

# Site Selection for Small Wind Systems



**R. Nolan Clark**

**Small Wind Systems Consultant  
Amarillo, TX**

# Home Wind Systems



# Business and Farms



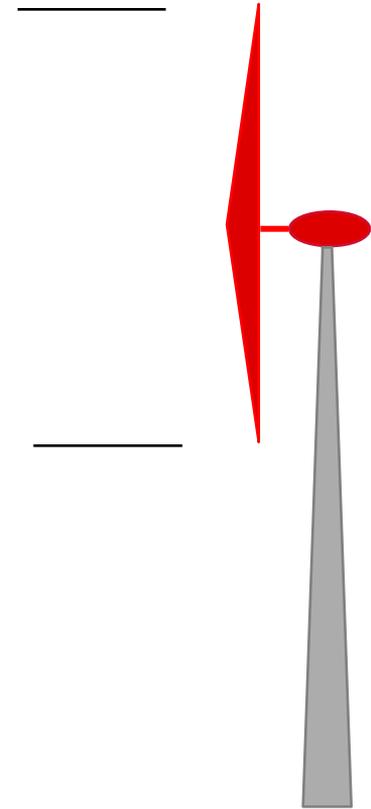
# Schools and Public Buildings



# Components for Siting

- **WIND RESOURCE ISSUES**
  - Determining the wind resource
  - Open area for wind turbine with reasonable access
- **INSTITUTIONAL ISSUES**
  - Interconnection to electric utility
  - Zoning laws and permits
  - Environmental Issues
  - Reception of Community and Neighbors

$$P = \frac{1}{2} \cdot c_p \cdot \rho \cdot v^3 \cdot A$$



$P$  = power (watts)

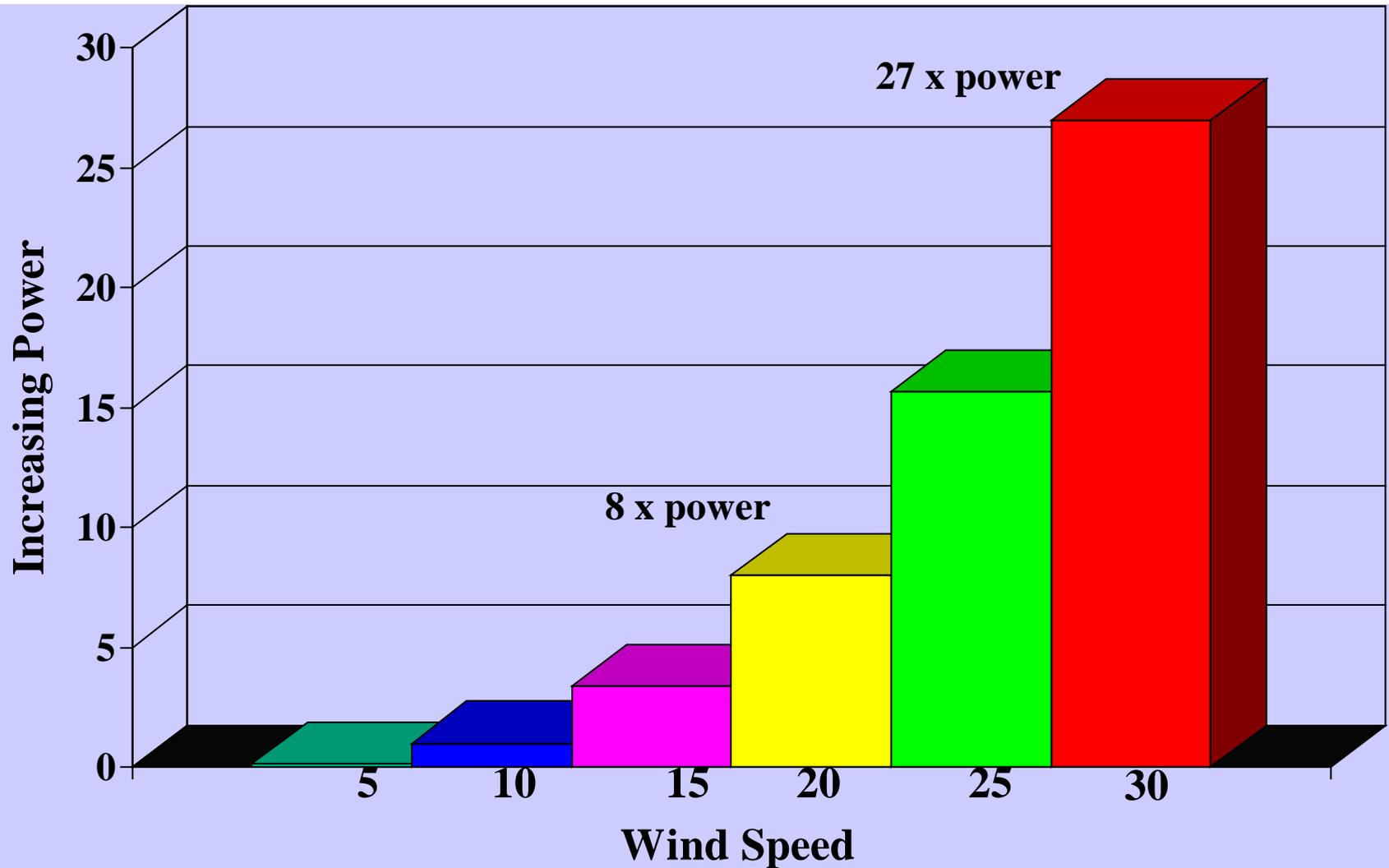
$c_p$  = coefficient of performance

$\rho$  = density of air ( $\text{kg}/\text{m}^3$ )

$v$  = wind speed (m/s)

$A$  = rotor swept area ( $\text{m}^2$ )

# Wind Speed Cubed



# Air Density

- **Depends on barometric pressure and temperature**
- **Standard density is the air pressure at sea level and 15 degrees C.**
- **Higher elevations will have lower air density**
- **Summers will have lower air density**

# Flagged Tree



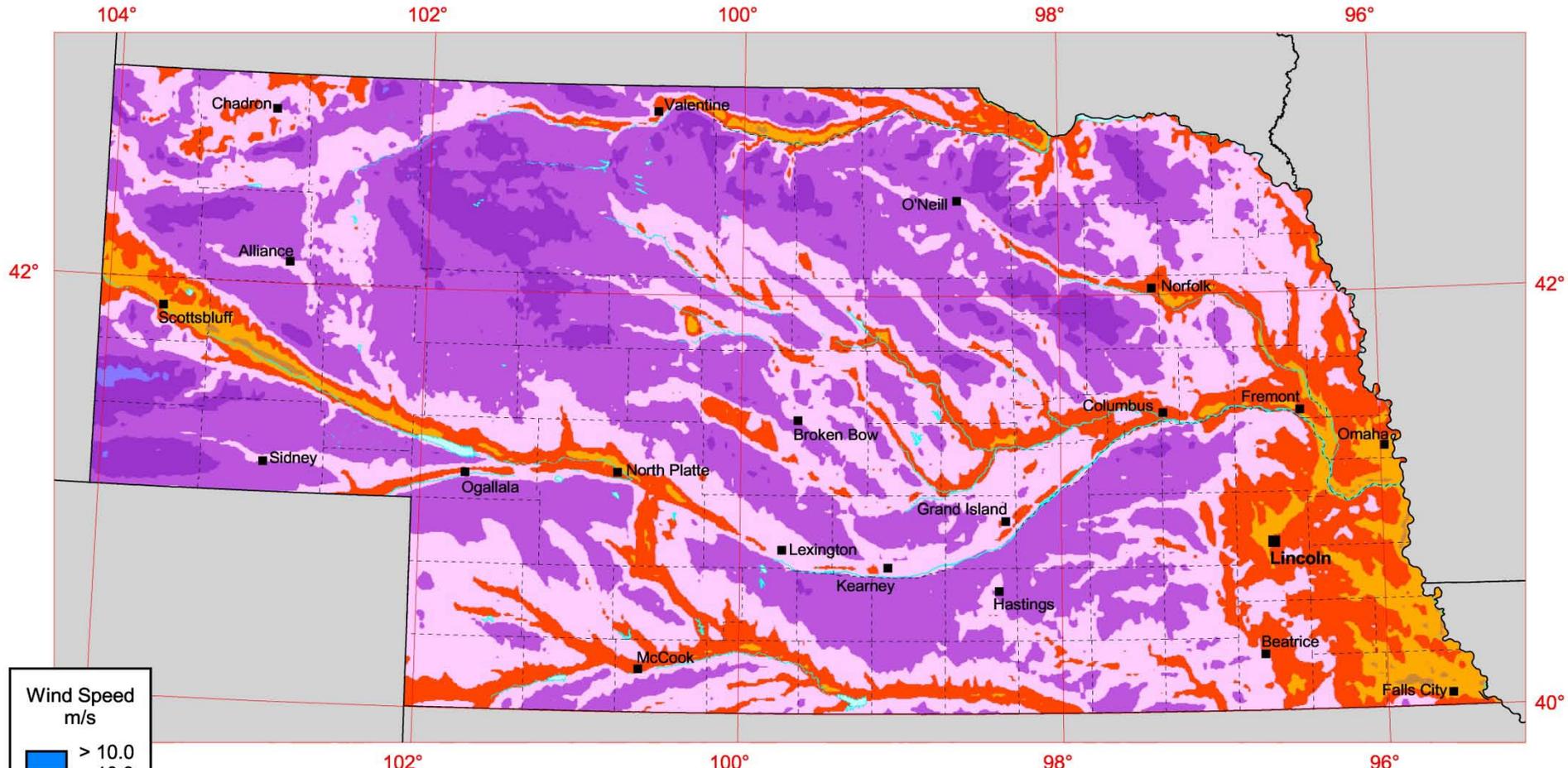


# Wind Maps and Data

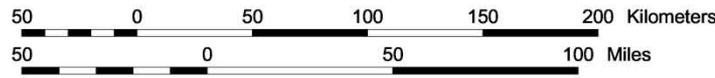
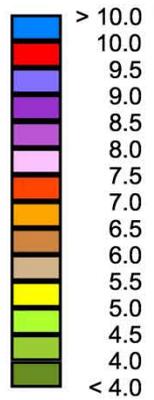
Information on wind resources in the United States is available from the following Department of Energy Web site:

[http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind\\_maps.asp](http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp)

# Nebraska - Annual Average Wind Speed at 80 m



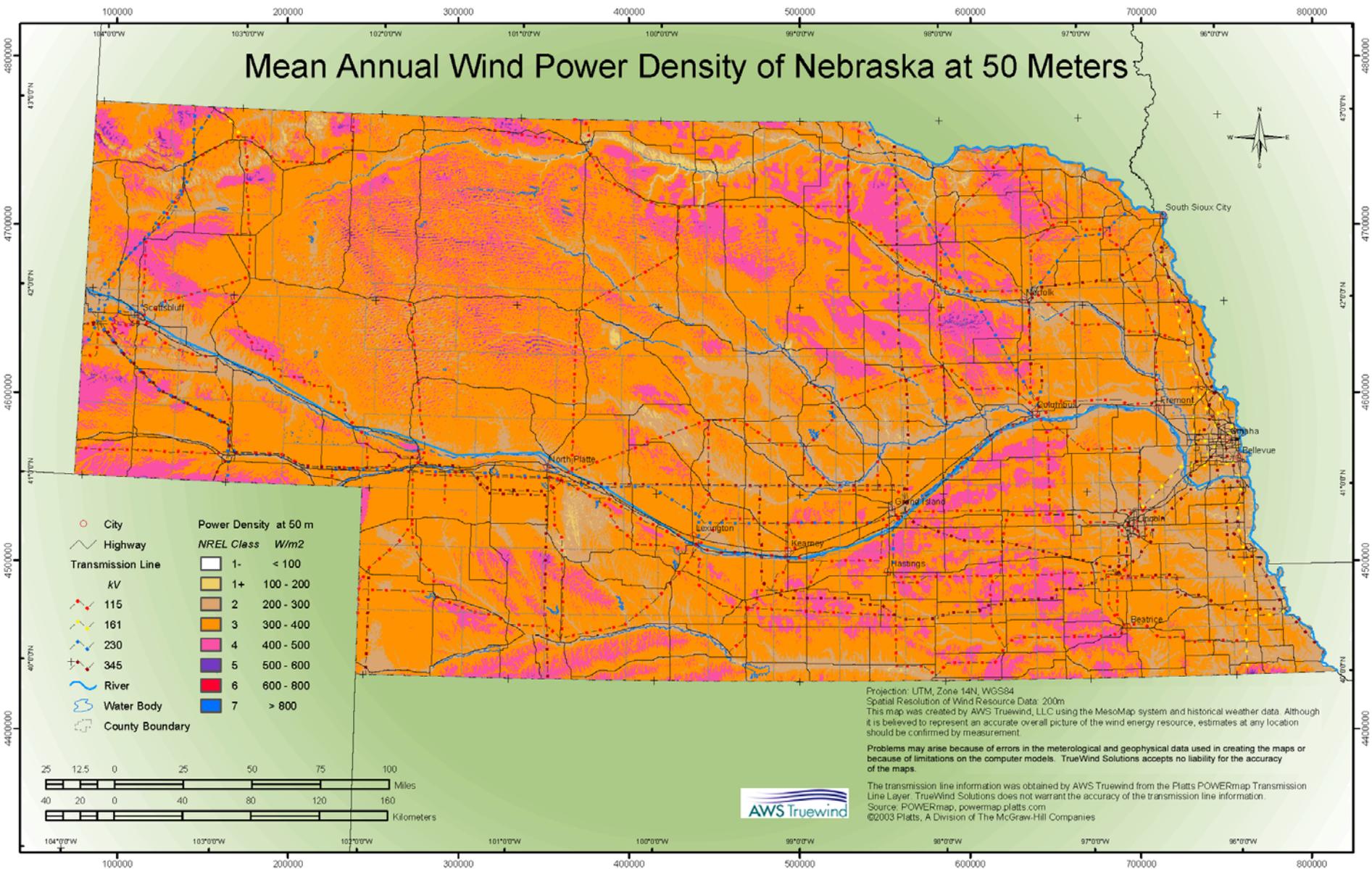
Wind Speed  
m/s



Source: Wind resource estimates developed by AWS Truewind, LLC for windNavigator®. Web: <http://navigator.awstruewind.com> | [www.awstruewind.com](http://www.awstruewind.com). Spatial resolution of wind resource data: 2.5 km. Projection: UTM Zone 14 WGS84.



# Mean Annual Wind Power Density of Nebraska at 50 Meters



Projection: UTM, Zone 14N, WGS84  
 Spatial Resolution of Wind Resource Data: 200m  
 This map was created by AWS Truewind, LLC using the MesoMap system and historical weather data. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement.

Problems may arise because of errors in the meteorological and geophysical data used in creating the maps or because of limitations on the computer models. TrueWind Solutions accepts no liability for the accuracy of the maps.

The transmission line information was obtained by AWS Truewind from the Platts POWERmap Transmission Line Layer. TrueWind Solutions does not warrant the accuracy of the transmission line information.  
 Source: POWERmap, powermap.platts.com  
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**Measure Wind Speed  
And  
Wind Direction  
  
at  
Proposed wind turbine  
hub height**







# WIND CHARACTERISTICS AND RESOURCE

Wind Speed

Wind Direction

Sample Rate, 1 Hz

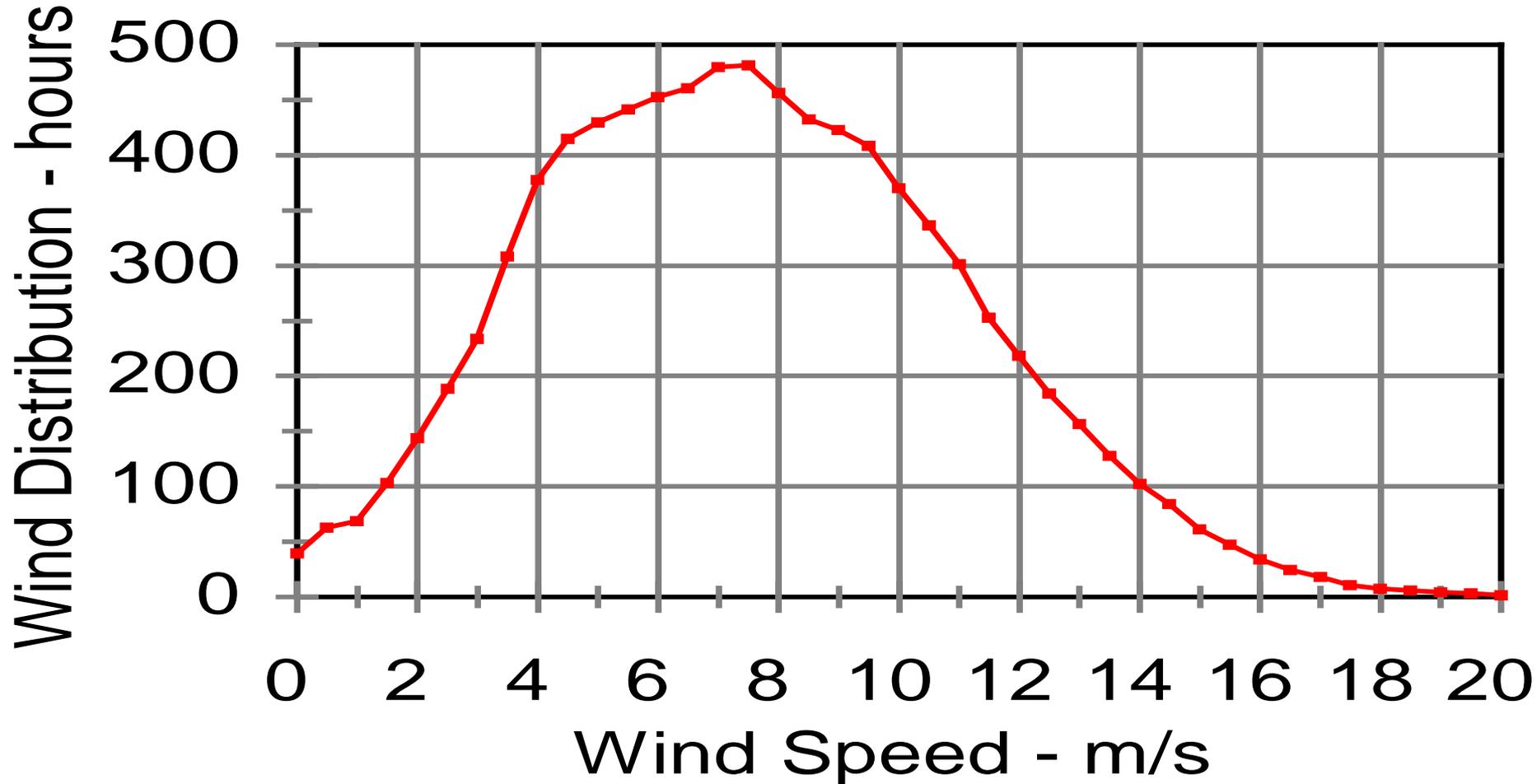
Averaging Time, 1 hr

Histograms (method of bins)

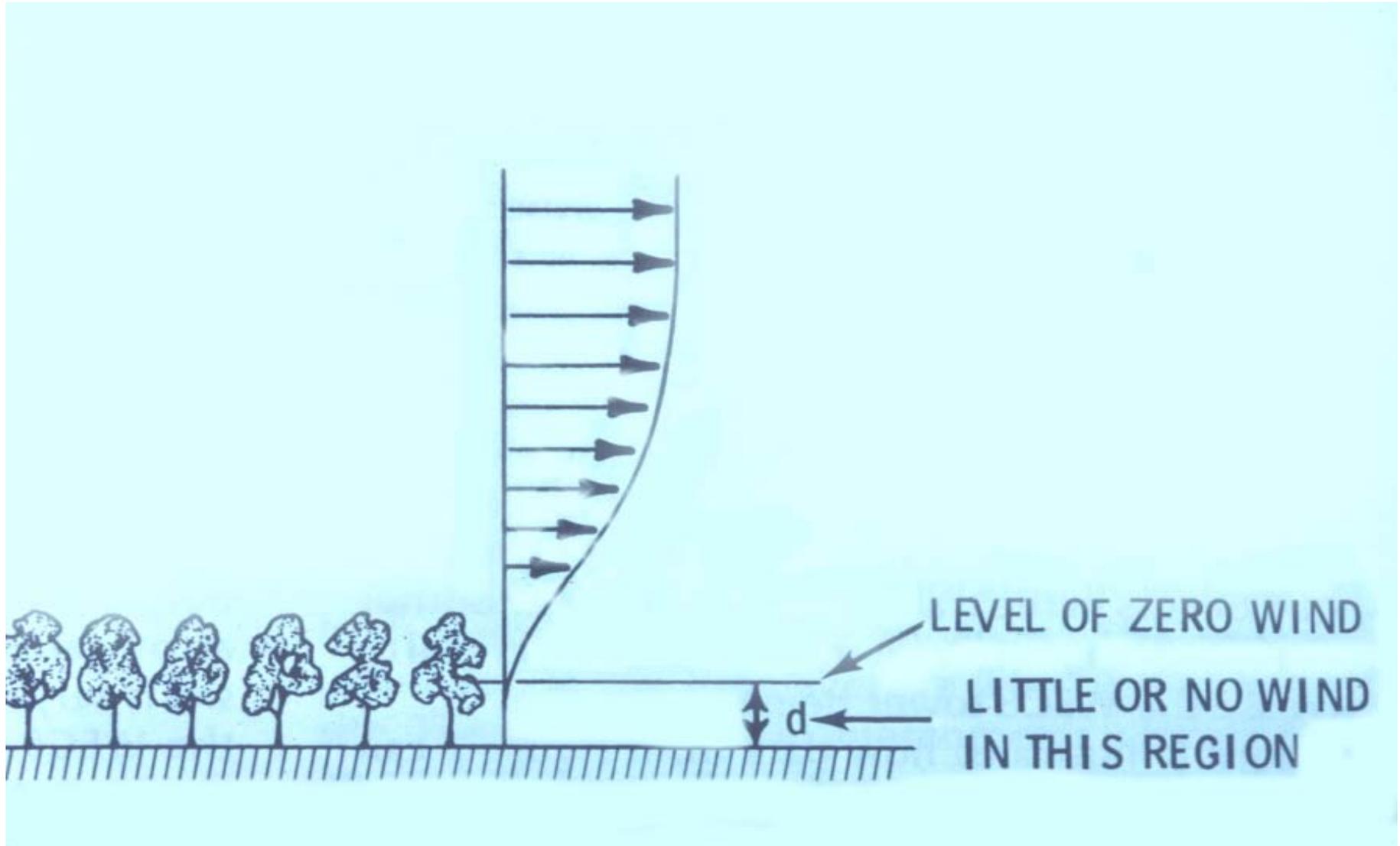
Wind speed change with height

# Annual Wind Distr

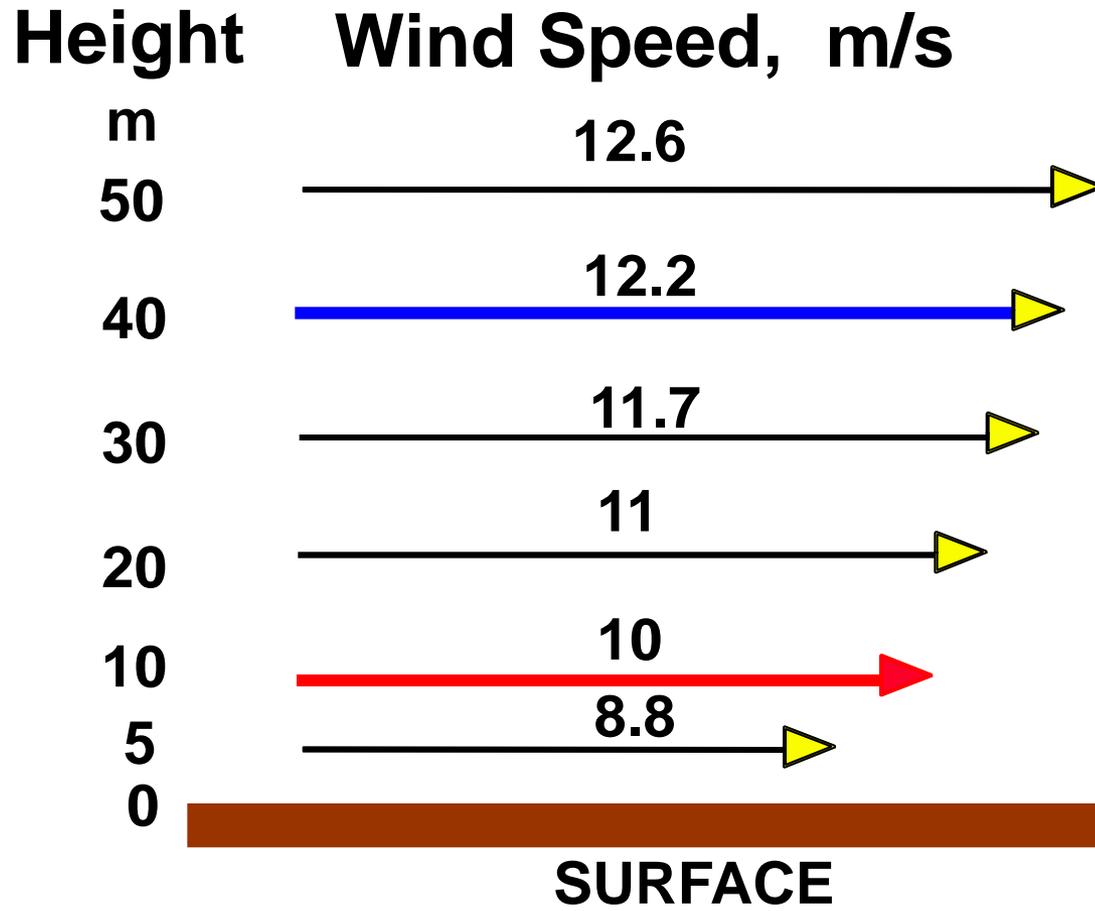
Amarillo, TX (1995-7, 40 m



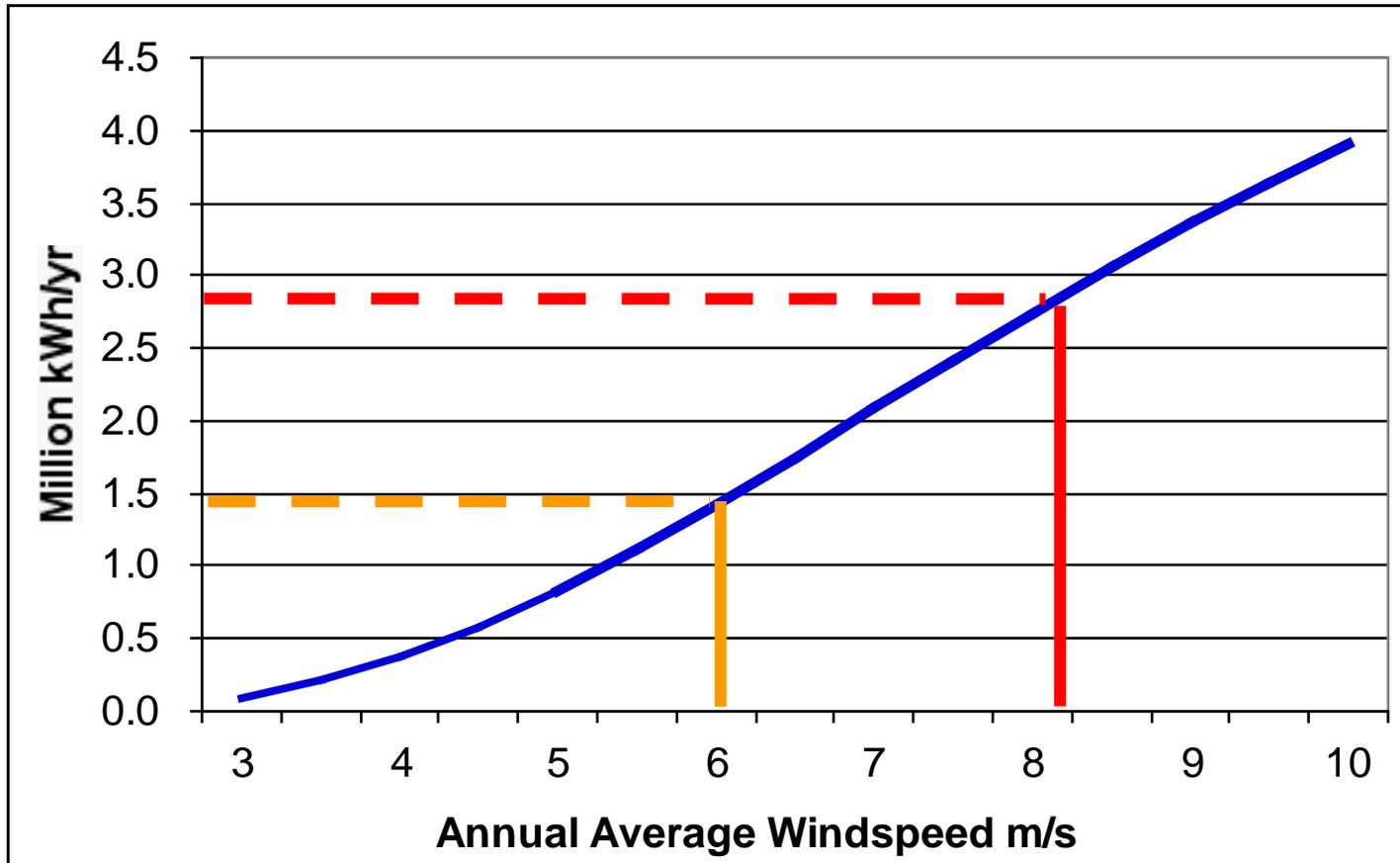
# Disturbed Wind Profile



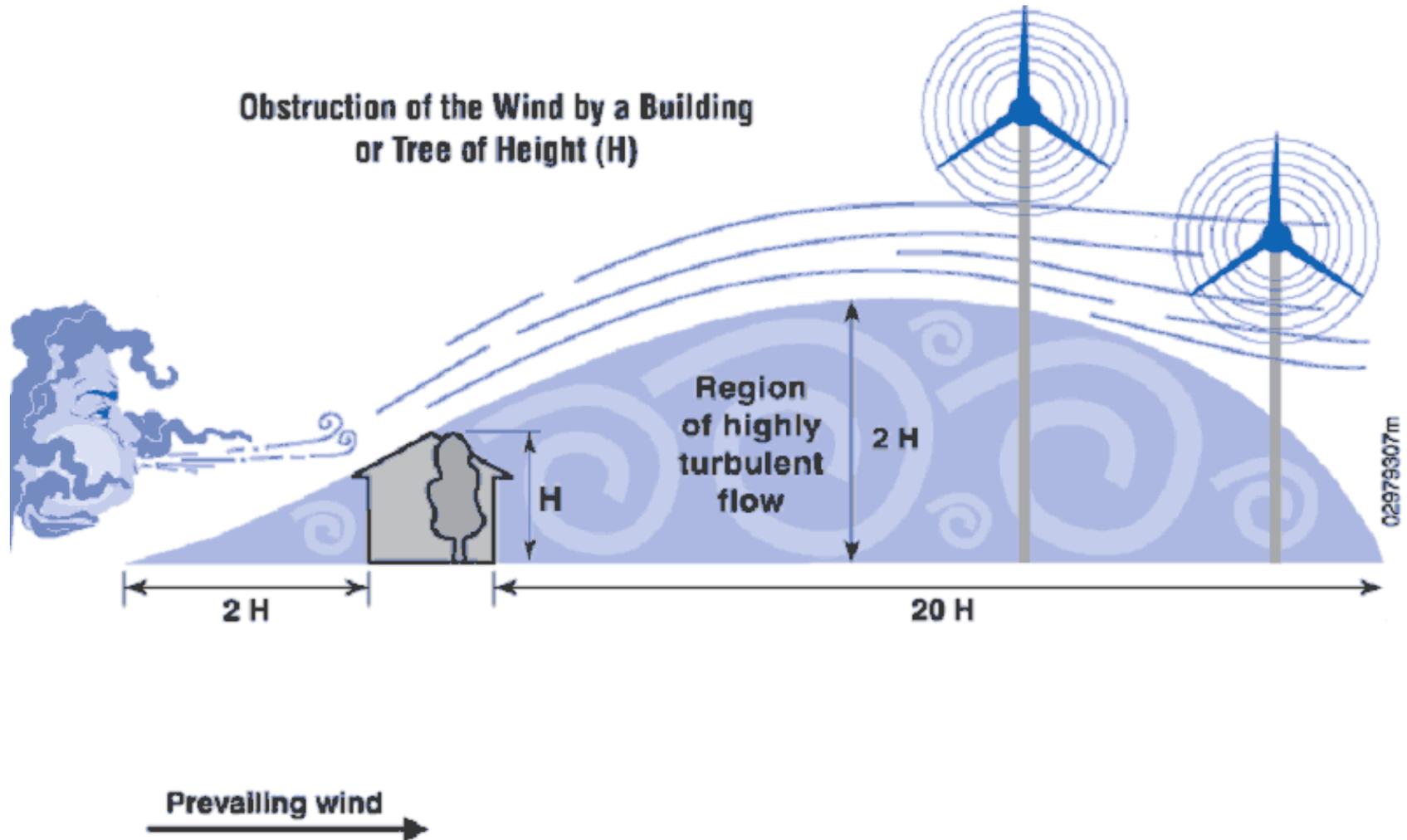
# WIND SHEAR



# ANNUAL ENERGY vs AVERAGE WINDSPEED



# Height or Distance Needed



# **INSTITUTIONAL ISSUES**

- **Interconnection to electric utility**
- **Zoning laws and permits**
- **Environmental Issues**
- **Reception of community and Neighbors**

# Wind Electric Choices

## Stand-Alone System



- Batteries to store excess power
- Charge controller
- Inverter (DC to AC)
- Back-up power source for complete energy independence

## Grid-Connected System



- Inverter (DC to AC)
- Annual wind speed  $\geq 10$  mph (4.5 m/s)
- Customer motivated by high utility prices, self sufficiency, or environmental concerns

# Metering

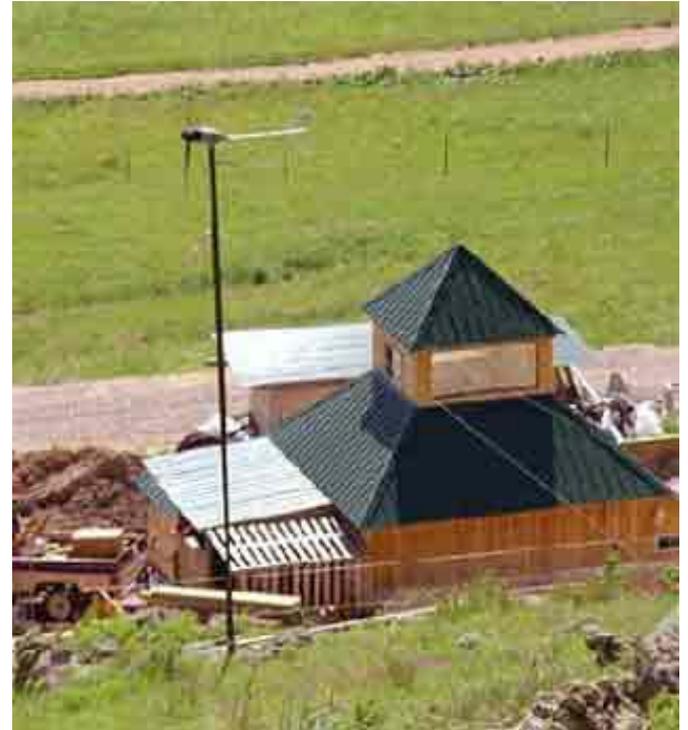
- Single Meter or Two Meters
  - Energy use/production is measured independently
- Varies for each utility or Coop



# Interconnection Requirements

## Safety Issues

- Must meet electrical codes
- Must stop supplying power to grid during power outages



## Power Quality Issues

- Must synchronize with grid
- Must match utility power's voltage, frequency and quality

# Zoning Laws and Permits

- Land use permits
  - Local, State, Federal
- Building permits
  - Usually local permits required
  - Code enforcement
- Inspections
- Fencing

# Environmental

- **Cursory review for endangered species**
- **Avian concerns (State, Local Audubon)**
  - **Migratory Birds, Raptors, Bats**
- **Archaeological Sites**
- **Noise**
- **Visual**
- **Icing**

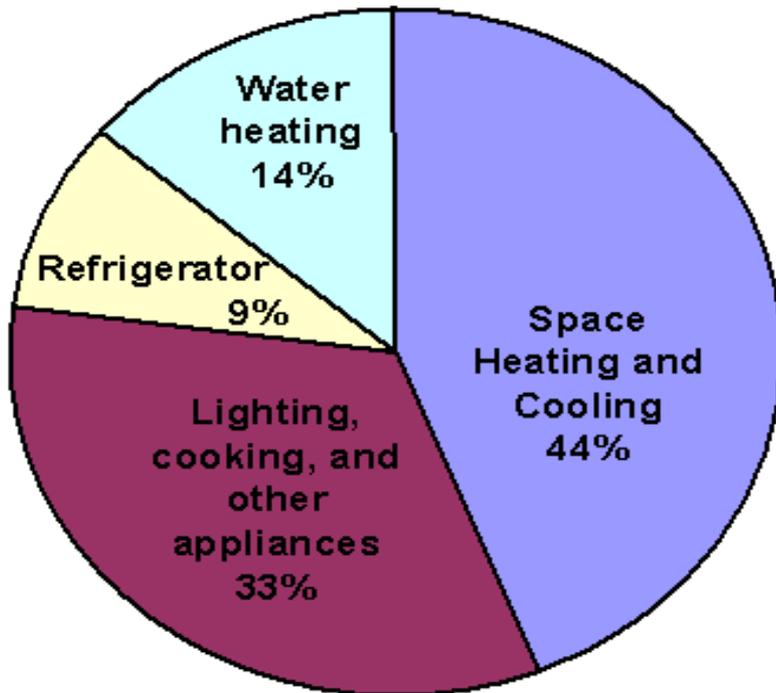
# Community and Neighbors

- Meet with neighbors to ensure them about
  - safety of selected design
  - Setback from property line
  - Noise level (50 decibels or about like an air conditioner)
- Community Leaders
  - Increase tax base
  - Reducing pollution
  - Potential for new jobs
  - Less dependency on outside sources for electrical energy.

# Before You Buy

The local wind resource, electricity costs, and how you use your wind system will influence the system selected.

Average Home Energy Use



*Evaluate energy efficiency options first!*

*Approach investment as you would any other major purchase – do your homework*

