

Yukon-Kuskokwim Region Wind Resource Summary

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Regional Wind Development Workshop
Bethel

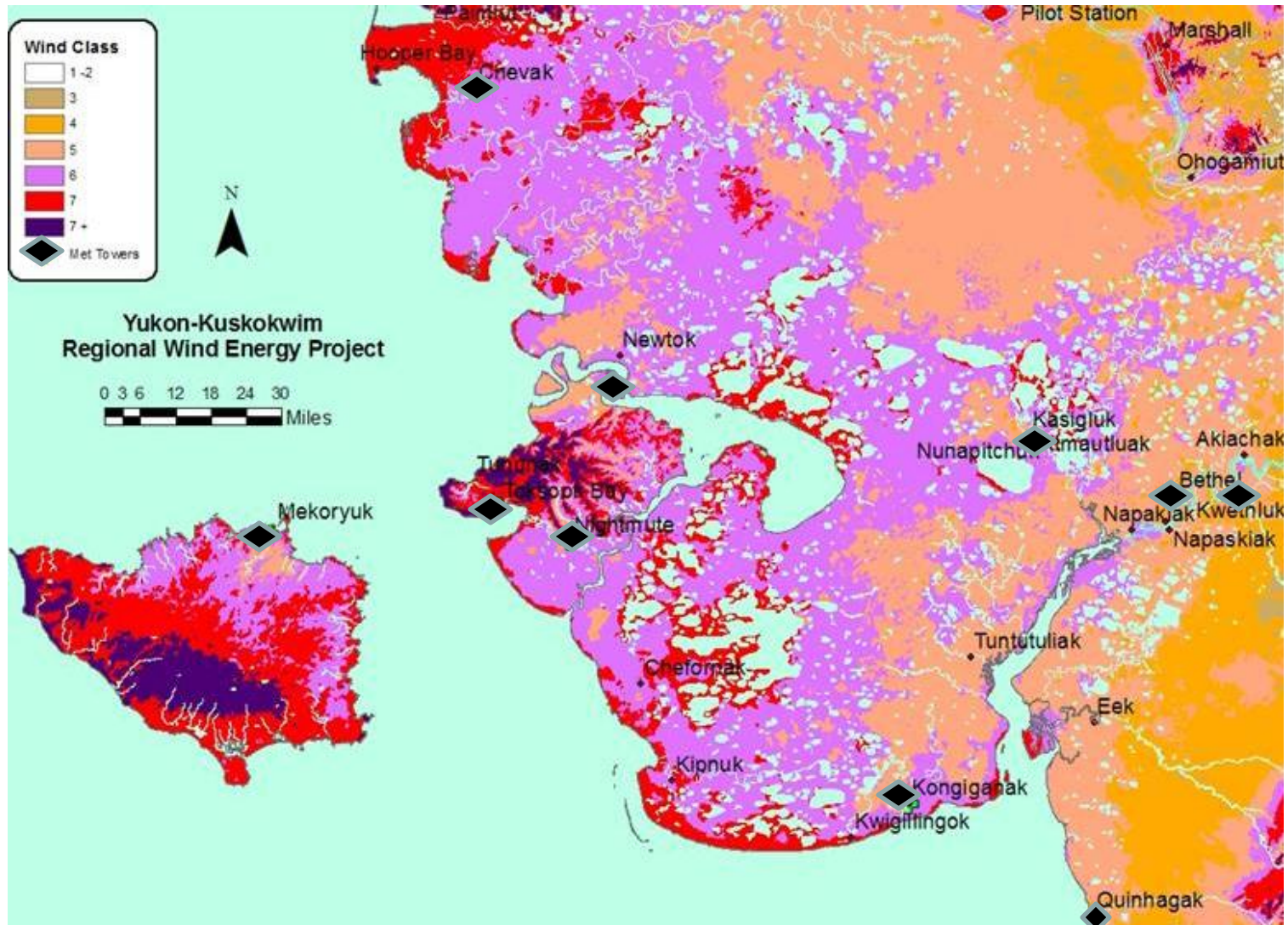


Outline

- Sources of wind data
- Interpreting the wind data
- Results from 8 villages
- Potential wind power production



Wind Map of Y-K Region



Class 6 and 7 Wind Regimes

Wind Power Classes

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	

- Wind Power Density is what matters
- Dependent on Height
- Rating is subjective (large wind farms)

Wind Data Analysis

- Measure one year of data
- Filter out bad data
- Compare with long-term measurements from nearby airport weather stations
- Make long-term predictions of typical wind resource at the site



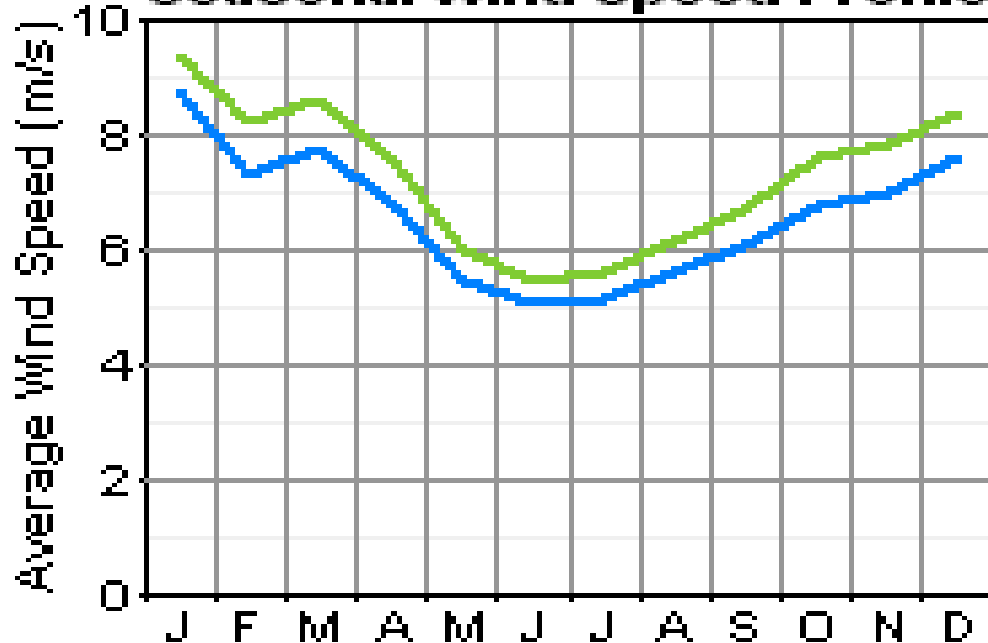
Bethel Wind Resource



- 165-foot tower
- Installed Dec 04 – Feb 06
- Average Speed:
 - 100ft height - 6.7 m/s (15 mph)
 - 165ft height - 7.3 m/s (16.3 mph)
- Wind Power Density:
 - 100ft height – 345 W/m² (Class 4)
 - 165ft height – 440 W/m² (Class 4)

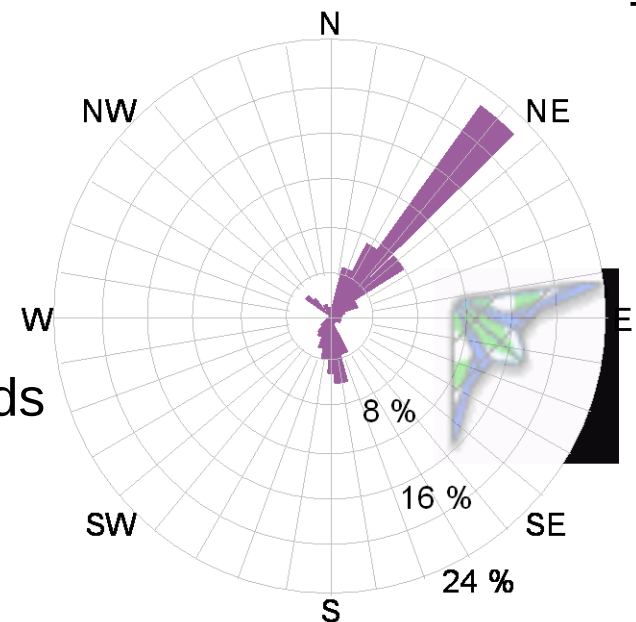
Bethel Wind Resource

Seasonal Wind Speed Profile



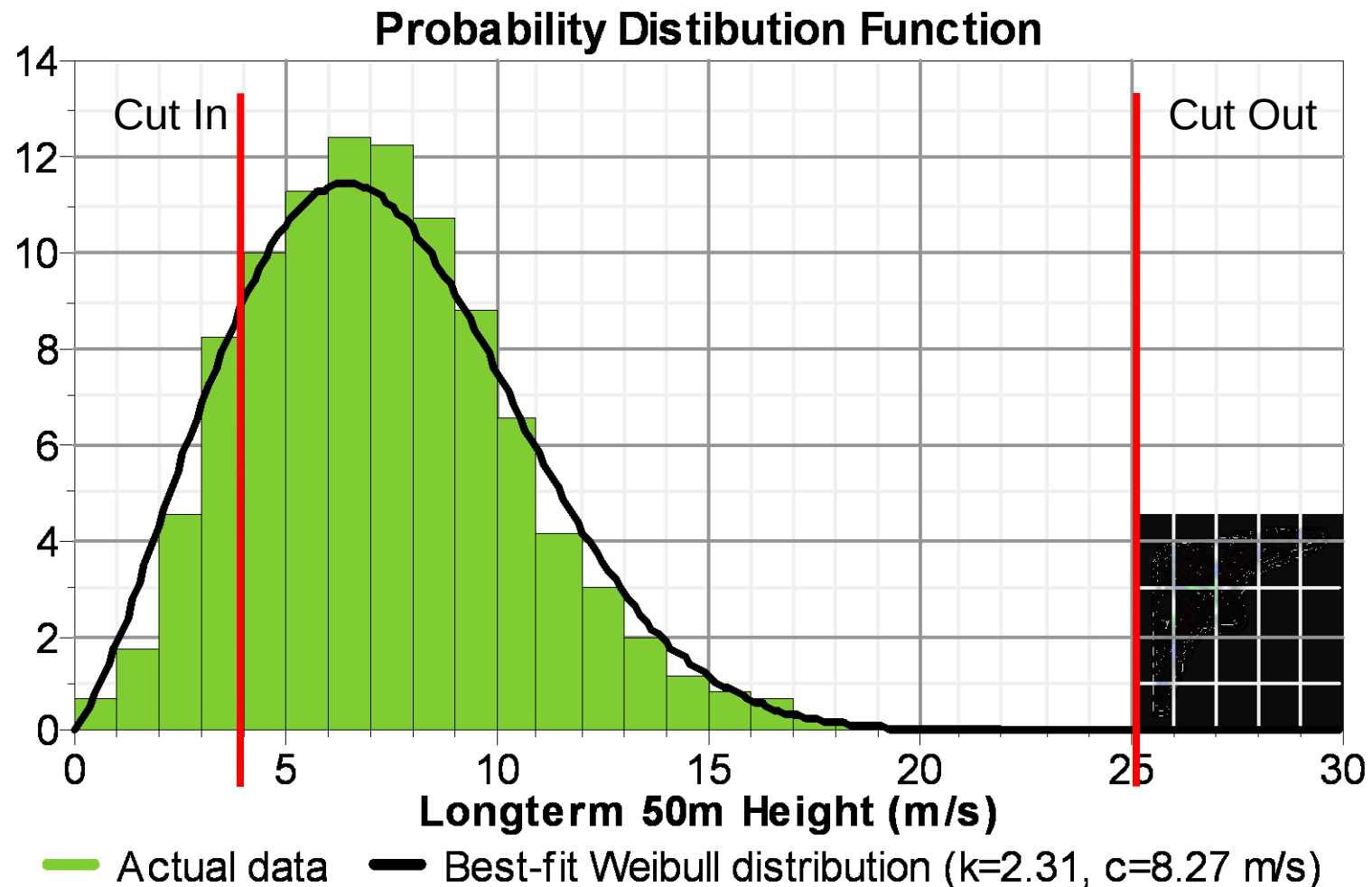
- 30m and 50m wind speeds
- Strongest winds in winter
 - Coincides with high loads
 - More difficult repairs

Wind Power Rose



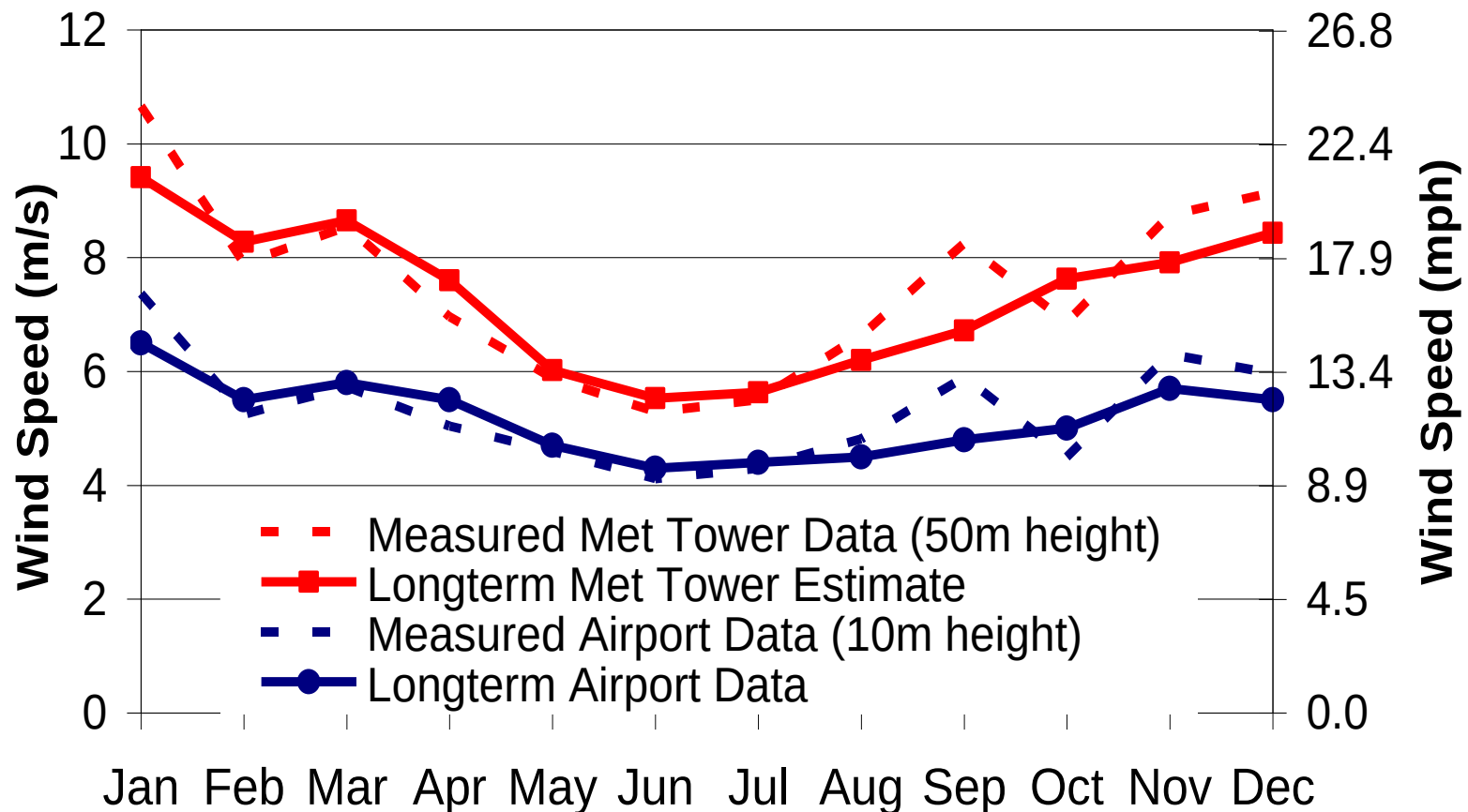
- Most of the Power in NE Winds
- Impacts turbine site selection
 - Positioning of turbines
 - Positioning of farm

Bethel Wind Resource



85% of winds are power producing

Bethel Wind Resource

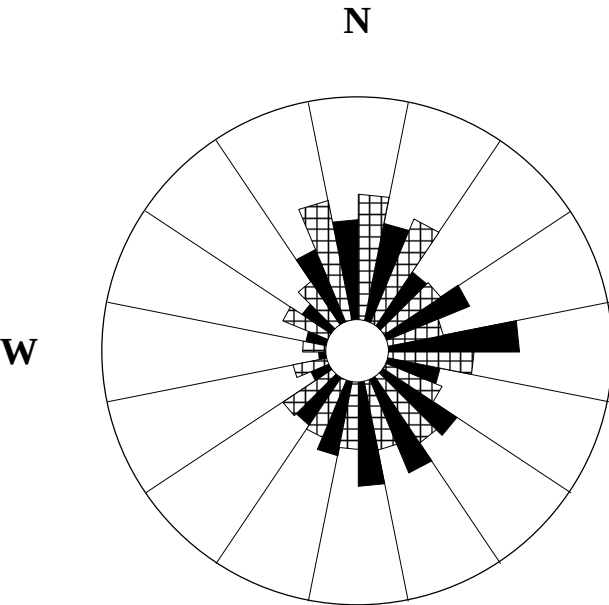


Bethel Wind Resource

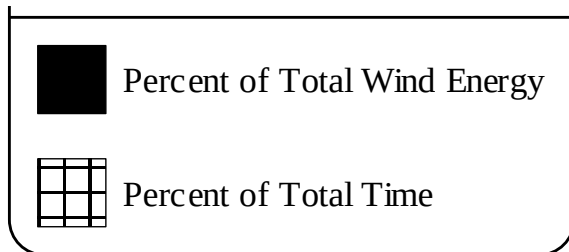
Iced Met Tower Anemometers

Month	Data Recovery Rate	Data Loss Due to Icing
January 2005	100%	11%
February 2005	100%	34%
March 2005	100%	8%
April 2005	100%	6%
May 2005	100%	2%
June 2005	100%	0%
July 2005	100%	0%
August 2005	100%	0%
September 2005	100%	0%
October 2005	100%	16%
November 2005	100%	31%
December 2005	100%	54%
Annual Average	100%	13%

Toksook Bay Wind Resource



100-foot MET Tower
Installed June 04 – Aug 05
Annual average = 6.9 m/s (15.4mph)
Class 6



NRG Systems SDR Version 5.03



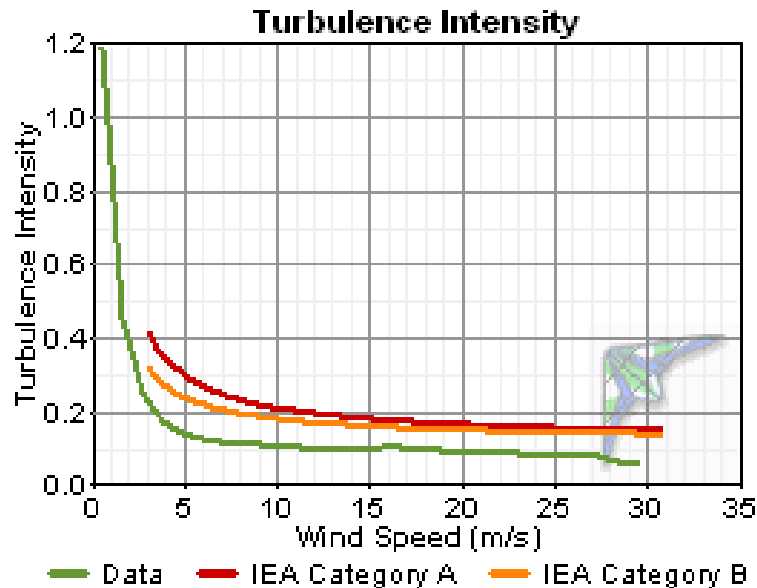
Photo: Doug Vaught, V3 Energy LLC

Nightmute Wind Resource

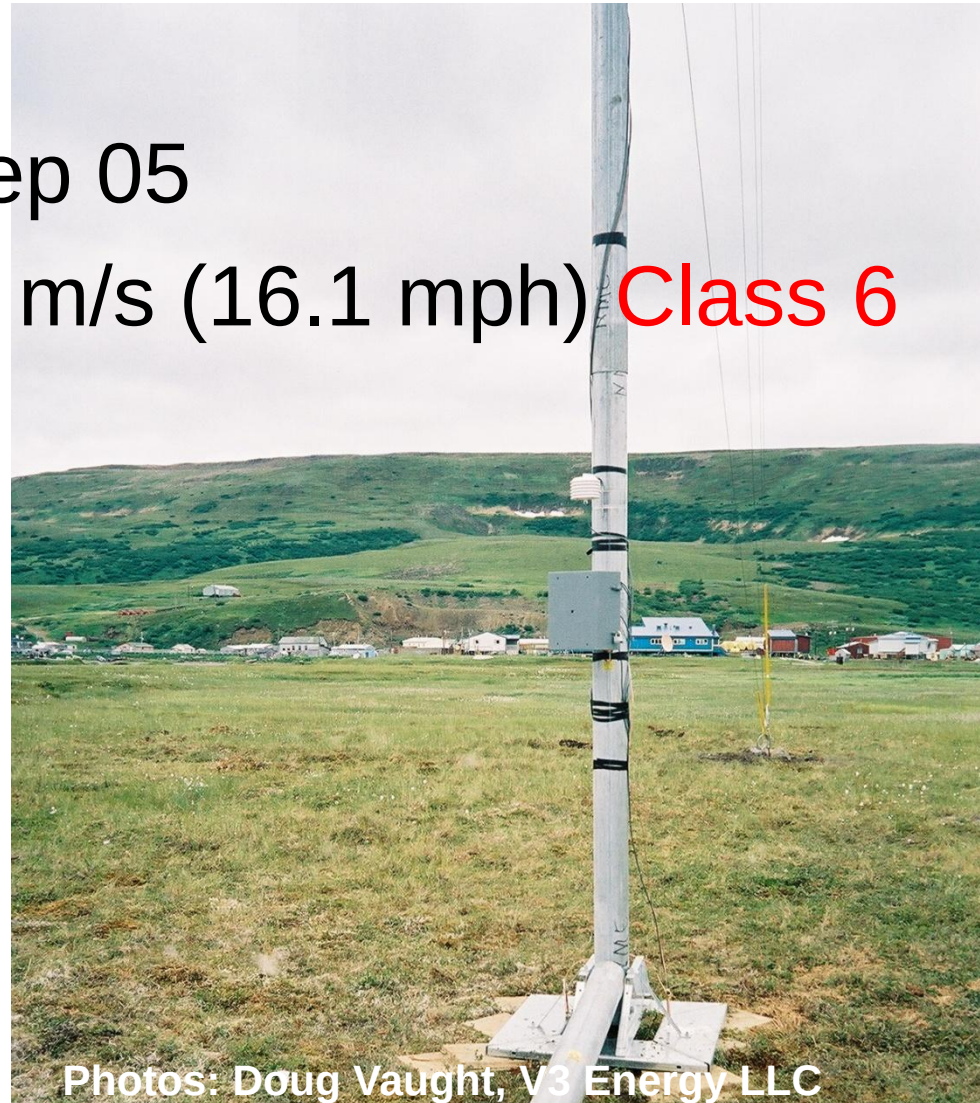
100-foot tower

Installed June 04 – Sep 05

Annual average = 7.2 m/s (16.1 mph) **Class 6**



TI= std. dev. wind speed / average speed



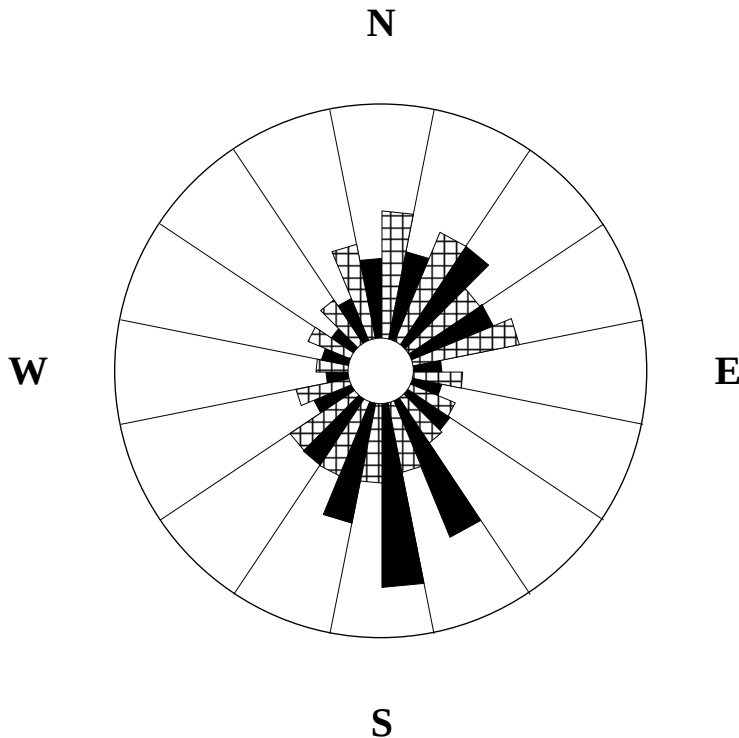
Photos: Doug Vaught, V3 Energy LLC

Kongiganak Wind Resource

100-foot tower

Installed Oct 04 – Oct 05

Annual average = 7.9 m/s (17.7 mph) **Class 6**

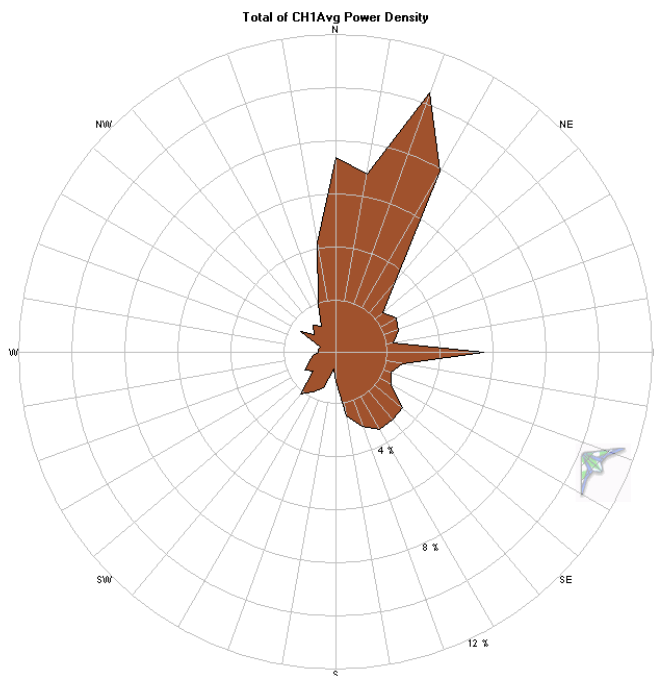


Chevak Wind Resource

100-foot tower

Installed Dec 04 – Oct 06

Annual average = 7.6 m/s (17 mph) **Class 6**

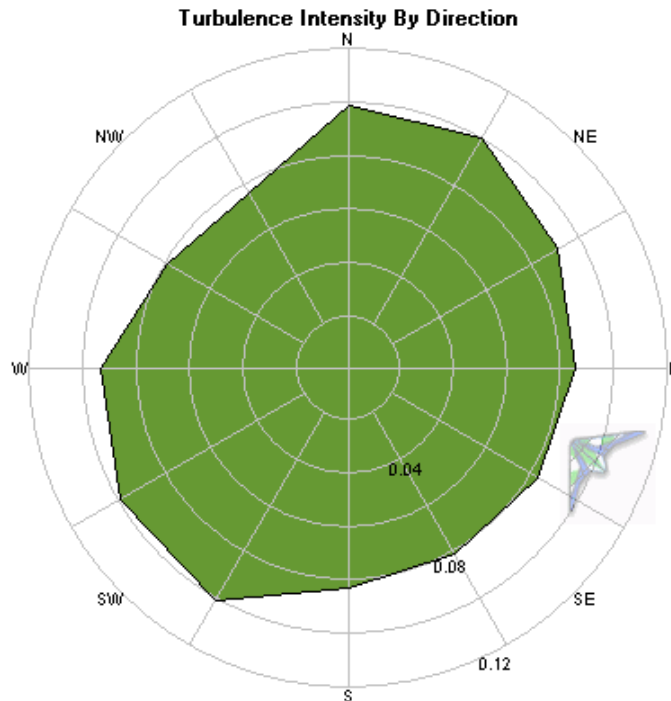


Quinhagak Wind Resource

100-foot tower

Installed Oct 05 – Oct 06

Annual average = 6.4 m/s **Class 3**



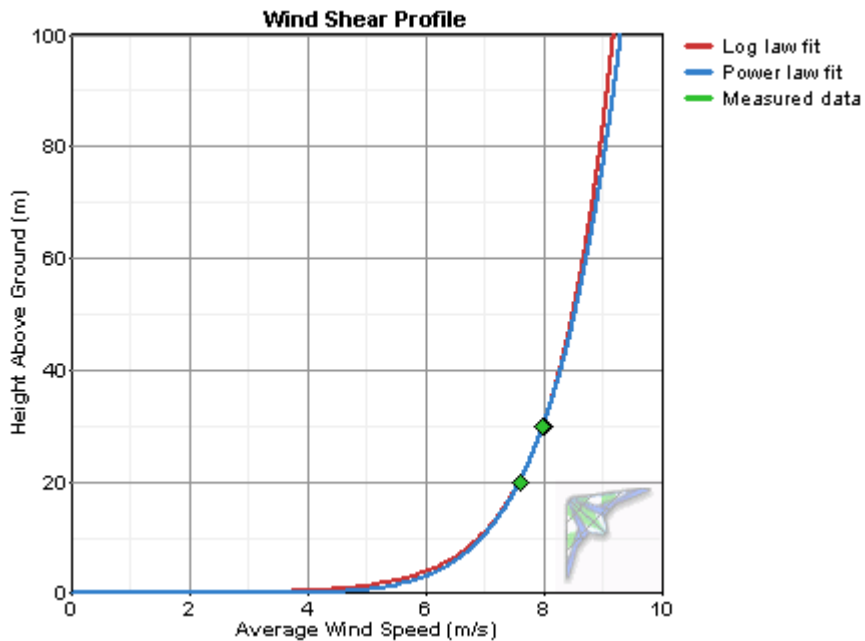
Mekoryuk Wind Resource

100-foot tower

Installed Jun 05 – Feb 07

Annual average = 7.6 m/s

Class 6



Power law exponent 0.127 (low wind shear)

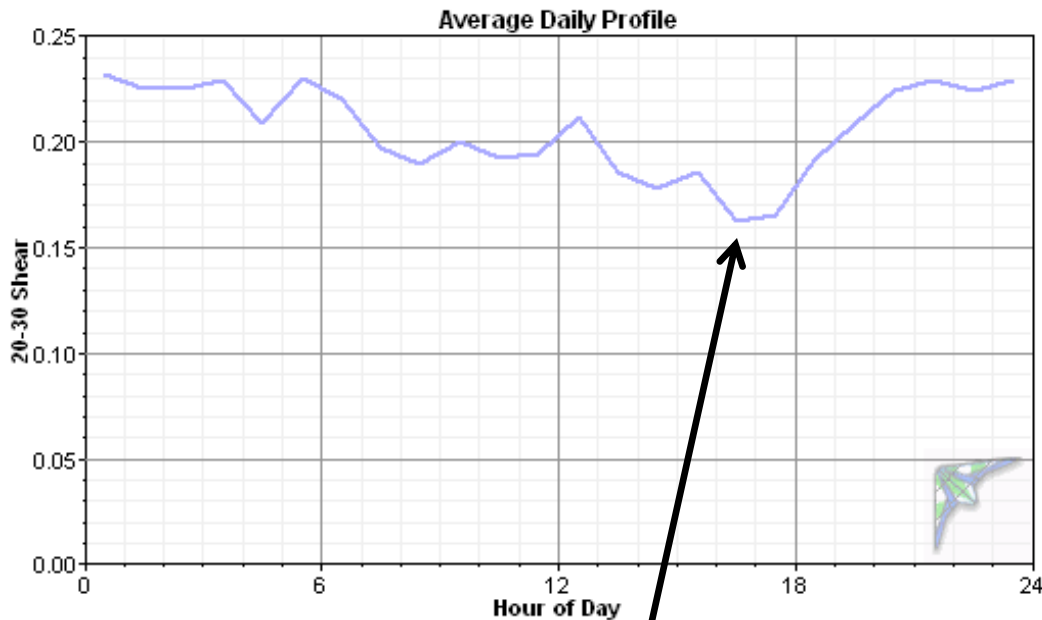


Atmautluak Wind Resource

100-foot tower

Installed Oct 05 – Dec 06

Annual average = 7.2 m/s **Class 5**



Typical shear profile fluctuating with atm. stability

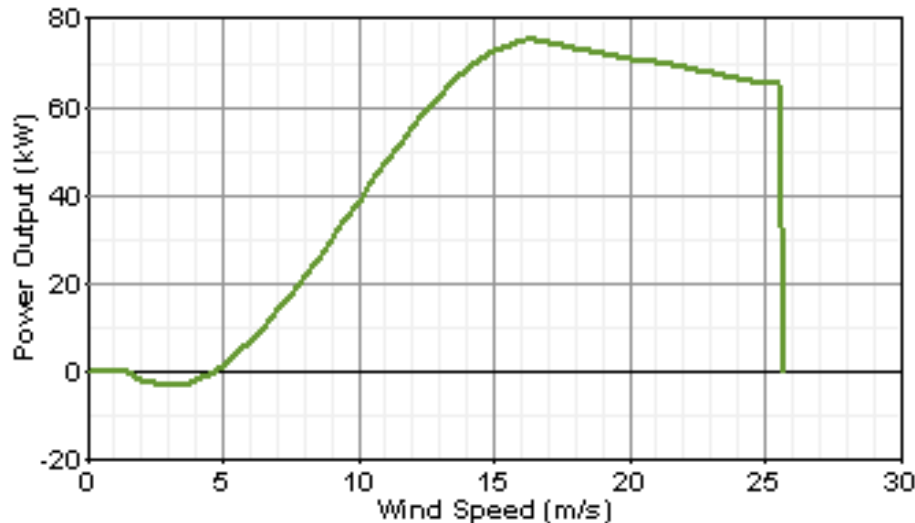




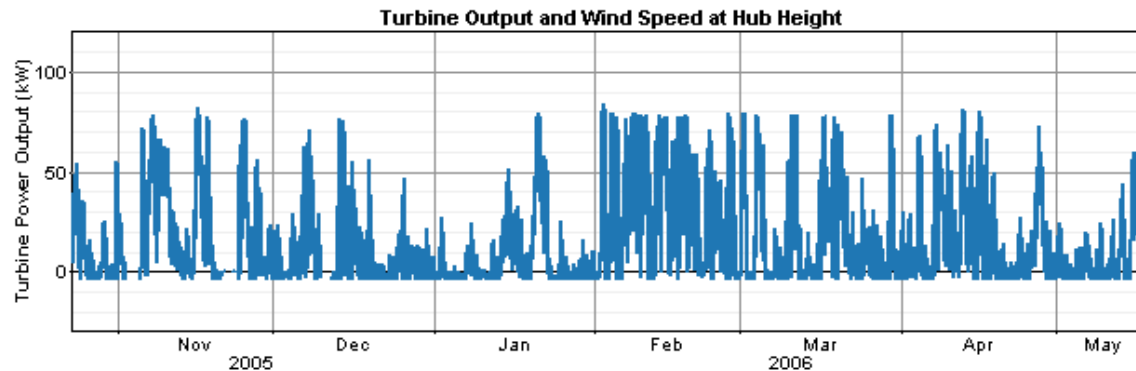
Regional Wind Summary

				Wind Map Predictions	
Communities	Wind Power Density (W/m ²)	Wind Class	Avg. Wind Speed (30m)	Wind Class	Wind Speed
Nightmute	610	6	7.2	6	8.4
Kongiganak	562	6	7.9	4	6.7
Chevak	553	6	7.6	4	7.2
Mekoryuk	543	6	7.6	5	7.5
Toksook Bay	518	6	6.9	5	7.4
Autmautluk	451	5	7.2	4	7.4
Bethel	345	4	6.7	3	6.7
Quinkagak	340	3	6.4	3	6.5

Potential Wind Power Production

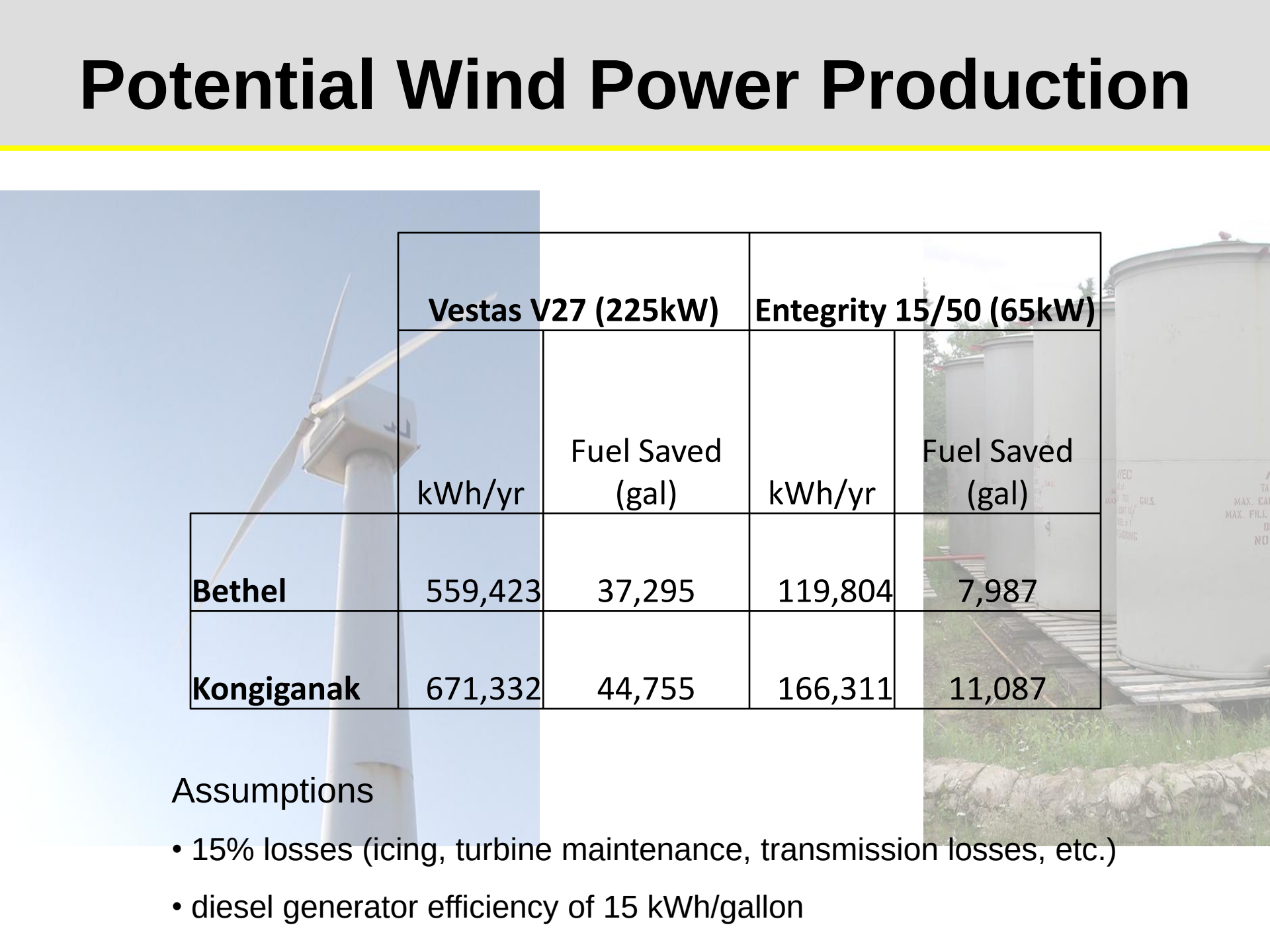


Wind speed average at 25-m hub height: 6.42 m/s
Capacity Factor: 21.4%
Annual energy output: 140,800 kW-hr/yr



Vestas V15: 75 kW output, 15 meter rotor, stall-controlled, 25-meter hub height (power curve provided by Powercorp Alaska LLC)

Potential Wind Power Production



	Vestas V27 (225kW)		Entegritty 15/50 (65kW)	
	kWh/yr	Fuel Saved (gal)	kWh/yr	Fuel Saved (gal)
Bethel	559,423	37,295	119,804	7,987
Kongiganak	671,332	44,755	166,311	11,087

Assumptions

- 15% losses (icing, turbine maintenance, transmission losses, etc.)
- diesel generator efficiency of 15 kWh/gallon

Conclusions

- MET tower installations show a superior wind resource in Y-K communities
- Coastal communities have best resource
- Not all communities have a good resource
- Visit www.akenergyauthority.org for complete wind reports

