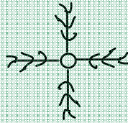
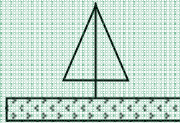
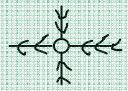
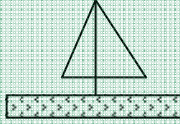
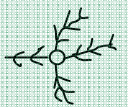
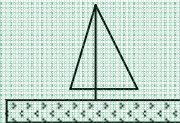

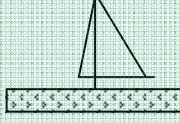

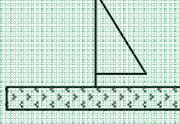

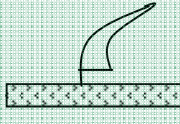

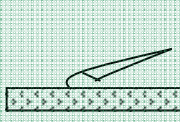

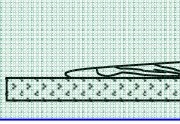


Estimating Wind Resources Using Visual References

The best way to estimate wind resources is to use actual measurements from an anemometer, wind maps, and data from nearby sources. For more information on these methods, visit our website: www.mariahpower.com. A cheap but less precise alternative is to use visual reference scales. This Info-Guide presents two of the most common tools.

Griggs-Putnam Index: This is based on permanent tree deformation caused by wind, and is useful for estimating the average wind speed in an area. It is scaled for use with true firs (Abies) in the Northeastern United States, but it is also relatively accurate for Douglas Fir and Ponderosa Pine. However, don't assume it will work for any conifer, since some trees are inherently stiffer than others. To use the scale, survey a set of trees (at least 5) in open terrain. The scale does not work for trees in a forest or protected by other geography or structures. Look at the degree of flagging (deformation) that is visible over at least 50% of the tree's height. Use the chart to find the approximate average wind speed, based on tree deformation.

Beaufort Scale: This gives land and sea conditions, as they correspond to wind speeds. This scale is for judging instantaneous wind speeds, not average wind speeds. By periodically spot-checking local wind speeds, and by knowing what is typical for your site, you should get a reasonable idea of your wind resources. Note that the sea conditions are for open water, not water along shorelines.

The Griggs-Putnam Index of Deformity				
Index	Top View of Tree	Side View of Tree	Description	Average Wind Speed
0			No Deformity	No Significant Wind
I			Brushing and Slight Flagging	7-9 Miles per Hour 3-4 Meters
II			Slight Flagging	9-11 MPH 4-5 m/s
III			Moderate Flagging	11-13 MPH 5-6 m/s
IV			Complete Flagging	13-16 MPH 6-7 m/s
V			Partial Throwing	15-18 MPH 7-8 m/s
VI			Complete Throwing	16-21 MPH 8-9 m/s
VII			Carpeting	22+ MPH 10+ m/s

Beaufort Scale

Beaufort number	Wind speed				Mean wind speed (kt / km/h / mph)	Description	Wave height		Sea conditions	Land conditions
	kt	km/h	mph	m/s			m	ft		
0	0	0	0	0-0.2	0 / 0 / 0	Calm	0	0	Flat.	Calm. Smoke rises vertically.
1	1-3	1-6	1-3	0.3-1.5	2 / 4 / 2	Light air	0.1	0.33	Ripples without crests.	Wind motion visible in smoke.
2	4-6	7-11	4-7	1.6-3.3	5 / 9 / 6	Light breeze	0.2	0.66	Small wavelets. Crests of glassy appearance, not breaking	Wind felt on face. Leaves rustle. Small vanes move.
3	7-10	12-19	8-12	3.4-5.4	9 / 17 / 11	Gentle breeze	0.6	2	Large wavelets. Crests begin to break; scattered whitecaps	Leaves, small twigs, small flag in constant motion.
4	11-16	20-29	13-18	5.5-7.9	13 / 24 / 15	Moderate breeze	1	3.3	Small waves.	Dust and loose paper raised. Small branches begin to move.
5	17-21	30-39	19-24	8.0-10.7	19 / 35 / 22	Fresh breeze	2	6.6	Moderate (1.2 m) longer waves. Some foam and spray.	Smaller trees sway.
6	22-27	40-50	25-31	10.8-13.8	24 / 44 / 27	Strong breeze	3	9.9	Large waves with foam crests and some spray.	Large branches in motion. Whistling heard in overhead wires. Umbrella use difficult.
7	28-33	51-62	32-38	13.9-17.1	30 / 56 / 35	Near gale	4	13.1	Sea heaps up and foam begins to streak.	Whole trees in motion. Hard to walk against the wind.
8	34-40	63-75	39-46	17.2-20.7	37 / 68 / 42	Gale	5.5	18	Moderately high waves with breaking crests forming spindrift. Streaks of foam.	Twigs broken from trees. Cars veer on road.
9	41-47	76-87	47-54	20.8-24.4	44 / 81 / 50	Strong gale	7	23	High waves (2.75 m) with dense foam. Wave crests start to roll over. Considerable spray.	Light structural damage. Chimney pots, slates, tiles removed.
10	48-55	88-102	55-63	24.5-28.4	52 / 96 / 60	Storm	9	29.5	Very high waves. The sea surface is white and there is considerable tumbling. Visibility is reduced.	Trees uprooted. Considerable structural damage.
11	56-63	103-119	64-73	28.5-32.6	60 / 112 / 70	Violent storm	11.5	37.7	Exceptionally high waves.	Widespread structural damage. Rare inland.
12	64-80	120	74-95	32.7-40.8	73 / 148 / 90	Hurricane	14+	46+	Huge waves. Air filled with foam and spray. Sea completely white with driving spray. Visibility greatly reduced.	Considerable and widespread damage to structures. Very rare inland.