

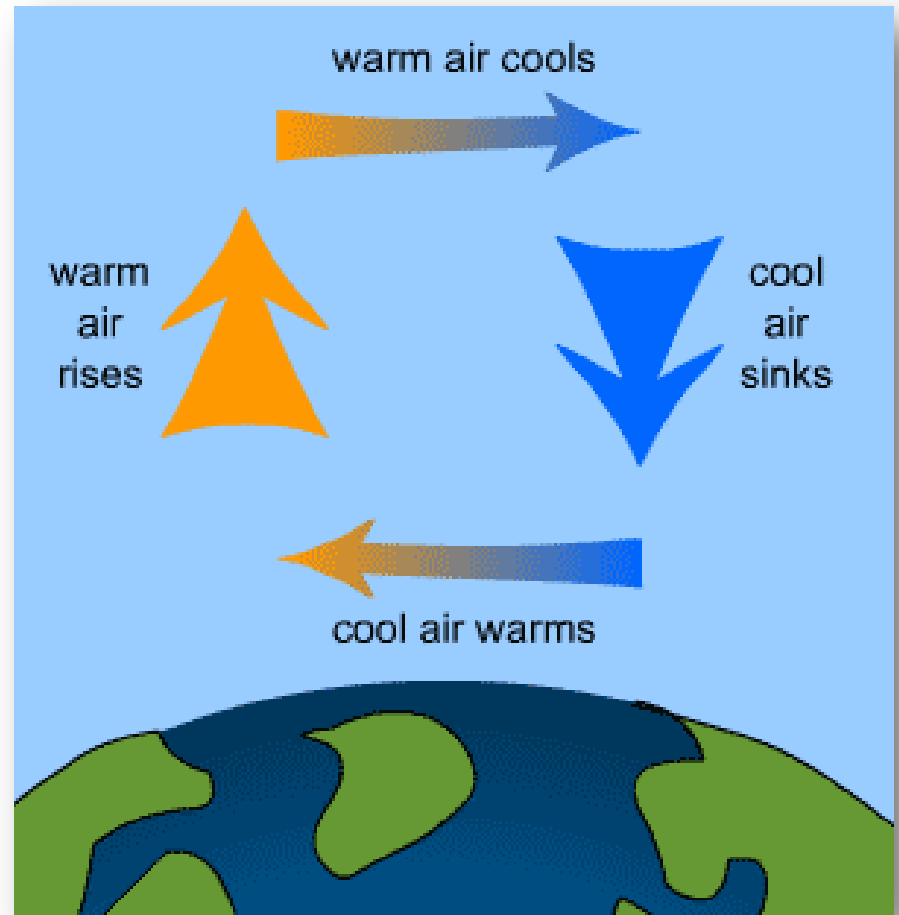
INTRODUCTION TO
WIND ENERGY

Outline

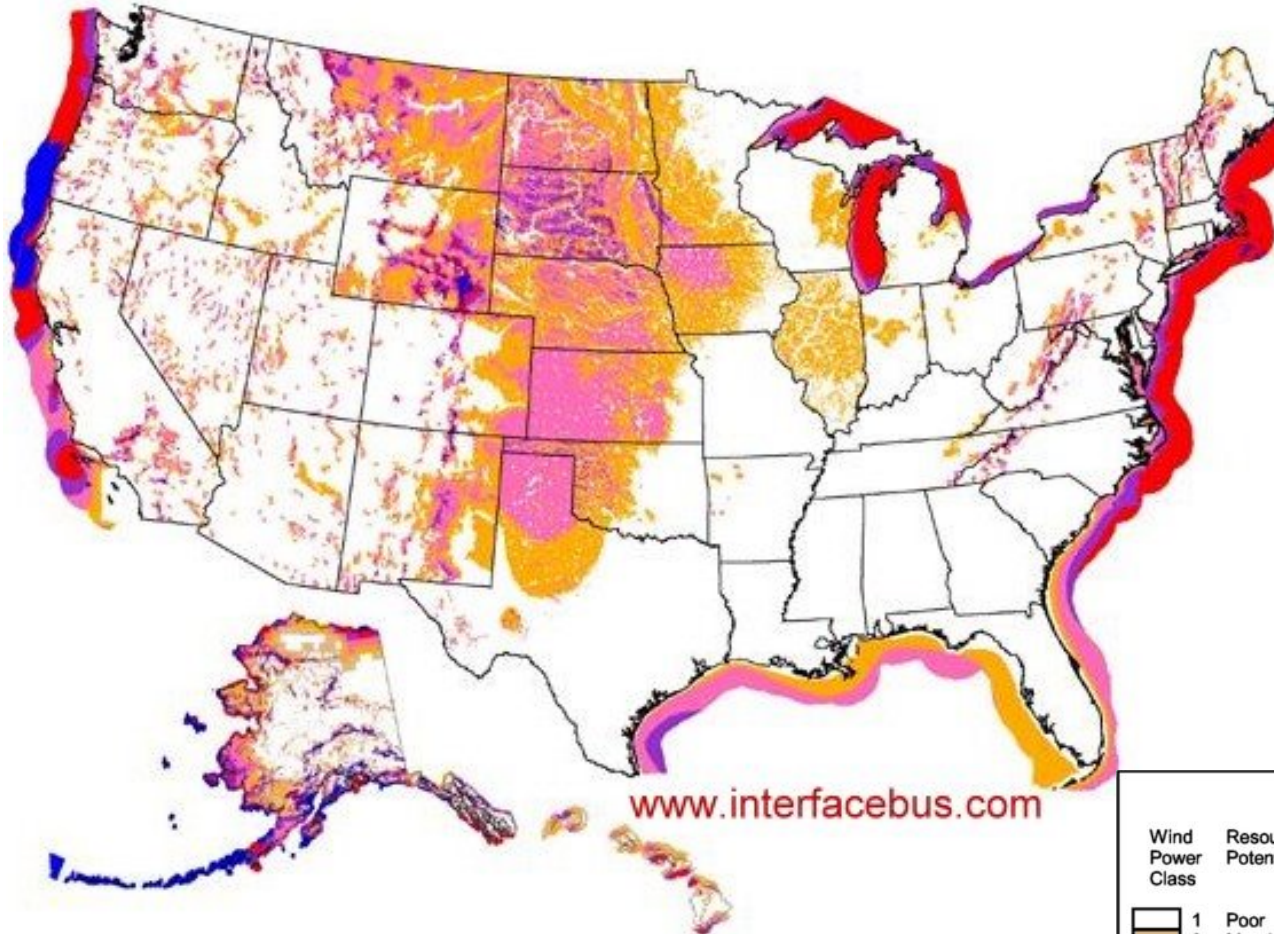
- How is wind created?
- Where is the wind?
- How do we measure the wind?
- How does a wind turbine work?
- What are the sizes of turbines?
- What size turbine goes where?
- How do you site a turbine?
- How much energy can we get?
- What are the pros and cons?

How is wind created?

- Temperatures vary according to the amount of sun it gets
- Uneven heating of the Earth's atmosphere and surface
- Balance between warm and cool air is constantly changing, creating wind.



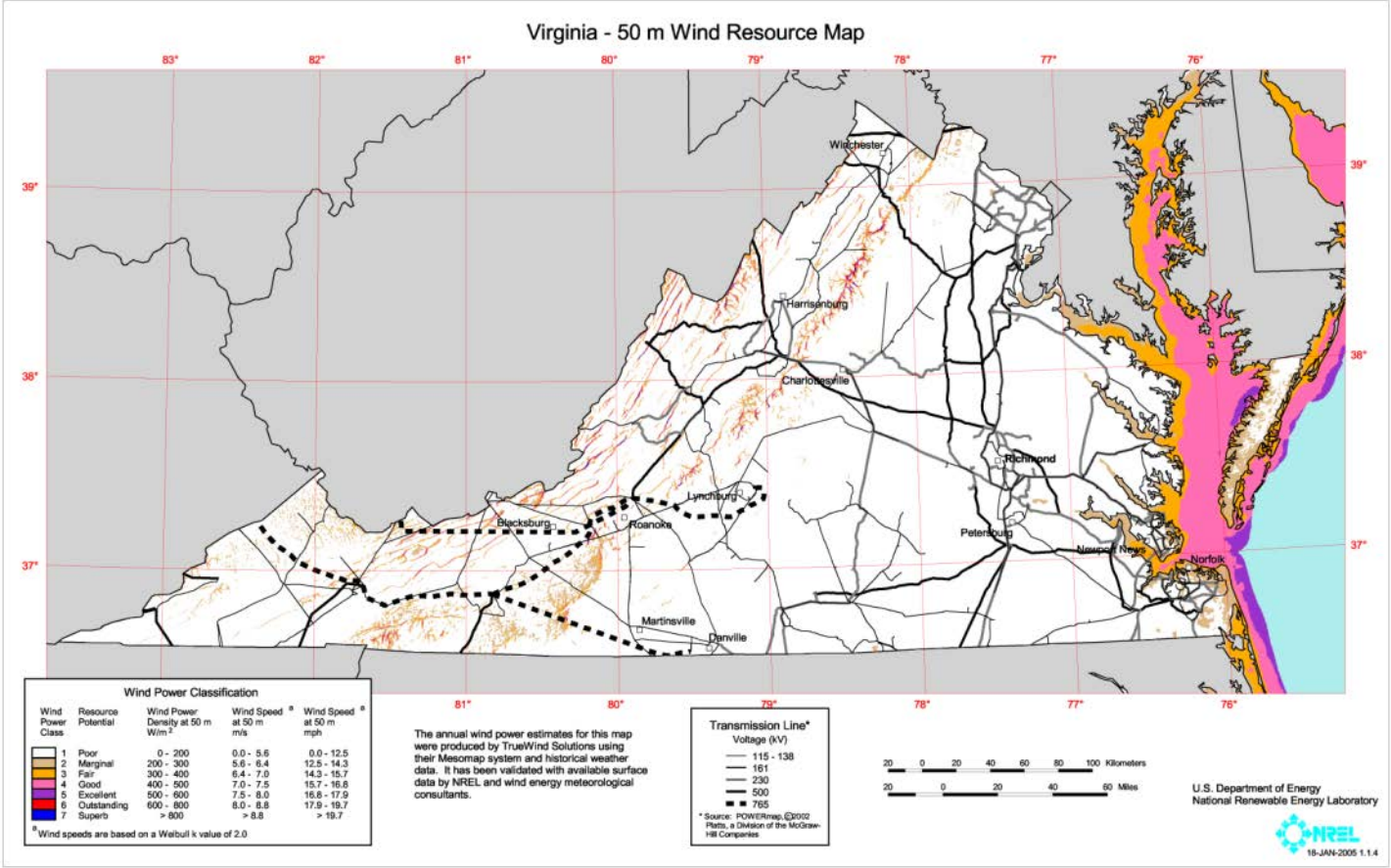
Where is the Wind?



Wind Power Classification				
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
1	Poor	0 - 200	0.0 - 5.6	0.0 - 12.5
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	> 800	> 8.8	> 19.7

^a Wind speeds are based on a Weibull k value of 2.0

Where is the Wind?



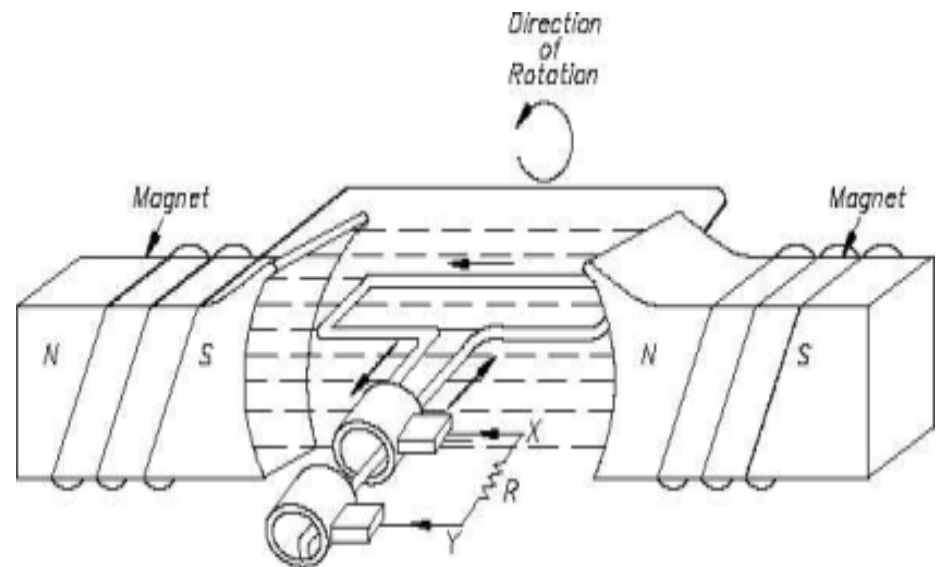
How do we measure wind?

- Meteorological tower
- Anemometer
- Wind vane or sock
- Data logger
- Data chip



How is electricity generated?

- Needed:
 - Conductor – loop of wire
 - Magnetic field – electromagnets
- Conductor moves within the magnetic field
 - Conductor rotates through a magnetic field
 - Magnets move back and forth through a looped wire

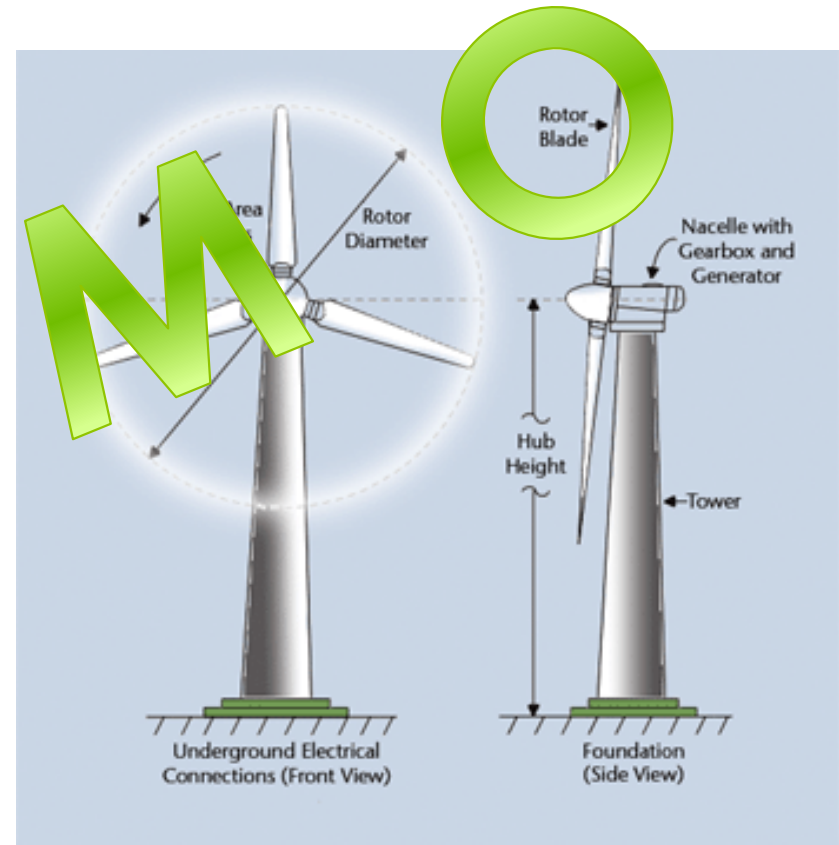


How does a wind turbine work?

- Kinetic energy of wind transformed into rotational energy to turn the motor's axle

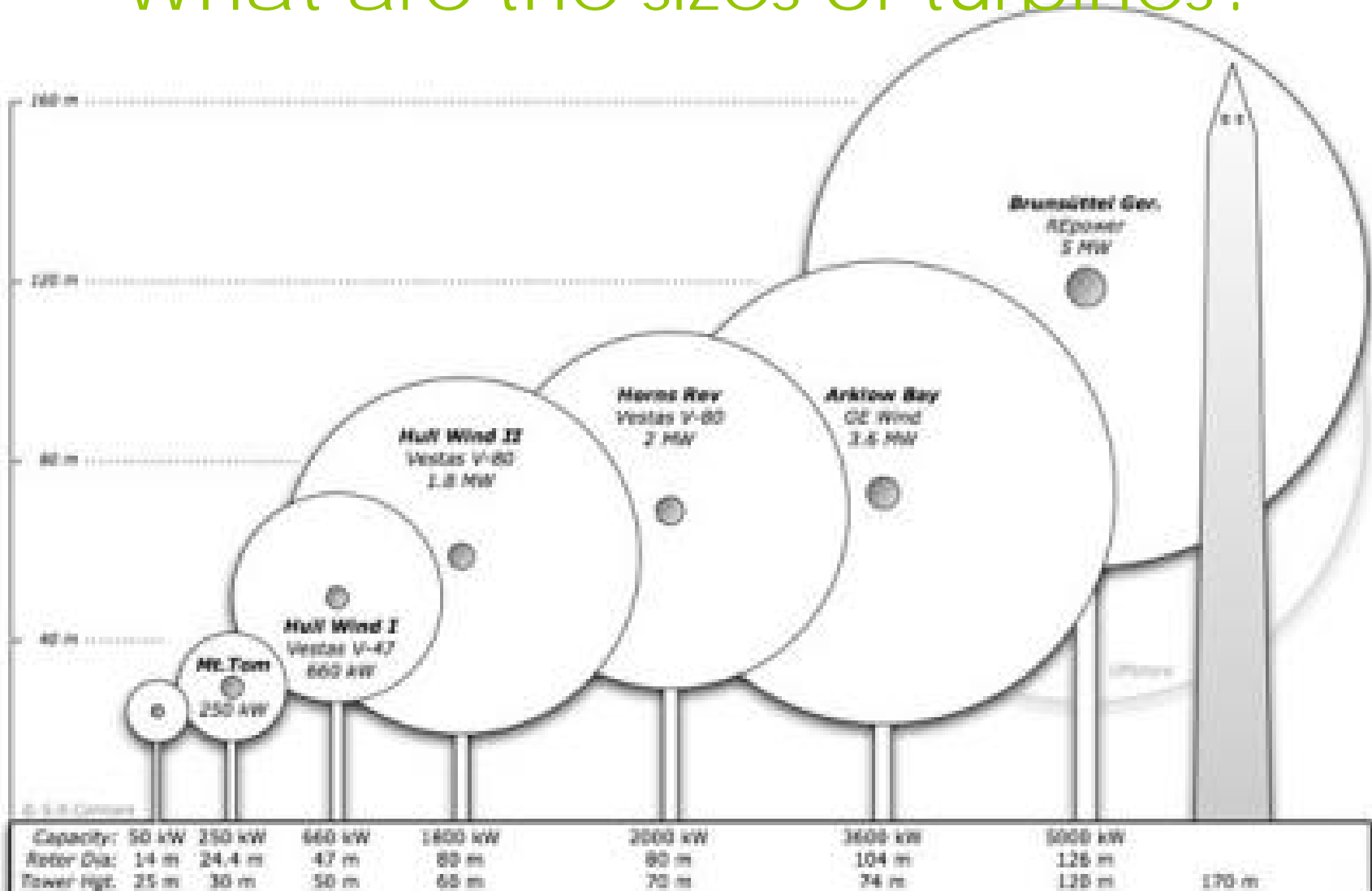
○ Components

- Tower
- Nacelle
- Rotor – hub and blades



Drawing of the rotor and blades of a wind turbine, courtesy of ESN

What are the sizes of turbines?



What size turbine goes where?



What size turbine goes where?

Wind Class	Potential for Wind Development
Class 1 or 2	<ul style="list-style-type: none">• Marginal for onsite• Unsuitable to marginal for community-scale• Unsuitable for utility-scale
Class 3	<ul style="list-style-type: none">• Appropriate for onsite• Marginal to appropriate for community-scale• Generally unsuitable for utility-scale
Class 4	<ul style="list-style-type: none">• Appropriate for onsite or community-scale• Marginal for utility-scale
Class 5+	<ul style="list-style-type: none">• Appropriate for all scales

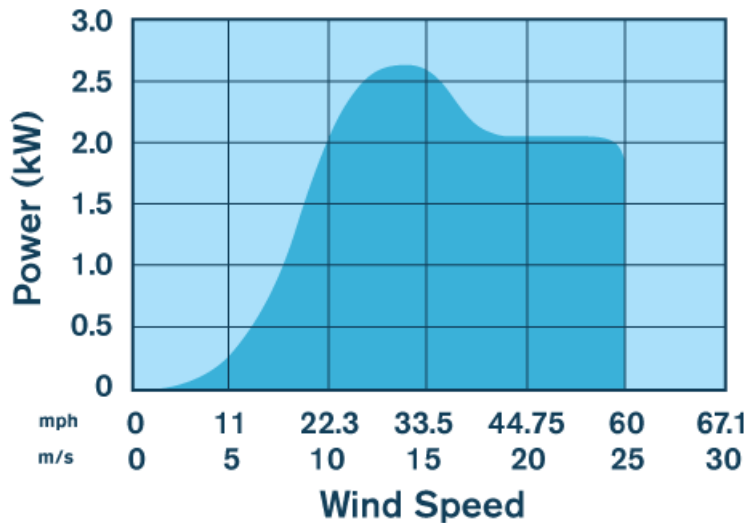
How do you site a turbine?

- Wind resource
- Current land use
- Environmental impacts
- Government regulations
- Cost of wind farm
- Economic payback
- Community opinion – aesthetics
- Noise and flicker issues
- Transmission lines
- Spacing of turbines
- Much, much more!

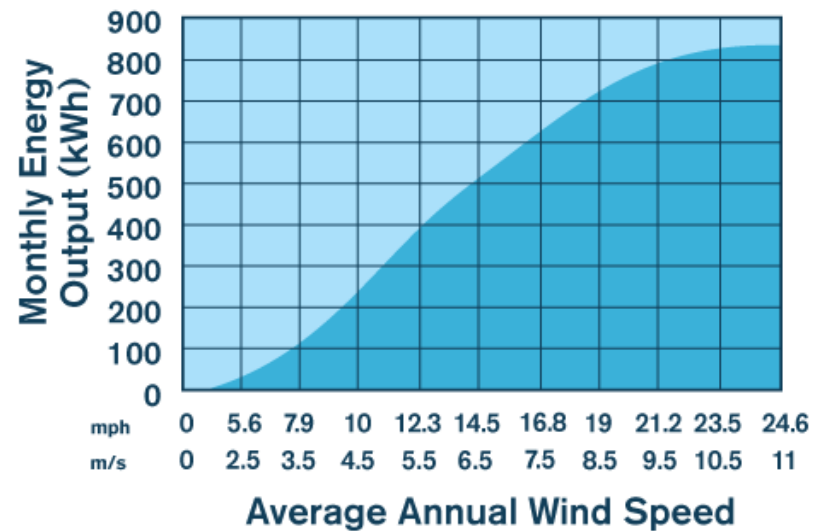


Mountaineer Wind Energy Center, WV
www.communityenergy.com

How much energy can we get?



Data measured and compiled by USDA-ARS Research Lab, Bushland, TX



What are the pros and cons?

- Oil independence
- Locally produced (jobs)
- No air pollution (or CO2)
- Uses no water
- Renewable
- Lower cost

BUT...

- Bird and bat issues
- Aesthetic issues
- Intermittency

