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Wind Resource Assessment for DEADHORSE, ALASKA

Date last modified: 4/18/2006
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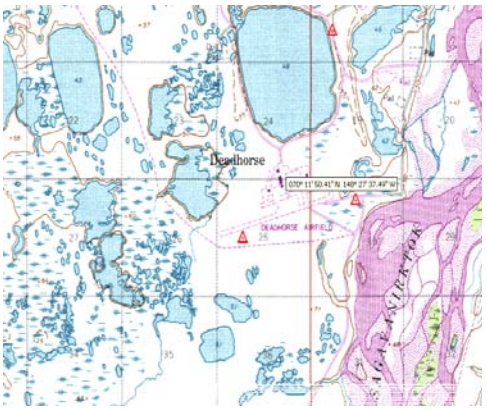
SITE SUMMARY

ICAO Station ID:	PACS
NCDC Data Set:	700637
Latitude (NAD27):	70.2
Longitude (NAD27):	- 148.467
Magnetic Declination:	24˚ 23' East
Tower Type:	ASOS
Sensor Heights:	8 meters above ground level
Elevation:	19 meters
Monitor Start:	Jan 1, 1995
Monitor End:	Dec 31, 2004



This report summarizes wind resource data collected from the Automated Surface Observing System (ASOS) in Deadhorse, Alaska. The hourly data set from 1995-2004 was purchased from the National Climatic Data Center. The purpose of providing this analysis is to assist the community in evaluating the feasibility of utilizing wind energy in Deadhorse.

The Deadhorse ASOS equipment and surrounding terrain are shown to the right. Deadhorse is an industrial camp on the North Slope located next to Prudhoe Bay on the north slope of Alaska. The Alyeska Pipeline starts here.

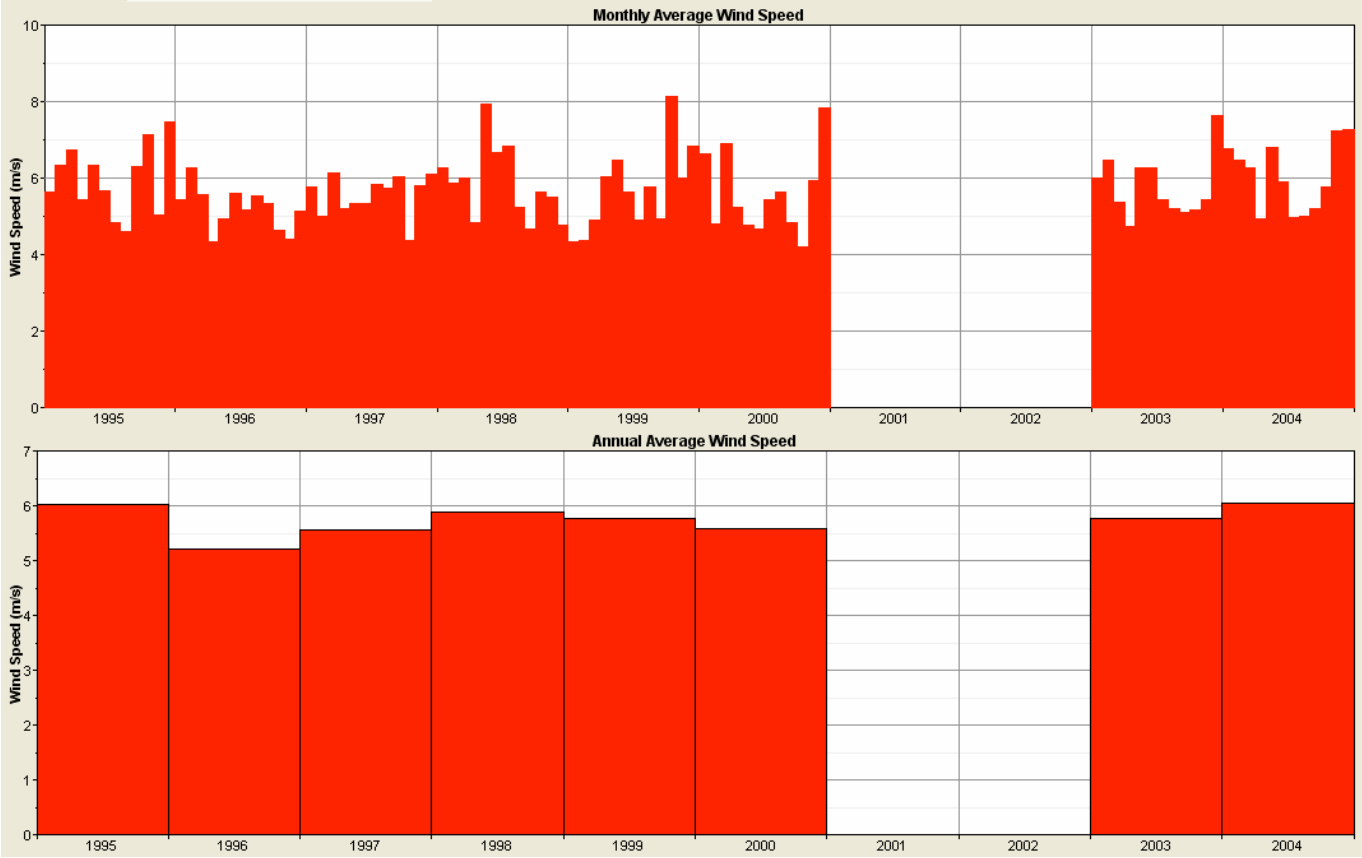
WIND RESOURCE SUMMARY

Annual Average Wind Speed (8m height):	5.7 m/s (12.8 mph)
Annual Average Wind Speed (30m height, estimated):	6.7 m/s (15.0 mph)
Average Wind Power Density (8m height):	236 W/m^2
Average Wind Power Density (30m height, estimated):	353 W/m^2
Wind Power Class (range = 1 to 7):	Class 4
Rating (Poor, Marginal, Fair, Good, Excellent, Outstanding):	Good
Prevailing Wind Direction:	East, Southwest

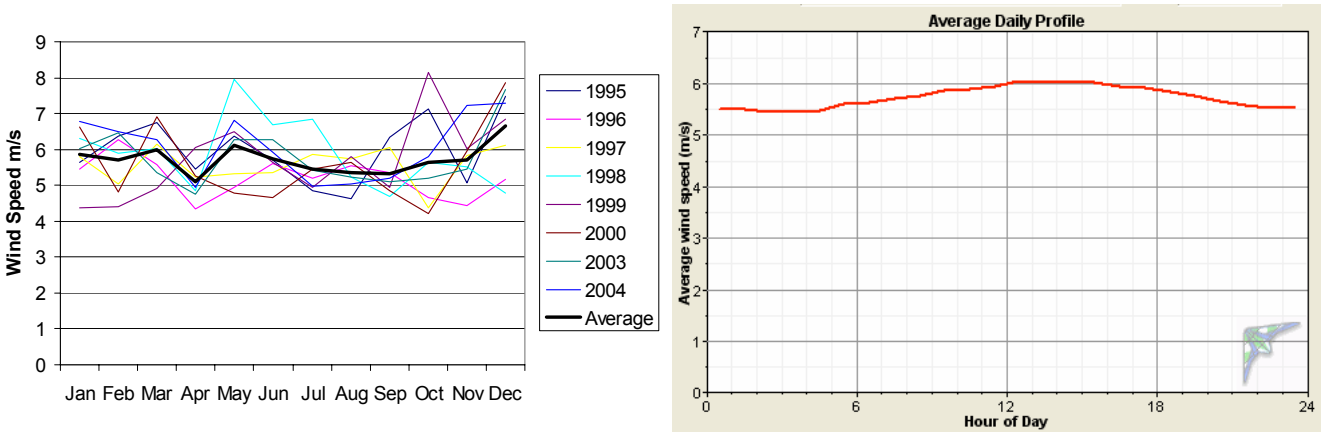
Based on data collected at the ASOS site, Deadhorse has a Class 4 wind resource, which is rated as "good" for wind power development.

WIND DATA RESULTS FOR DEADHORSE ASOS SITE

Wind speeds from January 1995 through December 2004 are summarized below, minus the years of 2001 and 2002 because of the lack of data. The average wind speed over the 8-year period is 5.7 m/s at a height of 8 meters above ground level. The annual wind speed rarely deviates more than 5% above or below this average.

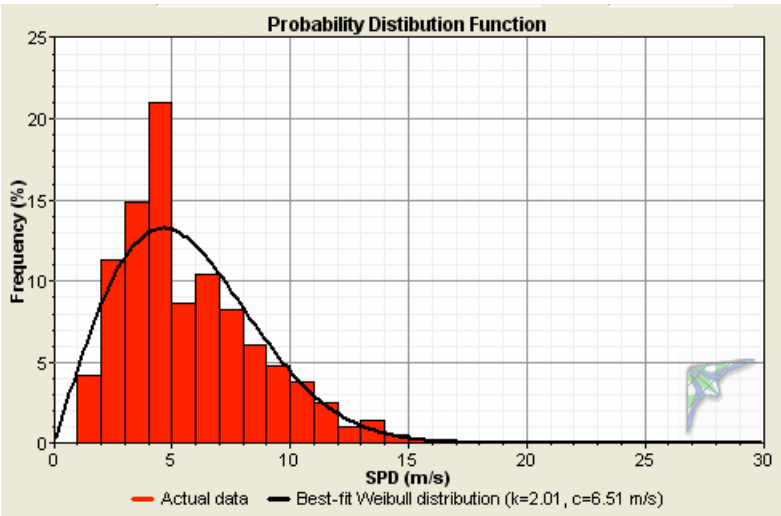


As shown, the highest wind month is typically February and the lowest wind month is typically June. Winds are typically lowest in the morning and increase in the afternoon.



Average Monthly and Daily Wind Speeds from Deadhorse ASOS, 8-m Height

The wind frequency distribution below shows the percent of the year that each wind speed occurs. The measured distribution as well as the best matched Weibull distribution is displayed. The cut-in wind speed of many wind turbines is 4 m/s and the cut-out wind speed is around 25 m/s. The frequency distribution shows that 86% of the wind in Deering occurs within this operational zone.



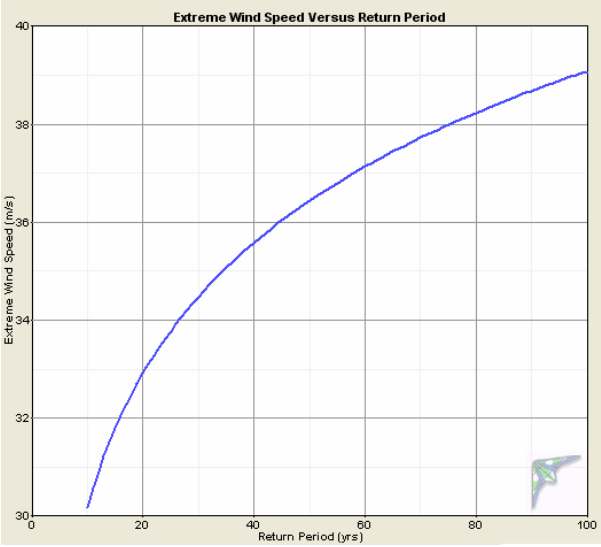
Wind Speed Frequency Distribution for Deadhorse ASOS

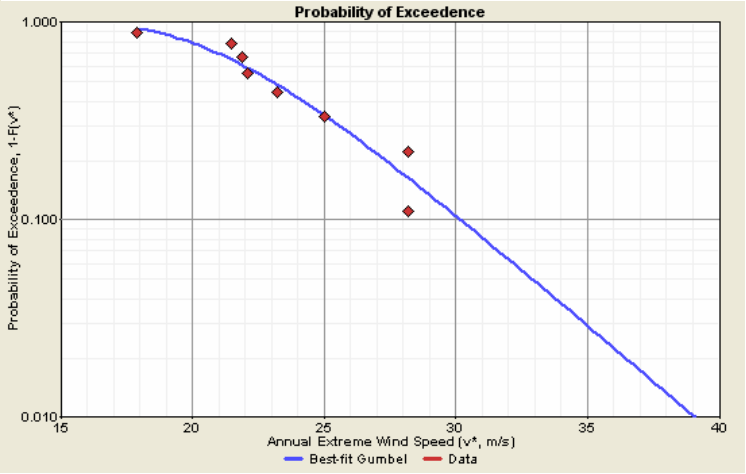
Average Wind Speeds at Deadhorse ASOS, 8-m Height (m/s)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	5.9	5.7	5.9	5.0	5.8	5.2	4.7	4.9	4.7	5.8	5.5	6.6
1	6.0	5.5	5.9	4.8	5.8	5.2	4.8	5.0	4.8	5.8	5.6	6.6
2	5.9	5.7	5.9	4.7	5.7	5.1	4.8	4.9	4.7	5.6	5.5	6.5
3	5.9	5.7	5.9	4.6	5.8	5.0	4.7	4.8	4.9	5.7	5.6	6.7
4	5.8	5.6	5.9	4.7	5.8	5.1	4.9	5.1	5.1	5.5	5.6	6.8
5	6.1	5.9	6.0	4.7	5.8	5.3	5.1	5.2	5.1	5.6	5.8	6.8
6	5.9	5.7	5.9	4.9	6.1	5.3	5.2	5.2	5.1	5.6	5.7	7.0
7	5.9	5.8	6.1	5.0	6.1	5.3	5.2	5.5	5.4	5.6	5.8	6.8
8	5.9	5.6	6.1	4.9	6.3	5.6	5.3	5.8	5.4	5.6	5.7	7.1
9	5.9	5.6	6.2	5.1	6.3	5.7	5.7	5.8	5.7	5.7	5.8	6.9
10	6.0	5.7	6.3	5.3	6.4	5.9	5.7	5.5	5.6	5.7	5.7	6.9
11	6.0	5.7	6.3	5.4	6.3	6.1	5.8	5.7	5.8	5.8	5.7	6.9
12	5.9	5.7	6.3	5.4	6.5	6.2	6.2	6.0	5.6	5.8	5.9	6.7
13	6.0	5.8	6.2	5.4	6.4	6.4	6.1	5.8	5.8	5.9	5.8	6.8
14	6.0	6.0	6.2	5.5	6.5	6.3	6.2	5.9	5.7	5.8	5.9	6.8
15	5.8	5.8	6.0	5.7	6.3	6.4	6.3	6.1	5.8	5.7	5.8	6.7
16	6.0	6.0	6.0	5.3	6.0	6.4	6.1	5.7	5.5	5.7	5.9	6.8
17	5.8	6.1	5.8	5.3	6.2	6.3	6.1	5.5	5.3	5.9	5.8	6.8
18	5.8	6.0	6.0	5.3	6.3	6.0	5.7	5.5	5.3	6.1	5.7	6.6
19	5.8	6.0	5.9	5.1	6.2	5.8	5.5	5.1	5.3	5.8	5.9	6.6
20	6.0	5.9	6.0	5.1	5.9	5.8	5.2	5.0	5.1	5.6	5.7	6.6
21	5.8	5.8	6.0	5.1	5.9	5.7	5.2	5.0	4.9	5.9	5.4	6.5
22	5.8	5.8	6.0	5.0	5.9	5.5	5.0	5.0	4.8	5.7	5.5	6.6
23	5.7	5.5	6.0	5.1	5.8	5.2	4.9	5.0	4.8	5.7	5.7	6.7
Ave	5.9	5.8	6.0	5.1	6.1	5.7	5.4	5.4	5.3	5.7	5.7	6.7

EXTREME GUST ANALYSIS

Using the Windographer software program (www.mistaya.ca), a Gumbel distribution is fit to the 8 years of wind data to determine the expected extreme wind speed over various periods of time. For example, the maximum gust that can be expected at a height of 8 meters above ground level over the next 100 years is 39.1 m/s.





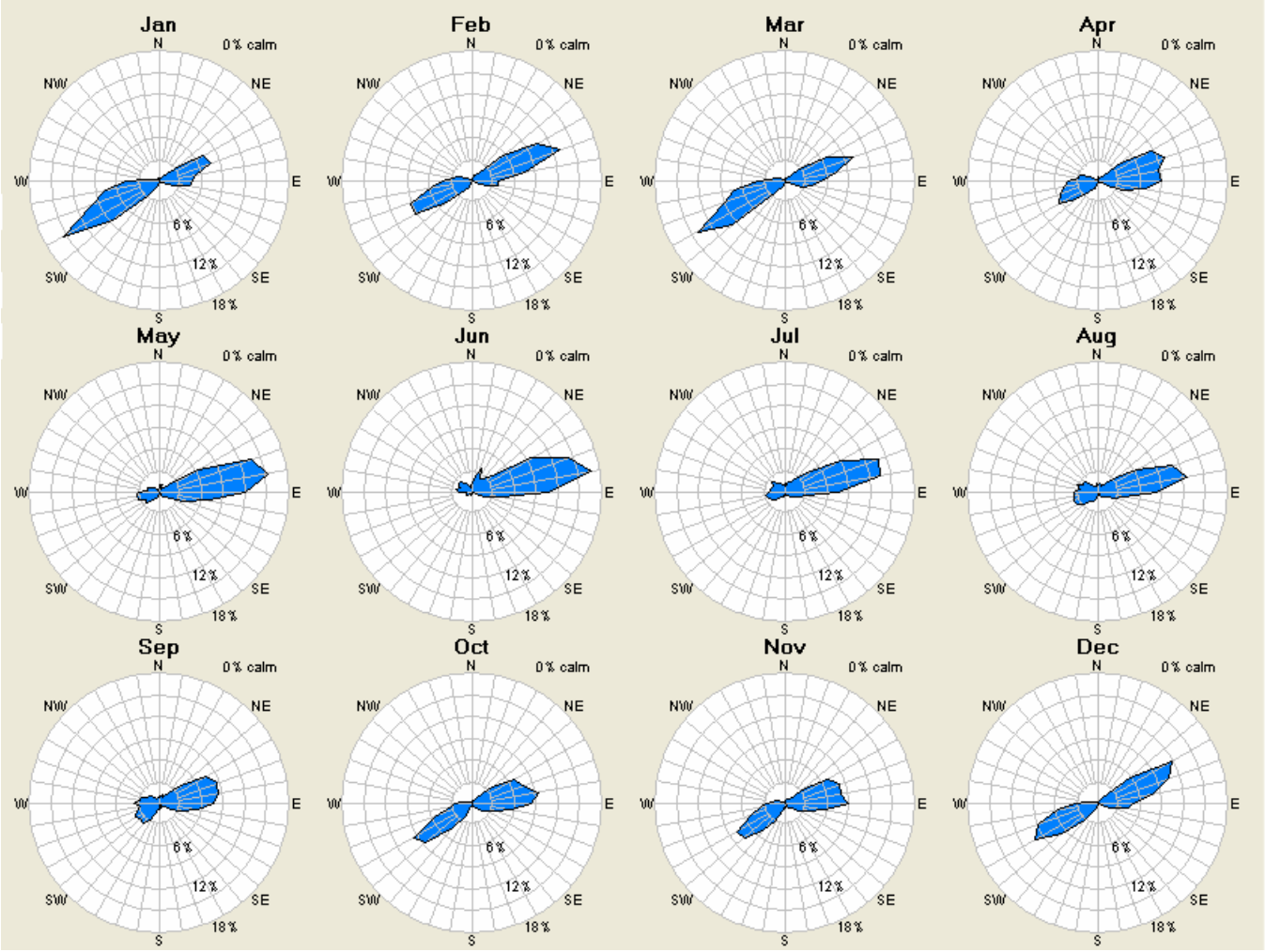
Return Period (yr)	Extreme Wind Speed (m/s)
20	32.9
25	33.8
50	36.4
100	39.1

Gumbel distribution parameters

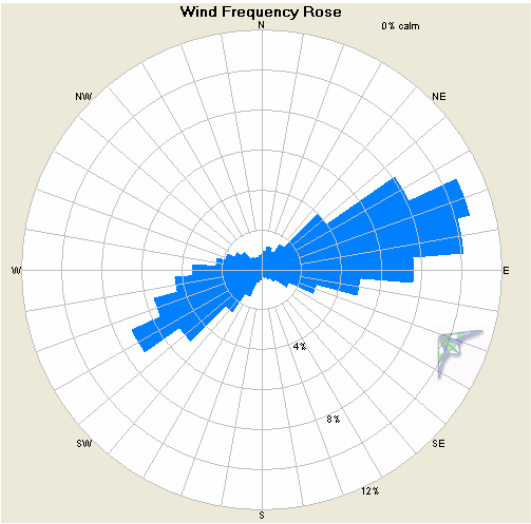
Scale:	3.79 m/s
Mode:	21.7 m/s
r^2	0.921

WIND DIRECTION

The monthly wind power roses, which show the percent of total power available in the wind from each direction, are shown below.

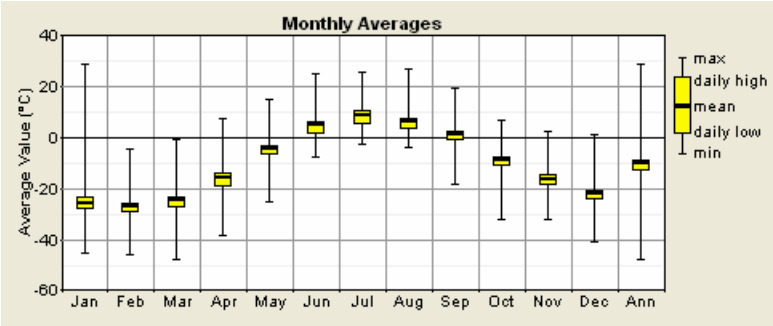


The annual wind power rose is shown below. Primary wind directions are the West and East.



TEMPERATURE

The air temperature can affect wind power production in two primary ways: 1) colder temperatures lead to higher air densities and therefore more power production, and 2) some wind turbines shut down in very cold situations (usually around –25°C). The monthly average temperatures measured at the ASOS site are shown below. Over the 8 year period, the temperature dropped below -25°C during 54.8% of the time, or 4800 hours per year.



Monthly Average Temperatures at Deadhorse ASOS, 1995-2004

POTENTIAL POWER PRODUCTION FROM WIND TURBINES IN DEERING

The power curves from various wind turbines were used to calculate potential energy production in Deadhorse. Although different wind turbines are available with different tower heights, to be consistent it is assumed that any wind turbine rated at 100 kW or less would be mounted on a 30-meter tall tower, while anything larger would be mounted on a 50-meter tower. The wind resource was adjusted to these heights based on a wind shear value of 0.10. Results are shown below.

Among the results is the gross capacity factor, which is defined as the actual amount of energy produced divided by the maximum amount of energy that could be produced if the wind turbine were to operate at rated power for the entire year. Inefficiencies such as transformer/line losses, turbine downtime, soiling of the blades, icing of the blades, yaw losses, array losses, and extreme weather conditions can further reduce turbine output. To account for these factors the gross capacity factor is multiplied by about 0.90, resulting in the net capacity factor listed.

CONCLUSION

This report provides a summary of wind resource data collected from January 1995 through December 2004 at the airport ASOS site in Deadhorse, Alaska. The long-term annual average wind speed at the site is 5.7 m/s at a height of 8 meters above ground level. Taking the local air density into account, the average wind power density for the site is 253 W/m^2. Deadhorse has a Class 4 wind resource, which is rated “good” for wind power development. The net capacity factor for wind turbines would range from 21% to 32%.

Based on this initial review, the community of Deadhorse appears to be a good candidate for wind power. However, before investing in wind turbines, the actual wind resource at the potential wind turbine location should be verified, as the wind resource can be highly variable between sites. The information in this report is based on the site of the ASOS equipment. If the topography of the potential wind turbine location varies from the ASOS location, the information provided in this report cannot be used with certainty. The level of turbulence of the wind also cannot be determined from the ASOS data.

Power Production Analysis of Various Wind Turbine Models

Wind Turbine Options								
Manufacturer Information	Bergey 10 kW	Fuhrlander FL30 30 kW	Entegrity 15/50 65 kW	Fuhrlander FL100 100 kW	Northern Power NW100 100 kW	Fuhrlander FL250 250 kW	Vestas V27 225 kW	Vestas V47 660 kW
Tower Height	30 meters	30 meters	30 meters	50 meters	50 meters	50 meters	50 meters	50 meters
Swept Area	38.5 m^2	133 m^2	177 m^2	348 m^2	284 m^2	684 m^2	573 m^2	1,735 m^2
Weight (nacelle & rotor)	N/A	410 kg	2,420 kg	2,380 kg	7,086 kg	4,050 kg	N/A	N/A
Gross Energy Production (kWh/year)								
Jan	1,848	8,476	12,923	25,714	21,100	57,872	53,118	187,386
Feb	1,631	7,580	11,379	22,669	18,589	51,766	47,474	167,544
Mar	1,949	8,992	13,753	27,309	22,399	61,832	56,692	198,317
Apr	1,246	6,023	8,407	16,966	13,777	40,154	36,484	132,132
May	1,878	8,646	13,251	26,320	21,591	59,011	54,178	190,559
Jun	1,623	7,607	11,227	22,436	18,353	51,293	47,231	167,717
July	1,499	7,076	10,196	20,483	16,729	47,627	43,518	155,906
Aug	1,450	6,879	9,859	19,805	16,144	46,291	42,279	151,927
Sep	1,347	6,428	9,104	18,344	14,941	42,883	39,100	140,803
Oct	1,672	7,819	11,552	23,063	18,886	52,237	48,604	172,580
Nov	1,579	7,489	11,062	22,004	18,011	49,651	46,615	165,587
Dec	2,293	10,507	16,760	32,991	27,054	74,046	67,814	232,515
Annual	20,015	93,523	139,473	278,101	227,574	634,661	583,106	2,062,971
Annual Average Capacity Factor								
Gross CF	23%	36%	24%	32%	26%	29%	30%	36%
Net CF	21%	32%	22%	29%	23%	26%	27%	32%

Notes: The sizes of Vestas turbines listed are no longer available new. Remanufactured turbines are available from various suppliers.
Energy estimates are based on the long-term wind resource measured at the airport ASOS site.