

Wind Monitoring, Modeling and Analysis Services by WES Engineering Inc.

WES Engineering Inc. is able to offer complete wind measurement, monitoring, and analysis services to wind energy projects. This includes measuring wind using traditional pole mounted cup-anemometers, modeling of wind speed over the project area and predicting wind speeds and energy at each turbine location using WAsP modeling software, and optional Sound Doppler Radar (SODAR) or Laser Doppler Radar (LiDAR) mobile wind measurement at potential turbine locations.

Wind Measurement Towers (Met Towers):

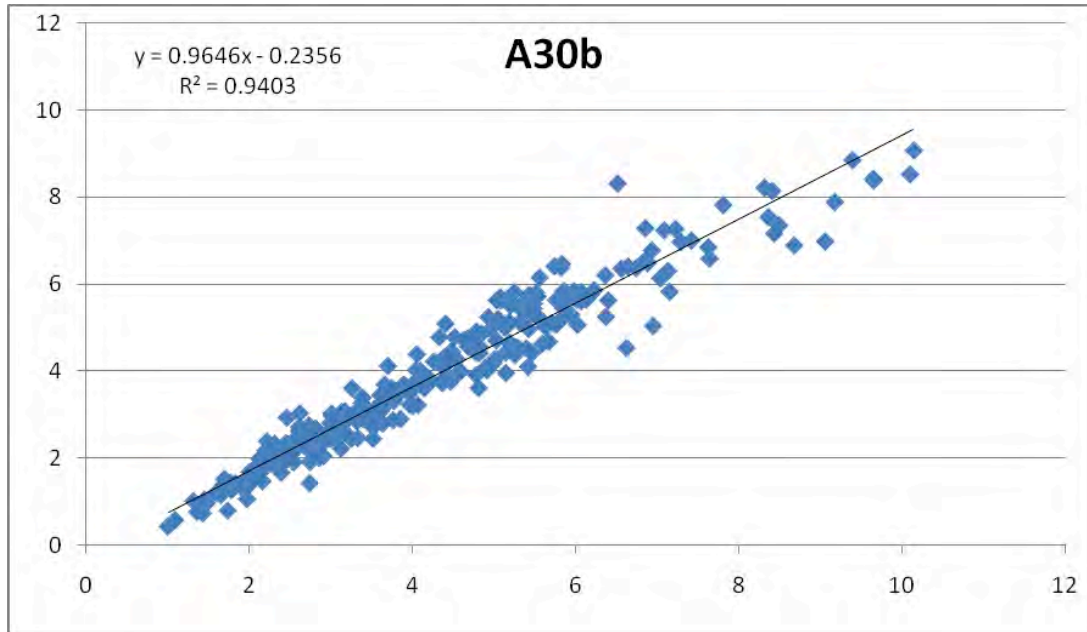
Met towers are the backbone of any wind measurement campaign. WES is experienced in managing installation and operation of both stand alone guyed wind measurement towers as well as installation of measurement equipment on nearby existing radio or cell towers.



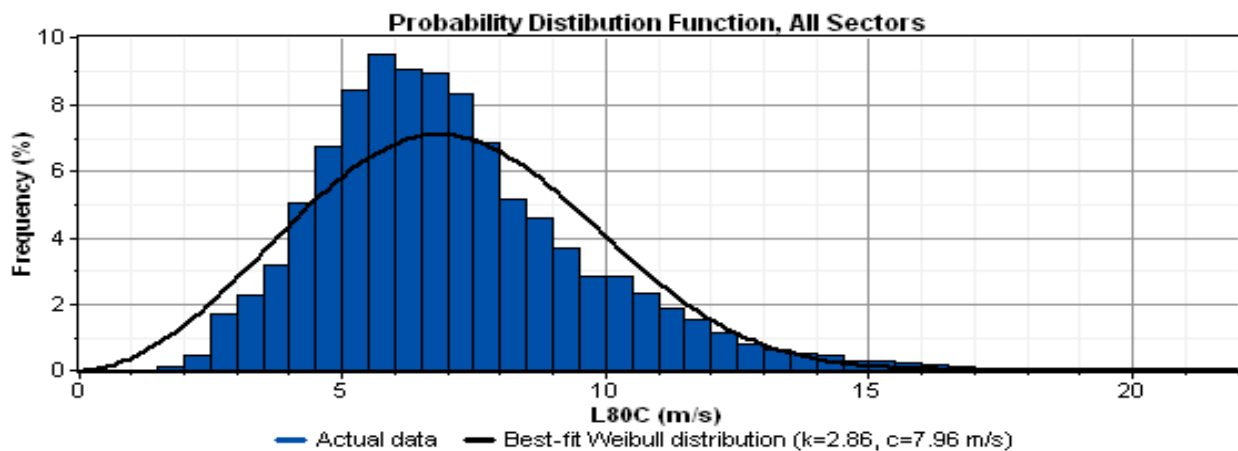
Wind Modeling and Analysis

WES staff use the industry accepted software tools and methods to analyze wind data, including Windographer for data cleaning and export to WAsP for wind flow modeling and wake loss calculations and Windfarmer for multiple turbine project output and Probability distribution (P50, P99) numbers used in project finance.

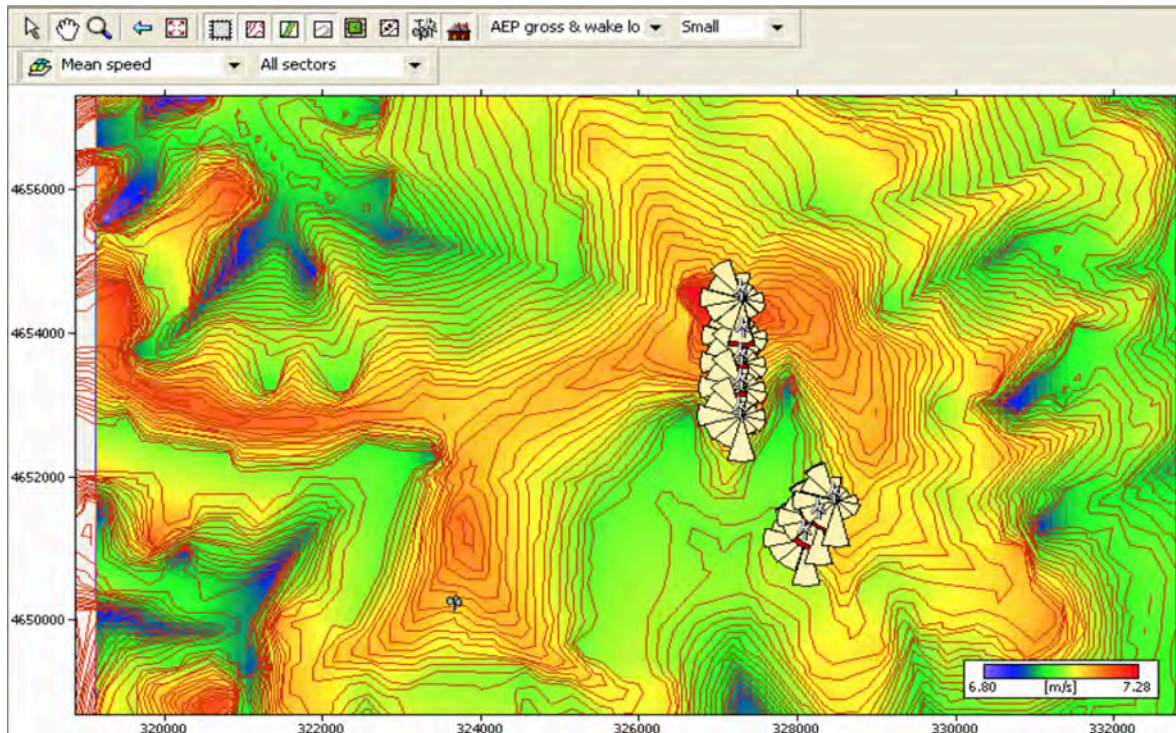
Correlation to nearby long term airport data set:



Wind Speed Distribution:

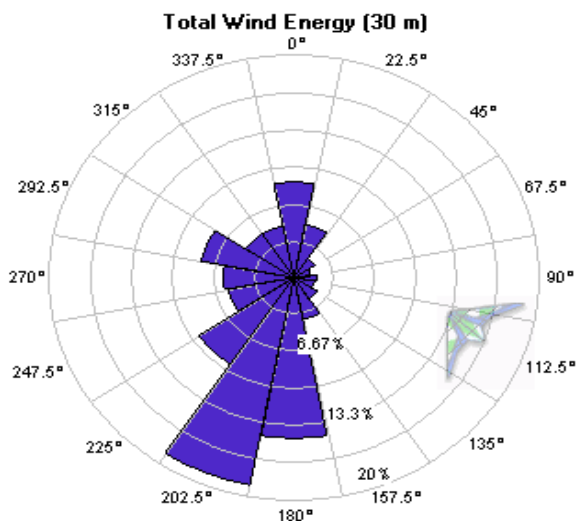


Wind Speed Modeling and Energy Estimates using WAsP and Windfarmer



Wind data is modeled across the project site and energy estimates are made that include the reduction in energy from nearby wind turbines (wake losses).

WES staff collect, remove data of poor quality, and analyze the data set to create a long term wind speed estimate that can be used for accurate energy estimates. We have successfully measured, predicted and verified results with operating turbines placed at modeled locations and operated for a year or more.



Percentile	Actual	Normal
	Distribution	Distribution
	kW	kW
P99		531.2
P95	558.5	550.9
P90	558.7	561.4
P75	574.3	579.0
P50	599.3	598.5
P25	608.1	618.0
P10	641.0	635.6
P5	651.7	646.1
P1		665.8

Wind Measurement with LIDAR and SODAR



SODAR uses sound signals sent up into the sky and reflected back to the receiver to measure wind speeds, and LIDAR operates on the same principle using light instead of sound. The unit is best operated in conjunction with on-site wind measurement equipment installed on a nearby tower. A temporary met mast can be added on the site near the SODAR if no additional cup anemometer (or similar) wind data and wind direction data is available.

Verification of Shear:

