

# What's Happening in the Small Wind Market?

Jenny Heinzen

Lakeshore Technical College

# Lesson 1:

**Windmill**



**Turban**



**Wind Turbine**



# Definition: Small Wind

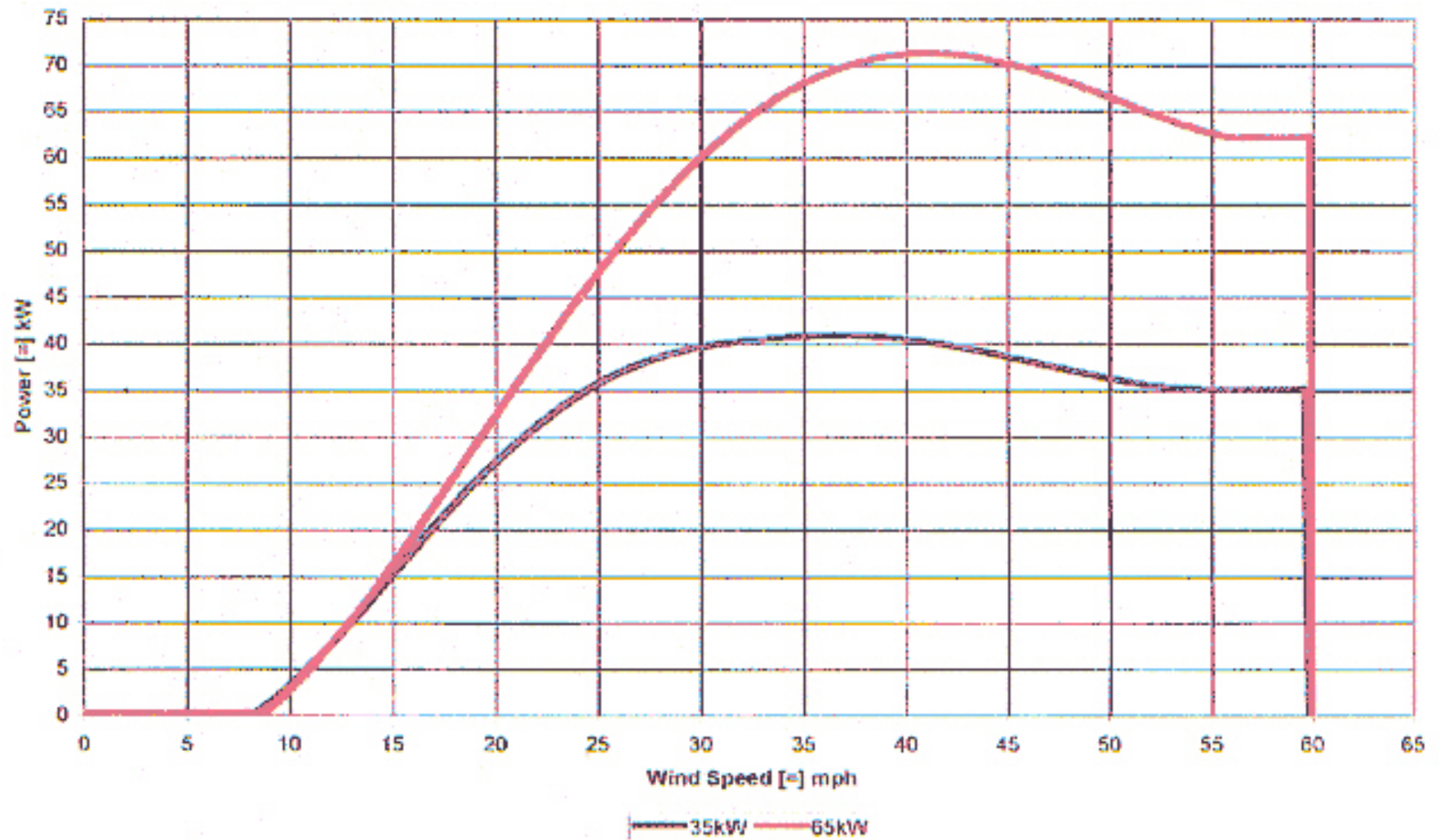
- $\leq 100$  kW nameplate rating
- Distributed Generation (DG)
- Grid-tied, interconnected
- Homes, farms, schools & businesses
- NOT wind farm equipment



*65 kW Vestas V-15 at Lakeshore  
Technical College, Manitowoc Co.*

# Power Curve

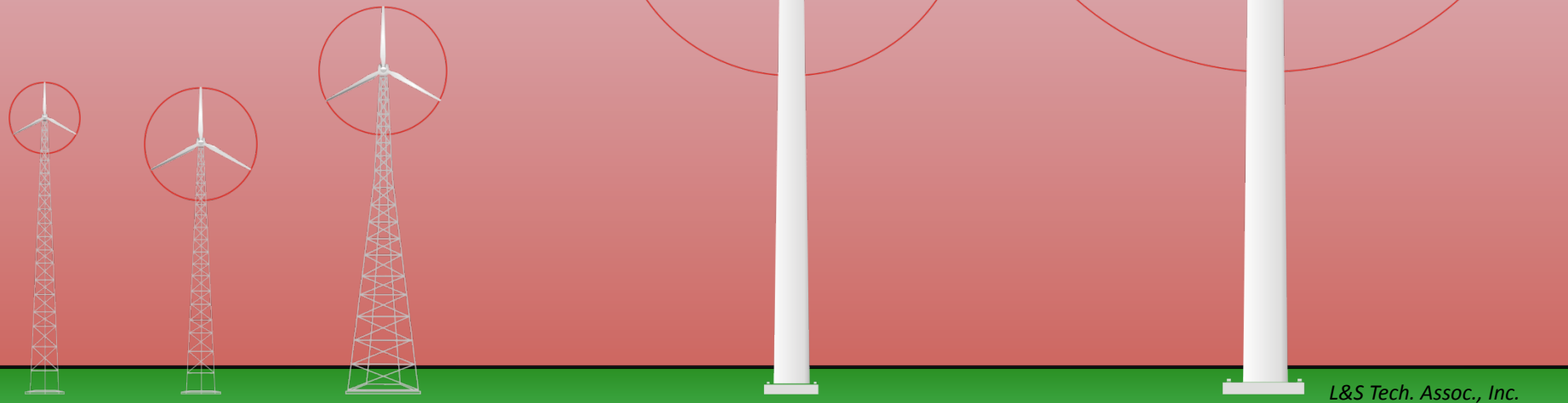
E15 Estimated Power Curves  
[Rayleigh Distribution in Unobstructed Airflow]



# Relative Sizes of Wind Turbines - proportionally scaled

**Small Scale**

**Utility  
Scale**



*L&S Tech. Assoc., Inc.*

<b>Jacobs 31-20</b>	<b>Vestas V15-65</b>	<b>Vestas V17-90</b>	<b>Vestas V47-660</b>	<b>G. E. 1.5 MW</b>	
31 ft	49.22 ft.	55.8 ft	154.2 ft	252.6 ft	<b>Rotor Diameter</b>
120 ft	110 ft.	140 ft	213.64 ft	262.5 ft	<b>Hub Height</b>
<b>3.5</b>	<b>11.5</b>	<b>18.5</b>	<b>145</b>	<b>325</b>	<b>Average Homes Powered</b>

# Power From a Wind Turbine

$$P = \frac{1}{2} d A v^3$$

Where:

**P = Power**

**d = Air density**

(Temperature, Humidity & Altitude)

**A = Area of Rotor**

**v = Wind Speed**

# Height is Everything

- The taller the tower, the better the wind
- The better the wind, the more production
- Avoid short towers
- Avoid rooftop installations
- Avoid “urban turbines”



# The “urban turbine”

- <http://www.mge.com/environment/innovative/urban.htm>
- Madison Gas & Electric
- Made 54 kWh from 12/18/09-2/22/10
- @10¢/kWh, has saved \$5.40 in two months



*If system makes ~50kWh in 2 months, it will make ~300kWh/yr*

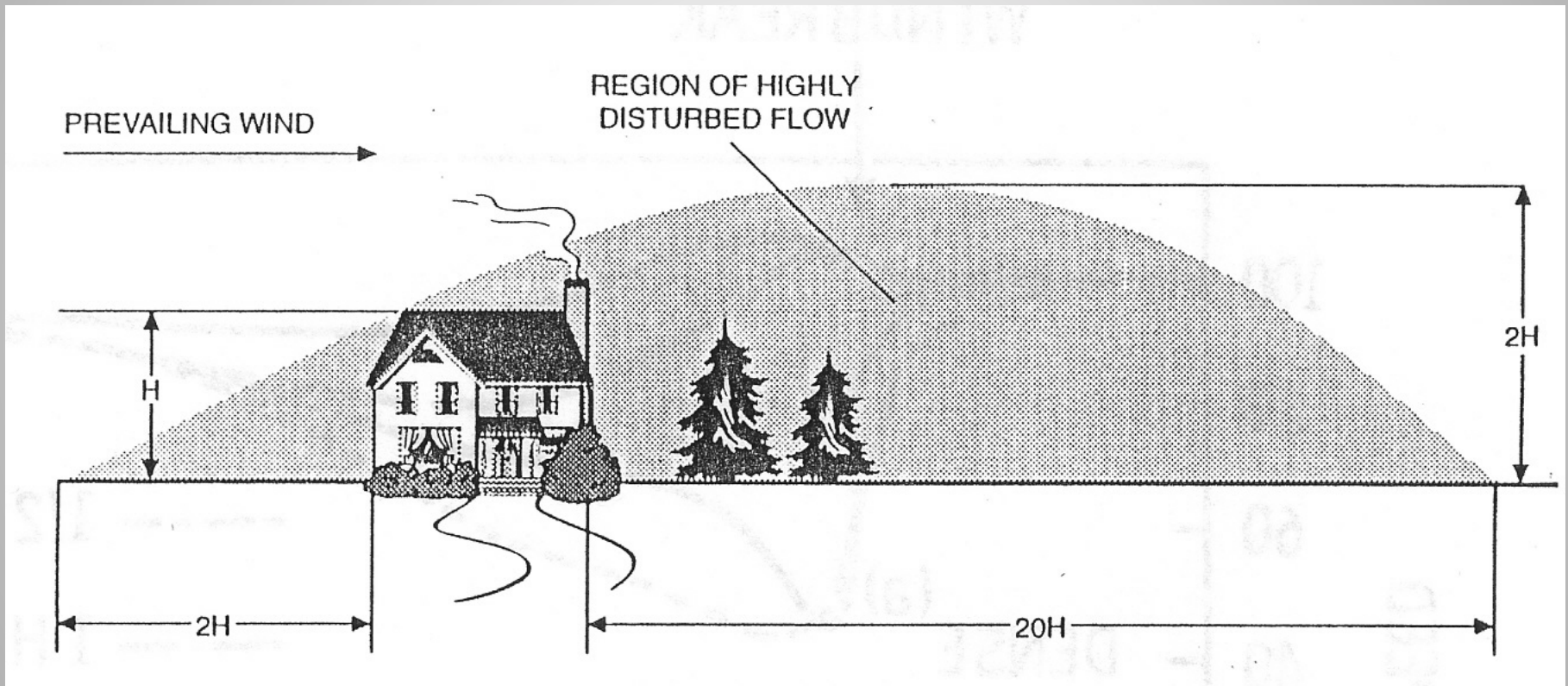
*@ 10¢/kWh = \$30.00/yr annual revenue*

***@\$40,000 installed cost, payback is ~1,333 years!***

# Technology that works

- Horizontal axis wind turbines
- Tall towers
- Away from buildings & trees
  - As a general rule, keep bottom of blade 30' above anything within 500'
- Site assessment isn't just a good idea; it's required for Focus on Energy funding

# Keep turbines out of turbulence

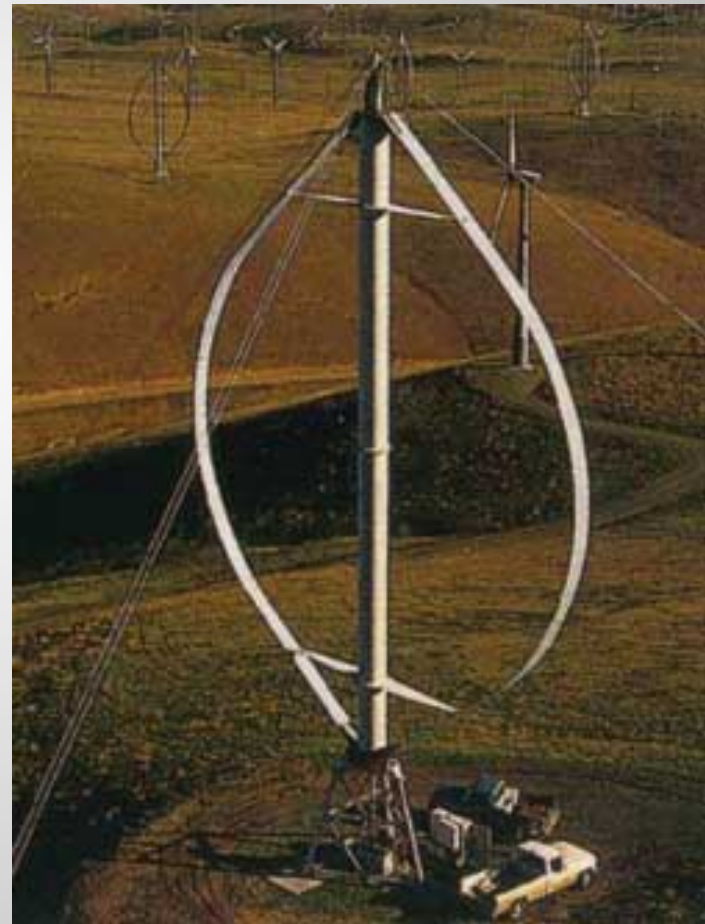


# So what's really happening with the small wind market?

- There are no new “breakthrough” technologies to report
- Large influx of new companies making outlandish production claims
- Sudden & frustrating interest in vertical, rooftop & “urban” turbines

# Vertical-axis claims:

- ***“Can accept wind from any direction”***
  - So can horizontal-axis machines
- ***“Bird-friendly”***
  - So are horizontal-axis machines
- ***“No climbing required”***
  - Bolts, cables, grease??



# The problem with rooftop turbines

- Rooftops are turbulent zones
- Machines don't perform well in turbulence
- Vibrations & forces absorbed by building
  - Structural integrity
  - Noise



*Boston Logan Airport*

# When is a short tower okay?

- If you only need to produce a few kWh
- If you live on a ridge in Montana



# Challenges in the small wind market

- Educating consumers & general public
- Dispelling myths & rumors
- Supply chain issues
- Standardization of power curves & estimated annual output
- Local zoning ordinances, uniformity
- Return on investment (ROI)
- Local interconnection issues

# Supply Chain Issues

- Exclusivity between manufacturers, dealers & installers
- Small shops w/o assembly lines
- Buyouts, turnovers & bankruptcies
- Systems aren't sold as "whole" packages – machine, tower & inverter are typically separate components

# Performance Standards

- Small Wind Certification Council (SWCC) recently announced power curve standards
- Voluntary
  - [http://www.awea.org/smallwind/documents/AWEA Small Turbine Standard Adopted Dec09.pdf](http://www.awea.org/smallwind/documents/AWEA_Small_Turbine_Standard_Adopted_Dec09.pdf)
- National Renewable Energy Laboratory (NREL) Wind Technology Center, Colorado (DOE)
  - <http://www.nrel.gov/wind/facilities.html>

# Zoning Issues



- Large wind projects create controversy
- Local ordinances are written in response to large proposed projects
- Small wind projects are often found *guilty by association* and outlawed

# Wind systems are accused of:

- Killing birds
- Being noisy
- Casting shadows
- Throwing ice
- Causing stray voltage
- Contaminating ground & well water
- Interfering with radar & communication systems
- Emitting low frequency vibrations
- Making people sick – *wind turbine syndrome*
- Marring the landscape
- Disrupting flight-for-life landing procedures
- Changing global weather patterns (!)

# Wisconsin's new wind turbine siting law for projects up to 100 MW

- Ordinances were written by townships
- Local decision makers were overwhelmed
- Ordinances became restrictive
- No uniformity
- Projects were stalled & abandoned
- All project rules will now be determined by the Public Service Commission

# ROI

- Annual kWh x price of electricity = savings
- Total installed cost ÷ annual savings = payback
- Annual savings ÷ total installed cost = ROI
- *Example:*
  - 55,000 kWh x 7¢/kWh = \$3850 annual savings
  - \$100,000 ÷ \$3850 = 26 year payback (3.85% ROI)
  - With 12¢ ART, = \$6600 annual savings
  - \$100,000 ÷ \$6600 = 15 year payback (6.6% ROI)

# Advanced Renewable Tariffs

- Known as ARTs, feed-in tariffs, buy-back rates
- Established rates for customer-generated energy, like small wind
- Increases ROI
- Models successful European policies
- Proposed in Green Energy Jobs Act

# Interconnection Issues

- Local requirements & procedures vary
- PSC 119 applies in WI
- NEC Article 705 – *Interconnected Electric Power Production Sources*
- Currently no article in NEC about wind turbines, but planned for 2011
- Multiple interpretations of listing, grounding
- Act 63 – licensed electricians only

# My Contact Information:



Jenny Heinzen

Instructor

Wind Energy Technology

Lakeshore Technical College

1290 North Avenue

Cleveland, WI 53015

920-693-1267

[jenny.heinzen@gotoltc.edu](mailto:jenny.heinzen@gotoltc.edu)