PO.222

Optimising pre-construction energy yield analysis for operational budgets

Natural Power

Abstract

Perceived turbine underperformance based on pre-construction energy yield analysis has been a common theme across the industry. To rectify this, Natural Power has conducted a pre-construction methodology validation to determine the limitations of the pre-construction methodology and to incorporate these findings into producing a high quality energy yield product. Looking forward, Natural Power examines how wind farm energy budgets derived from pre-construction energy estimates, can allow for a better understanding and assessment of wind farm and individual turbine performance.

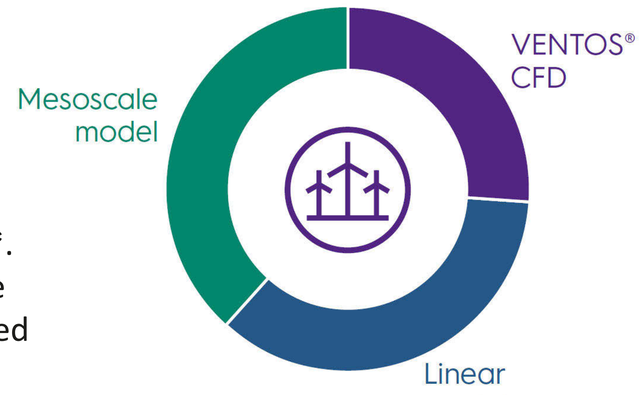
Methodology

42 operational wind farms were selected for this study. Pre-construction and operational analyses were conducted at each. The following describes a brief overview of each analysis.

Pre-construction

The sites were required to have finance-grade pre-construction data available. The pre-construction data were then analysed with no foresight of the operational data.

Three different spatial models were utilised based on site-specific climatic and terrain conditions. These included a linear model, a mesoscale model, and VENTOS®/2*. The pie chart shows the percentage of sites that each model was selected for.



Operational

Operational data were analysed and corrected for pre-construction estimates of availability to remove possible bias due to low first year availability. Two sets of results were produced. The first, long-term corrected to get a view of the expected long-term production of the farm; the second, a value produced for each individual year of operation, to identify the uncertainty related to the inter-annual variability. Each set of results was then compared into the expected pre-construction assessment.

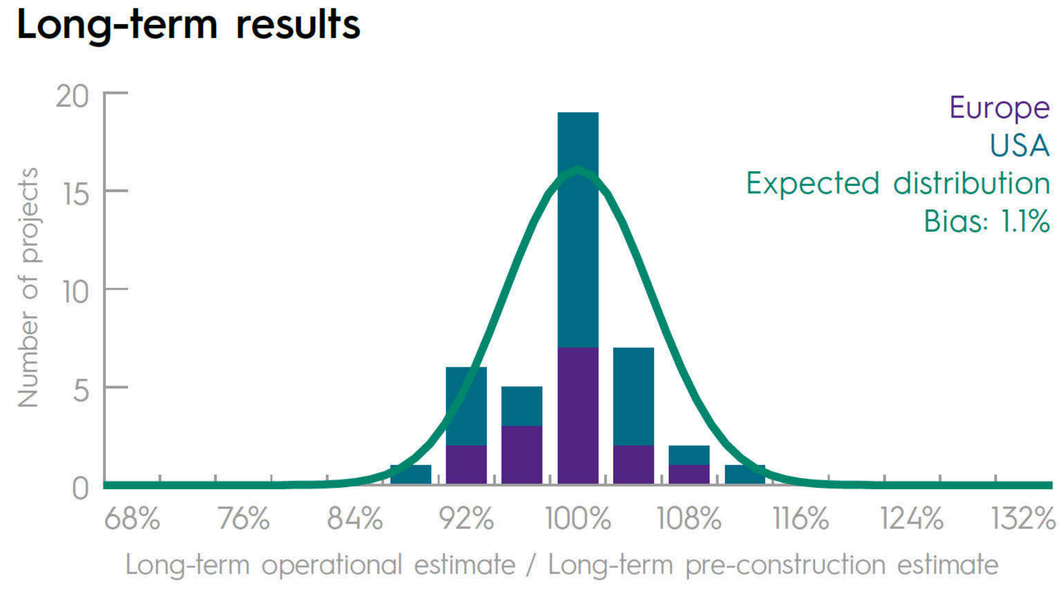
Sites

The sites analysed in the study consisted of a wide range of complexity across six countries. Below shows the statistics relating to the sites.

Number of projects	42
Number of WTGs	2309
Number of wind farm years	127
Total GWs	4.2

Results

The histogram below show s the results of the analysis. Positive results indicate a pre-construction over estimation.



Discussion

The results of the study show that the median bias is minimal for the long-term results. Outliers were analysed to determine probably causes. The following were determined to have a significant impact on the final result:

- Insufficient or unrepresentative meteorological campaigns
- Sites had both climatic and terrain complexities, resulting in two different spatial models being recommended
- Detailed forestry data during the pre-construction measurement campaign were not available leading to approximate tree height estimation

Recommendations

Based on the outcome of this assessment, the following are recommended to ensure accurate quantification of the long-term operational budget:

- Hub height measurements at locations representative of the proposed turbine layout
- Accurate forestry / terrain data
- Use of appropriate spatial model; on sites that have both climatic and terrain complexities consider VENTOS/M*, a mesoscale-coupled CFD model
- Detailed electrical loss calculations, curtailment requirements, and site specific power curves

* Developed by the Centre for Wind Energy and Atmospheric Flows, University of Porto under a joint venture with RES and Natural Power