

## New Innovation Demands Proven Validation

Vaisala's Wind Due Diligence methodology blends innovative technologies with standard best practices familiar to the industry. Advancing the science of wind resource assessment requires continuous evaluation, ensuring that each improvement adds value to the process. For that reason, Vaisala has embarked on a rigorous and ongoing validation study to provide the industry with a full understanding of the accuracy of our methods as well as evidence confirming our calibration with actual, operational production data.

### Current validation dataset details

- Size: 30 wind farms totaling 127 wind farm years (WFYs)
- Approximate project size range: 20 MW - 300 MW
- Mean bias error: +0.1%
- Standard deviation of error: 8.8%
- Geographic coverage: United States, with additional sites in Europe and Asia (Figure 1)
- 85% of WFYs between 2010-2014



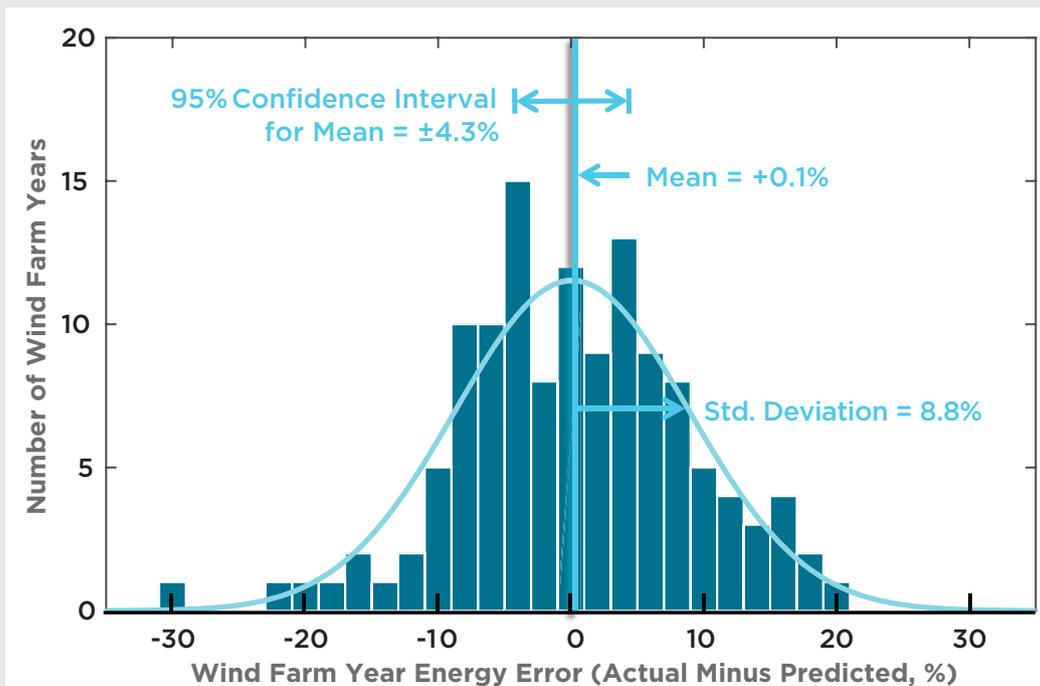
Figure 1. Approximate locations of the wind farms used in the validation study. Number in each circle indicates the number of wind farms included in the study from each region.

### Process

For each wind farm in the study, Vaisala performed our standard wind energy assessment process using available pre-construction data to create the key final numbers of mean annual net energy production in GWh and production uncertainty for any one year as a percentage. Monthly production data from each wind farm was gathered into groups of 12 consecutive months to create “wind farm years” (WFYs) of energy production.

## Results

In this study, the most critical and fundamental measurement of validity to uncover is whether, on average, Vaisala's estimate of mean annual wind energy production is unbiased, or calibrated, with respect to actual production. To demonstrate this we calculate the deviation between each production WFY and our pre-construction estimate of mean annual energy production and compile them as a histogram.



*Histogram of wind farm year energy errors (1-year actual minus long-term predicted, %). The vertical line shows the mean bias error (+0.1%). The bell curve shows the fitted normal distribution using the mean bias and standard deviation of errors. The interval at the top indicates the 95% confidence interval on the mean bias error.*

On average, wind projects performed 0.1% above Vaisala's pre-construction estimates. The mean deviation, though, is not statistically different from 0.0%, i.e. a bias of zero lies well within the 95% confidence interval. Thus, Vaisala 3TIER Services' wind energy assessment methodologies may be confidently used to estimate the expected generation of your wind farm.