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ALASKA ENERGY AUTHORITY

Typical 30-meter Met Tower Installation

Overview

The purpose of this document is to help you understand the terms and graphs used to describe wind data. This information is useful in determining the feasibilty of wind power systems at specific sites.

Measuring The Wind

The amount of power available in the wind at a given location depends on a number of factors, as shown in the equation below:

Power =
$^1/_2$ X Swept Area X Density of Air X (Velocity of Wind)^3

Swept Area
Different sizes of wind turbines have different lengths of blades. The swept area is the area that the blades cover as they rotate around the hub. The greater the swept area, the more wind the turbine captures and the more power it can produce.

Density
The density of air depends on both elevation and air temperature. The higher the elevation, the thinner (less dense) the air, this results in a lower power potential. Cold temperatures lead to denser air and a greater power potential.

Velocity
Since the power equation is multiplied by velocity three times, the velocity of the wind is the most important variable. This is why it is so important to accurately measure local wind speed.

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Why does measurement height matter?
Measurement height is an important factor when analyzing the data since wind speed generally increases with height above ground level. Data in Alaska is collected at various heights, usually 10, 20, or 30 meters, and occasionally at 50 meters.

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What is wind power density?
Since swept area varies depending on the wind turbine model, the power equation is normalized by area, resulting in power per unit area, or wind power density. Wind power density is a method of characterizing the power potential of sites without having to choose a specific wind turbine.

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Classes of Wind Power Density at 10 Meter Height

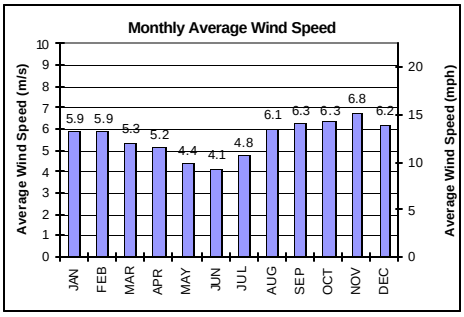
Wind Power Class	Wind Power Density (W/m^2)	Wind Speed Range m/s (mph)	Rating
1	<100	<4.4 (9.8)	Poor
2	100-150	4.4-5.1 (9.8-11.5)	Marginal
3	150-200	5.1-5.6.0 (11.5-12.5)	Fair
4	200-250	5.6-6.0 (12.5-13.4)	Good
5	250-300	6.0-6.4 (13.4-14.3)	Excellent
6	300-400	6.4-7.0 (14.3-15.7)	Outstanding
7	>400	>7.0 (15.7)	Very Outstanding

Source: AWEA, www.awea.org/faq/basicwr.html

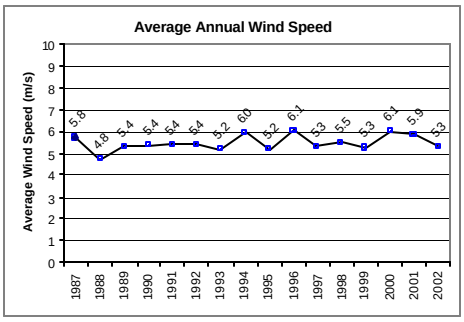
Graphs

The following describes how to interpret typical wind data graphs.

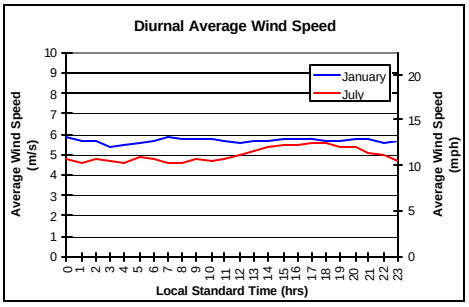
Wind speeds can change seasonally, as shown below. Many locations in Alaska are windier in the winter than the summer.



Wind speeds can change from year to year, as shown in the graph below. If wind speeds are only measured for one year in a specific location, it is important to compare that year with trends from a nearby weather station.

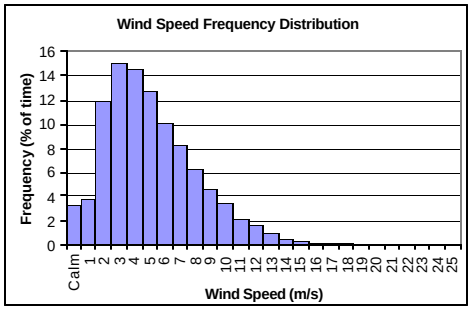


Wind speeds can change throughout the day. The graph below shows an average day in January versus an average day in July.

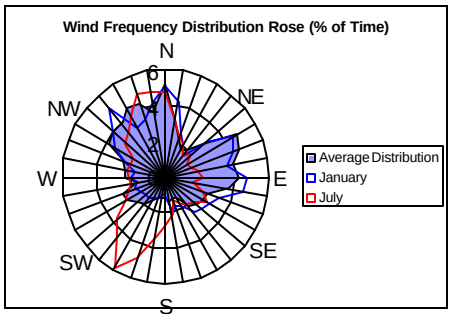


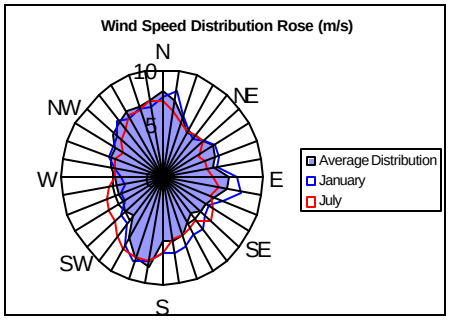
The next graph illustrates the percent of time per year the wind is blowing at various speeds.

If a wind turbine starts producing electricity at wind speeds above 4 m/s, it is important to know how many hours per year the wind blows above that speed.



The graphs below represent a compass and illustrate two factors used in determining wind turbine placement. The wind frequency rose illustrates the percent of time the wind comes from a given direction. The wind speed rose shows the average wind speed from each direction.





For More Information

Weather Data

- National Climatic Data Center: www.ncdc.noaa.gov/oa/ncdc.html

-National Weather Service: www.arh.noaa.gov/

General Wind Power

-Danish Wind Industry Association: www.windpower.org/en/core.htm