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The Untapped Returns of Targeted Solar Tracker Repowering



Why targeted tracker repowering is emerging as a compelling capital allocation decision

For much of the past two decades, the story of U.S. solar has been one of building: more projects, more capacity and more generation.

That story is far from over. But as the installed fleet grows and matures, another source of value is becoming increasingly important: ensuring all those operational project continue generation to their fullest potential and finding ways to get more from them.

The United States ended 2025 with approximately 279 GWdc of installed solar capacity, after adding another 43.2 GWdc during the year. Solar alone represented 54% of all new U.S. electricity-generating capacity added in 2025, while solar and energy storage together accounted for 79%. Utility-scale solar contributed 34.7 GWdc of the year's additions.

The impact is already visible in electricity production. U.S. utility-scale solar generated 296,000 GWh in 2025, up 34% year over year. Combined, utility-scale wind and solar supplied 17% of U.S. electricity; including small-scale solar raises that figure to 19%.

Yet those growth statistics tell only part of the story.

As new projects face increasingly complex paths to the grid, the generating capacity that is already permitted, financed, constructed and interconnected is becoming more strategically valuable. That changes the calculation around aging and underperforming solar plants. Keeping existing projects operating as close as possible to their achievable performance is no longer simply an O&M issue. It is an asset-value, infrastructure and system-capacity issue.

> When you look at how these plants are actually performing today compared to their first year of operation, not modeled projections, the picture is striking. More than 13 gigawatts of capacity are generating at least 10% less electricity today than they did in their first year of operation. Some of that is expected module degradation, but not all of it. The portion that is avoidable represents real, recoverable value for owners.
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> **Matt Schneider —** Strategic Advisor, Schneider Consulting

The grid constraint puts a premium on what is already built.

The scale of the U.S. development pipeline underscores the value of existing interconnections.

At the end of 2025, approximately 8,200 projects representing 2,061 GW of generation and storage capacity were actively seeking U.S. grid interconnection. That included 1,312 GW of generation, 749 GW of storage and 773 GW of solar.

But entering an interconnection queue is a long way from reaching commercial operation. For projects built in 2025, the median period between submitting an interconnection request and reaching commercial operation had grown to more than five years. Of the capacity that entered queues between 2000 and 2020, only 13% had reached commercial operation by the end of 2025; 75% had withdrawn.

Even projects that have advanced further face a substantial wait. Some 549 GW of capacity had obtained a draft or executed interconnection agreement by the end of 2025 but had not yet entered commercial operation, including 256 GW of solar.

Against that backdrop, every operating solar asset possesses something increasingly difficult to replicate: a position on the grid.

That does not mean every aging project should be repowered or every percentage point of lost production can economically be recovered. It does mean that underperformance deserves closer scrutiny. When an operating plant produces less electricity than it reasonably could, the cost is not confined to forgone project revenue. Existing land, permits and interconnection capacity are also being underutilized.

The scale makes even small performance differences meaningful. As a simple illustration, 1% of today's roughly 279 GWdc U.S. solar fleet is equivalent to approximately 2.79 GWdc of nameplate capacity, demonstrating why incremental performance improvements across a large installed base matter.

Similarly, 1% of 2025 utility-scale solar generation represents approximately 2.96 TWh of annual electricity generation.

The implication for owners is clear: alongside the continued race to build new capacity, the industry has a growing incentive to protect and optimize the capacity it has already fought to put on the grid.

> An operating solar plant has two connection points that are hugely valuable. First, an interconnection agreement that allows it to export to the utility grid. Second, a conditional use land development permit that was issued for this plant to be built on this site. These two things took years to obtain – and you do not want to change them. Everything between those two connection points is available to upgrade or repower the site.
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> **Tobin Booth —** Board of Directors Member, OneEnergy

Aging does not have to mean accepting underperformance.

Some decline in PV performance is expected.

Research from the National Renewable Energy Laboratory indicates that PV modules typically degrade slowly, often at less than 1% per year, while recent lifetime research has found median degradation rates around the 0.5% range for multiple module cohorts.

That expected physical degradation is fundamentally different from avoidable performance loss.

A mature solar plant is a system, not simply a collection of modules. As projects age, performance can be affected by controls, motors, mechanical and electrical equipment, component obsolescence, maintenance challenges, unsupported technology and, in some instances, the exit of an original equipment manufacturer.

These issues can create a difficult diagnostic problem. Gradual deterioration may be interpreted as simply what happens to an older asset—even when part of the loss comes from a fault or limitation that can be addressed.

For asset owners and operators, the important question is therefore not simply, "*How old is this plant?*" It is: Is the asset performing as an asset of this age and configuration reasonably should?

Answering that requires owners to establish an expected performance baseline and understand the causes of any divergence from it. A plant experiencing normal module degradation calls for a very different response from one losing production because parts of its tracker system are unavailable, controls are outdated or critical components have become difficult to maintain. The distinction also has to be made at portfolio scale. A recurring 1% or 2% avoidable performance problem across multiple assets has very different implications from an isolated component failure at a single site.

> We studied a 100-megawatt solar plant near Sacramento, 12 years into a 25-year life. Thirty percent of the trackers were facing 45 degrees east. There aren't off-the-shelf products that can tell you total costs, but that plant was losing $1.1 million in revenue every year.
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> **Matt Schneider —** Strategic Advisor, Schneider Consulting

The cost of doing nothing changes over the asset lifecycle

Once an avoidable loss has been identified, the next question is economic rather than purely technical.

Lost production means lost revenue. Persistent underperformance can also affect the value and future financeability of an asset. For projects approaching refinancing or other capital decisions, the owner must be able to demonstrate not only historical operating performance but confidence in the plant's ability to perform through its remaining economic life.

The calculation is especially important for older projects that may retain attractive power purchase agreements. A megawatt-hour not generated under a valuable legacy contract may carry a different economic cost from the same shortfall at another plant.

Owners therefore need to weigh several paths:

- continuing to maintain the existing equipment;
- replacing specific obsolete or failure-prone components;
- modernizing controls or other subsystems;

- undertaking a broader repowering; or
- accepting the loss where intervention cannot deliver an adequate return

The right answer is highly asset-specific.

Remaining project life, contracted revenue, expected energy recovery, capital cost, ongoing O&M requirements, equipment availability and the value of the interconnection can all influence the decision.

This is also where one persistent misconception can distort the economics: repowering does not necessarily mean ripping out an entire tracker system and starting again.

In some cases, full replacement may be justified. In others, targeted changes to controls, motors or individual components can address the underlying problem at materially lower cost and with less disruption. The business case can look very different once the intervention is matched to the actual failure rather than to an assumed solution. This targeted-versus-full-replacement distinction is a central theme of the underlying lifecycle discussion. In practice, targeted interventions on underperforming tracker systems have demonstrated payback periods of under two years, a fraction of a project's operating life.

> You don't scrap your car when it breaks down on the side of the road—and you don't have to scrap your tracker when it breaks down either. We've worked with owners who believed their entire plant was beyond recovery and that they needed to replace slew drives, motors, and control systems across the board. But after a detailed assessment, what initially appeared to be a major mechanical failure often turned out to require only a controller replacement and targeted mechanical repairs.
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> **Jeffrey Lamb —** Vice President of Solar Hardware, Kinematics

Diagnose first. Repower second.

The most important principle for an owner evaluating an aging asset may also be the simplest: start with the problem, not the product.

Performance data can reveal that an asset has fallen below expectations, identify patterns of downtime and narrow the range of possible causes. But remote analysis does not always tell the full story.

As-built documentation may not perfectly represent what is in the field years later. Equipment may have been repaired, replaced or modified. Owners, asset managers and third-party O&M providers may each hold different pieces of the asset history. A physical assessment can therefore identify issues that would not be apparent from performance data alone.

A structured lifecycle intervention can move through several stages:

1. **Performance and technology assessment.**
   Establish what the asset should be producing, quantify the performance gap and identify the systems most likely to be responsible.

2. **Site assessment and field survey.**
   Verify actual site conditions and understand the condition, configuration and serviceability of the installed equipment.

3. **Define the intervention.**
   Develop a scope and bill of materials that address the diagnosed problem rather than defaulting to wholesale replacement.

4. **Validate where appropriate.**
   For significant interventions, a pilot can help verify expected performance improvements and installation assumptions before portfolio-wide deployment.

5. **Install, test and commission.**
   Execute the project and establish that the upgraded system is delivering the intended operating result.

That diagnosis-led process reflects the discussion guide's intended progression from performance data and physical assessment through scope definition, installation, testing and commissioning.

It can also reveal opportunities beyond the issue that originally triggered the investigation. A field survey undertaken to diagnose tracker availability, for example, may identify other maintenance or optimization opportunities that improve the long-term asset strategy.

> Not every IPP wants to hold a project for 20 to 40 years. Regardless, spend the money up front to prepare for years 5, 10, 15, and 20. If you do end up wanting to sell, that spare parts inventory and documented maintenance strategy is still extremely valuable capital that transfers to the next ownership group."

Patrick Allen — Vice President of Asset Operations, Silicon Ranch Corporation

From reactive maintenance to lifecycle strategy

With U.S. solar capacity projected to continue expanding significantly over the coming decade, the population of mid-life and mature operating assets will grow with it. SEIA and Wood Mackenzie project U.S. solar capacity approaching 769 GWdc by 2036.

That means lifecycle performance will increasingly sit alongside new development as a core industry competency.

For owners, the objective should not be to repower every older plant. Nor should age alone be interpreted as evidence of a problem. Instead, asset management should become more proactive about three questions:

- **What performance should this asset be delivering today?** Owners need baselines that separate reasonable long-term degradation from avoidable loss.
- **What is the economic value of closing the gap?** The answer must reflect the plant's remaining life, revenue, financing position, O&M cost and increasingly valuable grid interconnection.
- **What is the minimum intervention required to achieve the objective?** An effective lifecycle strategy favors evidence over assumptions and targeted solutions where they offer the best return.

This shifts the industry away from two equally limiting extremes: maintaining obsolete equipment indefinitely because it is already installed, or assuming that correcting underperformance requires wholesale replacement.

Repowering is better understood as **one tool within a broader lifecycle strategy**—a strategy focused on maximizing performance, extending useful project life and improving long-term returns. That is also the central conclusion of the source discussion guide.

For an industry accustomed to measuring progress in newly installed gigawatts, the next phase of solar growth requires another measure of success: how effectively the gigawatts already connected to the grid continue to perform.

> The fundamentals are straightforward. Once a project is operational, its expected energy generation—and the revenue tied to that generation—is largely established. The challenge begins when both fall short of projections. Lower revenue compresses operating budgets, leaving owners with fewer resources to recover lost production. If that cycle continues for too long, restoring performance may eventually require a major capital investment.
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> This is where we operate: identifying and surgically addressing the specific issues draining a system's potential. Much like improving the energy efficiency of an existing building, you don't tear down every wall to upgrade the lighting—you focus on the components that need improvement. Applying that same targeted approach to solar tracker systems is complex, but it is often the smartest and most cost-effective solution.
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> **Josh Fraughton —** Founding CEO of RenuTrak and VP of North America Repowers at Kinematics

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