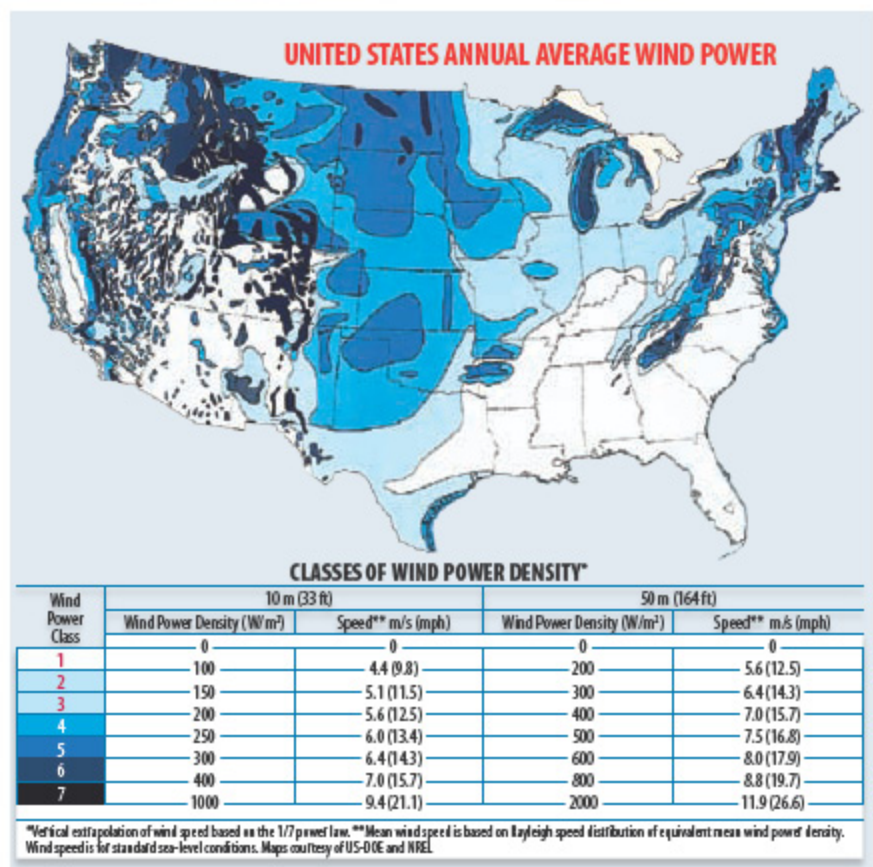# Estimating Wind Power

Several respected marine sources explain ways to mathematically compute potential output of a wind turbine. But for boats, this is a bit like estimating ETA without knowing how fast you are going. According to Betz's Law, you can convert 59 percent of the kinetic wind energy into mechanical energy using a wind turbine. Rotor diameter, air density, and generator efficiency (generally an average of about 20 percent) determine output. These bits of information might provide the basis for estimating output, were it not for the vagaries of the wind. The National Renewable Energy Lab maps wind power density (measured in watts per square meter) across the country and rates areas by class, the higher the rating, the better the site.

Locations with a minimum average annual wind of less than 11.5 miles per hour (5.1 meters per second), are considered poor. However, the data resolution on these maps is low, and wind speeds are typically sampled at 10 meters or higher. The map at right features annual averages. Numbers for the summer sailing season in some regions will obviously be lower. Even this very optimistic scenario reveals large sections of the coast as poor for wind power generation. With reliable output data from a specific wind turbine and close monitoring of a specific location, you can come close to guesstimating output, but honest, real-world reports from sailors cruising with a wind generator in your chosen locale are probably a more accurate guide.

UNITED STATES ANNUAL AVERAGE WIND POWER

CLASSES OF WIND POWER DENSITY*

Wind Power Class	10 m (33 ft)		50 m (164 ft)	
	Wind Power Density (W/m²)	Speed** m/s (mph)	Wind Power Density (W/m²)	Speed** m/s (mph)
	0	0	0	0
1	100	4.4 (9.8)	200	5.6 (12.5)
2	150	5.1 (11.5)	300	6.4 (14.3)
3	200	5.6 (12.5)	400	7.0 (15.7)
4	250	6.0 (13.4)	500	7.5 (16.8)
5	300	6.4 (14.3)	600	8.0 (17.9)
6	400	7.0 (15.7)	800	8.8 (19.7)
7	1000	9.4 (21.1)	2000	11.9 (26.6)

*Vertical extrapolation of wind speed based on the 1/7 power law. **Mean wind speed is based on Rayleigh speed distribution of equivalent mean wind power density. Wind speed is for standard sea-level conditions. Maps courtesy of US-DOE and NREL

SAILFLOW.COM 2006 MEAN WIND SPEED (MPH)													
MONTH	J	F	M	A	M	J	J	A	S	O	N	D	2006
PURDY, WASH.	7	6	7	5	5	5	6	4	4	4	9	4	5.5
NEWPORT, R.I.	15	15	15	14	13	12	11	10	13	11	13	13	12.1
POMPANO, FLA.	13	11	15	15	13	7	9	9	10	15	13	10	13.3
HAMPTON BAR, VA.	13	12	12	12	11	10	10	10	11	12	11	10	11.2

Data collected at specific locations near your favorite anchorage or harbor, like those above from www.sailflow.com, are more useful for estimating potential wind power than the NREL maps. However, both can lead to optimistic assumptions. The location of the anemometers where the data is collected is typically far more favorable than any anchorage or marina.