Small Wind Standards, Testing and Certification

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Presentation Outline

- What is small wind?
- Wind resource and power in the wind
- Overview of U.S./AWEA Small Wind Performance and Safety Standard and international standards
- Other certifications required by U.S. market
- NREL small wind testing projects
- Testing strategies
- Certification process summary
- 12 steps for small wind systems
- For more information

What is small wind?

- Turbines are up to 100 kW
- Typically owned by one individual or organization
- Typically provide energy for local use, retail value
- U.S. industry leads in this market sector throughout the world

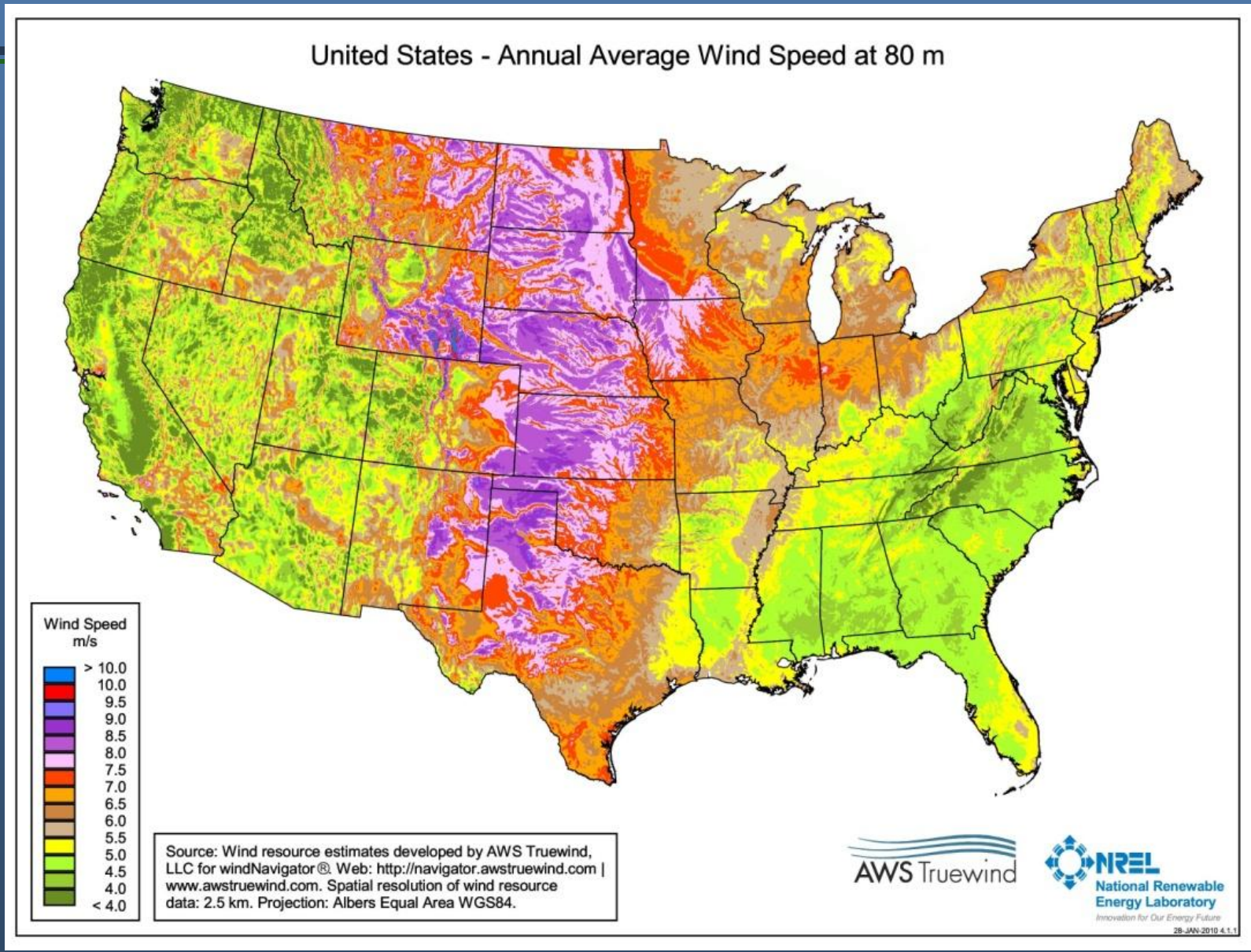
Sizes and Applications

Small (≤100 kW)
- Homes
- Farms
- Remote Applications
- Small Businesses

Mid-size (100-1MW)
- Village Power
- Public Facility Power
- Community Power
- Light industrial

Large (1MW+)
- Central Station Wind Farms
- Community Power

Lower 48 Wind Resources

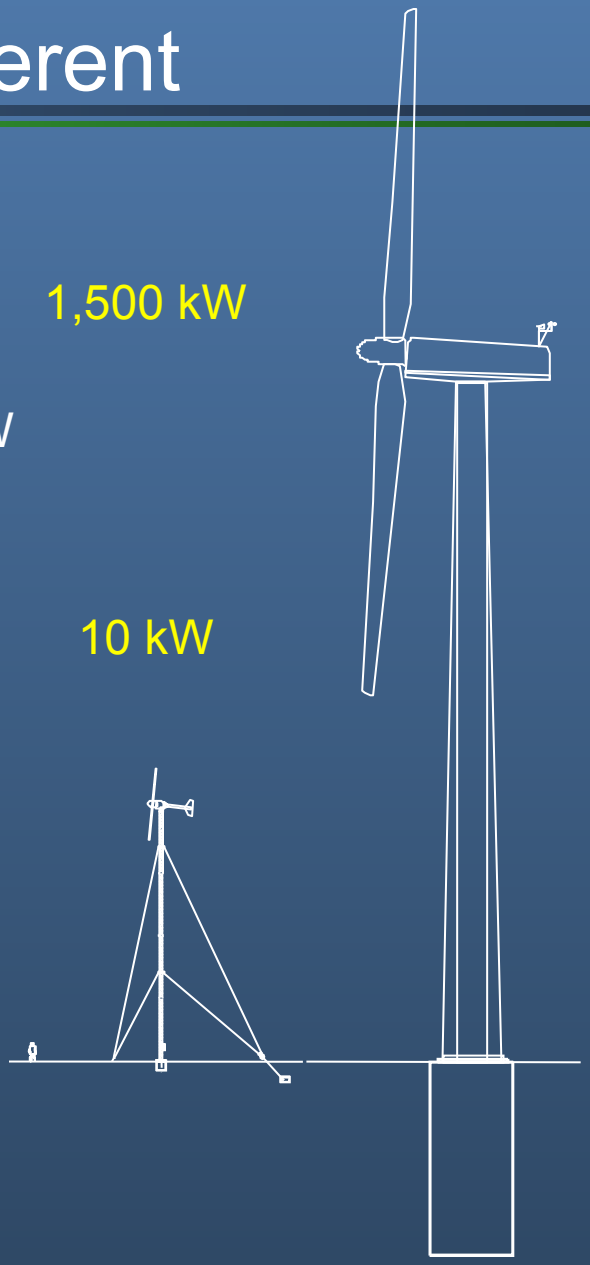


Calculation of Wind Power

- Power in the wind = $\frac{1}{2} \rho A V^3$
  - Effect of wind speed, V
  - Effect of rotor diameter on swept area, A
  - Effect of elevation and temperature on air density, ρ

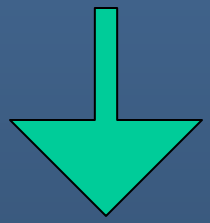
Small Wind Turbines Are Different

- Utility-Scale Wind Power
  1,000 – 4,500 kW wind turbines
  - Typically installed on wind farms, 10 – 300 MW
  - Professional maintenance crews
  - 13 mph (6 m/s) average wind speed
- Small Wind Power
  300 W - 100 kW wind turbines
  - Installed at individual homes, farms, businesses, schools, etc.
  - On the “customer side” of the meter, or off the utility grid entirely
  - High reliability, low maintenance
  - 9 mph (4 m/s) average wind speed



Various Certification Standards

- International Electrotechnical Commission (IEC) 61400 series
  - -2 Design Requirements for Small Wind Turbines – fur turbines up to 200m^2 or about 60 kW
  - -11 Acoustics
  - -12-1 Power Performance

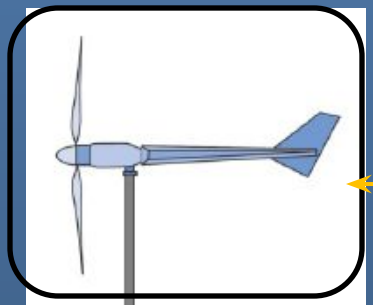


- American Wind Energy Association (AWEA – national)
  - **Small Wind Turbine Performance and Safety Standard** 9.1 – 2009
    - Parts of IEC -2, -11, -12-1
- British Wind Energy Association (BWEA – national)
  - **Small Wind Turbine Performance and Safety Standard**
    - Parts of IEC -2, -11, -12-1
    - -11 Acoustics reporting is different

What is in IEC 61400-2

- External conditions
- Structural design
  - Design load: simple equations, aero elastic, direct measurement
  - Safety factors
- Protection and shutdown system requirements
- Testing
  - Design data testing
  - Duration
  - Safety and function
- Electrical system
- Support structure
- Documentation

SWCC and NRTLs certify Mechanical Strength, Durability, Function & Performance of Turbine System (excludes tower only) to AWEA standard



NRTLs **will** certify Electrical Safety of Turbine & Controller (*new UL Standards in development*)

PE certifies Tower & Foundation

NRTLs certify Inverter to IEEE 1547/UL 1741

NABCEP certifies the Installer

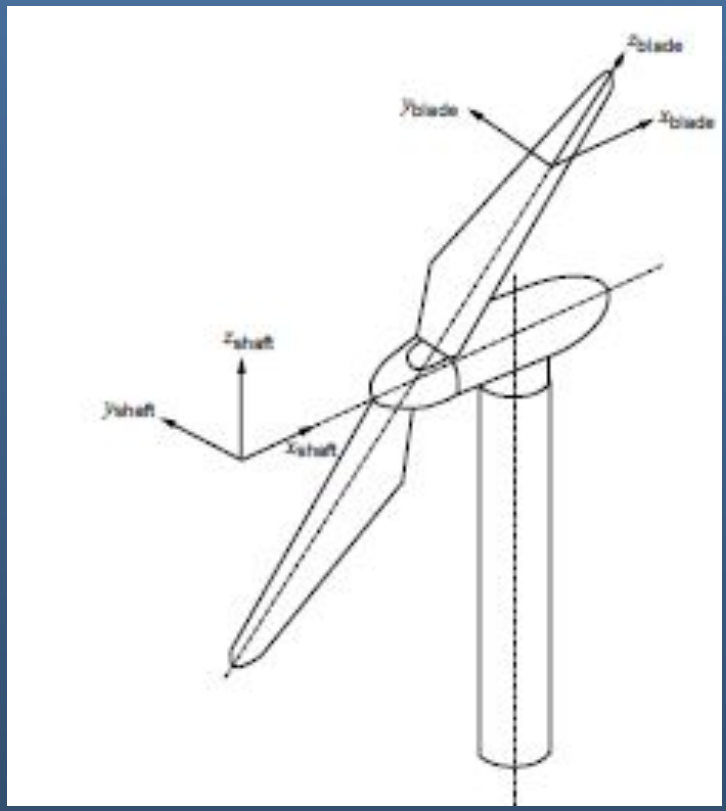
Wired per NEC *(new article 694 in 2011)*

Equipment Eligibility

- Per the AWEA standard
  - Newly manufactured, electricity-producing wind turbines with a swept area up to 200 m^2
  - 200m^2 ~ 16m diameter rotor
    ~ 65 kW (or less)
  - Horizontal and vertical axis turbines are eligible

Certification based on…

- an evaluation of:
  - Wind turbine design
  - Field testing



SWT Manufacturer
(structural analysis)

AWEA AMERICAN WIND ENERGY ASSOCIATION

the Standard

Test Organization
(field testing)

Certifies Conformity

Field Testing

- Power Performance
  - Power Curve
  - Energy Curve
  - Rated Annual Energy
  - Rated Power
- Acoustics
  - Sound pressure levels
  - Rated Sound Level
- Safety and Function
  - Pass/Fail
- Duration
  - Pass/Fail

Qualified Testing Organizations

1. Accredited Test Organization
   - Currently only two accredited labs in North America (NREL and DNV)

2. Non-Accredited Test Organization
   - **On-site audits**

3. Manufacturer Testing
   - On-site audits plus **further scrutiny**

- Testing outside North America is acceptable

To see some results/reports: NREL Independent Testing

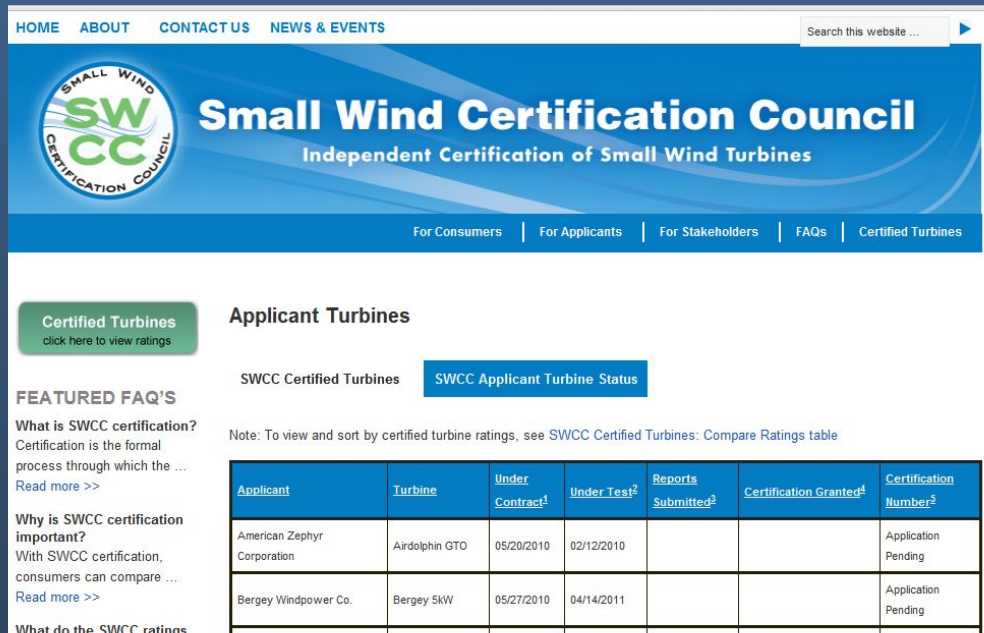
www.nrel.gov/wind/smallwind/independent_testing.html

SWCC Program Status

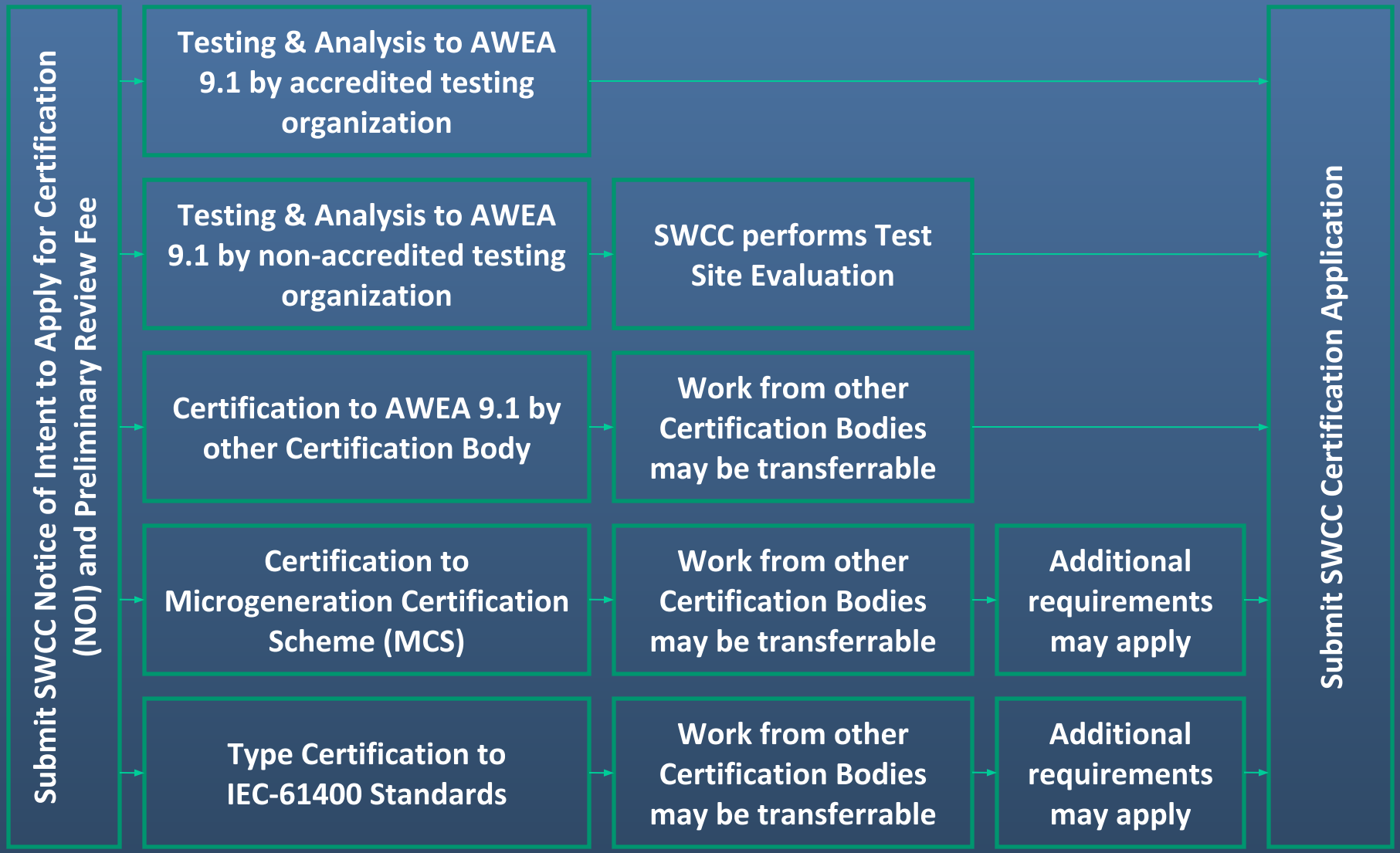
- Began to Accept Notices of Intent in February 2010
- As of November 2011
  - 3 certified turbines “Conditional Temporary Certification”
    - Evance R9000, Evoco 10, Skystream 3.7
  - 13 turbines “Under Test”
  - 12 additional turbines “Under Contract”
- www.smallwindcertification.org

See the list on new website
www.smallwindcertification.org

- New SWCC Status reporting
  - Under Contract
  - Under Test
  - Reports Submitted
  - Limited Power Performance Certification
  - Conditional Temporary Certification
  - Certified



Pathways to SWCC Certification

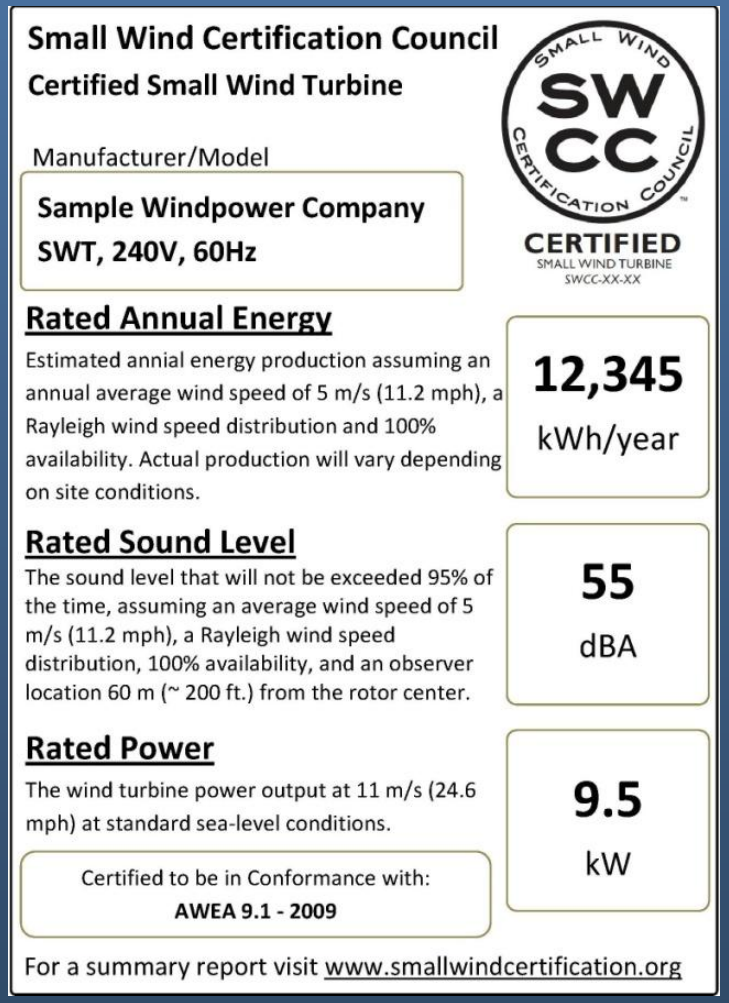


States adding certification requirements

- Energy Trust of **Oregon**
- Focus on Energy (**Wisconsin**)
- **New York** State Energy Research and Development Authority (NYSERDA)
- **Massachusetts** Clean Energy Center (MassCEC)
- **California** Energy Commission (CEC)
- Colorado, Iowa, Maine, Maryland, Minnesota, Nevada, Vermont
- New Jersey?

SWCC Certification Label

- Rated Annual Energy (kWh)
  - @ annual average wind speed of 11.2 mph (5 m/s)
- Rated Sound Level (dBA)
  - Sound pressure level not exceeded 95% of time with average wind speed of 11.2 mph (5 m/s) at 60 meters from rotor
- Rated Power (kW)
  - @ 24.6 mph (11 m/s)



New Technology Questions

- What is the performance?
  - Power curve or annual energy output
  - System performance (power to the grid)
- Was this performance measured in a field test?
  - Not estimated, not from wind tunnel or truck testing
- Has this performance been independently verified?
- Is it labeled for compliance with UL 1741?
  - For safe interconnection to the utility grid
- Is it compliant with an IEC design/safety standard?
- Who can provide parts and service?
- What is the warranty?
- Where has it been demonstrated?
- Is price estimated, or based on real manufacturing experience?

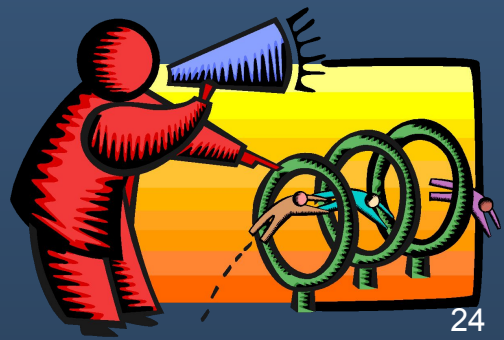
Maintenance, Warranty, and Lifetime

- "Low Maintenance" not "No Maintenance"
  - Inspection and maintenance every 1-2 years
  - Inspect mechanical and electrical connections, check for corrosion, check guy wire tension, inspect/replace leading-edge tape, etc.
  - Beyond 10 years: blade or bearing replacement may be needed
- Warranties
  - 2-5 years, coverage of materials and workmanship
- Lifetimes of 15 to 30 years with regular maintenance

"A wind turbine will see as many operating hours in one year as an automobile will see in 200,000 miles!"

12 Step Program for a Small Wind Project

1. Assess your electricity consumption, cost, and your utility tariff
2. Be more energy efficient → reduce your consumption
3. Estimate or measure wind resource
4. Select turbine size (model) and tower height
    1. Check turbine certification
5. Investigate incentives & economics
6. Get zoning approval



Zoning Scenarios

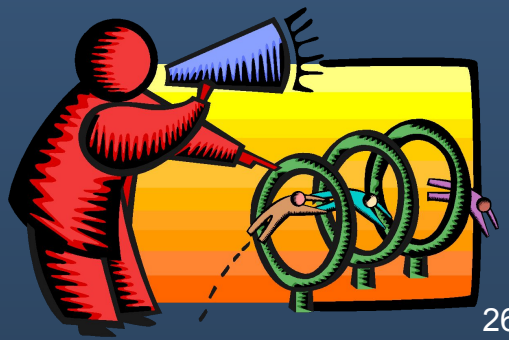
1. No Zoning – Your local jurisdiction may not have exercised their authority to regulate land use.

For Jurisdictions With Zoning:

2. Wind turbine tower is allowed – common in agricultural zones?
3. Structures above 35 ft are not allowed – common in residential zones
   - Obtain a "Variance" or a "Special Use Permit"
     (permission to violate the zoning code on one property)
   - Hearing process can cost thousands of dollars and take several months
4. Work with the local jurisdiction to pass a small wind zoning ordinance (broad application to many properties)

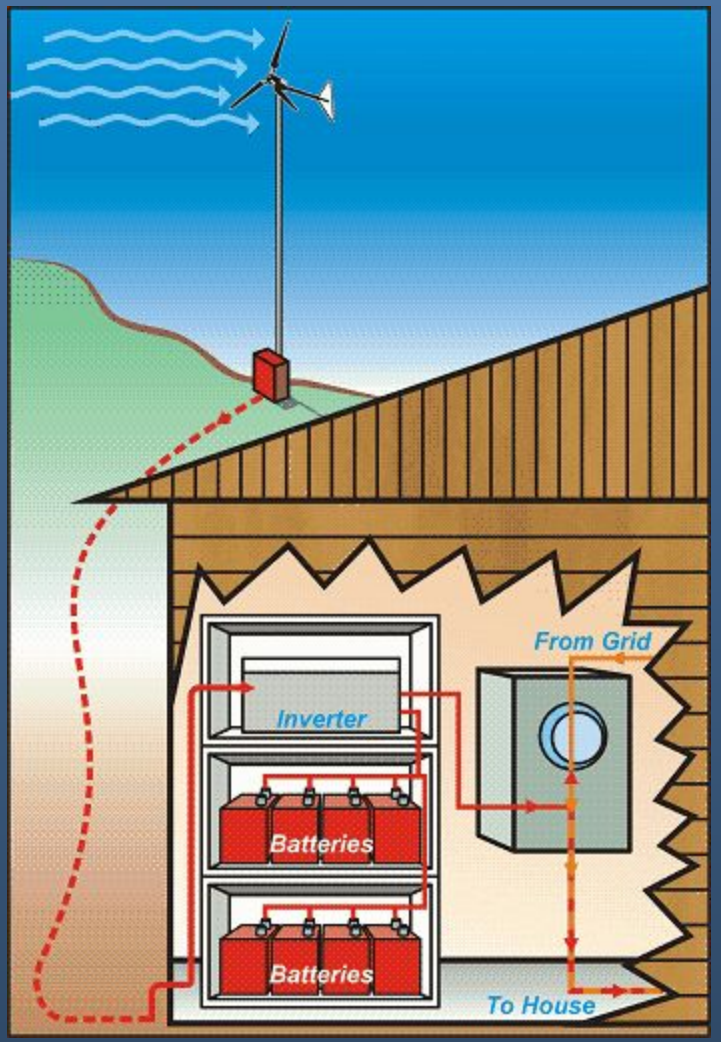
12 Step Program for a Small Wind Project

7. Complete a utility interconnection agreement
8. Obtain building & electrical permits
9. Order turbine and tower
10. Install the turbine
11. Commission the turbine
12. Perform periodic inspections & maintenance



Connecting to the Grid

- **PURPA requires utilities to connect with and purchase power from small wind systems**
- **Reduce consumption of utility-supplied electricity**
- **Utility acts as a big "battery bank"**
- **Contact individual utility before connecting to its lines**



For More Information

- Wind Powering America (see Consumers Guides) www.windpoweringamerica.gov
- American Wind Energy Association – www.awea.org
- Distributed Wind Energy Association – www.distributedwind.org
- Community Wind - Windustry - www.windustry.org
- Incentives – www.dsireusa.org
- Small Wind Certification Council - www.smallwindcertification.org
- North American Board of Certified Energy Practioners – www.nabcep.org
- Home Power Magazine www.homepower.com

Seize the breeze!