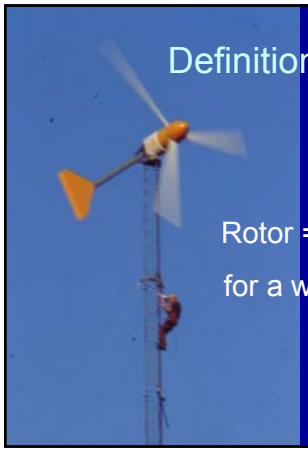
Zoning for Small Wind:

The Importance of Tower Height

An ASES Small Wind Webinar
Mick Sagrillo—Wisconsin's Focus on Energy

Definitions: rotor



Rotor = "collector"
for a wind system

L&S Tech. Assoc., Inc.

Definitions: wind

- Wind = the 'fuel'
- Wind has two 'components'
  - Quantity
    = wind speed (velocity or V)
  - Quality
    = 'clean' flowing wind

Quantity

- = average annual wind speed
- Climate, not weather
- Akin to annual average sun hours for PV or head and flow for hydro

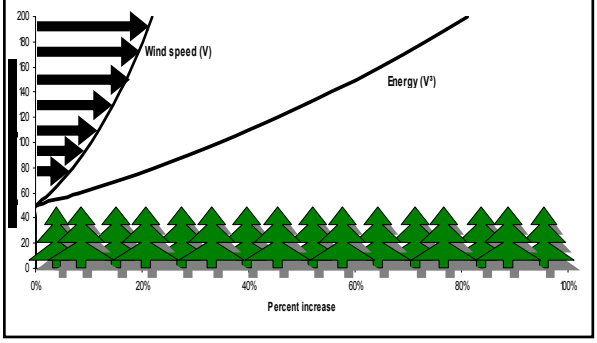
- Wind speed increases with height above ground…
- …Due to diminished ground drag (friction)

Power in the wind

- Wind speed = V
- Power available is proportional to wind speed x wind speed x wind speed
  - or P ~ V x V x V
  - or **P ~ V ³**

- Therefore, 10% V = 33% P
- Lesson !

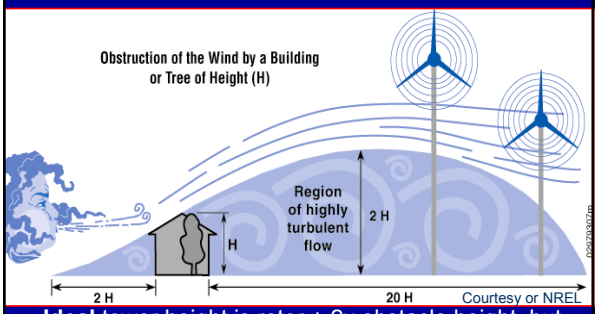
Quantity: **P ~ V³**



Quality

- Turbulence = tumbling & turmoil
- Turbulence is trouble…
- …For the equipment
  - Increased wear & tear
  - Therefore, increased maintenance
  - Decreased life expectance
  - …For the electricity generated
    - Decreased kWh
  - Remember: 10% V = 33% P

Rule of thumb for siting residential wind turbines



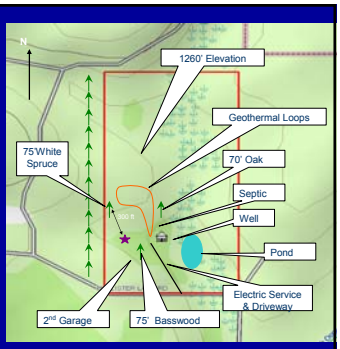
Ideal tower height is rotor + 2x obstacle height, but…

…the ideal may not be practical

"Ideal" may not be practical

- Wind farm prospectors seek the ideal…
  - …do "blank sheet of paper" siting
  - …seek out elevated exposed sites
    - To optimize quantity
    - By reducing ground drag to increase V
  - …strive for horizontal separation between ground clutter and their towers
    - To optimize quality
    - Reduce turbulence
    - By reducing ground clutter (trees and buildings)

- But homeowners, farmers, schools, and businesses are stuck with their real estate
- Horizontal separation is not an option



Courtesy of Sam Simonetta

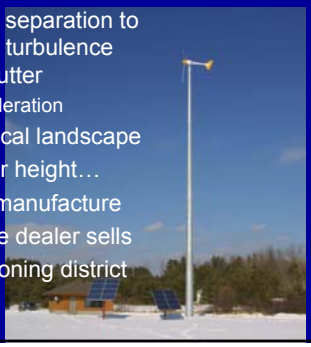
So, what to do?

Rules of thumb for siting residential wind turbines

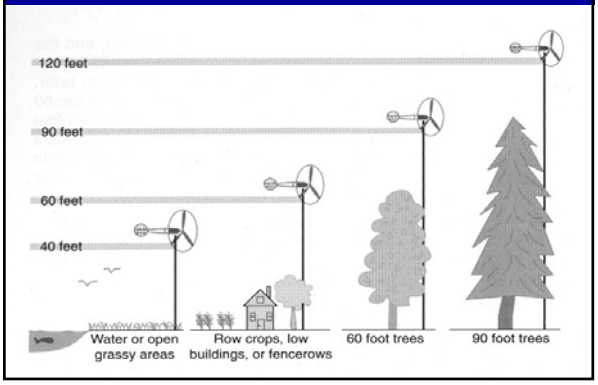
- Increase vertical separation to reduce drag and turbulence due to ground clutter
  - Foremost consideration
- Therefore, the local landscape determines tower height…

  …not what the manufacture offers or what the dealer sells

  …not what the zoning district permits

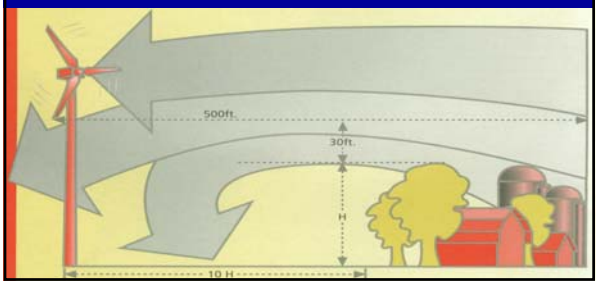


Local landscape determines tower height



Rule for siting--practical

- Entire rotor **MUST** be at least 30’ above anything within 500’
- Or treeline, which ever is higher
- Minimum clearance criteria

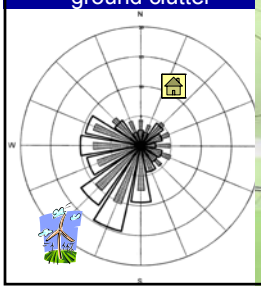


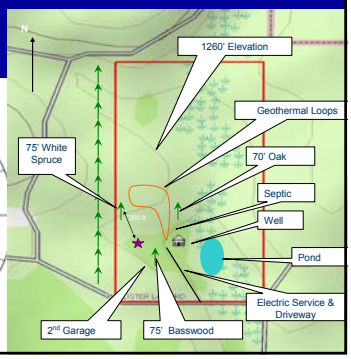
Rules of thumb for siting residential wind turbines

- Rougher surfaces or terrain produce gustier winds
  - (turbulence is trouble)
- Therefore minimize turbulence with taller towers

Rules of thumb for siting residential wind turbines

- Site upwind of ground clutter

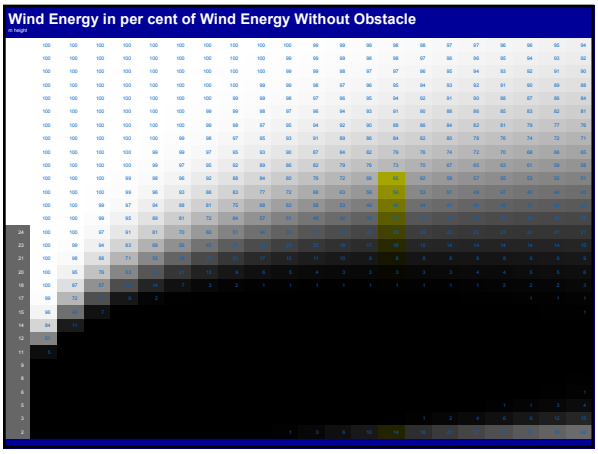




Rules of thumb for siting residential wind turbines

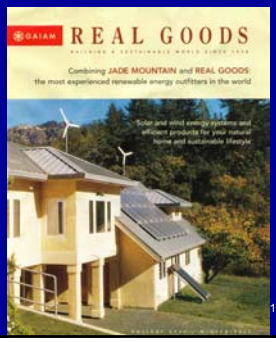
- A basic fact about trees, but often forgotten…
- Beware of “disappearing winds”

A basic, but little remembered, fact about trees…



Where does the insistence on short towers come from?

- "Eye candy" photos
- Aversion to climbing and heights
- Restrictive zoning
- Reinforced by those more interested in selling equipment than generating kWh
- It's about generating, not just spinning



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Rules of thumb for siting residential wind turbines

1. Wind generators are about renewably generated kWh, not spinning blades
2. Towers can be a considerable expense, are visible on the landscape, and must be climbed, but…
3. Without a proper tower…see rule #1

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3 most common mistakes

- 1. Too short of a tower
- 2. Too short of a tower
- 3. Too short of a tower

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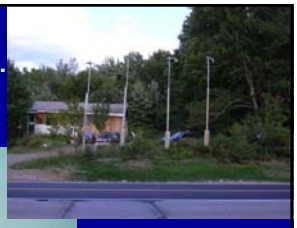
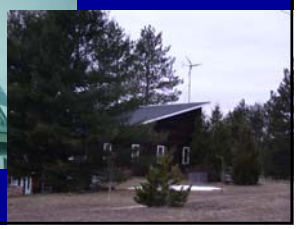
What not to do…





Resources

- *Wind Power—Renewable Energy for Home, Farm, and Business* by Paul Gipe
- Small Wind Toolboxes at
  - http://www.renewwisconsin.org/wind/windtoolbox.html
- Wind shade calculator at Danish Wind Energy Association
  - http://www.windpower.org/en/tour/wres/shelter/index.htm

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