INTRO TO DISTRIBUTED WIND

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WHAT IS DISTRIBUTED WIND?

Distributed wind, which is commonly referred to as small and community wind, is the use of typically smaller wind turbines at homes, farms, businesses, and public facilities to off-set all or a portion of on-site energy consumption.

How Do Small Wind Turbines Work

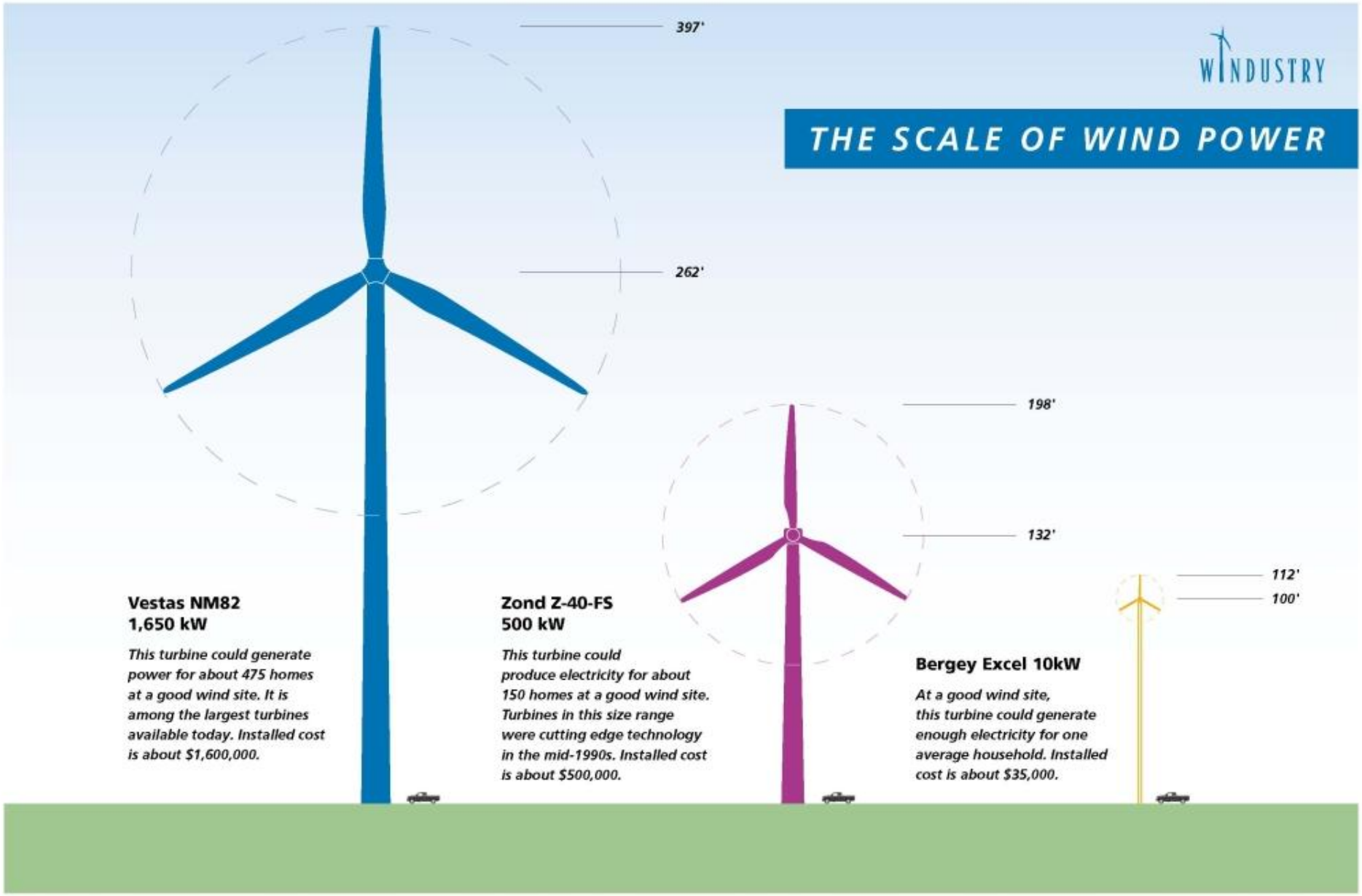
- Wind turns blades & rotor
- Electricity produced in the alternator
- Electricity (VAC or DC) sent down wiring
- BoS components rectify to usable household AC
- Synchronized to run in parallel with existing utility power
- Switching between wind & utility is automatic
- Off-grid applications may have additional BoS components

Distributed Wind Basics

- Distributed Wind, defined
  - Small Wind (100kW & under)
  - Community (mid-sized) wind
  - Towers typically 80’ – 160’
  - Rotors typically 3’ – 70’ diameter
  - Intended to off-set on-site usage
  - Often installed near building being powered
  - Does not feed directly into the grid for public use (may back-feed excess)
  - Generally installed in small numbers, not farms

Utility Scale Basics

- Utility Scale
  - Usually over 1MW
  - May include community (mid-sized) wind
  - Towers typically 300’ – 400’
  - Rotor Diameter typically 200’ – 300’+
  - Installed in groups (“farms”)
  - Spaced thousands of feet apart from each other
  - Intended to feed directly into the grid for public use
  - Regulated like a utility
  - Typically on monopole towers


WINDUSTRY
THE SCALE OF WIND POWER
397'
262'
198'
132'
112'
100'
Vestas NM82
1,650 kW
This turbine could generate power for about 475 homes at a good wind site. It is among the largest turbines available today. Installed cost is about $1,600,000.
Zond Z-40-FS
500 kW
This turbine could produce electricity for about 150 homes at a good wind site. Turbines in this size range were cutting edge technology in the mid-1990s. Installed cost is about $500,000.
Bergey Excel 10kW
At a good wind site, this turbine could generate enough electricity for one average household. Installed cost is about $35,000.

Small Wind Turbines are Different

Large Turbines (500-2500 kW)

- ~ $1,300/kW
- Designed for Low Cost of Energy
- Requires 6 m/s (13 mph) average sites

Small Wind Turbines are Different

Small Turbines (0.2-100 kW)

- Installed in "Rural Residential"
- On-Grid and Off-Grid
- ~ $4,000-6,000/kW
- Designed for Reliability/Low Maintenance
- Requires 4 m/s (9 mph) average sites

HOW IS DISTRIBUTED WIND USED?

Homes & Business

- Reduce all or a portion of utility-provided electricity

HOW IS DISTRIBUTED WIND USED?

Farms

- Reduce operating costs
- Aggregate net metering

HOW IS DISTRIBUTED WIND USED?

State Parks

- Save taxpayer money
- Educational benefits
- Demonstration projects

HOW IS DISTRIBUTED WIND USED?

Municipalities

- Save on energy costs (taxpayer dollars)
- Apply savings to other programs & services
- Support small wind

HOW IS DISTRIBUTED WIND USED?

Education

- Schools, Colleges, Universities, State Parks & Others

Project Example:
10 kW, Liberty County, Chester, MT

- 10 kW Bergey, 80 ft Guyed Tower installed at county maintenance facility
- Installed Dec. 2003
- Cost ~ $50,000, but US-DOE project and state grants paid for ~ 90%
- Produces ~ 10,000 kWh per year

Project Example:
50 kW, City of Perry, IA

- 50 kW Endurance, 140 ft Self-Supporting Lattice Tower installed at wastewater treatment plant
- Cost ~ $400,000, but is being leased to city
- Produces ~ 165,000 kWh per year

TYPES OF TURBINES

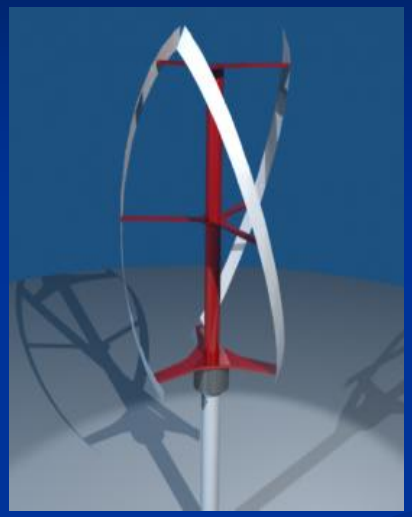
- Horizontal Axis Wind Turbine ("HAWT")
  - Name reflects horizontal axis of rotor orientation
  - Most common for both DG and Utility Scale wind
  - Many have proven track records/field tested
  - kWh productivity data available
  - 3 blades most common, but others used as well

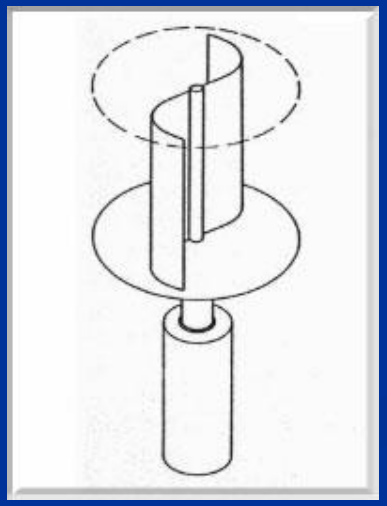
EXAMPLES OF HAWTS

TYPES OF TURBINES

- Vertical Axis Wind Turbine ("VAWT")
  - Reflects the vertical axis of rotor orientation
  - Less common
  - Often do not make it past prototype phase
  - Reliability/productivity issues
  - Actual kWh production data often unavailable
  - Still in the R&D/"emerging technologies" category

EXAMPLES OF VAWTS



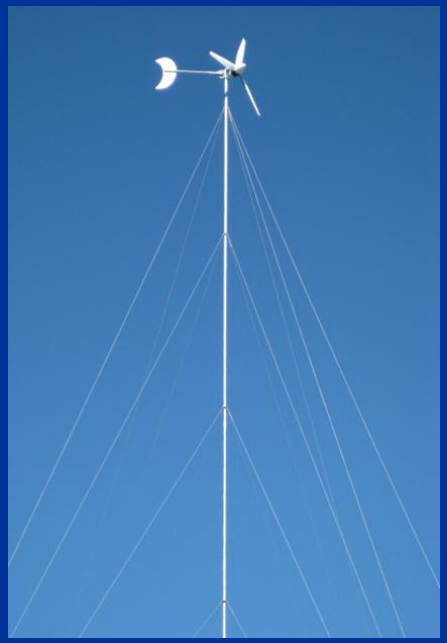


Basics on Towers

- **Tower** – supporting structure, engineered for unique load-handling
  - Wind loads on turbine
  - Turbine loads on tower
  - Icing and other loads on tower & turbine
  - Non-static loads

Tower Types

- Guyed Lattice
- Freestanding Lattice
- Tilt-up Pipe
- Monopole



System-Types

- **Grid-tied/Grid-direct**
  - Works in parallel with existing utility service
- **Off-grid/Stand-alone**
  - Is not tied with existing utility service
  - Requires batteries or other means of storing energy
- **Grid-tie w/battery backup**
  - Uses grid and has storage
  - Requires additional BoS components