

Validating solar energy yield analyses: why methods matter more than ever



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Energy yield analysis (EYA) has always played a central role in solar project development. It underpins investment decisions, influences financing structures and ultimately shapes expectations around long-term project performance. But as the solar sector matures and competition intensifies, the scrutiny placed on EYAs has increased significantly.

Today, developers, lenders and asset owners are looking for more than just accurate forecasts. They want transparency, consistency and confidence that the assumptions underpinning an EYA can withstand real-world operating conditions over the lifetime of a project.

That is why validation methods have become more important than ever.

At its core, an EYA is still a prediction. It combines long-term meteorological data, equipment specifications, system design parameters and operational assumptions to estimate how much energy a solar project is expected to generate. However sophisticated the modelling software may be, the reliability of the outcome still depends heavily on the quality of the assumptions and data inputs behind it.

Validation provides the critical link between theoretical modelling and operational reality.

As the industry accumulates larger operational datasets and portfolios continue to expand globally, validation is evolving from a supplementary exercise into a fundamental part of delivering robust, bankable solar energy assessments.



Long-term irradiance datasets form the foundation of any solar energy prediction, yet different data sources can produce materially different outcomes for the same site. Validating meteorological assumptions is therefore essential to reducing financial risk and improving confidence in projected energy yields.

A common approach is cross-dataset comparison, where analysts evaluate multiple irradiance sources, including satellite-derived datasets, reanalysis products and ground-based measurements, to assess consistency and identify potential biases.

This helps determine whether a dataset accurately reflects the long-term solar resource at a particular location and whether certain sources systematically over- or under-estimate irradiance levels.

Where on-site ground measurements are available, they provide an especially valuable reference point. Correlating long-term satellite data with local sensor measurements enables analysts to identify seasonal deviations, directional biases or localised weather influences that may not be fully captured within broader datasets.

This is particularly important for projects located in complex environments such as coastal regions, mountainous terrain or high-altitude locations. In these areas, atmospheric conditions, aerosols and elevation effects can interfere with satellite algorithms and increase uncertainty within resource assessments.

Applying appropriate correction factors based on measured site data can significantly improve long-term accuracy and reduce uncertainty for investors and lenders alike.

Understanding the impact of losses

Loss assumptions can have a substantial impact on final energy predictions, yet they are often one of the most variable components within an EYA.

Soiling, shading, mismatch losses, degradation, clipping behaviour and equipment availability all influence system performance. Even relatively small inaccuracies in these assumptions can materially affect financial projections across the lifespan of a utility-scale solar project.

Validation, therefore, requires both comparison against industry benchmarks and analysis of real operational data where available.

Academic studies, manufacturer specifications, independent laboratory testing and industry reports provide useful reference points for expected loss ranges. However, portfolio operational data offers a much more powerful tool for understanding how systems perform in practice.

Using SCADA and monitoring data, analysts can examine actual soiling rates, seasonal clipping patterns, inverter downtime and degradation behaviour under real operating

Turning operational data into better predictions

One of the most valuable ways to validate an EYA is by benchmarking it against operational performance data from existing solar assets.

This allows analysts to compare predicted generation with actual measured output across portfolios operating in different climates, technologies and system configurations. By analysing results at various stages of the system, from DC generation through to AC conversion and grid export, it becomes possible to identify recurring trends or biases in modelling assumptions.

For example, a portfolio-wide review may reveal that inverter availability has consistently been overestimated, or that soiling losses have been underestimated in certain environmental conditions. Equally, it can highlight where assumptions have proven conservative, helping refine future modelling practices.

This process becomes increasingly valuable as technology continues to evolve. The rapid

adoption of bifacial modules, larger inverter architectures and newer module technologies such as n-type silicon means there is often limited long-term field data available when projects are first modelled. Operational benchmarking helps bridge that gap. Although caution should be exercised as projects using newer technologies may have fewer years available for validation. Nonetheless, careful data handling and scrutiny can help reduce errors and improve aspects of EYAs with these newer types of developments.

By comparing real-world performance against manufacturer guarantees, independent laboratory testing and academic studies, the industry can build a clearer understanding of how emerging technologies behave under different operating conditions. In turn, this allows future EYAs to become more accurate and representative over time.

Improving confidence in meteorological data

Meteorological uncertainty remains one of the largest contributors to overall EYA uncertainty.



conditions. This enables future EYAs to move away from generic assumptions and become increasingly calibrated to observed asset performance.

As solar portfolios continue to grow, this feedback loop between operations and modelling is becoming one of the industry's most valuable sources of insight.

Why model-to-model comparisons still matter

No modelling tool is perfect. Different platforms use different assumptions, algorithms and calculation methodologies, meaning results can vary even when analysing the same project design and meteorological dataset. Running parallel simulations across multiple tools can therefore be a valuable validation exercise.

Comparisons between platforms such as PVsyst, PlantPredict, System Advisor Model (SAM) and others can help identify differences in irradiance transposition models, shading calculations or loss assumptions that may otherwise go unnoticed. While this process does not necessarily determine which model is correct, it helps analysts understand where further scrutiny may be required.

Importantly, it also improves transparency. As investors and lenders place increasing emphasis on understanding modelling methodology, being able to demonstrate that outputs have been cross-checked between multiple approaches can strengthen confidence in the final assessment.

Quantifying uncertainty more effectively

Validation is not simply about achieving the closest match between predicted and measured values. It is also about understanding uncertainty and communicating it clearly.

Advanced statistical approaches are now playing a much larger role in solar analytics as

the industry seeks to quantify risk more rigorously.

Monte Carlo simulations, for example, would enable analysts to evaluate how uncertainty in key variables (such as irradiance, temperature or system losses) propagates through the model and influences overall energy predictions.

Similarly, back-testing historical EYAs against operational performance enables consultants to assess prediction accuracy across different climates, technologies and market conditions.

This is becoming increasingly important from a financing perspective. Lenders are not only interested in projected energy output but also in understanding the reliability and historical performance of the methodologies used to produce those projections.

As the sector matures, the ability to demonstrate long-term consistency and low bias across portfolios is becoming a key differentiator for technical advisors and consultants.

The future of EYA validation

The solar industry is entering a period when the volume of operational data available is transforming how EYAs are developed and validated.

Machine learning tools are beginning to support anomaly detection and improve loss modelling. Higher-resolution meteorological datasets are reducing uncertainty in solar resource assessments. Automated data pipelines are enabling continuous calibration of EYAs using live operational information.

At the portfolio level, advanced analytics are also enabling consultants to benchmark performance across hundreds of assets simultaneously, providing unprecedented visibility into technology behaviour and modelling accuracy.

However, while digitalisation and automation are improving analytical capability, engineering judgement remains essential.

Understanding why discrepancies occur, interpreting operational anomalies and determining appropriate assumptions still require technical expertise and practical experience. The most effective validation approaches combine sophisticated analytical tools with a deep understanding of how solar assets behave in real-world environments.

Building confidence through transparency

Ultimately, validation is no longer a secondary exercise performed after modelling is complete and requires continuous reassessment of all aspects. It has become a core component of delivering high-quality, bankable energy yield assessments.

As projects become larger, technologies become more complex and investors demand greater certainty, the industry must continue improving the transparency and robustness of its validation practices.

The next phase of solar development will be focused on performing accurate and robust yield assessments to enable the creation of reliable solar assets and secure clean energy for the future. The organisations leading this next phase will be the ones delivering assessments grounded in operational evidence, rigorous analysis and transparent methodologies.

In an increasingly competitive market, confidence matters as much as accuracy. And robust validation is what turns energy predictions into trusted investment decisions.

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Natural Power is an independent consultancy and service provider that supports a global client base in the effective delivery of a wide range of renewable projects, including onshore wind, solar, renewable heat, energy storage and offshore technologies.

It has a global reach, employing more than 550 staff across 12 international offices.

Its experience extends across all phases of the project lifecycle, from initial feasibility through construction to operations and throughout all stages of the transaction cycle.

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