Wind Resource Assessment

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Outline

• Why measure the wind?
• How to measure the wind
• Analyzing the data
• What’s next?
Why Measure the Wind?

Power = Density x Area x (Velocity)^3

• Density depends on temperature & elevation
• Area depends on the wind turbine (area swept by the blades)
• Velocity depends on the location & height
### Why Measure the Wind?

- Different heights
- Based on wind power density; not wind speed

#### Classes of Wind Power Density

<table>
<thead>
<tr>
<th>Class</th>
<th>10 m</th>
<th>30m</th>
<th>50m</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WPD (W/m²)</td>
<td>Speed (m/s)</td>
<td>WPD (W/m²)</td>
<td>Speed (m/s)</td>
</tr>
<tr>
<td>1</td>
<td>&lt;100</td>
<td>&lt;4.4</td>
<td>&lt;160</td>
<td>&lt;5.1</td>
</tr>
<tr>
<td>2</td>
<td>100 - 150</td>
<td>4.4 - 5.1</td>
<td>160 - 240</td>
<td>5.1 - 5.8</td>
</tr>
<tr>
<td>3</td>
<td>150 - 200</td>
<td>5.1 - 5.6</td>
<td>240 - 320</td>
<td>5.8 - 6.5</td>
</tr>
<tr>
<td>4</td>
<td>200 - 250</td>
<td>5.6 - 6.0</td>
<td>320 - 400</td>
<td>6.5 - 7.0</td>
</tr>
<tr>
<td>5</td>
<td>250 - 300</td>
<td>6.0 - 6.4</td>
<td>400 - 480</td>
<td>7.0 - 7.4</td>
</tr>
<tr>
<td>6</td>
<td>300 - 400</td>
<td>6.4 - 7.0</td>
<td>480 - 640</td>
<td>7.4 - 8.2</td>
</tr>
<tr>
<td>7</td>
<td>&gt;400</td>
<td>&gt;7.0</td>
<td>&gt;640</td>
<td>&gt;8.2</td>
</tr>
</tbody>
</table>

-Wind power density classes based on different heights
-Classes are determined by wind power density, not wind speed
Wind Speed vs. Power Density

Wind Power Density:
- 400 W/m²  Class 7
- 250 W/m²  Class 5
- 200 W/m²  Class 4

Ave = 6 m/s, Weibull = 1.5
Ave = 6 m/s, Weibull = 2
Ave = 6 m/s, Weibull = 3
Outline

• Why measure the wind?
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Wind Map of Alaska
Anemometer Loan Program

Met tower kit includes:

• Anemometers
• Wind vane
• Temperature sensor
• Data logger
• 100-foot tower
State Anemometer Loan Program

AEA provides:
• Tower kit
• Installation assistance
• Technical assistance

Community provides:
• Land use for 1 year of monitoring
• Installation assistance
• Maintenance
• Data collection
Location of Met Towers

25 Sites
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Data Analysis Software

- NRG Data Retriever Software (www.nrgsystems.com)
- Excel spreadsheets
- Windographer (www.mistaya.ca)
- WindFarm
Quality Control

- Min/Max values
- Metric Units
- Vane offset is correct
- Tower shadow
- Icing of sensors
Icing Event

![Graph showing wind speed and SD of vane over October 2005](image)

- **Wind Speed**
- **SD of Vane**
Potential Wind Power Production

NW100 power curve

NW100 in Kotzebue

Toksook Bay wind turbine construction
Wind Rose

Wind Frequency Rose

Average of Wind Speed

Total of Wind Power Density
Turbulence Intensity

\[ TI = \frac{SD_{\text{windspeed}}}{AVE_{\text{windspeed}}} \]

- <0.15 Low
- 0.15 to 0.25 Moderate
- > 0.25 High
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Feasibility Studies

- How many wind turbines?
- What kind of wind turbines?
- How much fuel would be saved?
- What’s the payback?
Computer Models

- RETScreen (www.retscreen.net)
- Hybrid2 (www.ceere.org)

- Available FREE at www.nrel.gov/homer
- Developed by the National Renewable Energy Laboratory
Wind Energy Program Website

AEA’s wind energy program provides information and technical assistance, wind monitoring equipment, and educational opportunities for Alaskans interested in this increasingly viable energy source.

**Anemometer Loan Program**
(equipment for onsite monitoring of wind resource)

**Resource Assessment Data**
(get data files and reports of wind data measured at various locations across the state)

**Wind Map**
(find out the power potential of your location on the wind resource map)