



TRAFFIX[®]

THE STATE OF

SOLAR LOGISTICS

How a changing supply chain is reshaping solar logistics across North America.

Solar continues to drive new power generation across North America. In the United States alone, a record 50 GW of new solar capacity was installed in 2024, followed by another 43.2 GW in 2025. Despite changing tax incentives and evolving trade policies, demand continues to grow as expanding data centers, electrification, and utility-scale development drive larger, more complex projects that require greater coordination across the supply chain.

Execution is where solar projects are won or lost. Success depends on more than moving equipment from one location to another. **This is where logistics expertise becomes critical:** coordinating modules, battery energy storage systems (BESS) inverters, trackers, transformers, and other essential components so they arrive at the right place, at the right time, and in the right sequence. As project schedules, site readiness, and other conditions continue to evolve, delays at any stage can increase costs, disrupt installation timelines, and impact overall project performance.

This white paper explores the logistics strategies that support successful solar project execution, including transportation planning, warehousing and inventory staging, supply chain visibility, and cross-border operations. It also examines the market forces reshaping solar logistics and provides practical guidance for building more resilient, efficient, and predictable solar supply chains.



THE STATE OF SOLAR LOGISTICS

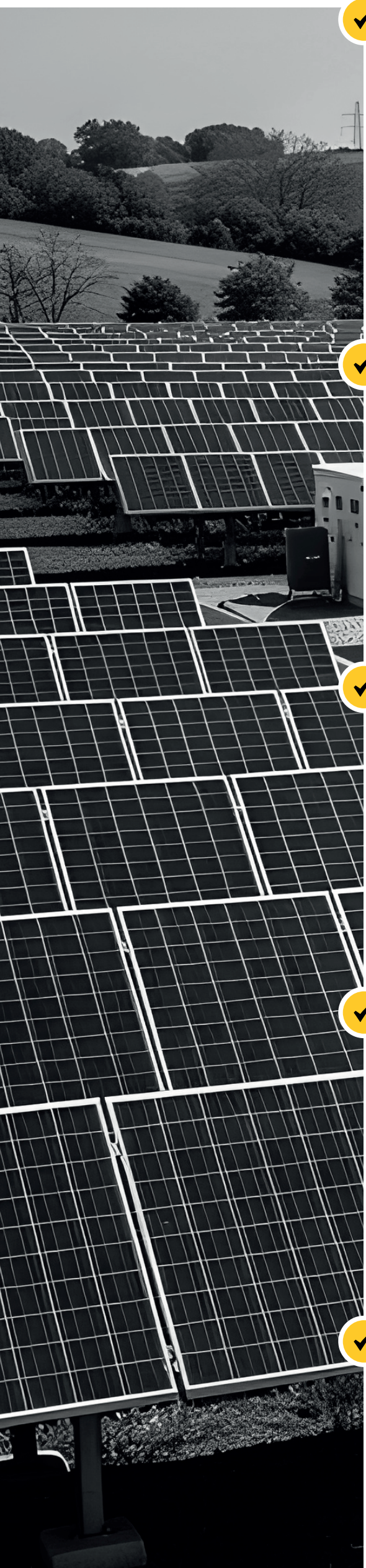
Unlike many industries that move freight through predictable distribution networks, solar logistics is driven by individual projects. Every installation has its own combination of suppliers, project schedules, site conditions, delivery windows, permitting requirements, and construction milestones. As a result, solar logistics strategies must be built around the unique requirements of each project rather than relying on standardized shipping patterns.

Solar logistics is driven by construction schedules rather than ongoing customer demand. Instead of replenishing inventory on a predictable cadence, logistics teams must coordinate large volumes of material to arrive within narrow installation windows. This requires careful planning across transportation, warehousing, inventory staging, and site readiness to keep projects moving safely and efficiently.

Beyond project execution, solar logistics is also being reshaped by broader industry trends. Evolving trade policies, stricter customs enforcement, expanding domestic manufacturing, and changing project economics are influencing how solar materials move across North America. Organizations that understand and adapt to these market forces will be better positioned to improve project execution, reduce risk, and build more resilient supply chains.

MARKET FORCES SHAPING SOLAR LOGISTICS

The solar industry is evolving rapidly, and logistics strategies must evolve with it. Changes in global trade, domestic manufacturing, project financing, regulatory compliance, and grid infrastructure are reshaping how solar equipment moves across North America. Understanding these forces allows organizations to anticipate disruptions, improve planning, and build more resilient supply chains.



Trade Policy and Global Sourcing

Trade policy has become one of the most significant factors influencing solar supply chains. **In 2025, the U.S. finalized anti-dumping and countervailing duties on solar cells and modules imported from Cambodia, Malaysia, Thailand, and Vietnam, prompting many manufacturers and developers to diversify sourcing strategies.** These changes affect more than procurement - they influence ports of entry, transportation routes, transit times, and overall network design. Organizations that maintain flexible logistics strategies are better positioned to adapt as sourcing patterns continue to evolve.



Customs and Supply Chain Compliance

Supply chain compliance has become an operational requirement rather than an administrative task. Under the Uyghur Forced Labor Prevention Act (UFLPA), solar products can be detained at the border if importers cannot demonstrate the origin of critical materials such as polysilicon. As a result, supplier traceability, country-of-origin documentation, and customs readiness must be established before shipments leave their point of origin. Delays at the border can quickly affect project schedules and installation timelines.



Domestic Manufacturing Expansion

Domestic solar manufacturing continues to reshape North American freight networks. According to the Solar Energy Industries Association (SEIA), **U.S. module manufacturing capacity grew by more than 50% in 2025, increasing from 42.5 GW to 65.5 GW as new facilities came online.** As manufacturing shifts closer to project sites, logistics strategies are also changing, with less reliance on international drayage and greater emphasis on regional truckload, LTL, and warehousing networks.



Project Economics and Material Timing

Solar developers continue to balance financing milestones, construction schedules, and evolving tax policies while managing project costs. These pressures often encourage earlier equipment procurement to secure pricing or maintain incentive eligibility, even when construction sites are not yet ready to receive materials. As a result, warehousing and inventory staging have become strategic capabilities that help bridge the gap between procurement and installation while reducing the risk of costly project delays.



Grid and Project Constraints

Transportation is only one factor influencing project schedules. Utility-scale solar projects must also navigate lengthy interconnection queues, limited availability of specialized labor, and extended lead times for critical equipment such as transformers and high-voltage switchgear. While logistics providers cannot eliminate these constraints, understanding them allows transportation and inventory strategies to better support overall project execution and reduce downstream risk.

HOW STRONG LOGISTICS STRATEGIES POWER SUCCESSFUL SOLAR PROJECTS

As solar projects continue to grow in size and complexity, logistics has evolved from a transportation function into a critical driver of project performance. Leading organizations recognize that successful execution begins long before the first shipment leaves a manufacturing facility. They align stakeholders early, confirm site readiness, establish clear communication protocols, and develop contingency plans before materials begin moving.

Execution is measured at the job site - not when freight arrives. A shipment delivered on schedule can still delay a project if the site is not ready to receive it or if installation activities have shifted. Materials may require temporary storage, equipment may need to be resequenced, and installation crews can be left waiting. Coordinating deliveries around actual construction milestones, rather than just transportation schedules, helps keep projects on track while reducing unnecessary costs.

High-performing organizations also distinguish themselves through visibility and consistency. End-to-end supply chain visibility allows project teams to identify and respond to potential disruptions before they affect construction schedules, while standardized logistics processes create more predictable outcomes across multiple projects. Together, these capabilities improve communication, reduce risk, and support more reliable project execution.

In today's solar industry, logistics is no longer measured solely by whether freight moved on time. Its value is measured by how effectively it supports construction, minimizes disruption, and helps projects reach completion safely, efficiently, and on schedule.

FIVE LOGISTICS PRIORITIES FOR SUCCESSFUL SOLAR PROJECTS

Delivering a successful solar project requires far more than moving freight from one location to another. Every shipment must support construction progress, site readiness, and project milestones. The strongest logistics strategies are designed around five priorities that help keep projects on schedule, reduce risk, and improve execution.

-  **1** **Deliver Materials When Construction Needs Them**
-  **2** **Protect High-Value Equipment**
-  **3** **Secure Reliable Transportation Capacity**
-  **4** **Align Transportation Planning with Site Readiness**
-  **5** **Maintain Visibility Across the Supply Chain**

Each priority is straightforward in principle but challenging to execute consistently across large, multi-phase projects. Together, they form the foundation of a high-performing solar logistics program.



1

DELIVER MATERIALS WHEN CONSTRUCTION NEEDS THEM

Unlike traditional distribution networks, utility-scale solar projects are driven by construction schedules rather than ongoing customer demand. A single project may require hundreds - or even thousands - of shipments to arrive within carefully planned installation windows. Delivering materials too early can create storage and inventory challenges, while late deliveries can delay construction and increase project costs.

Successful organizations coordinate transportation around actual construction milestones rather than simply shipping freight when it becomes available.

What this requires:

- ✓ Aligning transportation schedules with installation milestones
- ✓ Establishing inventory staging strategies before construction begins
- ✓ Developing contingency plans for transportation disruptions
- ✓ Maintaining clear communication between suppliers, carriers, and project teams



2

PROTECT HIGH-VALUE EQUIPMENT

Solar equipment represents a significant project investment, and each component presents unique transportation challenges. In solar, the most costly damage is often the damage you cannot see.

Vibration and improper handling during transportation can create microcracks within photovoltaic cells that may not be visible during a standard inspection but can reduce long-term module performance. For high-value or suspect module shipments, many organizations use unique testing methods such as electroluminescence (EL) testing upon receipt to identify hidden damage before installation.

Other components require different handling strategies, and this is where the expertise of an experienced solar logistics partner is essential. For example:

- Trackers are not moved to installation sites the same way as solar panels. Trackers are typically handled with flatbeds due to the size and weight of the commodity in contrast to panels that are transported via dry van.
- Central inverters, BESS Units, and transformers are heavy, high-value assets that often require specialized equipment and handling procedures.

What this requires:

- ✓ Working with carriers experienced in solar freight
- ✓ Following manufacturer loading and securement requirements
- ✓ Conducting pre-shipment and delivery inspections
- ✓ Establishing clear damage reporting and escalation procedures

**3**

SECURE RELIABLE TRANSPORTATION CAPACITY

Utility-scale solar projects often require dedicated transportation capacity over several months or even years. Transportation demand frequently increases alongside construction activity, creating regional capacity constraints and higher freight costs during peak building seasons.

Organizations that establish transportation partnerships early are better positioned to secure consistent capacity, improve service reliability, and reduce exposure to market volatility.

What this requires:

- ✓ Securing transportation partners early in the project lifecycle
- ✓ Building primary and backup carrier networks
- ✓ Forecasting transportation requirements well in advance
- ✓ Monitoring transportation market conditions throughout the project

**4**

ALIGN TRANSPORTATION PLANNING WITH SITE READINESS

A well-executed transportation plan cannot overcome a site that is not ready to receive materials.

Construction schedules change frequently due to weather, civil work, permitting, crane availability, or upstream project delays. Confirming site readiness before dispatch helps prevent congestion, unnecessary storage, repeat deliveries, and costly disruptions to installation schedules.

What this requires:

- ✓ Confirming site access requirements
- ✓ Validating unloading equipment availability
- ✓ Reviewing delivery appointment procedures
- ✓ Aligning deliveries with confirmed site-readiness milestones

**5**

MAINTAIN VISIBILITY ACROSS THE SUPPLY CHAIN

End-to-end visibility creates time to act.

Knowing where critical materials are - and identifying disruptions before they affect construction - allows project teams to adjust schedules, coordinate labor, and resolve issues before they become costly delays. Rather than reacting after problems occur, high-performing organizations use visibility to make proactive decisions throughout project execution.

What this requires:

- ✓ Establishing clear stakeholder communication protocols
- ✓ Providing end-to-end shipment visibility (ocean, port, and over-the-road tracking)
- ✓ Inventory visibility across all storage facilities
- ✓ Tracking project milestones and shipment exceptions
- ✓ Defining escalation procedures for potential disruptions

COMMON HIDDEN LOGISTICS RISKS IN SOLAR PROJECTS

Many of the biggest risks in solar logistics have little to do with transportation capacity. Instead, they stem from gaps in planning, coordination, communication, and visibility across the project lifecycle.

Common risks include:

- ✓ **Demurrage and detention charges** caused by delayed container pickup or return. For container-heavy module shipments, these costs can accumulate quickly but are often preventable through better scheduling.
- ✓ **Site congestion** when deliveries arrive before materials can be safely received or installed.
- ✓ **Temporary warehousing** costs created by changing project schedules or site-readiness delays.
- ✓ **Inventory visibility** gaps that make it difficult to confirm material availability.
- ✓ **Labor downtime** caused by delayed or incomplete deliveries.
- ✓ **Border delays** related to customs documentation or compliance requirements, including UFLPA enforcement.
- ✓ **Communication breakdowns** between suppliers, carriers, warehouses, and project teams.

High-performing organizations identify these risks early and incorporate mitigation strategies into their logistics plans before materials begin moving.



BUILDING RESILIENT CROSS-BORDER OPERATIONS

As solar supply chains become increasingly interconnected across North America, cross-border logistics has evolved from a transportation activity into a strategic capability. Successfully moving materials across international borders requires more than transportation planning - it demands proactive coordination, regulatory expertise, and end-to-end supply chain visibility.

One of the biggest changes affecting cross-border solar logistics is the increased scrutiny surrounding product origin and import compliance. Country-of-origin documentation, product classification, and supplier traceability now play a direct role in determining whether shipments move efficiently across the border or face delays, additional duties, or customs inspections.

That planning begins well before materials reach the border. Customs documentation, product classifications, compliance reviews, and shipment planning should be completed early to reduce the risk of unexpected delays. Because cross-border projects often involve manufacturers, customs brokers, carriers, warehouses, and project teams operating in different locations, clear communication and shipment visibility are essential for identifying issues before they affect construction schedules.

Resilient organizations also prepare for disruption. Border delays, changing trade requirements, weather events, and transportation capacity constraints can all affect material availability. Developing contingency plans - and maintaining access to alternative transportation, warehousing, and inventory strategies - helps project teams respond quickly when conditions change.

Many organizations also leverage bonded freight programs, Foreign Trade Zones (FTZs), and strategically located distribution facilities to improve inventory positioning, support project schedules, and increase supply chain flexibility.

Ultimately, resilient cross-border operations depend on more than moving freight across a border. They require integrated planning, regulatory expertise, proactive communication, and coordinated execution across the entire supply chain.

Learn More: For additional insights into customs planning, transportation strategies, and best practices for moving freight across North America, explore our **Mexico Cross-Border Logistics Guide**.





CREATING AN EXECUTION-READY LOGISTICS NETWORK

Solar project schedules are rarely static. Construction timelines shift, site readiness changes, and delivery requirements evolve throughout the project lifecycle. **To maintain momentum under changing conditions, leading organizations build flexibility into their logistics networks through strategic warehousing, inventory staging, and coordinated transportation planning.**

Recent changes in trade policy and project financing have also increased the need for flexible warehousing strategies. **Developers often procure modules and other critical equipment well before installation begins to manage sourcing risks, preserve project economics, or maintain construction schedules.** As a result, materials may arrive weeks or even months before project sites are ready to receive them. Short-term warehousing helps bridge the gap between procurement and installation, allowing organizations to coordinate deliveries, support phased construction, and reduce congestion at the job site. Inventory staging, title-transfer programs, and manufacturing overflow storage provide additional flexibility as project requirements evolve.

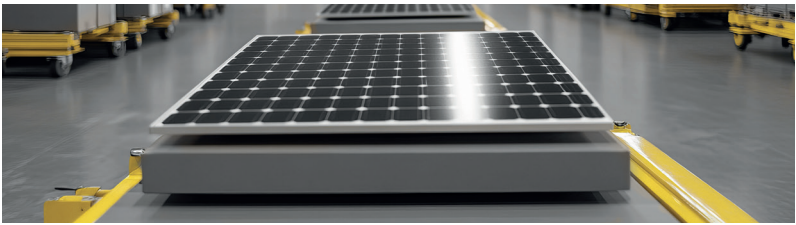
Once materials enter storage, visibility becomes just as important as available warehouse space. Project teams need accurate, real-time information about inventory levels, shipment status, and material availability so they can respond quickly to schedule changes and coordinate deliveries with construction milestones. Without reliable inventory data and timely reporting, even well-stocked facilities can become a source of delays and unnecessary complexity.

For this reason, organizations should evaluate warehousing partners on more than storage capacity alone. Inventory accuracy, reporting capabilities, shipment visibility, communication processes, responsiveness to changing project schedules, safety procedures, damage prevention, and experience supporting project-based operations all contribute to successful project execution.

Ultimately, an execution-ready logistics network is built on more than transportation and storage. It combines flexible warehousing, accurate inventory management, and end-to-end visibility to ensure materials are available when - and where - the project needs them most.

EVALUATING A TEMPORARY WAREHOUSING PARTNER

Not all warehousing providers are equipped to support the demands of utility-scale solar projects. Beyond storage capacity, organizations should evaluate whether a partner can provide the visibility, flexibility, and operational support needed to keep projects on schedule. When evaluating a temporary warehousing partner, consider the following:



- Inventory Management**
- Real-time inventory visibility and reporting
 - Inventory accuracy and cycle-count processes
 - Experience supporting project-based inventory staging



- Transportation & Distribution**
- Shipment tracking and transportation coordination
 - Cross-border and regional distribution capabilities
 - Manufacturing overflow and title-transfer services



- Operational Flexibility**
- Flexible storage terms ranging from 1-day to multi-year contracts
 - Ability to accommodate changing project schedules
 - Defined communication and escalation procedures
 - Experience supporting utility-scale, project-based operations

The right warehousing partner does more than store inventory. **They become an extension of the project team, providing the visibility, coordination, and flexibility needed to bridge the gap between procurement and installation while keeping projects moving forward.**

THE SOLAR LOGISTICS SUCCESS FRAMEWORK

Every solar project is different, but high-performing teams often share a common approach: they treat logistics as an integrated execution strategy rather than a series of separate transportation, warehousing, or delivery decisions.

Project success comes from aligning logistics capabilities around one goal: reliable execution from planning through final delivery. Five principles support that approach.

PRINCIPLE	EXECUTION FOCUS
Plan Proactively	Align stakeholders early, understand site requirements, and build contingency plans before freight moves.
Execute Transportation Strategically	Build reliable transportation networks that support project timelines and protect high-value materials.
Position Inventory Intentionally	Use warehousing and staging to create flexibility as project requirements change.
Maintain End-to-End Visibility	Give stakeholders the information they need to identify issues early and make timely decisions.
Align Deliveries with Site Readiness	Coordinate deliveries around site procedures, construction milestones, and operational realities.

Individually, each principle improves execution. Together, they create a connected logistics strategy that helps solar project teams maintain momentum, adapt when conditions change, and deliver more predictable outcomes.

PREPARING FOR THE NEXT GENERATION OF SOLAR LOGISTICS

As the solar industry matures, logistics responsibilities are expanding beyond project delivery to include end-of-life management. Solar panels, inverters, and other system components must eventually be removed, transported, processed, and recycled responsibly, creating growing demand for reverse logistics strategies that support asset recovery, regulatory compliance, and sustainable disposal.

Unlike new construction, end-of-life logistics requires coordinating equipment removal, transportation from operating sites, material segregation, and delivery to qualified recycling or recovery facilities. As recycling infrastructure and circular economy initiatives continue to develop, logistics providers will play an increasingly important role in helping organizations recover valuable materials while meeting environmental and regulatory expectations.

The future of solar logistics extends beyond moving equipment to a project site. Organizations that develop capabilities across the full lifecycle - from procurement and project execution to decommissioning and recycling - will be better positioned to support the next generation of solar development.

CONCLUSION: PREPARING FOR THE NEXT PHASE OF SOLAR GROWTH

Solar is expected to remain one of the fastest-growing sources of new power generation across North America, driven by continued investment in utility-scale development, electrification, and growing demand from data centers. As projects become larger and more complex, success will depend not only on demand, but on an organization's ability to navigate interconnection queues, labor and equipment constraints, evolving trade policies, and changing supply chain dynamics.

In this environment, logistics has become a strategic enabler of project execution. Organizations that integrate transportation, warehousing, inventory management, supply chain visibility, and cross-border operations into a single, coordinated strategy will be better positioned to adapt to changing conditions, reduce risk, and keep projects on schedule.

Ultimately, successful solar projects are built on more than engineering and procurement - they depend on executing the right materials, at the right place, at the right time, and in the right sequence. As the industry enters its next phase of growth, organizations that view logistics as a strategic capability rather than a transportation function will be best positioned to deliver reliable, predictable project outcomes.

Continue the Conversation: For additional insights into customs planning, transportation strategies, and best practices for moving freight across North America, visit www.traffix.com.