maximum use of available land.

The Konyavo project demonstrated that with the right engineering approach, close coordination between design and production, and strong client collaboration, it is possible to develop custom structural solutions even in the most demanding locations. This investment has become a benchmark for enson in the design of non-standard PV structures.

K2 Systems

Connecting strength: scalable mounting solutions for a dynamic and ever-evolving solar landscape

K2 Systems GmbH is one of the world's leading manufacturers of PV mounting systems with decades of experience and a strong international presence. Founded in 2004 and headquartered in Germany near Stuttgart, K2 Systems offers universal mounting solutions for flat and pitched roofs, façades, ground-mounted systems and carports. Digital services, such as the K2 Base planning software simplify and accelerate the planning and documentation of PV projects. In 2025, K2 Systems introduced K2 KAI, its first AI-powered digital assistant, offering 24/7 support for planning and installation of K2 mounting systems – further enhancing its suite of digital services.

K2 Systems develops in Germany, manufactures predominantly in Europe and focuses on a sustainable sourcing strategy. This strategic approach minimises carbon emissions, ensures compliance with EU quality, environmental, and social standards, and supports local production. Today, K2 mounting systems are used in over 130 countries, helping generate approximately 124 GWh of solar energy per day.

With around 420 employees at eleven global locations, K2 Systems supports its installation partners with high performing products and reliable, expert service. The company is committed to knowledge sharing and offers free training programs in various formats to empower installers worldwide.

Driven by the vision of global electricity generation from solar energy, K2 Systems works closely with international partners to shape a more sustainable energy future.

K2 mounting systems form a safe and reliable interface between energy generation and the building environment. The company develops these solutions in close collaboration with research institutes, structural engineers, and specialists in building aerodynamics. The result: coordinated, scalable, and flexible products accompanied by services that accelerate and support every phase of a PV project – from inception through project completion. These steps are digitally integrated, eliminating time-consuming manual processes and significantly increasing efficiency and accuracy. K2's collaborative approach brings innovative, cost-effective, and tailor-made solutions that meet the unique demands of each project.

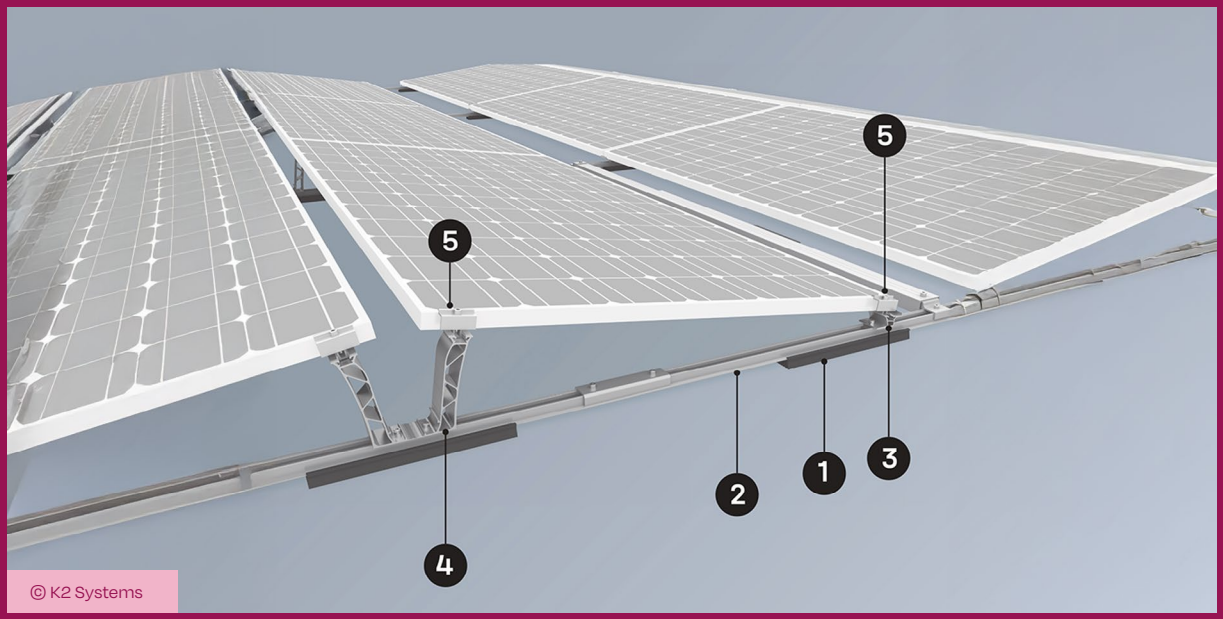
Solar projects in Europe

K2 Systems' mounting solutions are in use across a wide variety of applications and surfaces – demonstrating their adaptability from private homes to large-scale C&I projects.

- On a tiled roof in southern Germany, a 8 kW system powers a single-family home—showcasing how modularity and digital planning tools simplify residential installations. A rail system with hooks as roof fastener is best practice for 75 percent of pantile roofs.

8 kW rooftop solar, Germany

- In the C&I sector, a 2 MW system was installed on a membrane flat roof of a wine and sparkling wine production and storage facility with the ballast-optimised Dome 6 Classic System. This system complies with the latest wind tunnel testing standards and is certified with an abZ (German general building authority approval) and ETN (Étude Technique Nouvelle in France), ensuring regulatory compliance and structural safety. Even complex, tacle-rich flat roofs can be utilised to their full potential, efficiently, securely, and with maximum energy yield.



The basic components of a K2 D-Dome 6 mounting system are support pad (1), the mounting rail (2), the lower module support (3), the upper support (4) and the module clamps (5).

- **In the Czech Republic, a sports facility with a curved and trapezoidal metal roof was equipped with a 210 kW system. K2 Systems' modular solutions adapt to diverse architectural and structural conditions with mixed roof types.**

210 kWp rooftop solar, sports facility, Czech Republic

- K2 Systems has also delivered innovative projects on façades on warehouses and production halls, for example in Switzerland and Estonia, proving that vertical solar integration is possible.

- The company's expertise extends to ground-mounted systems as well. K2 solutions can be adapted to uneven terrain and with various foundation types: on a reclaimed quarry site in Illingen, Germany, a 1.5 MW installation was realised using pile-driven foundations, for example.

Barriers, challenges and opportunities

The dynamic nature of the solar PV industry, with its almost continuously decreasing levelised cost of electricity, stands in stark contrast to the numerous and growing requirements for mounting systems—especially in the building sector.

Here, mounting systems are increasingly becoming construction products, which brings with it demands for statics, quality, and durability. As safety-relevant components, they are subject to strict technical verification obligations and often require certification. Moreover, they must comply with the requirements of the EU Construction Products Regulation (EU CPR), which mandates, among other things, a Declaration of Performance and CE marking. This ensures that PV mounting systems can be safely, reliably, and compliantly applied to building structures.

Complying with harmonised technical specifications at the European level is complex and time-consuming, but it gradually improves the overall quality of these systems.

As mounting systems become more clearly integrated into construction products—and thus into the broader fieldof construction—this significantly expands their application potential in the building and car park sector.


The industry's most advanced solar tracking
Trusted by Europe. Tuned for performance.
nextracker
NX Horizon-XTR
Adapts to all-terrain, protects the land
TrueCapture
Delivers more energy with intelligent real-time control
Cold Weather Solutions
Built for Europe's harshest weather

Nextracker

Enabling the next phase of Europe's clean energy transition, using innovative tracking technology to optimise the value of PV projects

Nextracker (Nasdaq: NXT) is a global leader in advanced solar energy solutions, specialising in innovative, intelligent solar tracker systems and software. With over 130 GW of solar trackers shipped worldwide and utility-scale solar power plants operating in more than 40 countries, Nextracker delivers high-performing, integrated solar tracking solutions that optimise plant performance and maximise asset value. The company has expanded its European presence significantly, with local teams and strategic partnerships across the continent — from the UK to the Mediterranean — ensuring dedicated regional support and on-time project execution.

In Europe, Nextracker's regional headquarters are located in Madrid and Seville, supporting operations across the continent. The team works closely with local partners and manufacturers to deliver tracking systems adapted to a wide variety of project conditions — from repurposed mining land to complex terrain and cold-weather environments.

Project spotlight: "Oricheio PPC Ptolemaida" solar park, Greece

In a major milestone for Europe's renewable energy expansion, Nextracker's NX Horizon™ single-axis solar trackers were selected for the 550 MW "Oricheio PPC Ptolemaida" Solar Park, the largest solar power project in Greece and among the largest in Europe. Developed by PPC Renewables (PPCR) and constructed by Terna, the project repurposes a former coal mine in Western Macedonia into a clean energy powerhouse.

550 MW Ptolemaida solar park, Greece

To meet tight timelines and ensure reliability at scale for projects like this, Nextracker partners closely with local stakeholders, leveraging its robust European supply chain and regional manufacturing relationships. This allows for rapid deployment of advanced tracker technology, despite the often-occurring complexity of terrains such as retrofitting brownfield sites, working in hilly terrain

or ensuring a solid installation in peat soils. Projects such as these showcase Nextracker's ability to execute efficiently under high-performance demands, repeatedly setting benchmarks for utility-scale solar in Europe.

Responding to site-specific conditions in Europe

European solar developers increasingly face complex site requirements, including irregular terrain, seasonal weather extremes, and growing expectations around grid integration and sustainability. Nextracker's product offering in Europe focuses on addressing these needs through a targeted set of solutions. For example, **NX Horizon-XTR™** is designed for hillside and uneven terrain and reduces or eliminates the need for grading by adapting to land contours, preserving the natural landscape and reducing construction costs. Next, **TrueCapture™** is an intelligent tracking control system that enhances energy output by adjusting tracker angles based on site-specific conditions like cloud cover, terrain shading, and diffuse light. Its increased output supports grid stability. **NX Hail Pro™** is a predictive stow system that enables rapid response to hail events by moving modules to a steep stow position, reducing potential damage. Finally, Nextracker also provides cold weather solutions, engineering adaptations based on experience in Canada and northern Europe, designed to maintain performance and uptime in snowy and sub-zero conditions.

© Nextracker

These solutions are supported by Nextracker's local manufacturing partners and technical teams, allowing alignment with project requirements and responsiveness across the European market.

Industry challenges and perspective

As solar deployment scales across Europe in support of EU and national climate targets, developers face increasing complexity in delivering projects efficiently and reliably.

Recently, driven by high interest rates and low electricity prices, project economics especially have become more challenging, with many projects being put on hold or abandoned altogether. Here, PV power plants utilising tracking structures provide significantly increased value compared to fixed-tilt systems. In many European geographies, they can provide more than 30% additional value, due to a two-to-four-fold increase in energy generation in the morning and late afternoon hours, when electricity prices are higher. In this context, early-stage coordination, site-specific design strategies, and close engagement with local stakeholders, who often prefer innovative designs like tracking systems, are essential. Nextracker supports this process by collaborating with partners from the early stages of project planning through commissioning, helping projects adapt to local conditions while contributing to a more resilient and future-proof energy system across Europe.

Conclusion

More and more utilities, asset owners and IPPs recognise the significantly increased value which tracking systems can generate. Not only in sunny regions such as Spain or Greece, but also in Northern latitudes like the Baltics and Scandinavia where tracking systems have become more popular in recent years. Even in countries such as Germany, France and Poland, where traditionally fixed-tilt systems have been installed, tracking systems are now being evaluated and projects are being designed with them.

Nextracker's involvement in different types of utility scale projects reflects a broader commitment to enabling solar deployment in complex European contexts — through regional expertise, technical collaboration, and solutions adapted to environmental and regulatory challenges.

Allimex Green Power

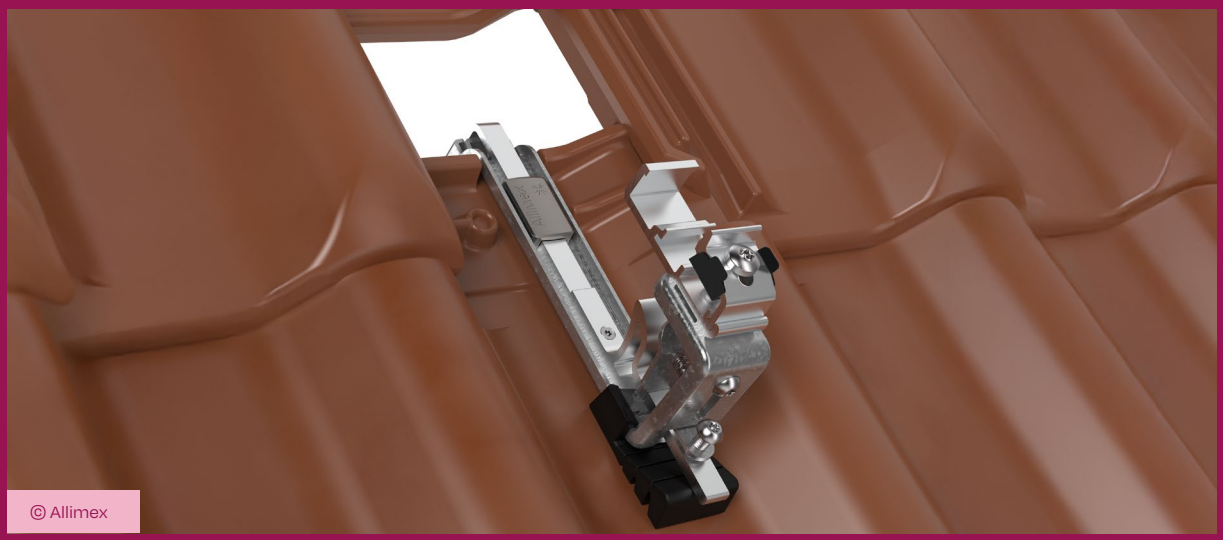
Founded in 2013, Allimex Green Power is a supplier of green energy solutions headquartered in Belgium. The renewable energy market is evolving rapidly, bringing both unprecedented opportunities and new challenges for installers and distributors.

Allimex Green Power offers a one-stop-shop service, supplying a full range of products, from solar mounting systems to solar panels, inverters and home batteries. Allimex's dedicated R&D department keeps it at the forefront of technological innovation, continually developing mounting solutions that are both robust and flexible, suitable for all types of residential and commercial PV installations.

Allimex mounting structures are easy to assemble, lightweight, corrosion-resistant, and customisable to different roofing systems and ground conditions. Whether flat roofs, pitched roofs, or ground-mounted projects, Allimex Green Power provides end-to-end support, from tailored design assistance to fast, flexible delivery logistics. In addition to its presence in Belgium and the Netherlands, Allimex has expanded operations to Spain, Italy, Germany, and Romania.

Solar projects in Europe developed with Allimex products

Project Hoorn



© Allimex

Allimex has been instrumental in advancing solar installation technology through several key projects across Europe. With a focus on innovation and reliability, Allimex has made strides in improving the efficiency and safety of solar energy installations.

The FastNSafe Roof Hook, developed by Allimex Green Power was selected for the Hoorn solar energy project in the Netherlands, commissioned by BAM Nederland. The FastNSafe roof hook is an innovative solution that combines durability, ease of use, and cutting-edge design, and was engineered to meet the growing demand for safe and efficient installation processes in the solar industry. The tool-free design of the FastNSafe hook enables installation in under 10 seconds, improving installation speed and reducing material costs by requiring up to 25% fewer hooks. The pre-assem-

bled design, which includes a filling rubber and cable clip, ensures a quick, secure, and safe mounting process, setting a new benchmark for safety and efficiency in solar installations.

Project Alba Iulia

In Alba Iulia, Romania, Allimex partnered with Delphi Electric to install a 70 kW solar system on the facade of an eco-friendly building. The project employed advanced chemically anchored studs, ALLiHOME pitched-roof profiles, and ALLiHOME clamps, ensuring a secure and robust attachment to the building's facade.

The chemically anchored studs guarantee stability even in complex structures, providing secure mounting in all weather conditions. Additionally, the ALLiHOME system, designed for durability and ease of installation, enables efficient solar panel integration while preserving the aesthetic appeal of the building's design. The main challenge in this project was adapting Allimex's mounting solution to a vertical surface, which differs significantly from usual flat and pitched roof installations.

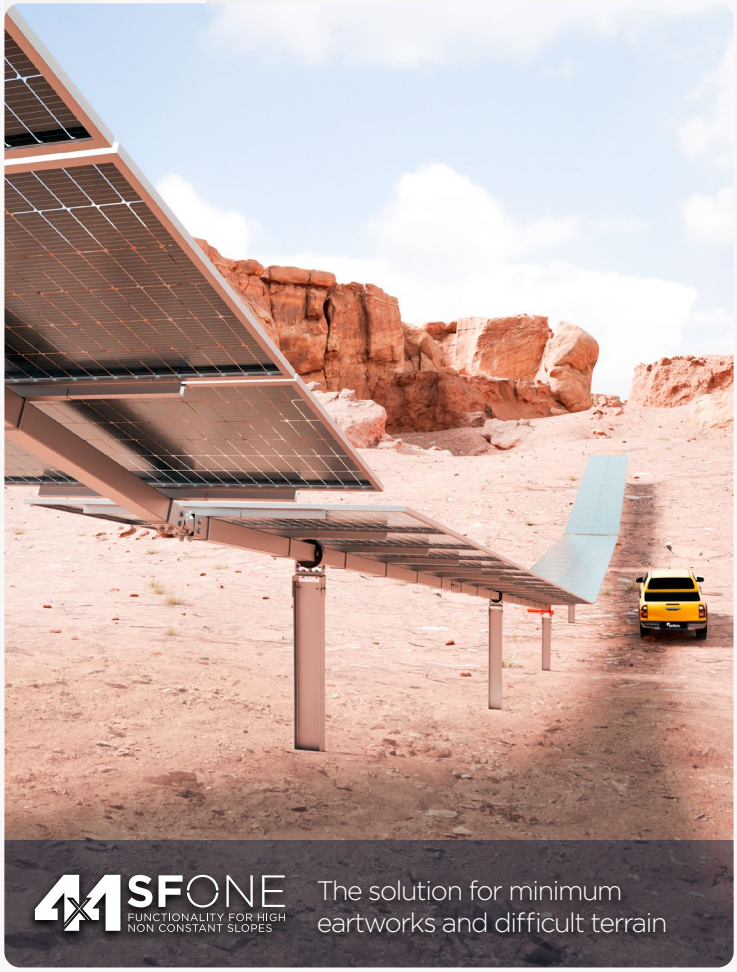
70 kW solar PV façade project, Alba Iulia, Romania

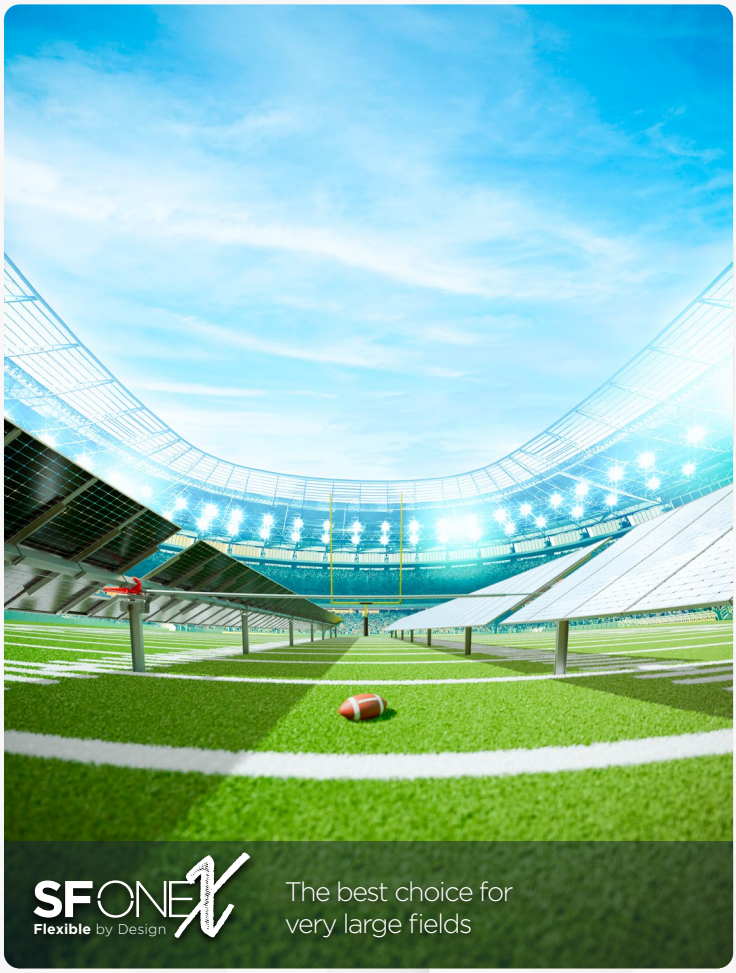
Market Insights and Challenges

Despite ongoing growth, the European solar sector is facing several structural challenges that are influencing its future development, such as an **oversaturation of installers, decreased customer trust and market uncertainty** after several governments cut support schemes launched during the energy crisis. Allimex Green Power addresses these challenges by focusing on partnership, innovation, and education. Allimex invests in long-term relationships with its customers, providing regular technical trainings, and maintaining its commitment to delivering quality products and services. By prioritising quality, flexibility, and customer support, Allimex helps strengthen the European solar sector for a sustainable future.

SFONE

SINGLE-AXIS TRACKER





THE ALL AROUND TRACKER

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