Virginia State Wind Energy Symposium
Residential Scale Wind Systems
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Southwest Windpower
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COMPANY OVERVIEW

- Founded in 1987
- The world’s largest producer of 400watt – 3kW small wind turbines
- Global leader in small wind industry
- 15,000+ turbines shipped annually
- 160,000+ turbines installed worldwide
- Representation in over 88 countries
THE SCIENCE BEHIND WIND ENERGY

How much kinetic energy a wind turbine can covert to mechanical energy follows the equation:

\[ \text{Wind Energy} = \frac{1}{2} \rho A V^3 t \]

\( \rho \) = air density
A = swept area
V = speed of wind

Power in 1 m\(^2\) at a wind speed of 5 m/s:
\[ 0.5 \times 1.204 \times 1 \times 5^3 = 75 \text{ W} \]

Power in 1 m\(^2\) at a wind speed of 10 m/s
\[ 0.5 \times 1.204 \times 1 \times 10^3 = 602 \text{ W} \]
DISTRIBUTED ENERGY vs. CENTRALIZED

**Distributed Energy**
- Point of Use Applications
- No major distribution network required
- Lower wind resources available

**Centralized Energy**
- Generate power on a “mass” scale
- Major distribution network required
- High wind sites
- Remote locations installations
“SMALL” AND “RESIDENTIAL” WIND

- **Small wind** is typically identified as a wind turbine with a rating of 100KW or less and works on the retail side of the meter.

- **Residential Scale Wind** is sized for the typical home and is usually 10kW and less

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Endurance 50KW  
Northern Power Systems 100KW  
Southwest Windpower 2.4KW
HOW SMALL OR DISTRIBUTED WIND ENERGY IS USED

Residential Grid Tie
13+ million homes are viable candidates for small wind
Requirements: ½ acre lot, wind resource, zoning

Commercial /Community
10+ million Commercial/Community sites are viable candidates

Micro Grid
Developing Country
Remote villages, rural, island electrification

Battery Charging/Off-Grid
Remote Power for Worldwide Applications
Remote homes, rural electrification, sailing, Telecom

<table>
<thead>
<tr>
<th>MARKET SEGMENTS</th>
<th>APPLICATIONS</th>
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<tbody>
<tr>
<td>OFF-GRID</td>
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<tr>
<td>Telecom</td>
<td>Battery Charging</td>
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<td>Marine / Boating</td>
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<td>Rural Electrification</td>
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<td>Street Lighting</td>
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<td>Off-Shore Platforms</td>
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<td>Remote Homes</td>
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<tr>
<td>Military</td>
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<td>GRID-TIE</td>
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<tr>
<td>Residential</td>
<td>Direct Power Grid Tie</td>
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<tr>
<td>Commercial</td>
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<td>Island Electrification</td>
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<tr>
<td>Agricultural</td>
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<td>University</td>
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<td>Healthcare</td>
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<td>Hospitality</td>
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<td>Government</td>
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Inverter will convert DC power to household AC.

The “grid” or your utility stores excess energy, usually giving it back to you in the form of a credit.
NEWER SYSTEMS INCLUDE MONITORING

- Monitor & graph energy production.
- Newer systems are packaged with custom monitoring.
- 3rd party vendors also can provide monitoring:
  - Fat Spaniel
  - TED
IS WIND RIGHT FOR YOU?

✓ Do you have a good wind resource?
  Typically 11 mph average annual wind speed is the minimum entry point for a system that performs well.
  People often overestimate their wind resource.

✓ Siting Considerations?
  Can you install a system on a tower?
  Usually requires ½ an acre of land or more.

✓ Zoning and Permitting Considerations?
  Will your city/town allow and installation?
  Don’t be afraid to be the first and pave the way!

✓ Utility Considerations?
  Does your utility provide and Interconnection agreement?
Power is an instantaneous measurement. The power rating gives you a general sense of the size of the turbine, the Energy Curve will give you data on the actual output of a system over time.

Energy is the ability to do work while power is the rate at which work is done.
HOW TO FIND YOUR WIND RESOURCE

Typical minimum requirements are 11 MPH or greater wind. However, this depends on other factors such as the cost of electricity at the site, annual variations of the wind and sun.

Traditional:
Site monitoring (long process)
Local Airport Data (may not be accurate)
Wind Maps (doesn’t drill down to the microsite)
Observational data (flagged trees)

New Technology:
Computer based wind modeling. Based on 40 years of historical data.
TrueWind, NREL, 3-Tier
MICRO SITING – PROPER PLACEMENT WILL GREATLY AFFECT PERFORMANCE

Wind systems perform best in a “clean” wind environment. Typically obstructions create turbulent wind which is not helpful to life of a system or the performance.
SITE FEATURES THAT AFFECT WIND TURBINE PERFORMANCE

Coast or Lakeside

Ridge top

Mesa
WIND SPEED AND TOWER HEIGHT

Calculations based on Power Law Exponent 0.02
(In area of tall row crops, hedges, a few trees).
Proper siting of a wind turbine is extremely important.

Similar to installing a solar panel on the north side of a roof, a poorly sited wind generator will do little more than just look nice.

Example of a poorly sited wind generator
ZONING AND PERMITTING

- There are no federal laws around zoning of small wind systems. Often Cities and Counties do not know what to do when the first system comes to system.
- Lack of permitting and NIMBY issues can often be roadblocks
  - Positive education is important
    - Small/Distributed wind IS NOT a large wind farm
    - Benefits of community and school installations
  - AWEA provides standard small wind zoning and permitting guidelines, a good start
Almost every small distributed system is directly tied to the electrical grid. This requires an interconnection agreement with the utility.

- Federal PURPA law requires a utility to allow interconnection. Most do, however some still make it difficult.
- All inverter based systems must be certified to UL 1741 and IEEE 1547
Ill blows the wind that profits nobody.

*William Shakespeare – Henry VI, Part III, Act II*
Several factors to consider

Not the same for every site and wind turbine

- Installed cost of system MINUS any rebates and incentives
- Energy output based wind resource and proper siting
- Current and future cost of electricity
- What is your personal motivation for purchasing a wind system?

Incentives help reduce cost of energy

<table>
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<tr>
<th>Item</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Installed Cost</td>
<td>$14,000</td>
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<tr>
<td>Federal Incentive (30%)</td>
<td>$4,200</td>
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<tr>
<td>State Incentive</td>
<td>$0</td>
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<tr>
<td>Final Cost</td>
<td>$9,800</td>
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1. NOTE: Installed cost is based on an average cost using a 33’ tower. Actual price may be more depending on tower height, location and site complexity.

2. NOTE: Cost of Energy estimate is based on ideal wind conditions over the life of the product plus maintenance. Actual performance will vary from site to site.

Cost/kWh compared to wind speed

<table>
<thead>
<tr>
<th>Wind speed (MPH)</th>
<th>Cost/kWh</th>
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<tbody>
<tr>
<td>8</td>
<td>$0.45</td>
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<tr>
<td>10</td>
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<tr>
<td>12.5</td>
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<td>15</td>
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<td>17.5</td>
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<tr>
<td>20</td>
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<tr>
<td>22.5</td>
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<tr>
<td>25</td>
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<tr>
<td>27</td>
<td>$0.05</td>
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<tr>
<td>29</td>
<td>$0.00</td>
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BUYING A SYSTEM - WHAT TO LOOK FOR

- Statements of Energy output, not just power
- Independently verified and certified systems
- Coming SOON – Small Wind Certification Council
- References and example installations
- Trained installers that can site and size the right system
WHAT TO LOOK OUT FOR: BAD DESIGN, FLY BY NIGHT

Beware of: “Breakthrough Wind Turbine Design” and “Roof-Mounted”
RESOURCES

• Resource assessment:  www.skystreamenergy.com
  www.windpoweringamerica.gov

• Wind turbine mfg’s:  www.awea.org

• Incentive database:  www.dsireusa.org

• Interconnection issues:  www.irec.org
Thank You

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