# A data based assessment of solar project availability in the United States

**In the last few years, asset owners, asset managers, independent engineers and academics have reported underperformance across their solar asset portfolios as compared with pre-construction P50[1] energy production estimates. One potential contributing cause of this underperformance is overly aggressive availability assumptions in pre-construction estimates. The "market standard" availability assumption for solar projects in the US market is 99% and includes equipment and well as grid availability. Recent reports[2] have shown that 99% is achievable but not necessarily typical for solar projects, and Natural Power has conducted an independent availability audit of a portfolio of US projects, further validating these conclusions.**

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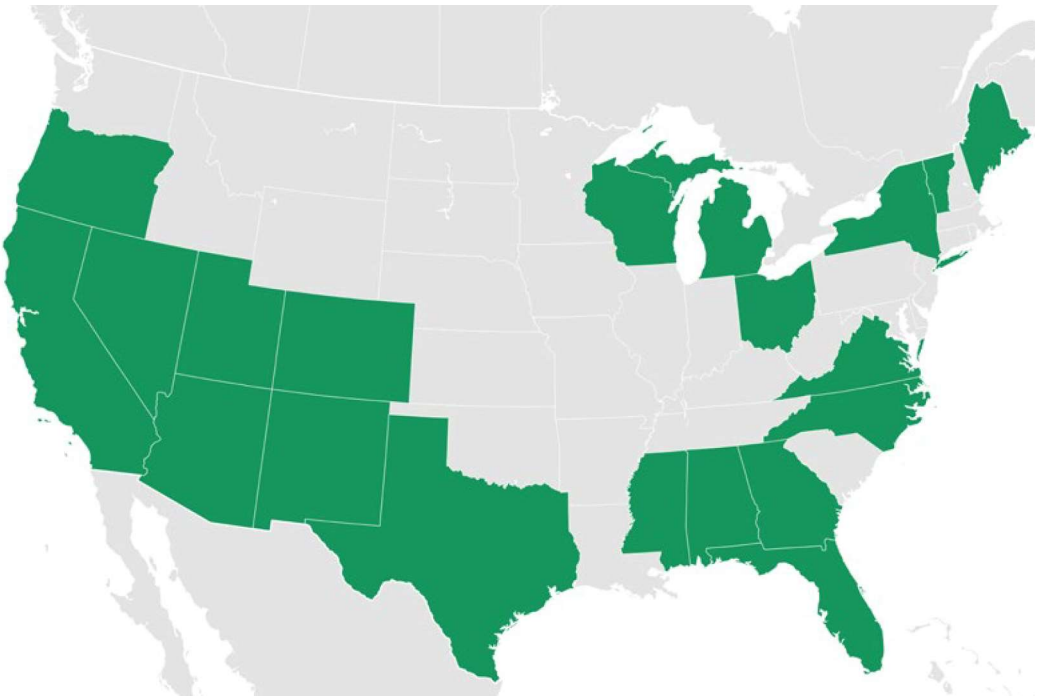
Natural Power evaluated the availability of a portfolio of 68 ground-mount solar projects totaling approximately 6 GWdc of capacity. The projects were spread across 22 states, sizes ranging from 20 MWdc to 300 MWdc, and commercial operation dates (COD) ranging from 2016 to 2021. The portfolio includes 11 operations and maintenance (O&M) contractors, 14 engineering procurement and construction (EPC) contractors, 10 module suppliers, 8 inverter suppliers, and 8 tracker suppliers. Collectively the portfolio includes approximately 1800 project-months of availability data.



**PORTFOLIO SUMMARY**

- 68 projects
- ~6 GWdc
- 22 states
- 20 MWac - 300 MWac
- COD 2016-2021
- 11 O&M contractors
- 14 EPC contractors
- 10 module suppliers
- 8 inverter suppliers
- 8 racking suppliers

**Figure 1:** Portfolio summary

[1] Fifty percent probability of exceedance (P50).
[2] ICF in the Solar Risk Assessment 2023. kWh Analytics.

Solar projects are known to experience "teething issues" in the initial stages of operation which is not necessarily representative of long-term operation. As such, Natural Power excluded the first 6 months of availability data of each project from this analysis. A Monte Carlo simulation was used to randomly select from the project-months of data available and generate 100,000 synthetic project-years. A Monte Carlo simulation was used here as the original dataset is limited to 1800 project-months, which translates to approximately 150 project-years. As such, high or low outliers could be biasing the results. A Monte Carlo simulation limits the impact of outliers and provides a better estimate of long-term availability trends.

The mean availability of each project-year was calculated and the distribution is presented in **Figure 2**. The distribution is non-normal primarily because the availability cannot exceed 100% but also because there are projects with low availability that are resulting in a long tail of low availability. A Weibull curve provides a better fit for the distribution, which is consistent with Natural Power's expectations. The majority of project years fall between 94.4% and 100%. The median availability is 98.2% and the mean is 97.7%. Additionally, the data shows that about 20-25% of the project-years fall above the "market standard" 99% availability.

## EVALUATING THE AVAILABILITY OF FUTURE PROJECTS

Evaluating the availability of an individual project before any operational data are available is challenging. Natural Power recommends reviewing the following categories when considering future availability for a project:

### Equipment Supplier and Technology

The equipment supplier's experience with providing products to the US market is an important factor in how the equipment will perform. Specifically, the equipment supplier should have a sizeable technical support team and appropriate warehousing for spare parts in the US as these two factors can determine how quickly failures can be addressed. Equipment that has a few years of field deployment data generally presents a more quantifiable failure risk than novel models of equipment. Natural Power recommends reviewing failure rates and/or warranty claim data for the individual models of equipment being deployed. However, the solar industry moves at a fast pace and it is not always commercially viable to deploy equipment with many years of field data. For newer generations of product, Natural Power recommends evaluating the individual changes made from the previous generations of equipment to determine the degree of risk associated with the new product.

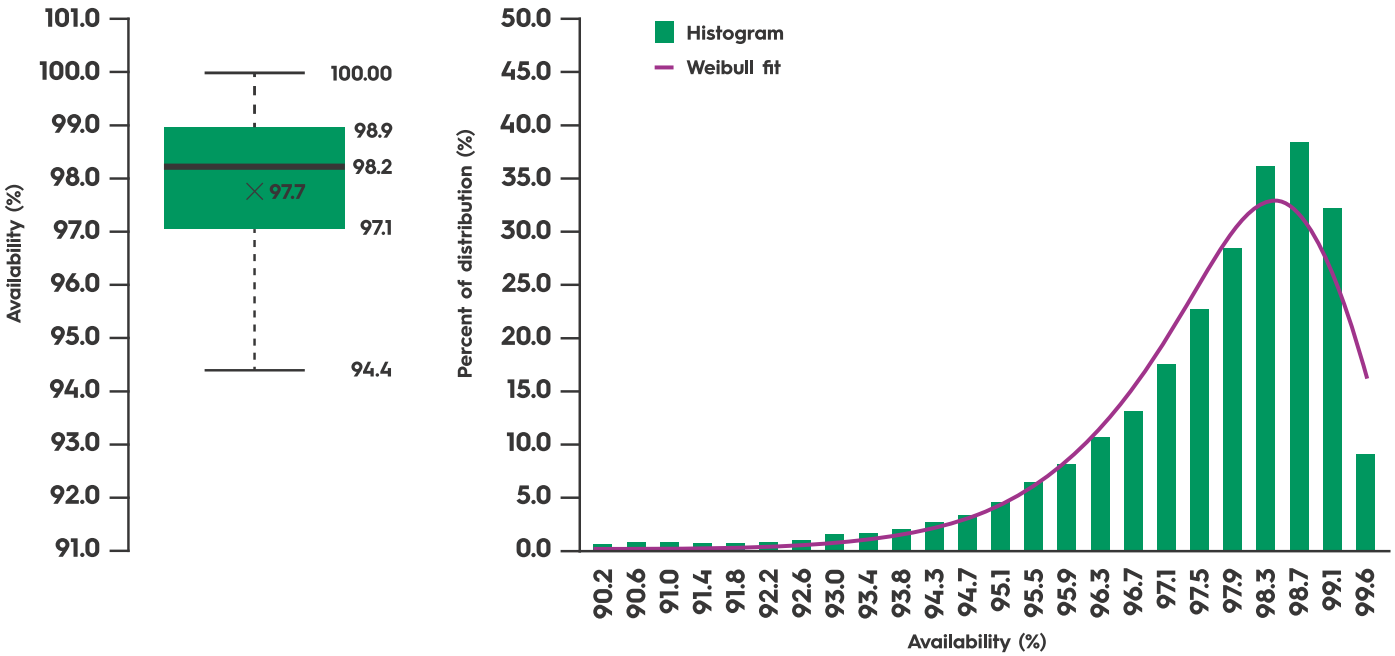



**Figure 2: Availability distribution of synthetic project-years**

### O&M Contractor, Scope and Budget

The O&M contractor should have experience with all of the pieces of equipment being deployed at the project. If the project is not staffed, they should have an appropriate presence of technicians in the project vicinity. Natural Power also recommends reviewing the O&M contractor's historical availability for other similar projects in the area. The scope of services in the O&M agreement should include comprehensive monitoring of the project as well as preventative maintenance measures that are consistent with industry best practices and manufacturer recommendations. If corrective maintenance is excluded from the agreement, additional funds should be included in the O&M budget with an active asset manager that is able to approve O&M task orders in a timely manner. For projects that are targeting to achieve availabilities above 99%, an availability guarantee with minimal exclusions and liquidated damages is a benefit. If it is not possible to include an availability guarantee, there should be stringent response time requirements that are consistent with the expected availability.

### Asset Manager

The asset manager's experience with similar projects and portfolio size can also drive project availability. Many projects are moving towards O&M agreements covering only preventative maintenance with additional budget included separately to be deployed by the asset manager as needed. In these cases, asset manager response times can impact the time to repair for failures.

## CONCLUSIONS

An availability audit was completed with monthly availability data from 68 projects totaling approximately 6 GWdc of capacity. The projects in the dataset were spread across 22 states, sizes ranging from 20 MWdc to 300 MWdc, and CODs ranging from 2016 to 2021. The dataset includes 11 O&M contractors, 14 EPC contractors, 10 module suppliers, 8 inverter suppliers, and 8 tracker suppliers. 1800 project-months of availability data was used to generate the mean yearly availability for 100,000 project-years. The results suggest that the "market standard" 99% availability assumption is achievable but not typical for most solar projects in the US market. The median project availability was 98.2% and the mean was 97.7%, with about 20-25% of the distribution above the "market standard" 99% availability assumption. When evaluating future project availability, Natural Power recommends considering the historical availability of the equipment to be deployed; the equipment supplier, O&M contractor and asset manager's experience; the O&M scope; and the overall O&M budget for the project.

***Natural Power would like to emphasize that the analysis presented in this paper is focused on the US market, and different availability trends may apply in other regions such as Europe.***

To find out more please contact:

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