

# Wind Systems



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The terms  
wind energy or wind power  
describe the process by  
which wind is used to  
generate mechanical  
power or electricity.



# Wind is a form of solar energy

- Uneven heating of the atmosphere by the sun
- Irregularities of the earth's surface
- Rotation of the earth



# Wind flow is affected by

- Earth's terrain
- Bodies of water
- Vegetation



# Wind turbines convert the kinetic energy of the wind into mechanical power

- Pumping
- Grinding
- Electrical generation



# History of Wind Power

- Phoenicians and Chinese 2000 BC
- 1891 First electrical output wind machine (Dane Paul LaCouv)
- 1920 1-3 kilowatt wind generators (Parris, Dunn and Jacobs Wind) used throughout the mid-western US
- 1930-1940 use came to an end with the rural power grid



# Why Wind Power?

Wind power avoids the negative impacts of generated fossil fuels

- Air emissions of heavy metals like mercury
- Emissions from extracting/transporting fuel
- Lake and streambed acidification
- Production of solid wastes, ash or slurry
- Renewable source of energy



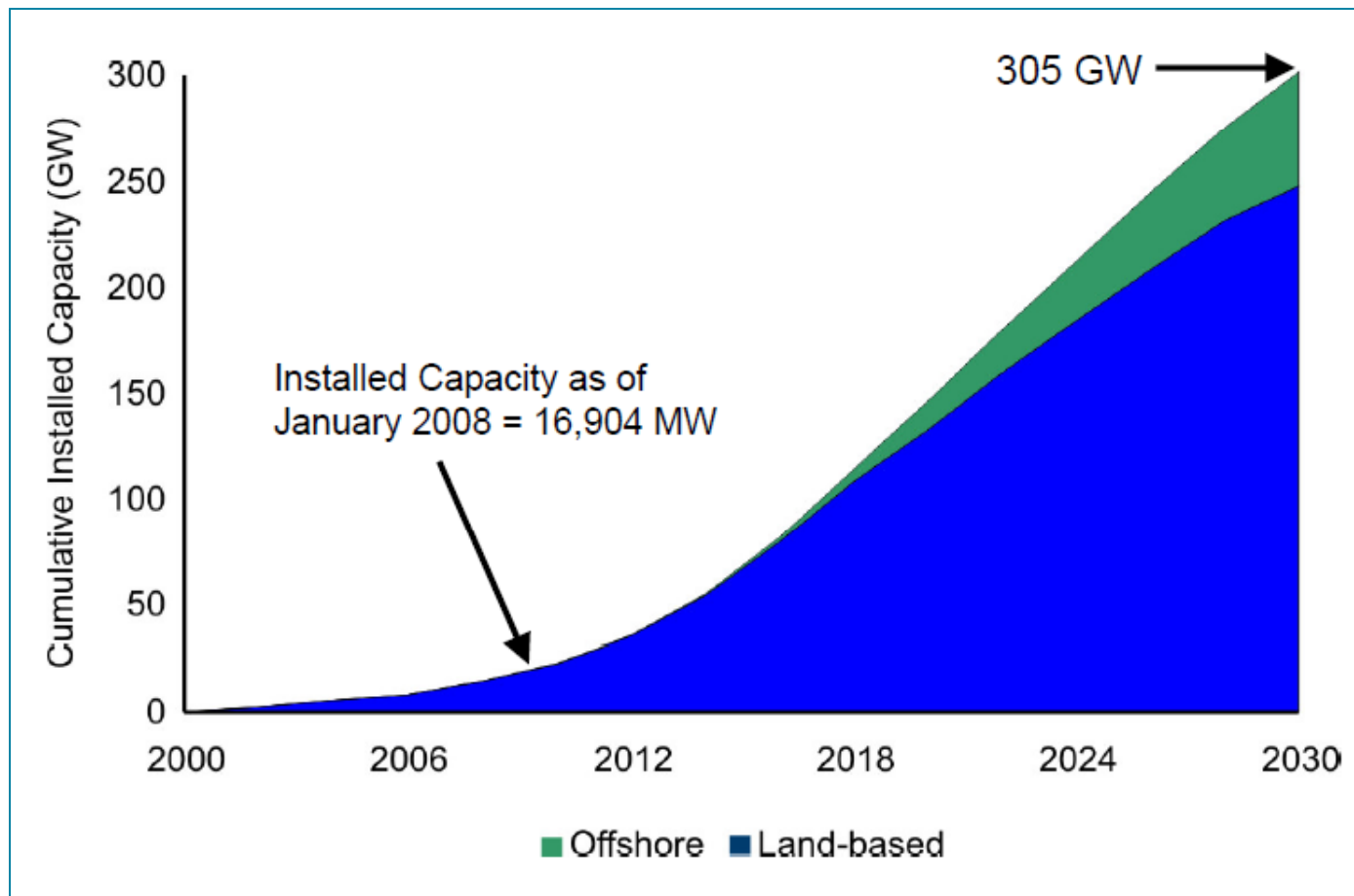
# Where do we want to go as a nation?

## *20% wind study*

A study that modeled reaching 20% of US power supply from wind energy by 2030

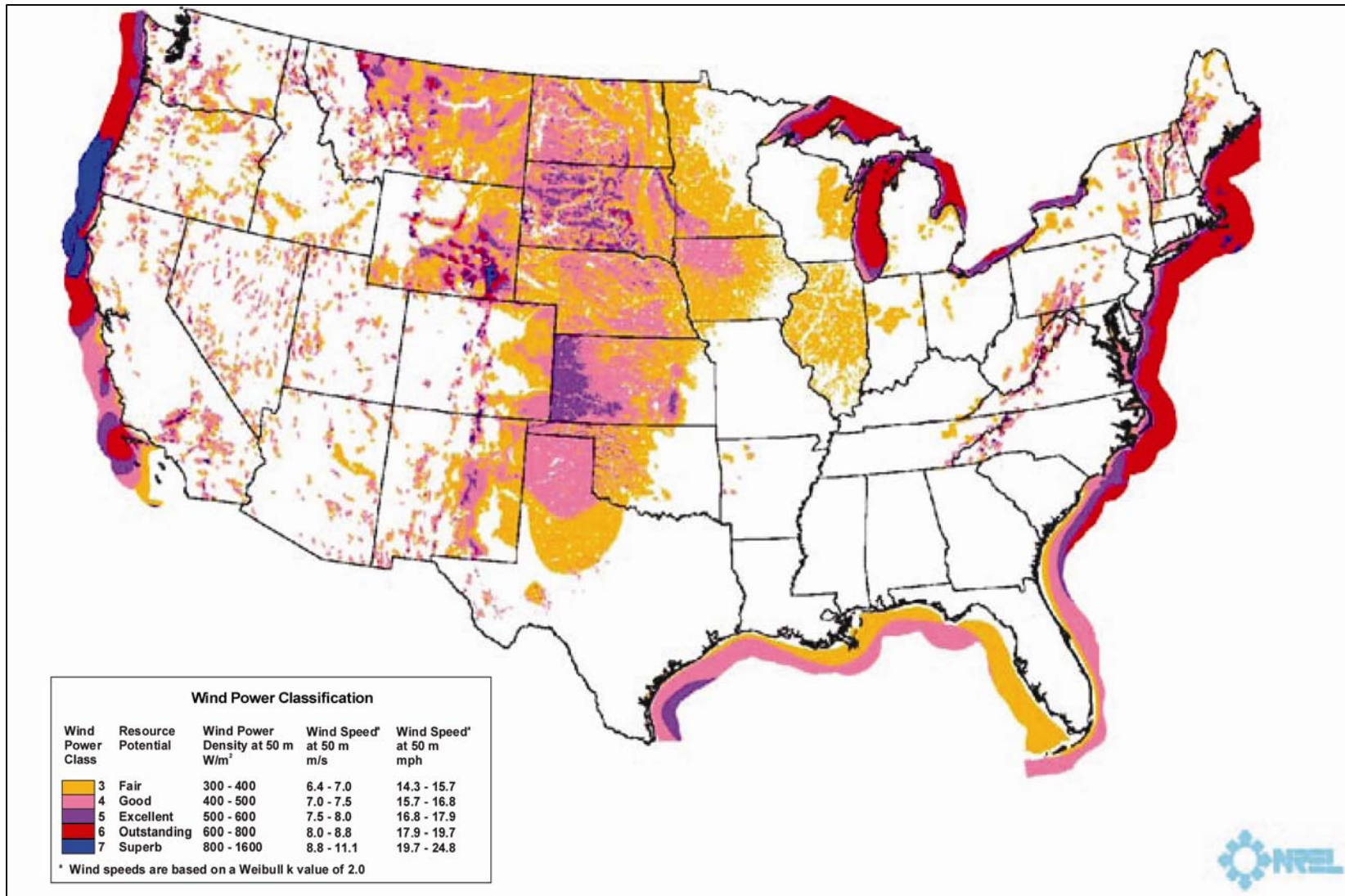
Year 2030

# 20% Wind Scenario

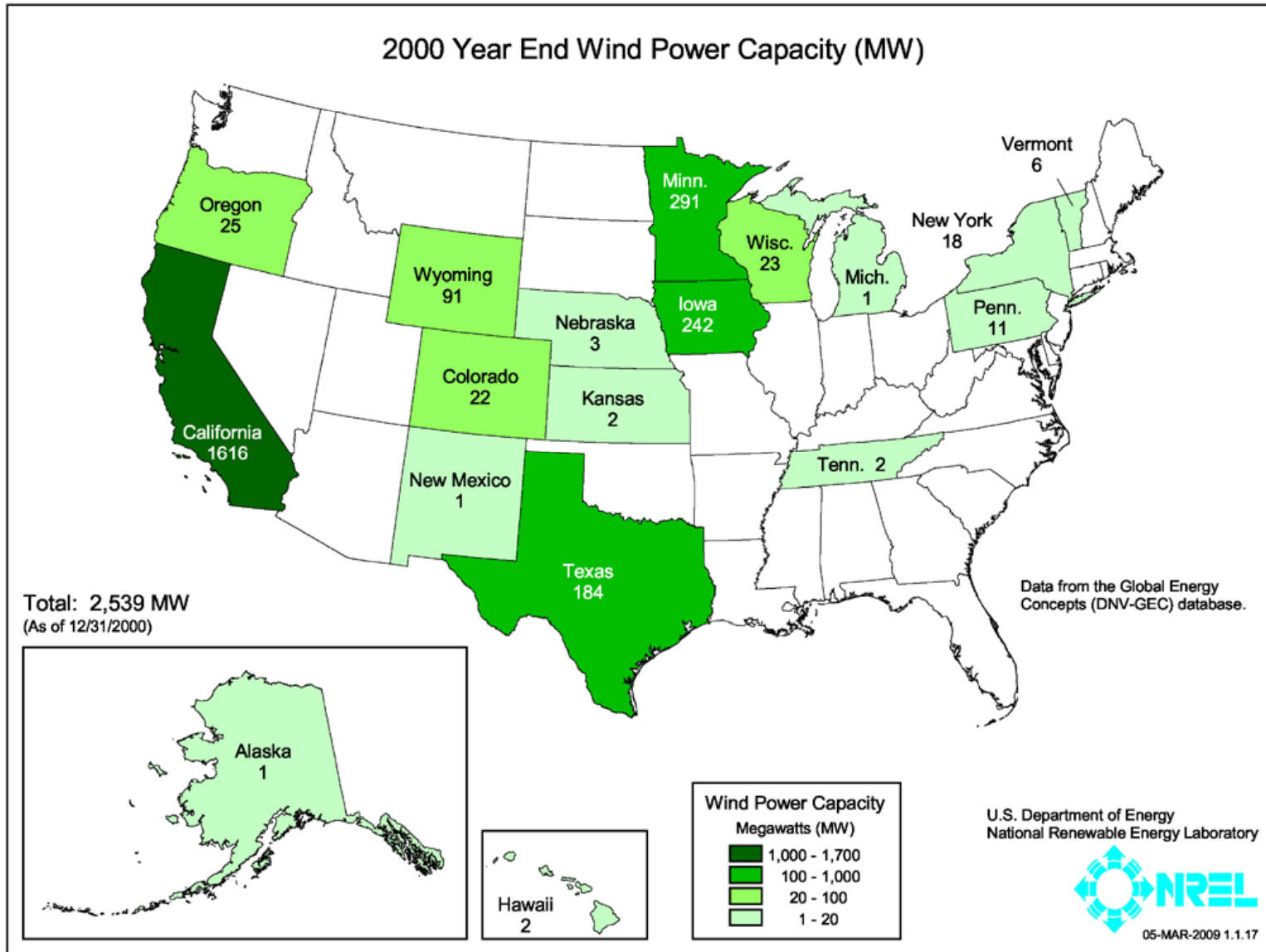


Source: US Department of Energy, Energy Efficiency and Renewable Energy, July 2008

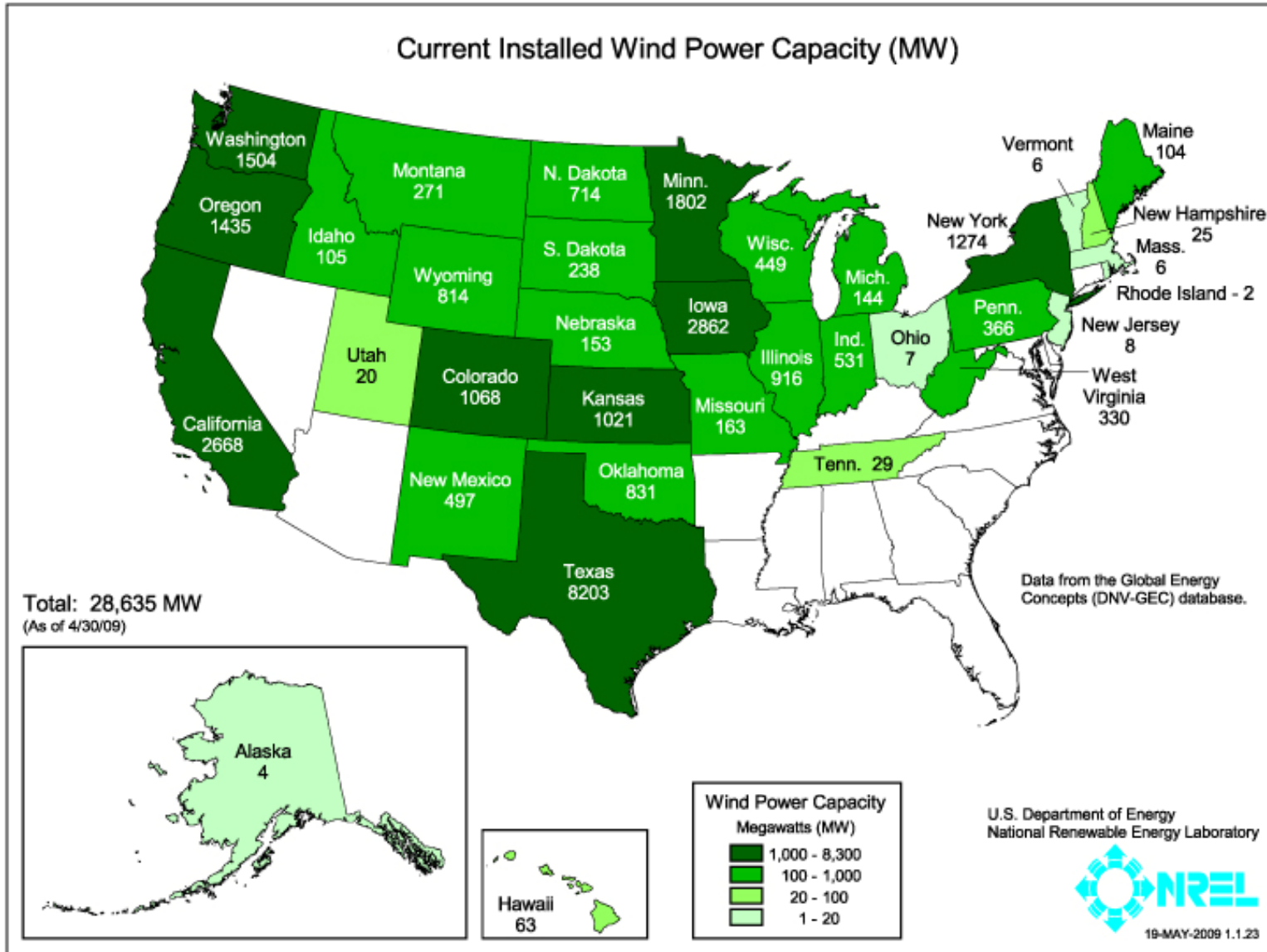
Imagine the result



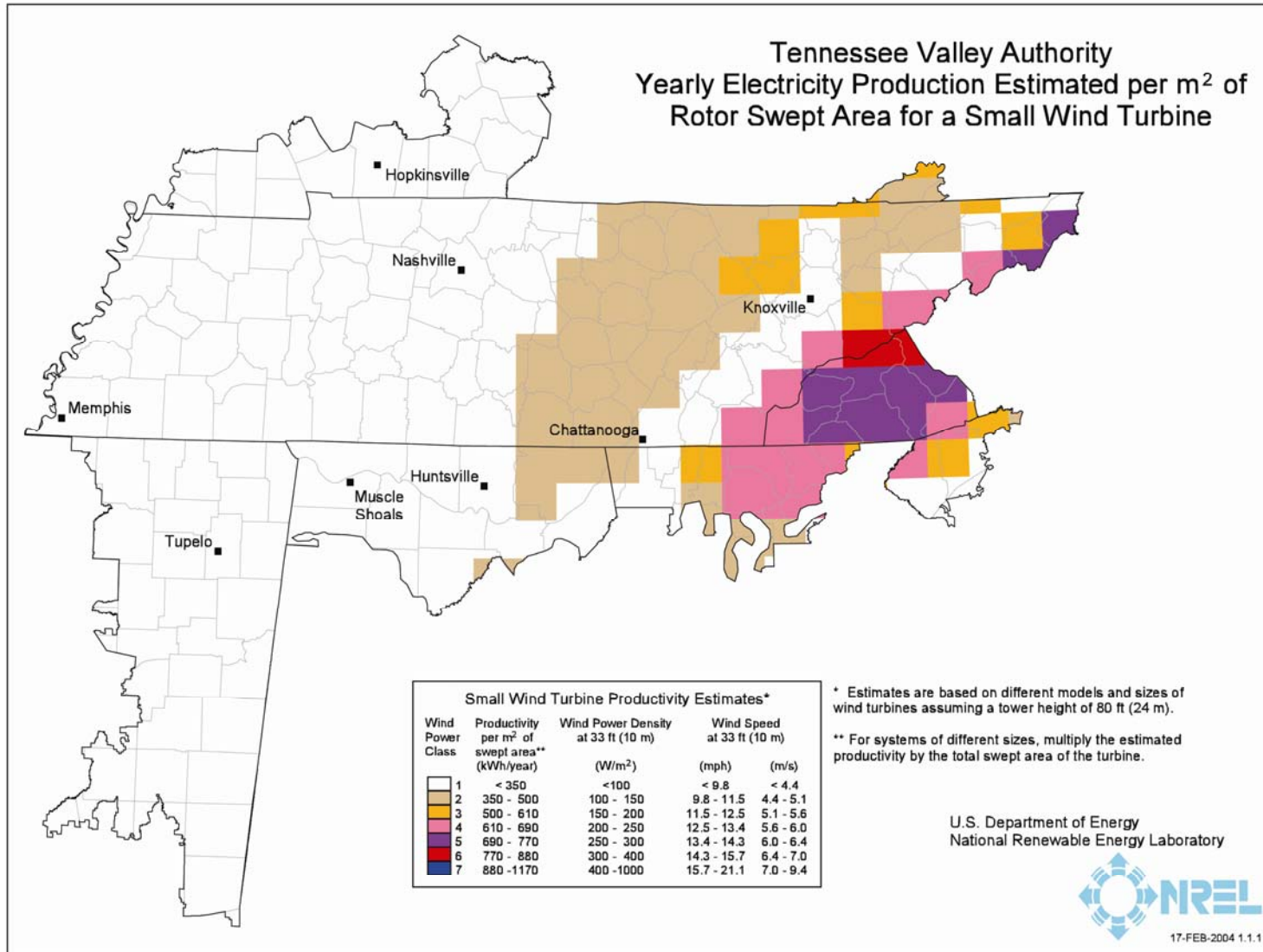
Source: National Renewable Energy Laboratory, March 2009



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# Wind Systems

Two basic wind systems that are important today:

1. Large Wind Systems
2. Small Wind Systems



# Large Systems

Typically 1.5 to 3.5 megawatt turbines



# TVA Buffalo Mountain Project

Tennessee's largest wind farm

- 2 mile long ridge facing southwest
- Total site capacity 29 megawatts
- **New turbines** - 135' long blades, 1.8 megawatts each, 260 feet tall
- **Old turbines** - 75' long blades, 660 kilowatts each, 213 feet tall

# Large System Construction

Construction took  
about 6 months















# Project Siting

- Things to determine first:
  - Wind availability
  - Power needs
  - Zoning
  - Environmental concerns
  - Visual concerns
  - Power transport



# Site Concerns

- Project sites generally raise local concerns about:
  - Visual impacts
  - Property value impacts
  - Wildlife/habitat impacts
  - Turbine noise
  - Land use



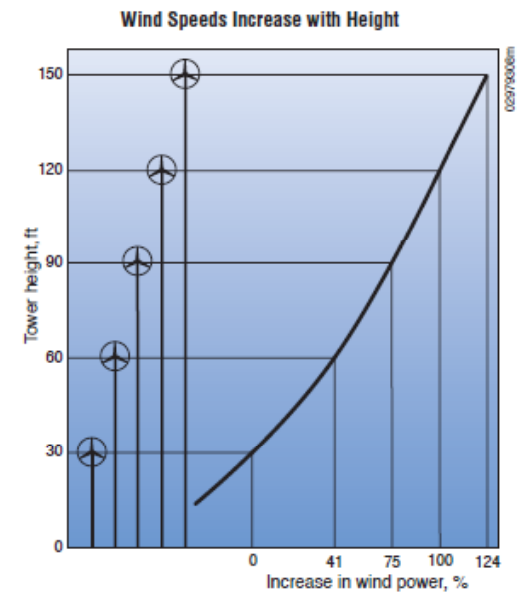
# Small Wind Systems

- Small wind systems have a rated capacity of below 100 KW
- Small wind systems are typically used for the following:
  - Homes
  - Farms
  - Small businesses
  - Public buildings



# Small Wind System Types

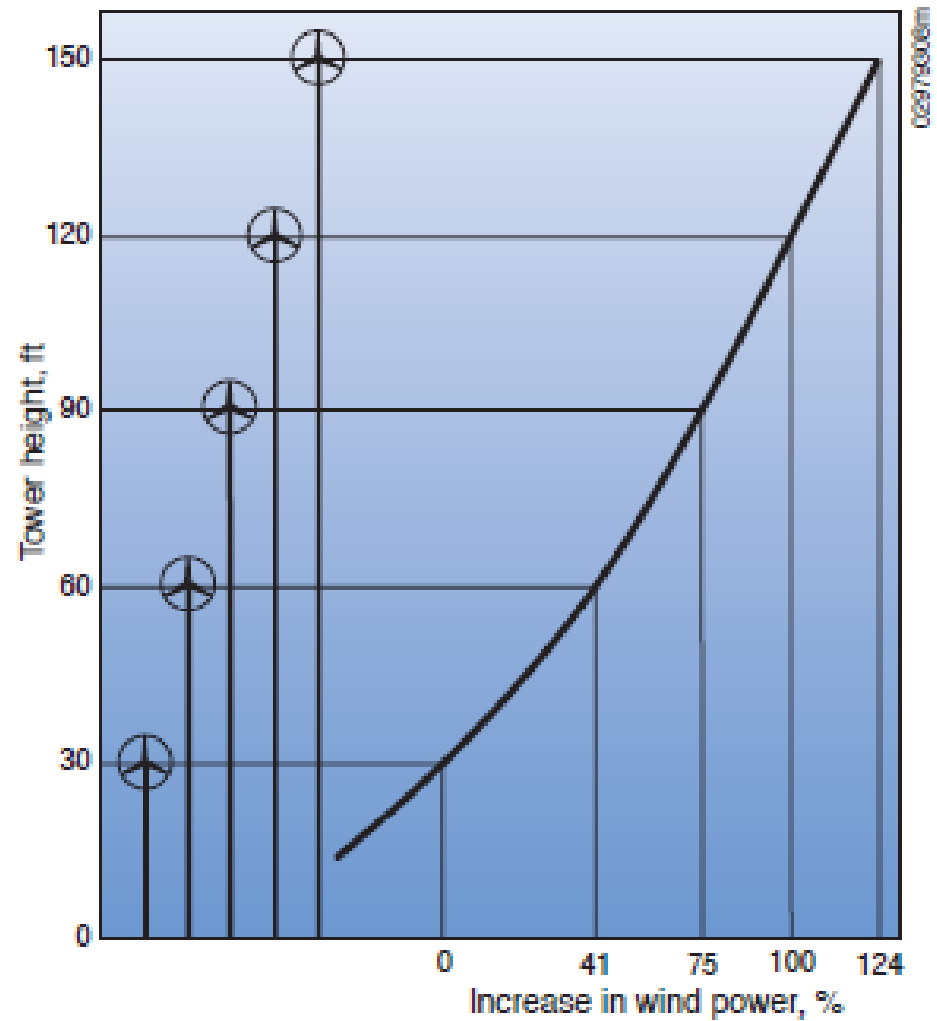
Basic small wind systems can be divided into two types: grid-connected and off-grid



Source: US Department of Energy, Energy Efficiency and Renewable Energy, A Guide Prepared for the Tennessee Valley Authority, May 2004



### Wind Speeds Increase with Height



Source: US Department of Energy, Energy Efficiency and Renewable Energy, A Guide Prepared for the Tennessee Valley Authority, May 2004



# Equipment Needs

- Grid-connected require:
  - Wind turbines including generators
  - Tower
  - Alternator
  - Controller
  - Power Conditioning Unit (inverter)
  - Meters
- Off Grid (or stand-alone systems) require deep-cycle batteries



# Zoning Issues

- How close to property lines?
- How high can we go?  
Most zoning ordinances have height restrictions
- Size of lot should be 1.5 acres or more.

# Reference

## ***In the Public Interest***

*How and Why to Permit for Small Wind Systems*

*A Guide for State and Local Governments*

*(American Wind Energy Association)*

Imagine the result