

Wind Resource Assessment for POINT HOPE, ALASKA

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SITE SUMMARY

ICAO Station ID: PAPO
 NCDC Data Set: 701043
 Latitude (NAD27): 68.35
 Longitude (NAD27): - 166.8
 Magnetic Declination: 13° 32' East
 Tower Type: AWOS
 Sensor Heights: 10 meters above ground level
 Elevation: 4 meters
 Monitor Start: Jan 1, 1995
 Monitor End: Dec 31, 2000

This report summarizes wind resource data collected from the Automated Weather Observing System (AWOS) in Point Hope, Alaska. The hourly data set from 1995-2000 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 Point Hope.

The Point Hope AWOS equipment and surrounding terrain are shown to the right. Point Hope is located near the tip of the Point Hope peninsula, a large gravel spit that forms the western-most extension of the northwest Alaska coast, 330 miles southwest of Barrow.



WIND RESOURCE SUMMARY

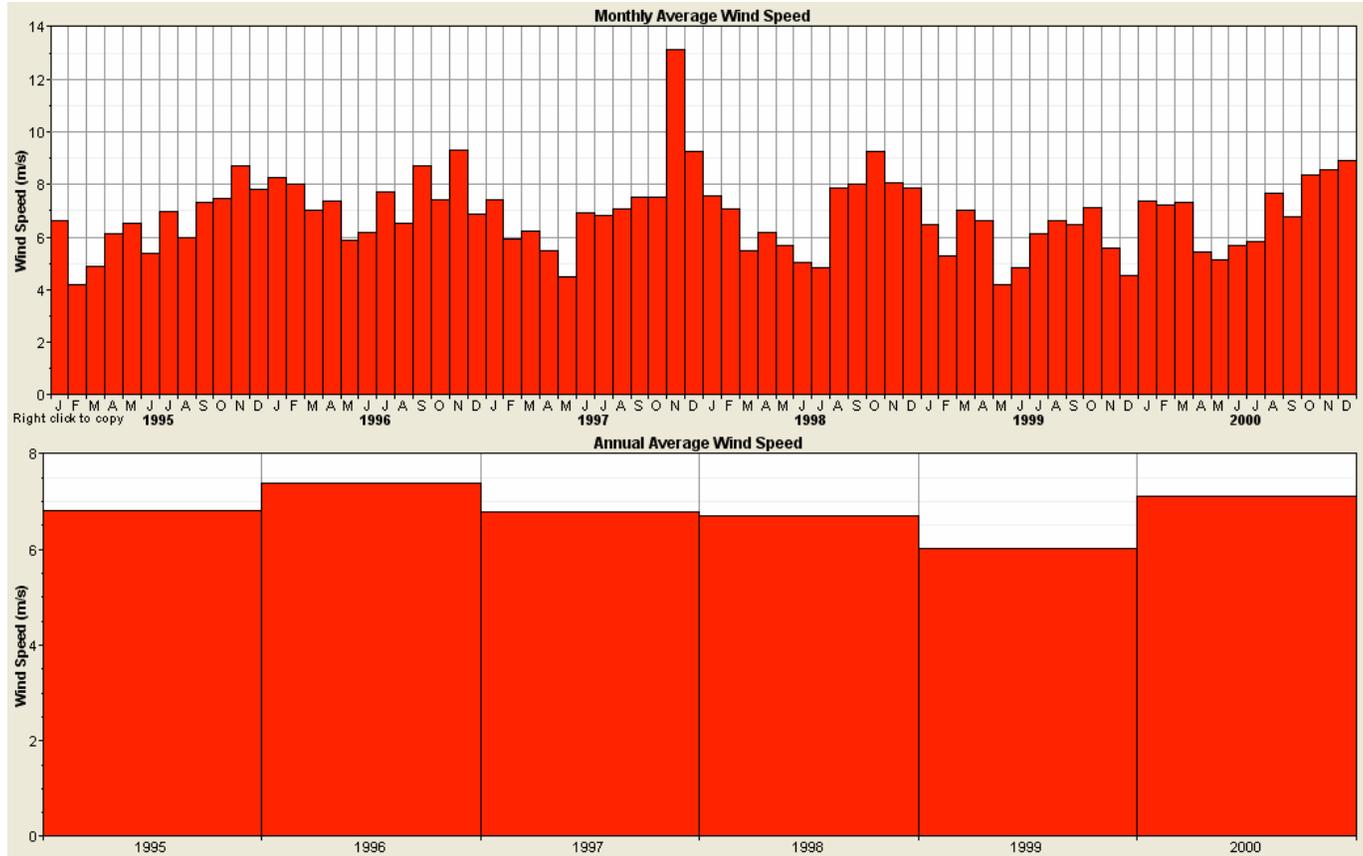
Annual Average Wind Speed (10m height):	6.8 m/s (15.2 mph)
Annual Average Wind Speed (30m height, estimated):	7.8 m/s (17.4 mph)
Average Wind Power Density (10m height):	418 W/m ²
Average Wind Power Density (30m height, estimated):	583 W/m ²
Wind Power Class (range = 1 to 7):	Class 6
Rating (Poor, Marginal, Fair, Good, Excellent, Outstanding):	Excellent
Prevailing Wind Direction:	North, Southeast



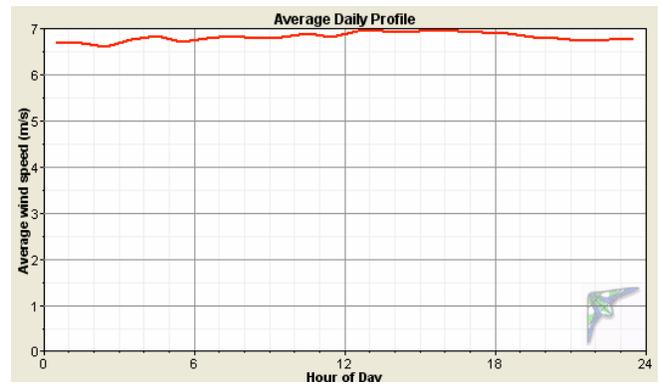
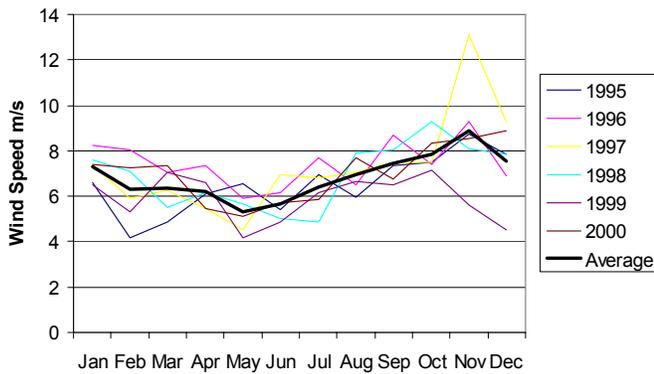
Based on data collected at the AWOS site, Point Hope has a Class 6 wind resource, which is rated as "excellent" for wind power development.

WIND DATA RESULTS FOR POINT HOPE AWOS SITE

Wind speeds from January 1995 through December 2000 are summarized below. The average wind speed over the 6-year period is 6.8 m/s at a height of 10 meters above ground level. The annual wind speed deviates more than 50% above or below this average.

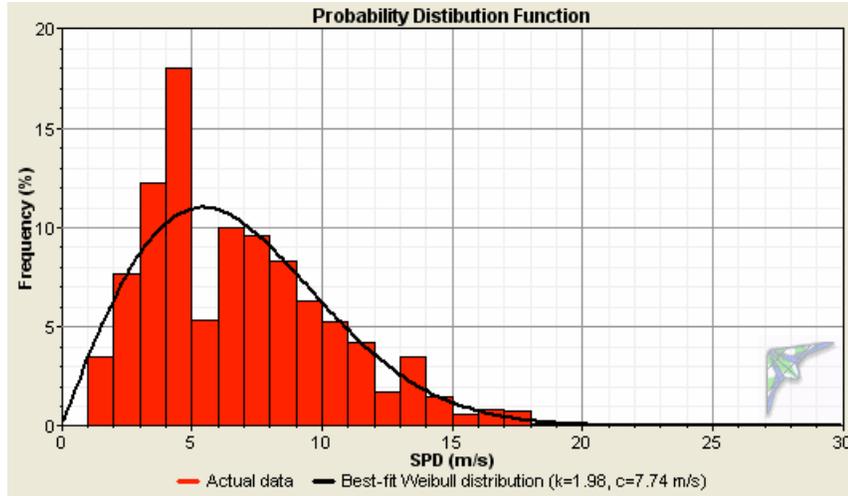


As shown, the highest wind month is typically February and the lowest wind month is typically June. Winds are typically lowest in the morning and increase in the afternoon.



Average Monthly and Daily Wind Speeds from Point Hope AWOS, 10-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 87% of the wind in Point Hope occurs within this operational zone.

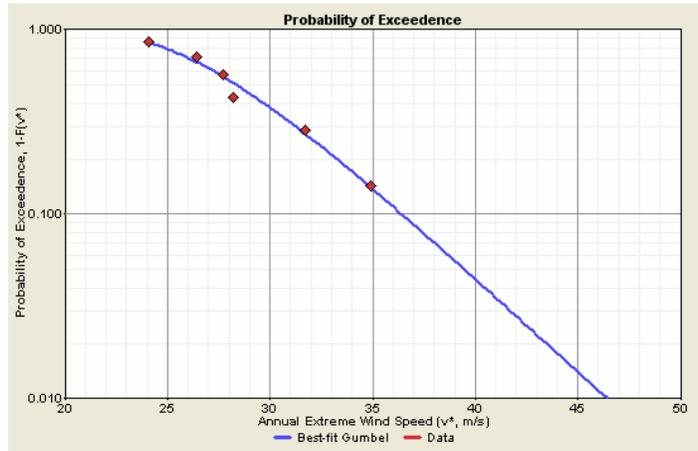
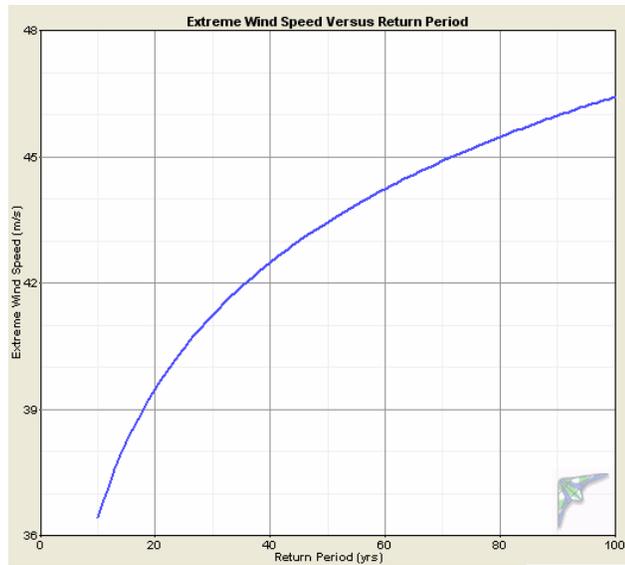


Average Wind Speeds at Point Hope AWOS, 10-m Height (m/s)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
0	7.7	6.4	6.3	5.7	5.1	5.6	6.3	6.8	7.2	7.8	8.1	7.8	6.7
1	7.3	6.8	6.3	6.0	4.9	5.6	6.0	6.7	7.5	7.5	8.3	7.5	6.7
2	7.8	7.0	6.4	5.7	4.7	5.2	6.2	6.7	7.4	7.3	8.6	7.4	6.7
3	7.6	6.6	6.3	5.9	5.0	5.6	6.3	6.8	7.4	7.6	8.4	7.8	6.8
4	7.3	6.8	6.6	5.9	5.2	5.5	6.4	6.7	7.5	7.6	8.3	7.8	6.8
5	7.5	6.7	6.4	6.1	5.1	5.6	6.2	6.7	7.3	7.3	8.7	7.7	6.8
6	7.6	6.7	6.5	5.9	5.3	5.5	6.1	7.0	7.5	7.6	8.1	7.9	6.8
7	7.0	6.9	6.5	6.2	5.2	5.5	6.3	7.0	7.6	7.9	8.4	7.7	6.9
8	7.3	6.5	6.4	6.1	5.5	5.6	6.1	7.0	7.4	7.6	8.5	7.9	6.8
9	7.1	6.6	6.3	6.2	5.5	5.8	6.5	6.8	7.6	7.7	8.1	7.7	6.8
10	7.3	6.9	6.6	6.3	5.8	5.8	6.3	6.9	7.5	7.7	8.2	7.4	6.9
11	7.5	7.0	6.3	6.2	5.7	5.9	6.3	6.9	7.4	7.5	8.2	7.4	6.9
12	7.1	6.8	6.9	6.7	5.6	6.0	6.6	7.1	7.5	7.5	8.2	7.6	7.0
13	6.9	6.7	6.6	6.8	5.8	6.1	6.4	7.1	7.6	7.8	8.0	7.5	6.9
14	7.5	6.9	6.7	7.1	5.5	5.9	6.4	7.1	7.5	7.5	8.7	7.2	7.0
15	6.9	7.0	6.9	6.9	5.9	6.0	6.4	7.3	7.4	7.9	8.0	7.3	7.0
16	7.2	6.8	6.5	6.7	5.9	5.8	6.5	7.2	7.6	7.8	8.1	7.5	7.0
17	7.3	6.9	6.6	6.5	5.7	6.0	6.5	7.2	7.4	8.0	8.3	7.2	7.0
18	7.1	6.7	6.4	6.4	5.7	5.6	6.5	7.1	7.3	8.3	8.0	7.6	6.9
19	7.0	6.7	6.2	6.3	5.7	5.7	6.4	7.0	7.5	8.1	8.3	7.2	6.8
20	7.4	6.3	6.4	6.2	5.5	5.7	6.4	6.9	7.5	8.0	8.4	7.5	6.9
21	7.2	6.4	6.2	6.0	5.5	5.6	6.4	6.9	7.3	8.0	8.0	7.7	6.8
22	7.1	6.4	6.4	6.0	5.5	5.6	6.4	7.0	7.2	7.8	8.2	7.4	6.8
23	7.4	6.8	6.4	6.1	5.4	5.5	6.5	6.8	7.4	7.7	8.0	7.5	6.8
Ave	7.3	6.7	6.5	6.2	5.4	5.7	6.3	6.9	7.4	7.7	8.3	7.6	6.8

EXTREME GUST ANALYSIS

Using the Windographer software program (www.mistaya.ca), a Gumbel distribution is fit to the 6 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 10 meters above ground level over the next 100 years is 46.3 m/s.



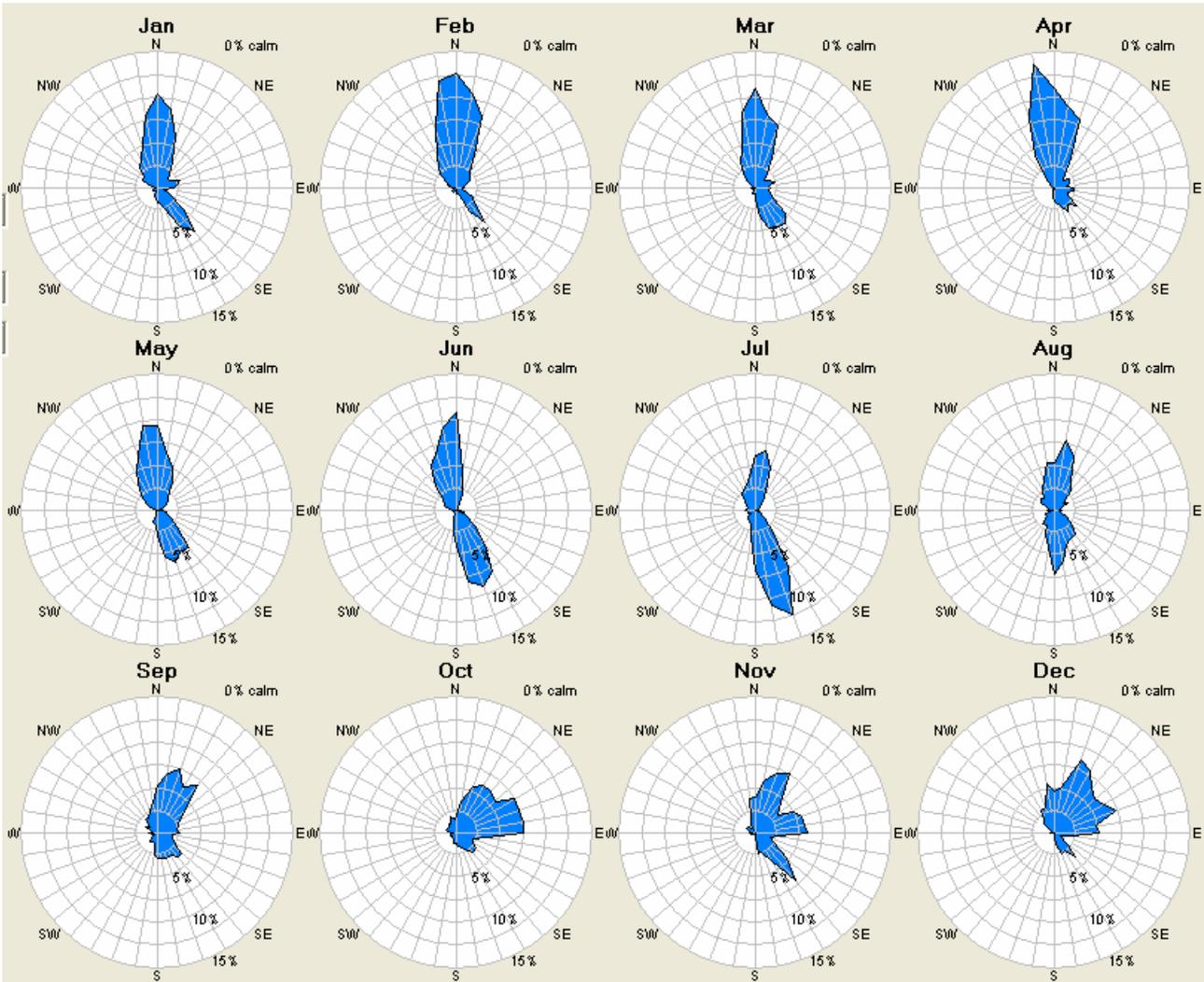
Return Period (yr)	Extreme Wind Speed (m/s)
20	39.5
25	40.5
50	43.5
100	46.4

Gumbel distribution parameters ———

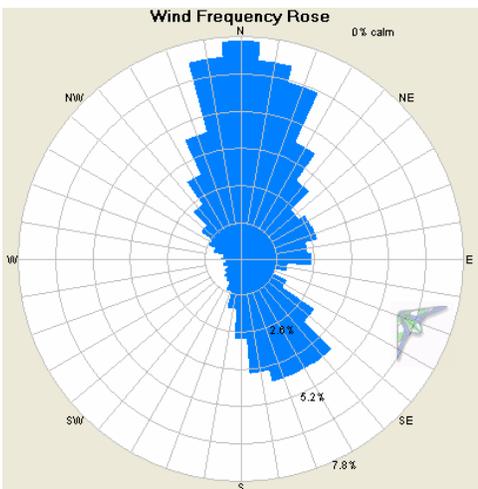
- Scale: 4.26 m/s
- Mode: 26.8 m/s
- r²: 0.979

WIND DIRECTION

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

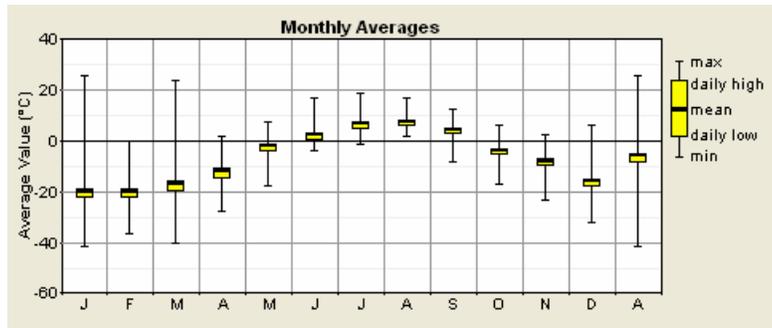


The annual wind power rose is shown below. Primary wind directions are the North and Southeast.



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 AWOS site are shown below. Over the 6 year period, the temperature dropped below -25°C during 7.5% of the time, or 657 hours per year.



Monthly Average Temperatures at Point Hope AWOS, 1995-2000

POTENTIAL POWER PRODUCTION FROM WIND TURBINES IN POINT HOPE

The power curves from various wind turbines were used to calculate potential energy production in Point Hope. 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 2000 at the airport AWOS site in Point Hope, Alaska. The long-term annual average wind speed at the site is 6.8 m/s at a height of 10 meters above ground level. Taking the local air density into account, the average wind power density for the site is 418 W/m^2 . Point Hope has a Class 6 wind resource, which is rated "excellent" for wind power development. The net capacity factor for wind turbines would range from 27% to 42%.

Based on this initial review, the community of Point Hope appears to be an excellent 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 AWOS equipment. If the topography of the potential wind turbine location varies from the AWOS 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 AWOS data.

Power Production Analysis of Various Wind Turbine Models

Wind Turbine Options								
Manufacturer Information	Bergey 10 kW	Fuhrlander FL30 30 kW	Entegrety 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	2,489	11,434	18,766	36,675	30,034	82,063	75,063	253,460
Feb	2,036	9,351	14,908	29,329	24,020	65,988	60,365	207,156
Mar	2,121	9,724	15,231	30,117	24,704	67,835	62,205	215,019
Apr	1,907	8,730	13,376	26,604	21,827	60,151	55,233	192,944
May	1,459	6,949	9,992	20,053	16,352	46,565	42,881	153,619
Jun	1,587	7,410	10,904	21,825	17,877	49,554	45,899	163,051
July	1,970	9,063	13,907	27,604	22,628	62,506	57,358	200,226
Aug	2,268	10,395	16,544	32,600	26,745	73,251	67,064	229,937
Sep	2,416	11,138	18,292	35,687	29,234	79,736	72,867	246,460
Oct	2,620	12,171	20,419	39,588	32,361	88,780	80,433	269,726
Nov	2,648	12,421	21,115	40,724	33,248	91,111	82,733	275,185
Dec	2,591	12,016	20,001	38,852	31,790	87,032	79,147	266,020
Annual	26,111	120,802	193,455	379,655	310,820	854,570	781,247	2,672,800
Annual Average Capacity Factor								
Gross CF	30%	46%	33%	43%	35%	39%	40%	46%
Net CF	27%	41%	30%	39%	32%	35%	36%	42%

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 AWOS site.