Wind Resource Assessment

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Outline

- Why measure the wind?
- How to measure the wind
- Analyzing the data
- What's next?

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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

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Why Measure the Wind?

Classes of Wind Power Density							
Class	10 m		30m		50m		Rating
	WPD (W/m^2)	Speed (m/s)	WPD (W/m^2)	Speed (m/s)	WPD (W/m^2)	Speed (m/s)	
1	<100	<4.4	<160	<5.1	<200	<5.6	Poor
2	100 - 150	4.4 - 5.1	160 - 240	5.1 - 5.8	200 - 300	5.6 - 6.4	Marginal
3	150 - 200	5.1 - 5.6	240 - 320	5.8 - 6.5	300 - 400	6.4 - 7.0	Fair
4	200 - 250	5.6 - 6.0	320 - 400	6.5 - 7.0	400 - 500	7.0 - 7.5	Good
5	250 - 300	6.0 - 6.4	400 - 480	7.0 - 7.4	500 - 600	7.5 - 8.0	Excellent
6	300 - 400	6.4 - 7.0	480 - 640	7.4 - 8.2	600 - 800	8.0 - 8.8	Outstanding
7	>400	>7.0	>640	>8.2	>800	>8.8	Superb

-Different heights

-Based on wind power density; not wind speed

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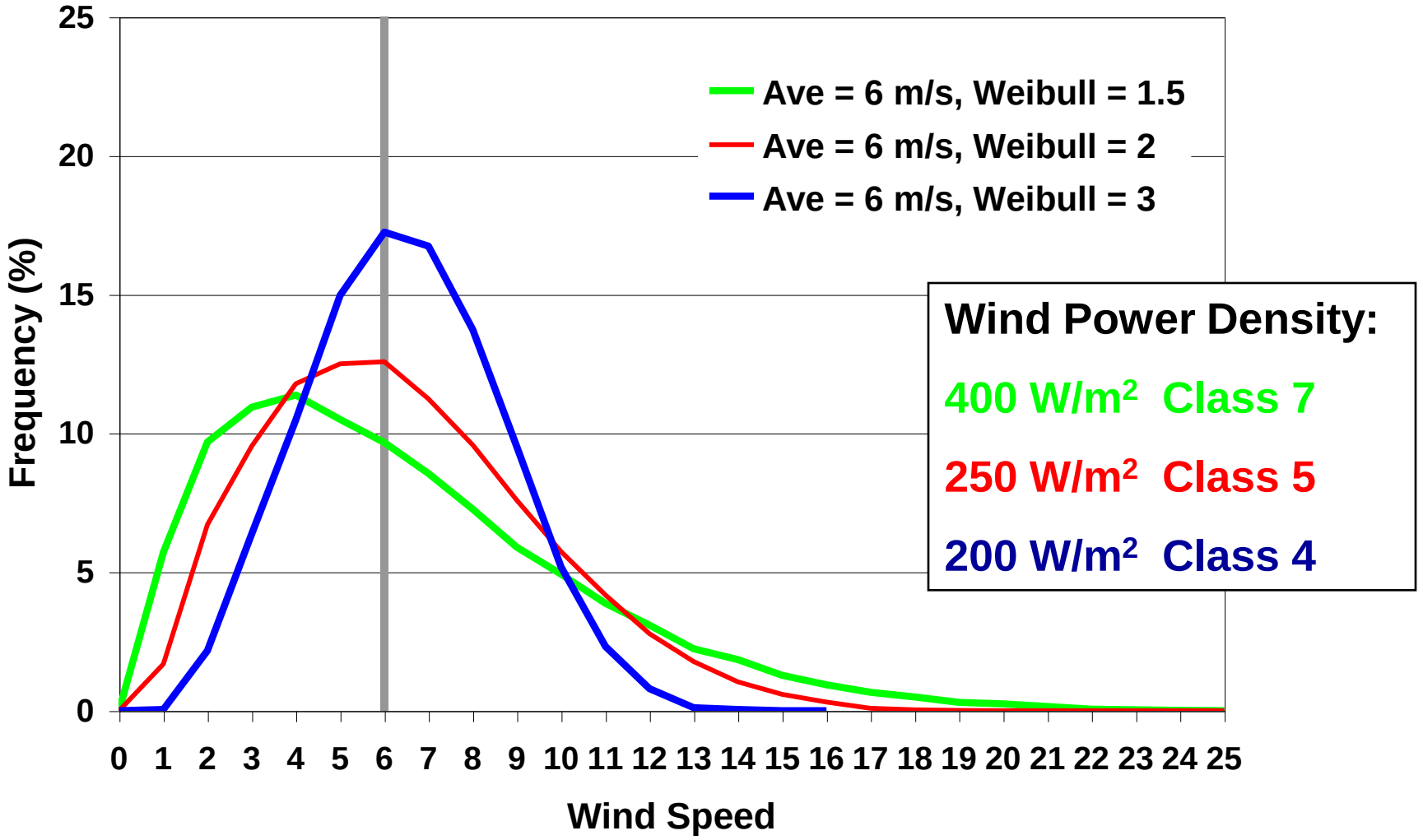
Wind Speed vs. Power Density



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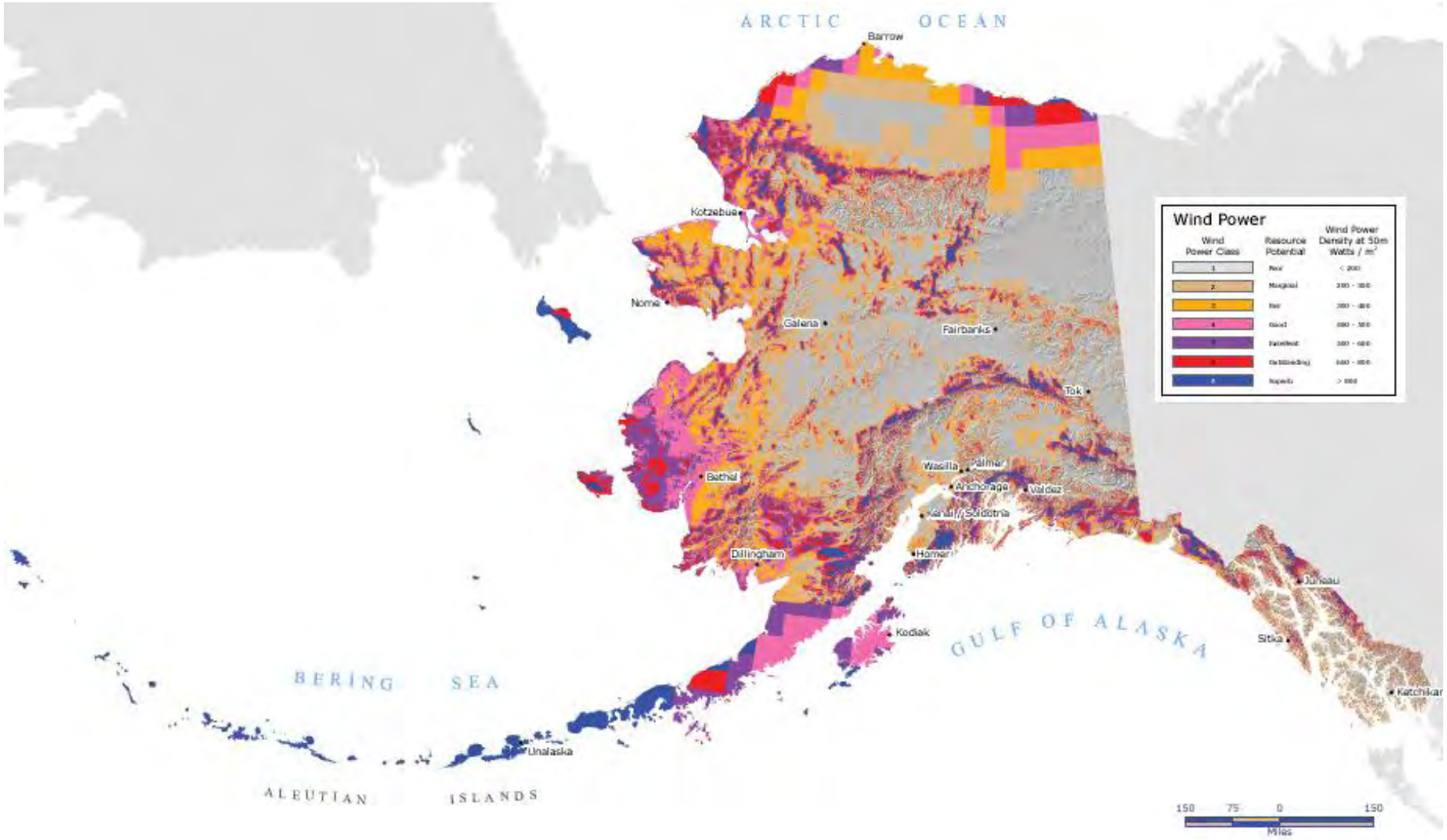
Wind Map of Alaska



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Anemometer Loan Program

Met tower kit includes:

- Anemometers
- Wind vane
- Temperature sensor
- Data logger
- 100-foot tower

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DENALI COMMISSION
ALASKA

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

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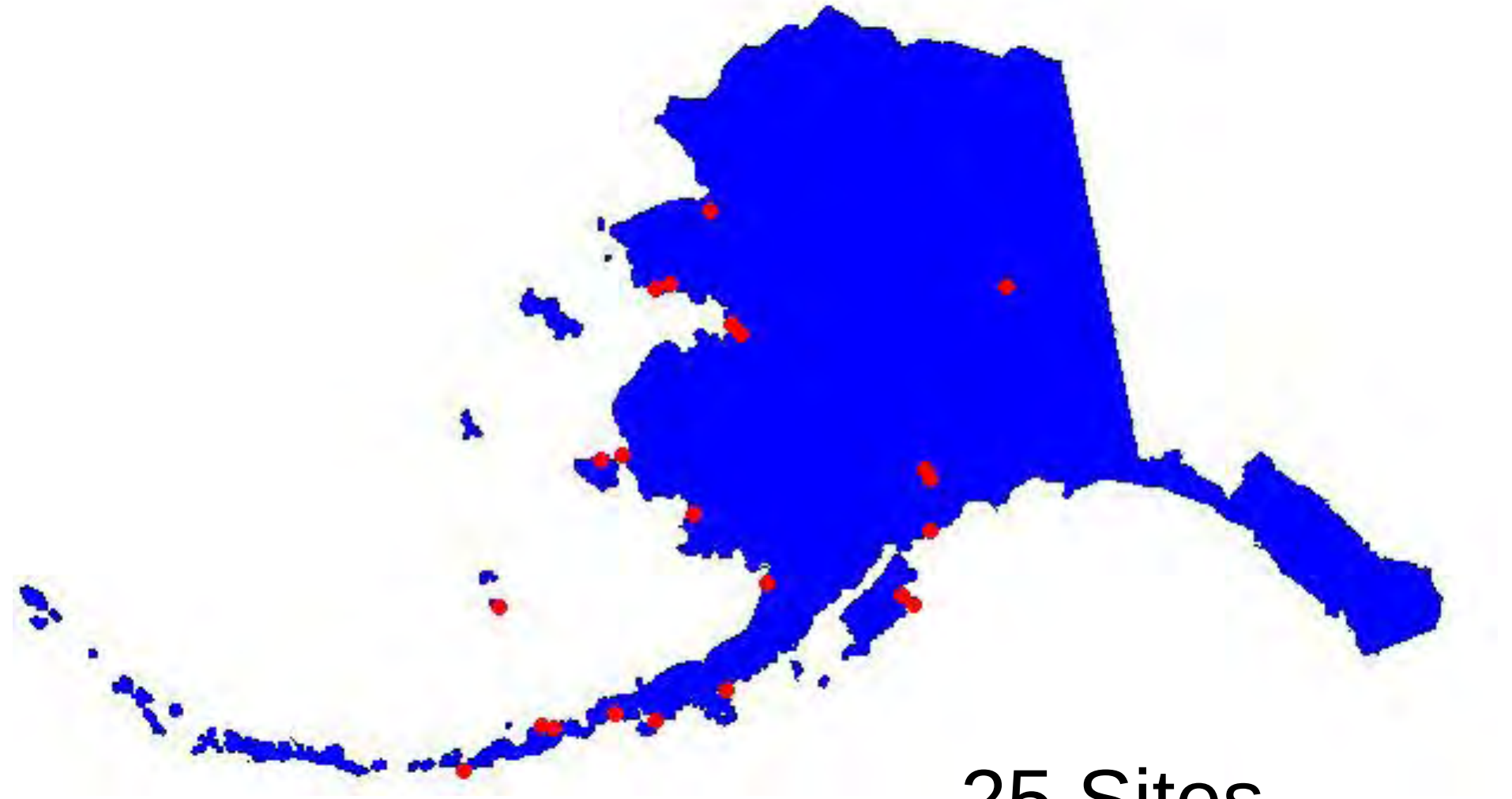
Location of Met Towers



25 Sites

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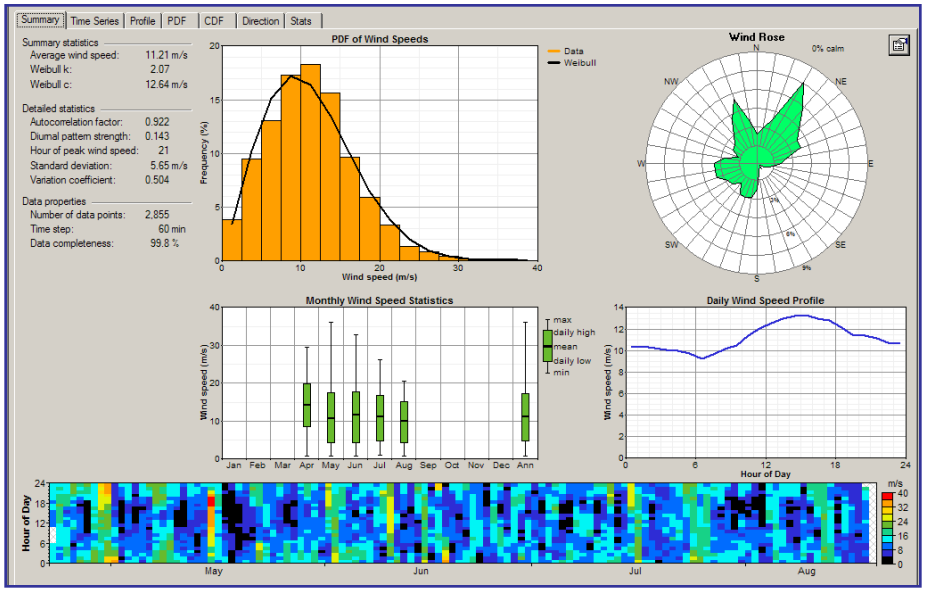
Data Analysis Software

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



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Quality Control

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

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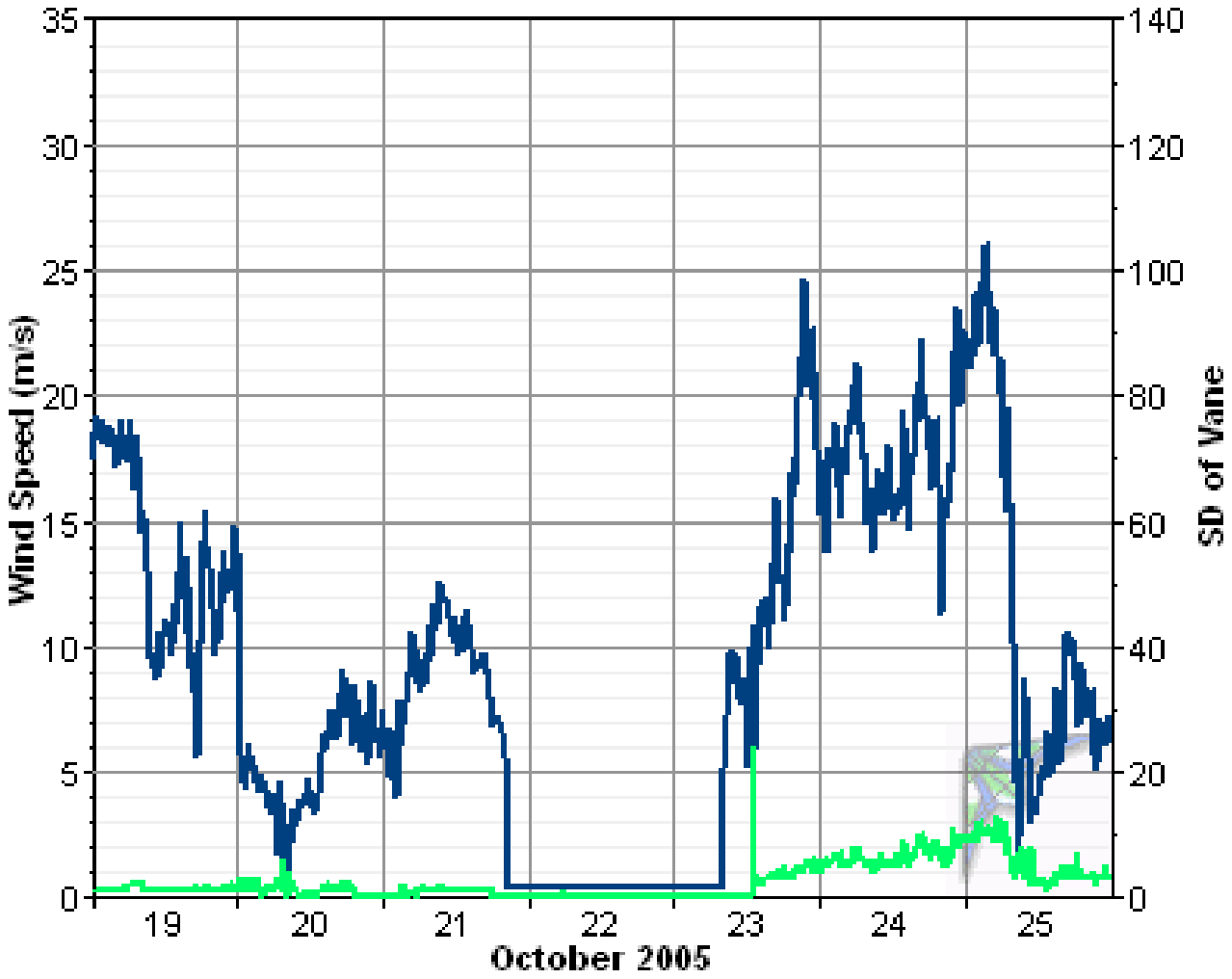
Icing Event



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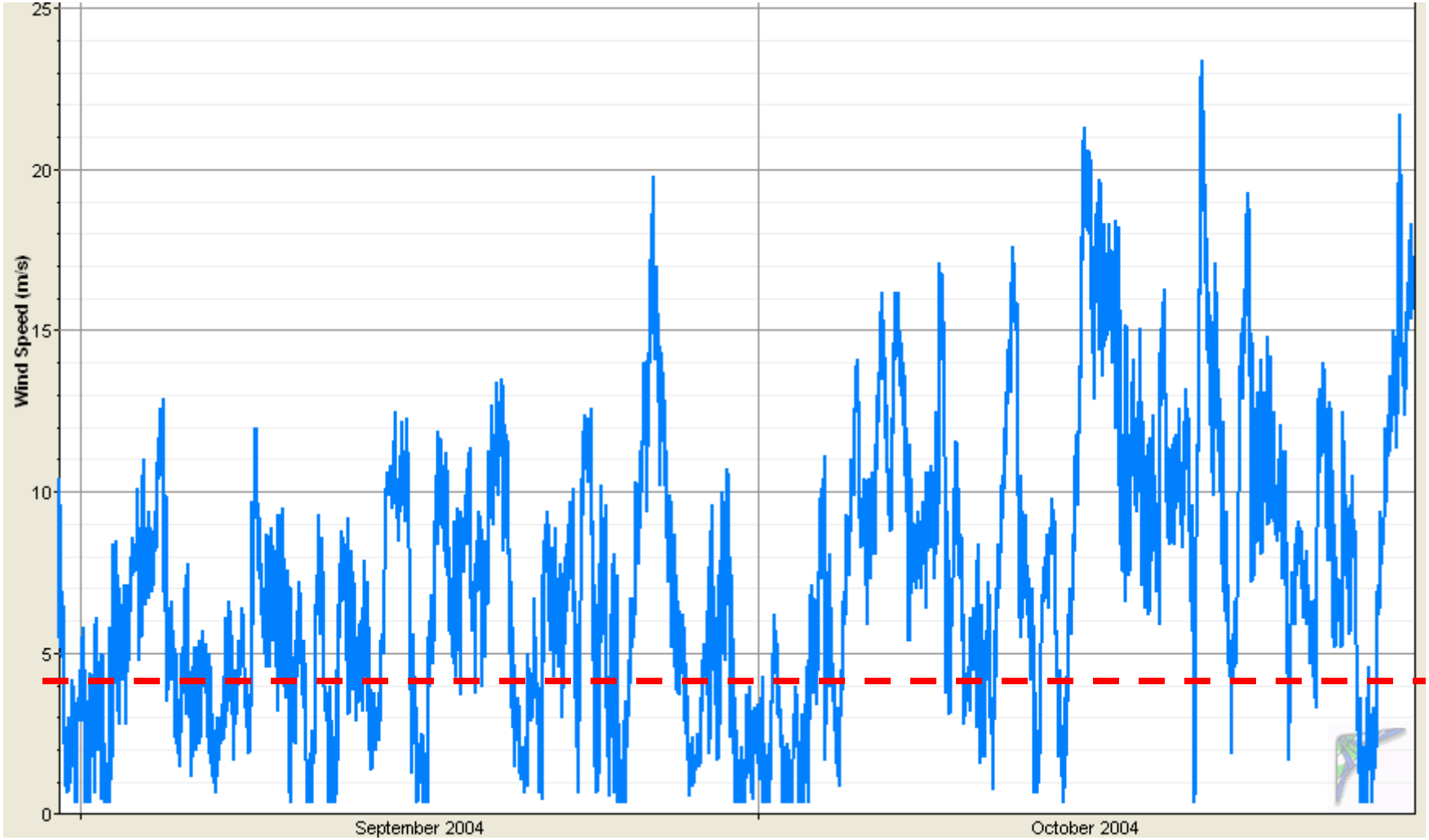
Time Series Data



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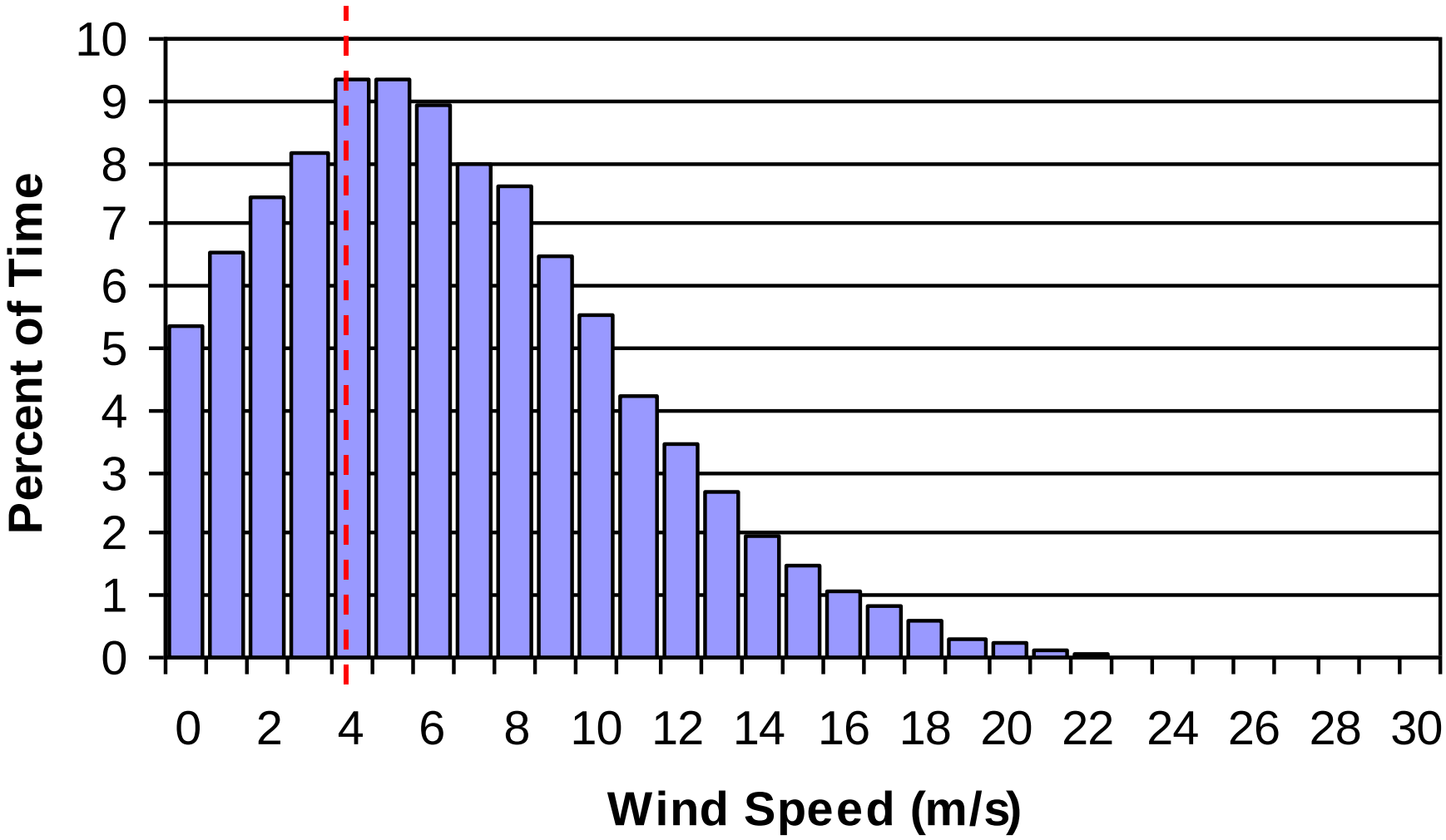
Wind Frequency Distribution



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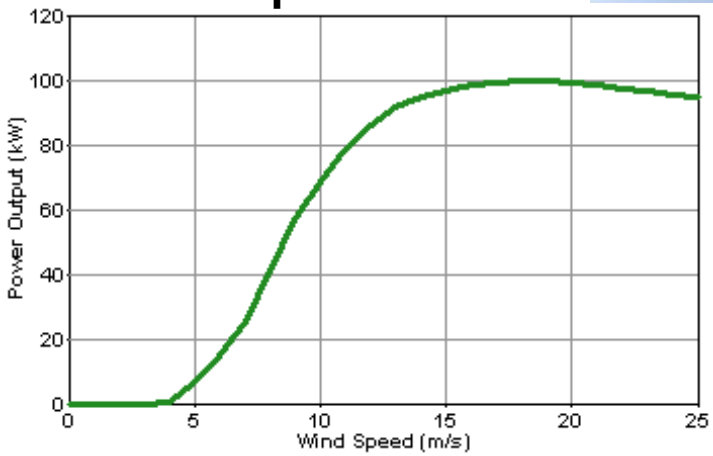
Potential Wind Power Production

NW100 in Kotzebue

NW100 power curve



Toksook Bay wind turbine construction

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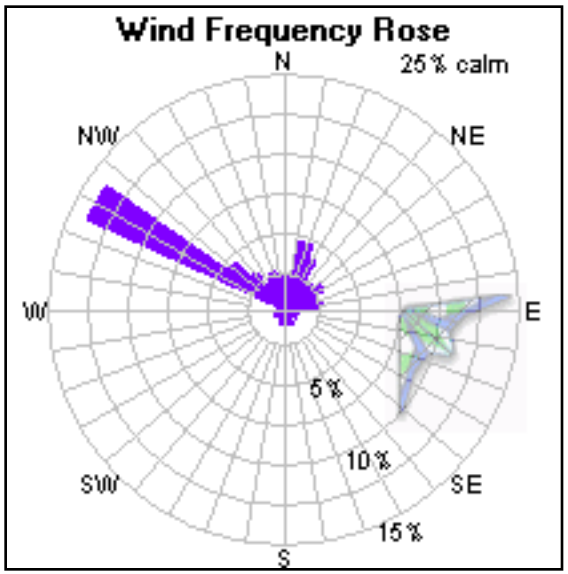
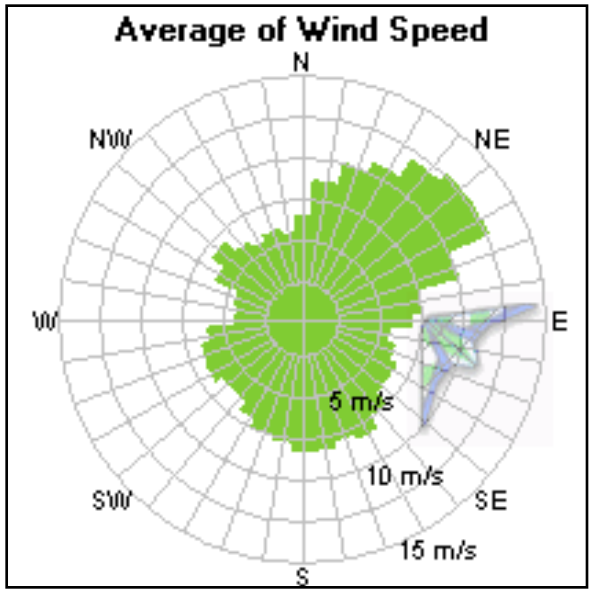
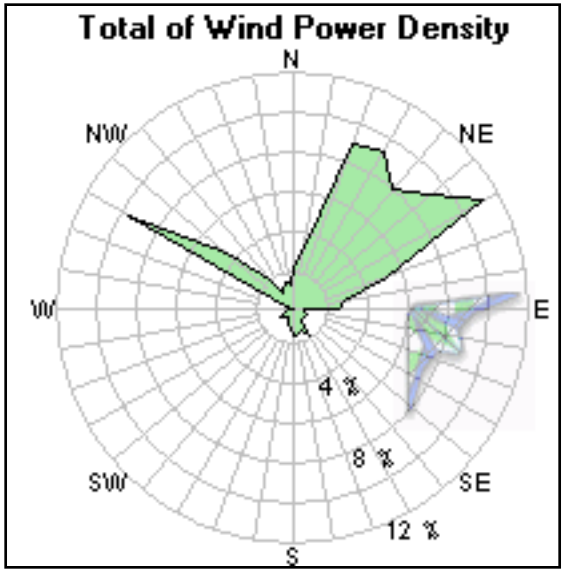
Wind Rose







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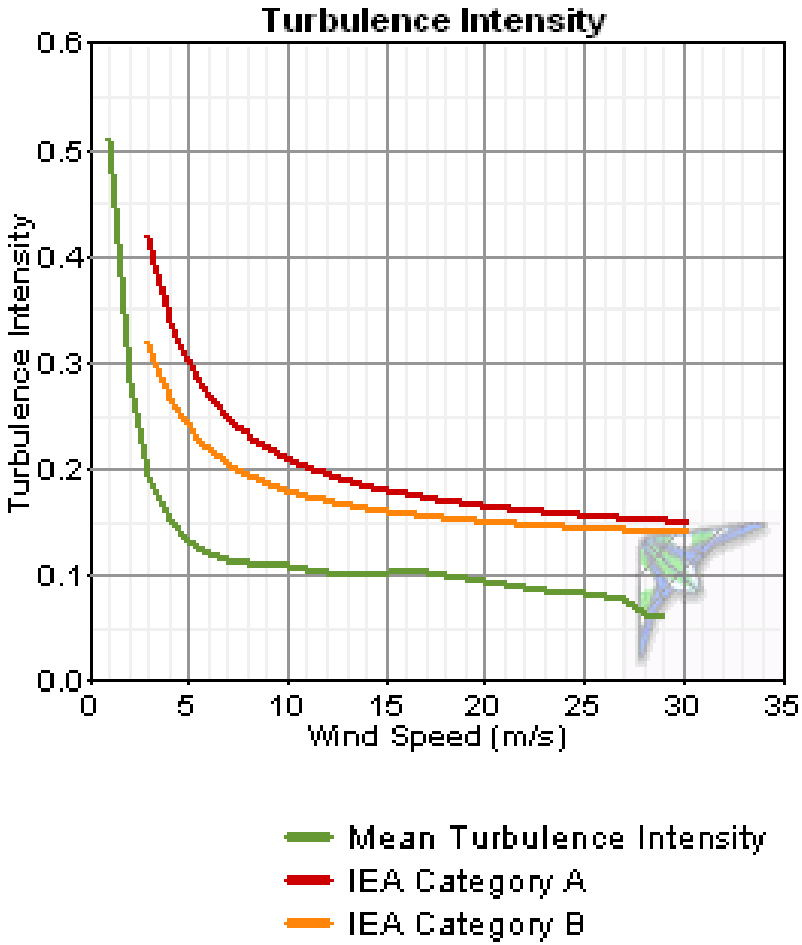
Turbulence Intensity

$$TI = \frac{SD_{windspeed}}{AVE_{windspeed}}$$

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



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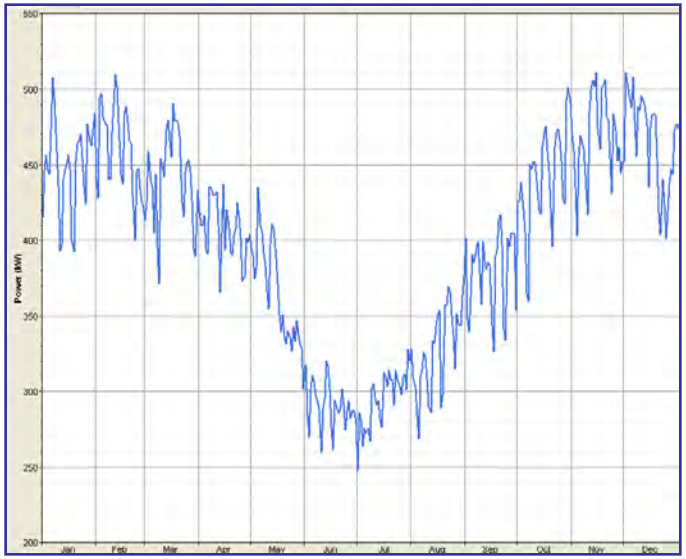
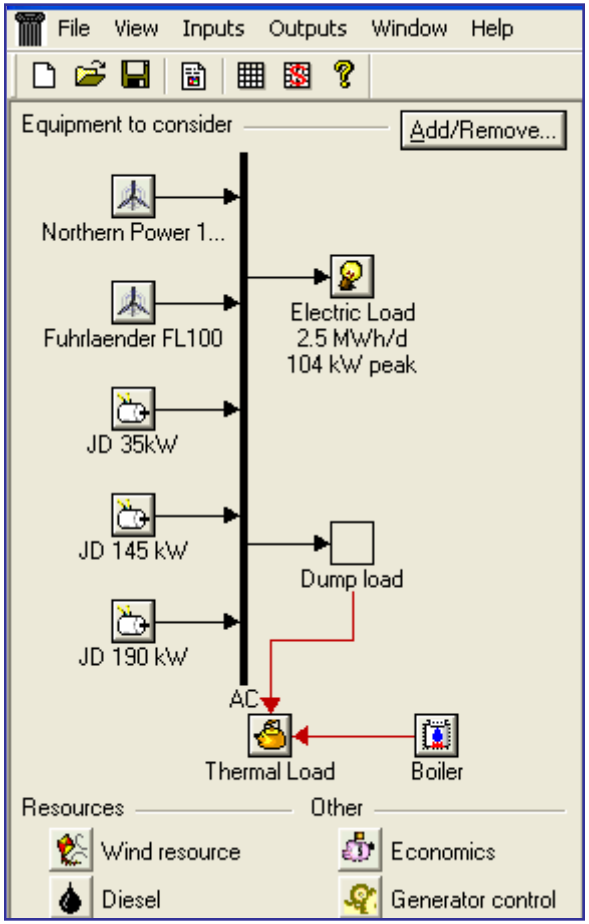
Feasibility Studies

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





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Computer Models

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

HOMER

THE OPTIMIZATION MODEL FOR DISTRIBUTED POWER

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

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Wind Energy Program Website

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