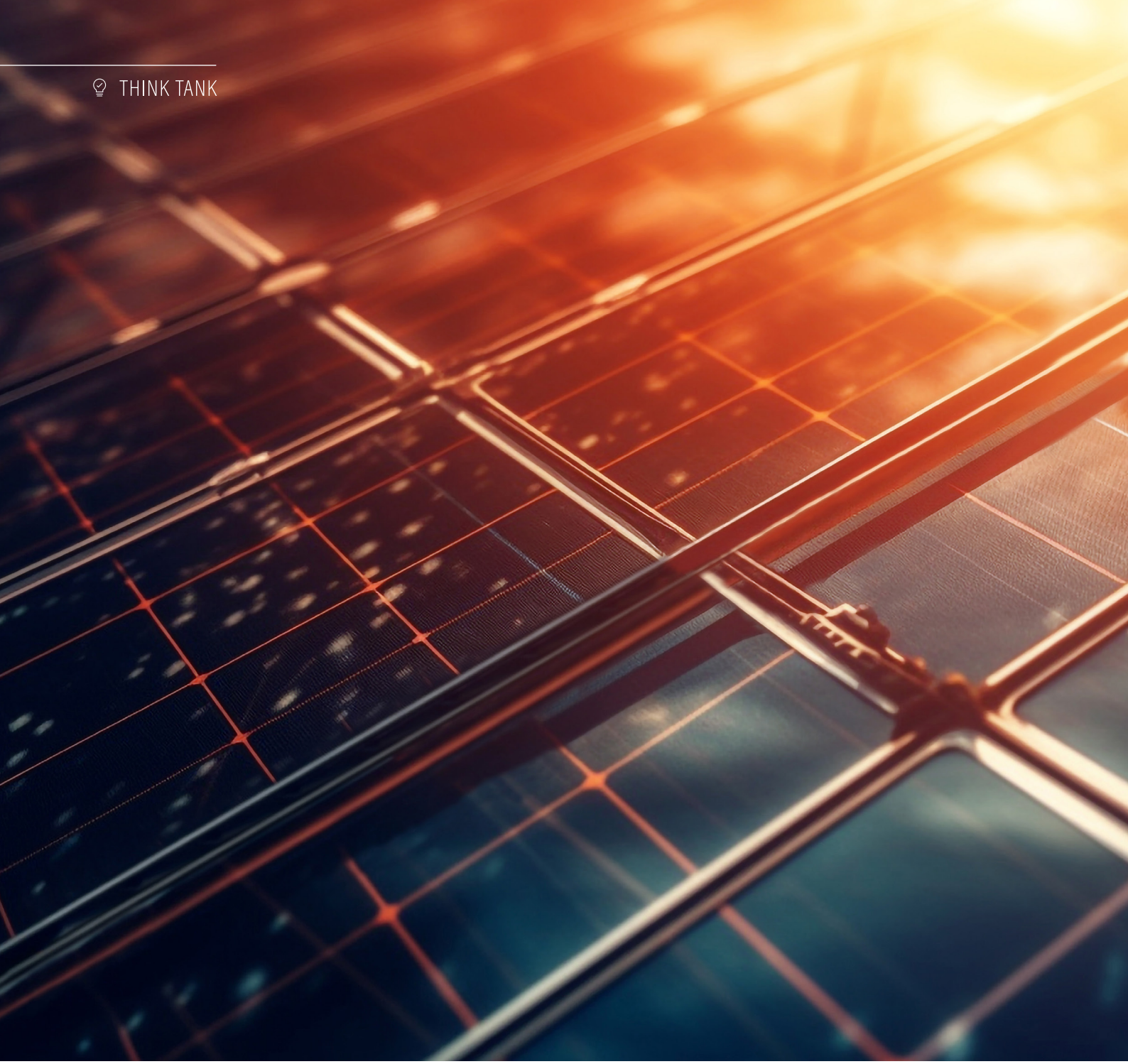


The shift to digital: are you keeping up?

Words: Karthik Yenduru, Technical Sales Manager at TGS

As solar and storage assets scale, ensuring optimal performance is critical. With US solar projects underperforming by up to 13%, digital solutions like asset performance management are helping operators improve efficiency, reduce downtime and maximize returns.

The global energy landscape is shifting rapidly, with solar and energy storage technologies playing an increasingly vital role in the transition to a low carbon future. As these projects scale in size and complexity, their financial performance has become as critical as their sustainability benefits. Investors and asset owners now demand not just clean energy, but also maximum efficiency, reliability and long-term profitability.

Yet a major challenge persists. Research from kWh Analytics shows that US solar installations consistently underperform by 7% to 13%, depending on location. This performance gap is a significant concern, as even small inefficiencies can translate into substantial financial losses over time. While external factors such as weather patterns and equipment degradation contribute to these discrepancies, a major factor remains within the control of asset owners and operators: operations and maintenance (O&M).

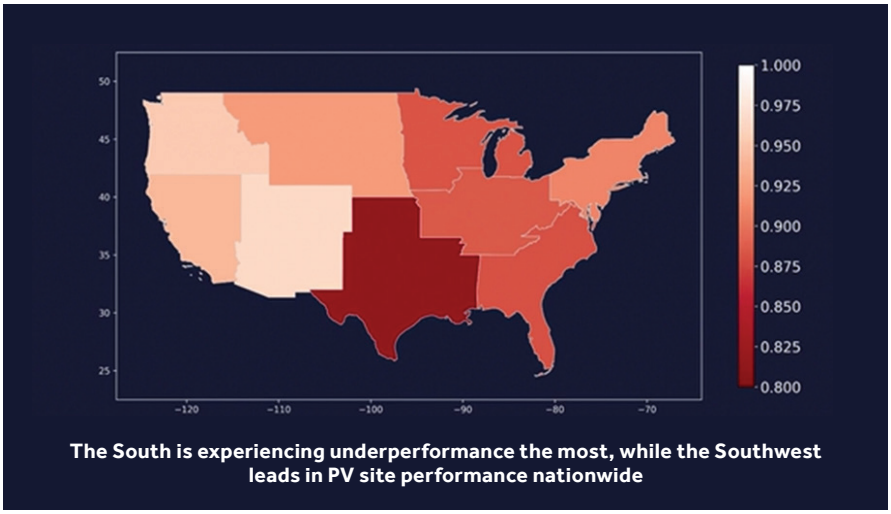
Traditional asset management methods, such as reactive maintenance and manual performance monitoring, are proving inadequate for the growing scale and complexity of modern solar and storage portfolios. The industry is at an inflection point, where digital transformation is no longer optional but essential. By using real-time monitoring, predictive analytics and centralized decision making, asset managers can unlock new levels of efficiency, minimize downtime and ensure their assets deliver optimal returns.

The rise of the digital asset management ecosystem

The days of relying on spreadsheets, fragmented software and siloed decision making are fading fast. Digital asset management has emerged, enabling energy companies to take a data-driven approach to asset performance and financial planning. This transformation is being driven by a new generation of digital tools that integrate multiple functions into a seamless and intelligent ecosystem.

At the heart of this digital transformation are supervisory control and data acquisition (SCADA) systems, which provide real-time monitoring and control of solar and storage assets. SCADA collects vast amounts of data from inverters, sensors and meters, offering granular insights into system performance. But monitoring alone is not enough. This data must be transformed into actionable intelligence, which is where asset performance management (APM) solutions come into play.

APM platforms use artificial intelligence, machine learning and advanced analytics to detect anomalies, predict failures and optimize operations. Unlike traditional monitoring systems that only flag issues once they have occurred, APM enables asset managers to identify potential problems before they lead to costly downtime. By continuously analyzing performance trends, APM helps to maximize energy yield, reduce maintenance costs and extend asset lifespans.



The South is experiencing underperformance the most, while the Southwest leads in PV site performance nationwide

Courtesy of kWh Analytics

Beyond APM, modern asset management also incorporates specialized tools for thermographic inspections, meteorological forecasting, financial asset tracking and cybersecurity. Together, these digital solutions create an interconnected ecosystem that allows asset owners to optimize every aspect of their operations, from energy generation and storage to financial performance and regulatory compliance.

Why APM is mission critical

In the past, solar and storage assets were often managed with a reactive approach, waiting for faults to occur before taking corrective action. However, as the industry matures and competitive pressures increase, this approach is no longer viable. APM has emerged as the cornerstone of modern asset management, shifting operations from reactive to proactive and ultimately, predictive.

One of the most significant benefits of APM is its ability to maximize performance. By identifying inefficiencies in real-time and analyzing historical trends, APM enables operators to optimize energy production. Digital twins, virtual replicas of physical assets, are increasingly being integrated with APM systems, allowing for advanced simulations that reveal potential performance improvements[1]. Studies have shown that such integrations can enhance asset output by fine-tuning operational parameters based on real-world and simulated data.

Predicting and preventing failures is another critical function of APM. Traditional maintenance models often rely on fixed schedules, where inspections and repairs occur at predetermined intervals. This approach can be inefficient, as some components may require servicing sooner, while others may not need intervention at all. APM, powered by AI-driven analytics, allows for condition-based maintenance, where servicing is performed precisely when and where it is needed[2]. Market research indicates that predictive maintenance enabled by APM can reduce unexpected downtime by up to 50%, leading to significant cost savings.

Improved decision making is another key advantage. By consolidating real-time and historical data into a centralized platform, APM provides asset owners with a comprehensive view of system health, performance trends and financial metrics. This intelligence allows for more accurate forecasting, better resource allocation and improved investment decisions. Operators can proactively adjust strategies based on predictive insights, rather than reacting to issues after they arise.

Regulatory compliance is also a major consideration for asset managers. With stringent grid codes, environmental regulations and financial reporting requirements, tracking key performance indicators (KPIs) is essential[3]. APM simplifies compliance by automating data collection, monitoring regulatory thresholds and generating reports that meet industry standards. Research has shown that well implemented asset management strategies can significantly enhance compliance rates in solar PV systems, reducing the risk of penalties and operational disruptions.

Ultimately, APM drives profitability by reducing downtime, optimizing maintenance schedules and enhancing operational efficiency[4]. Studies have linked advanced asset management strategies with increased financial returns in renewable energy projects, demonstrating that digital solutions are not just an operational advantage but a competitive necessity.

Data quality: the foundation of predictive analytics

For APM to deliver meaningful insights, it must be powered by accurate, high quality data. Poor data quality can lead to false alarms, incorrect diagnostics and suboptimal decision-making. Ensuring data integrity is therefore a critical step in digital asset management.

Platforms like Prediktor PowerView™ address this challenge by implementing rigorous data validation processes. This includes preprocessing and consistency checks to synchronize data streams, outlier detection to flag anomalies and intelligent data reconstruction techniques that fill in missing values. By standardizing and integrating diverse datasets, these platforms provide a reliable foundation for predictive analytics, enabling operators to make informed decisions with confidence.

Reliable data also enhances energy loss estimations and root cause analyses, allowing operators to pinpoint inefficiencies with precision. With continuous monitoring and automated quality control, APM ensures that decision-makers have access to trustworthy insights at all times.

The future of APM

As solar and storage portfolios expand, the role of APM will only become more critical. What started as a tool for fault detection is evolving into a comprehensive platform for autonomous asset management. By integrating AI, cloud computing and edge analytics, APM solutions are becoming more sophisticated, enabling real-time optimization and adaptive control strategies.

One of the most exciting developments in APM is the rise of self-learning algorithms. These AI-driven systems continuously refine their models based on new data, improving their predictive accuracy over time. This capability is paving the way for autonomous maintenance, where digital platforms not only identify issues but also recommend and even execute corrective actions.

The integration of APM with battery energy storage systems (BESS) is another key trend shaping the industry. As storage assets become more prevalent, managing their charge-discharge cycles, degradation rates and market participation strategies requires advanced analytics. APM plays a vital role in optimizing energy dispatch, balancing grid interactions and maximizing revenue opportunities in energy markets.

Looking ahead, the renewable energy sector will increasingly rely on digital solutions to remain competitive. APM will continue to be the backbone of modern asset management, enabling operators to maximize uptime, minimize operational costs and future-proof their investments.

Digital integration is no longer a luxury, it's a necessity. Companies that embrace data-driven decision-making will not only achieve superior financial performance but also strengthen their resilience in an increasingly complex and competitive market.

https://www.tgs.com/solar

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