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Wind Resource Assessment for SELAWIK, ALASKA

Date last modified: 2/24/2006
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SITE SUMMARY

ICAO Station ID:	PASK
NCDC Data Set:	700197
Latitude (NAD27):	N 66.617
Longitude (NAD27):	W 160
Magnetic Declination:	17° 6' E
Tower Type:	AWOS
Sensor Heights:	9 meters above ground level
Elevation:	8 meters
Monitor Start:	1/1/1995
Monitor End:	1/14/2006

This report summarizes wind resource data collected from the Automated Weather Observing System (AWOS) in Selawik, Alaska. The hourly data set from 1995-2006 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 Selawik.

The Selawik AWOS equipment and surrounding terrain are shown to the right. Selawik is located at the mouth of the Selawik River where it empties into Selawik Lake.

Picture taken from:
http://www.alaska.faa.gov/fai/airports.htm

WIND RESOURCE SUMMARY

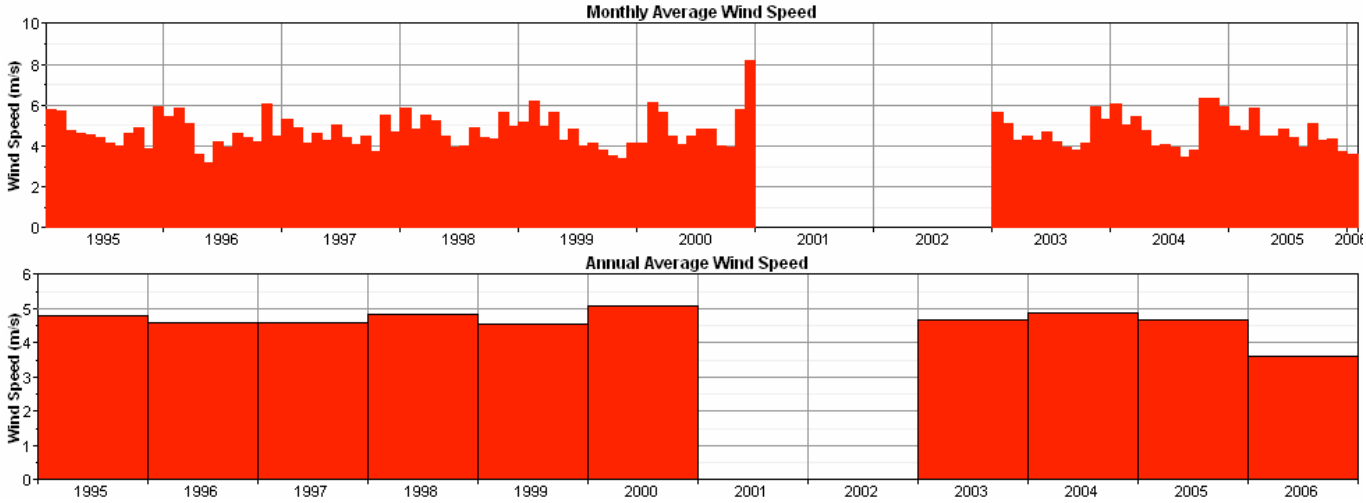
Annual Average Wind Speed (9m height):	4.7 m/s (10.7 mph)
Annual Average Wind Speed (30m height, estimated):	5.4 m/s (12.1 mph)
Average Wind Power Density (9m height):	130 W/m^2
Average Wind Power Density (30m height, estimated):	190 W/m^2
Wind Power Class (range = 1 to 7):	Class 2
Rating (Poor, Marginal, Fair, Good, Excellent, Outstanding):	Marginal
Prevailing Wind Direction:	East, West

Picture Courtesy of Jim Miller, AWOS

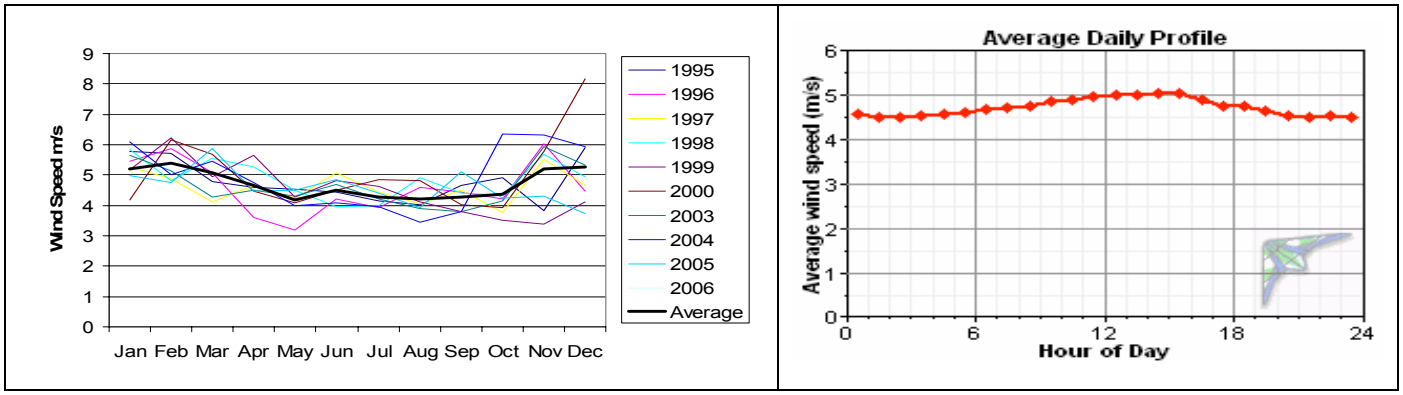
Based on data collected at the AWOS site, Selawik has a Class 2 wind resource, which is rated as “marginal” for wind power development.

WIND DATA RESULTS FOR SELWIK AWOS SITE

Wind speeds from January 1995 through January 2006 are summarized below. The average wind speed over the 9-year period is 4.8 m/s at a height of 9 meters above ground level. The annual wind speed rarely deviates more than 5% above or below this average. There was no data reported in 2001 and 2002.

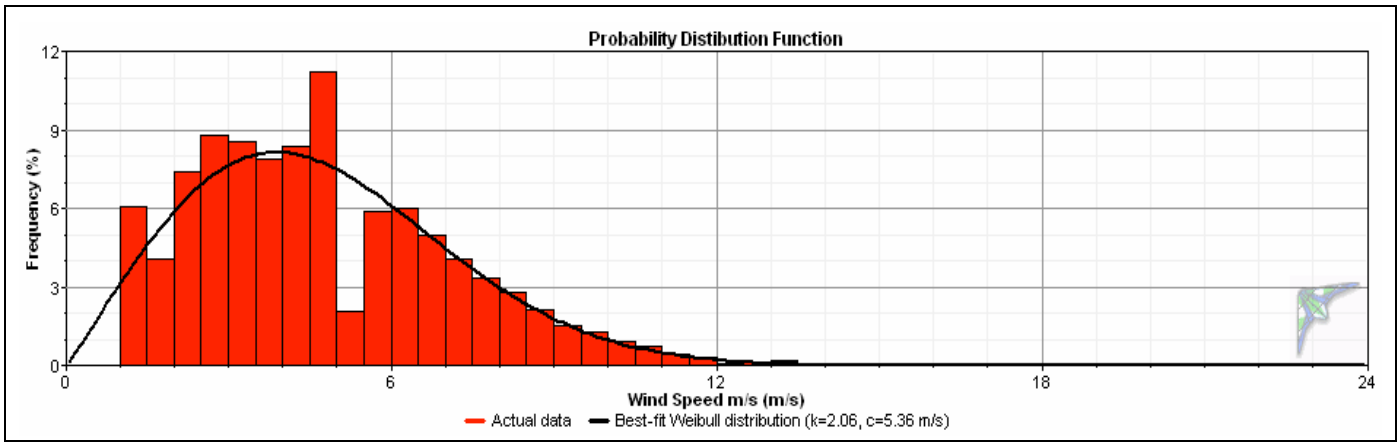


As shown, the highest wind month is typically February and the lowest wind month is typically May. Winds are typically highest in the afternoon.



Average Monthly and Daily Wind Speeds from Selawik AWOS, 9-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 57% of the wind in Selawik occurs within this operational zone at a height of 9 meters.

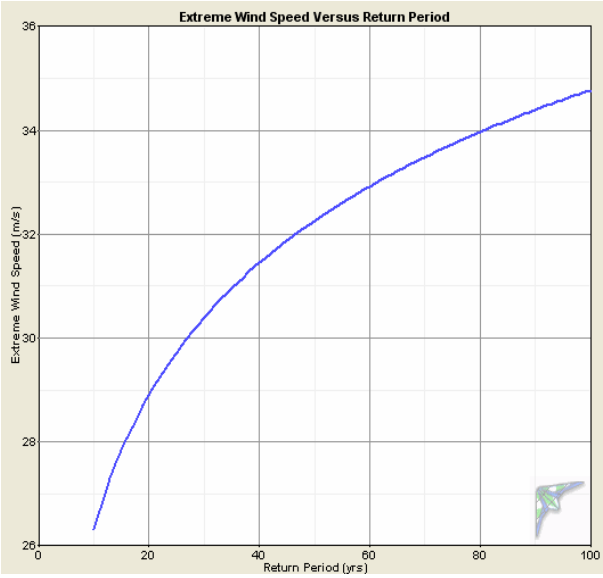


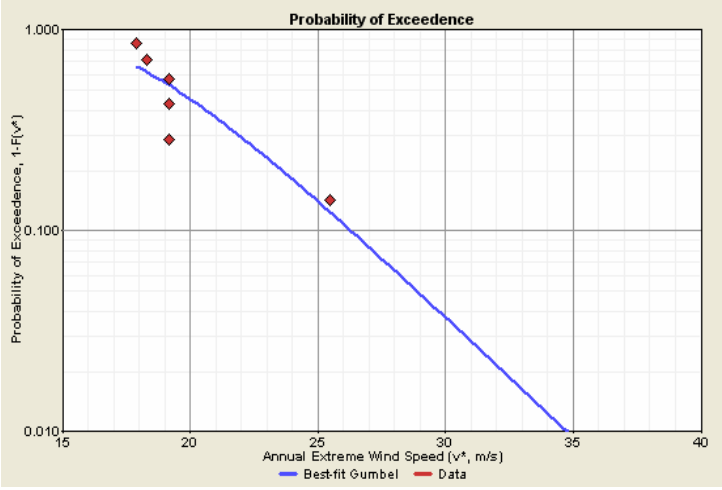
Average Wind Speeds at Selawik AWOS, 9-m Height (m/s)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
0	5.1	5.1	5.1	4.5	3.4	3.8	4.0	4.1	4.1	4.0	5.0	5.3	4.5
1	5.1	5.6	5.3	4.5	3.7	3.7	4.0	4.2	3.7	4.0	5.2	4.9	4.5
2	5.1	5.6	5.0	4.5	3.9	4.0	3.8	3.9	4.3	3.9	5.2	4.9	4.5
3	4.9	5.7	4.8	4.0	3.9	4.2	3.8	3.9	4.3	3.7	5.5	5.3	4.5
4	5.0	5.6	4.8	4.2	3.7	4.2	4.0	4.1	4.2	3.9	5.5	5.4	4.5
5	5.1	5.4	4.8	4.4	4.0	4.7	4.2	4.0	4.3	3.9	5.4	5.3	4.6
6	5.3	5.4	5.1	4.4	4.0	4.9	4.5	4.2	4.6	3.9	5.5	5.1	4.7
7	5.1	5.5	5.0	4.3	4.2	5.0	4.8	3.9	4.5	3.7	5.8	5.4	4.7
8	4.8	5.5	5.1	4.5	4.4	5.1	4.7	4.0	4.8	3.9	5.5	5.7	4.8
9	4.9	5.3	5.2	4.7	4.3	5.1	4.6	4.0	4.7	4.0	5.5	5.6	4.8
10	5.4	5.1	4.9	4.6	4.4	4.6	4.5	4.0	4.5	4.1	6.0	5.6	4.8
11	5.7	5.4	5.1	4.7	4.4	4.8	4.3	4.1	4.6	4.1	5.9	5.7	4.9
12	6.0	5.6	5.0	4.8	4.5	4.7	4.4	4.3	4.4	4.4	5.5	5.8	4.9
13	5.9	5.5	5.4	5.3	4.4	4.5	4.3	4.5	4.4	4.6	5.4	6.2	5.0
14	5.8	4.9	5.5	5.1	4.4	4.5	4.3	4.4	4.6	4.7	5.3	6.4	5.0
15	5.6	5.2	5.3	5.1	4.6	4.4	4.8	4.6	4.3	4.6	5.6	6.2	5.0
16	5.9	5.3	5.4	4.8	4.6	4.5	4.3	4.6	4.1	4.6	5.8	6.1	5.0
17	6.1	5.7	5.6	5.0	4.3	4.6	4.3	4.7	4.4	4.6	5.9	5.4	5.1
18	5.7	5.6	5.3	4.8	4.7	4.7	4.3	4.7	4.4	4.6	5.6	5.6	5.0
19	5.7	5.6	5.3	4.9	4.6	4.6	4.2	4.1	4.4	4.9	5.0	5.3	4.9
20	5.4	5.3	4.9	4.6	4.1	4.7	4.1	4.2	4.2	4.7	4.9	4.8	4.7
21	5.2	5.4	5.1	4.6	3.9	4.5	4.0	4.3	4.2	4.3	5.0	5.0	4.6
22	5.1	5.2	5.1	4.5	3.8	4.7	4.2	4.1	4.3	4.3	5.0	5.2	4.6
23	5.2	5.3	4.9	4.6	3.6	4.3	4.0	3.9	4.2	4.3	5.1	5.4	4.6
Ave	5.4	5.4	5.1	4.6	4.2	4.5	4.3	4.2	4.3	4.2	5.4	5.5	4.8

EXTREME GUST ANALYSIS

Using the Windographer software program (www.mistaya.ca), a Gumbel distribution is fit to the 9 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 9 meters above ground level over the next 100 years is 34.8 m/s.





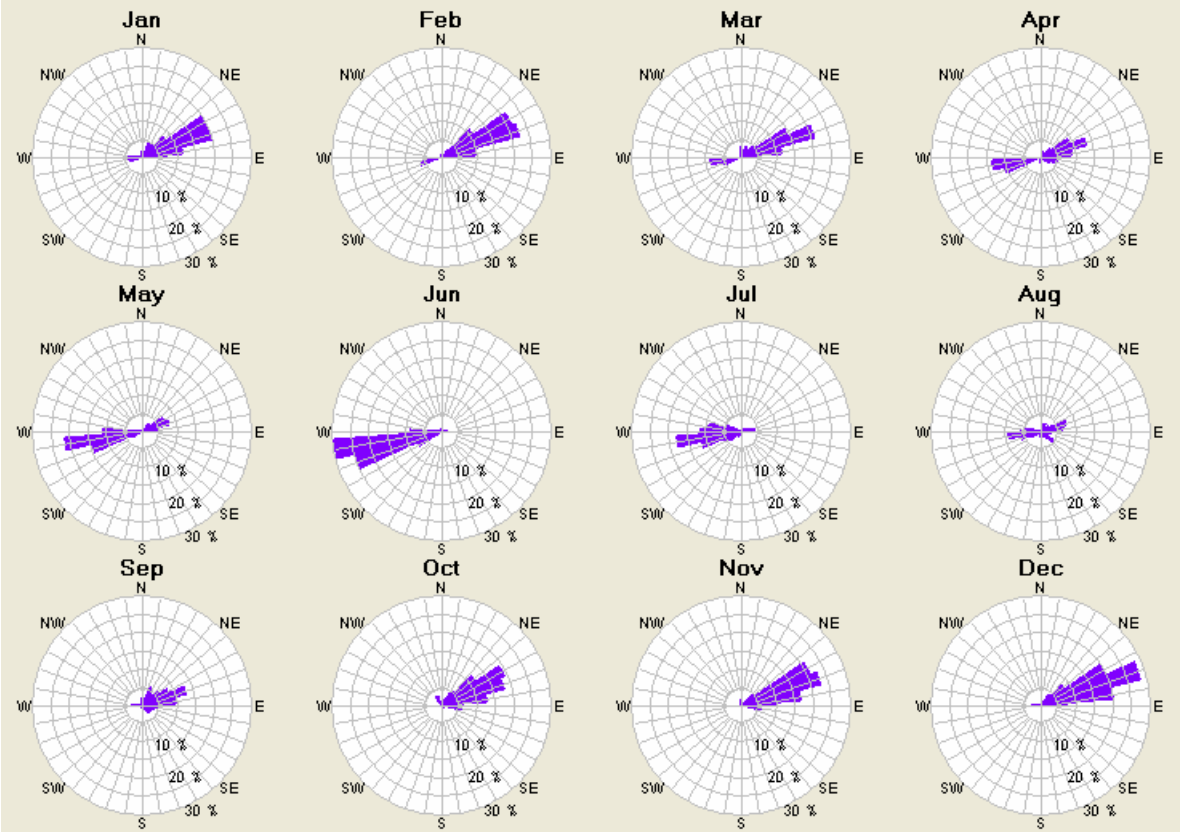
Return Period (yr)	Extreme Wind Speed (m/s)
20	28.9
25	29.7
50	32.3
100	34.8

Gumbel distribution parameters

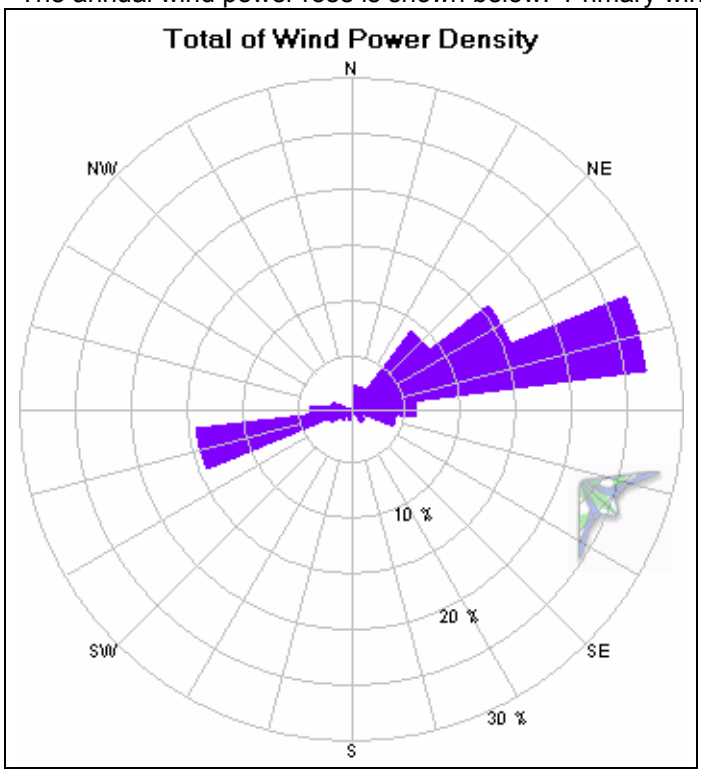
Scale:	3.61 m/s
Mode:	18.2 m/s
r^2	0.718

WIND DIRECTION

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

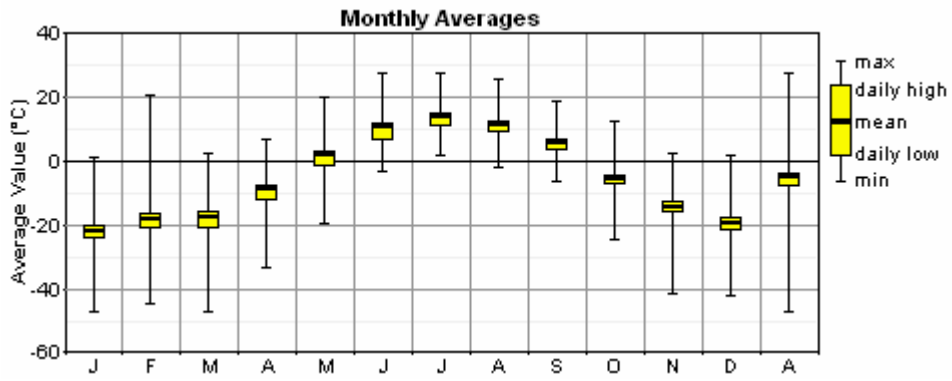


The annual wind power rose is shown below. Primary wind directions are the East and West.



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 9 year period, the temperature dropped below -25°C during 10.7% of the time, or 933 hours per year.



Monthly Average Temperatures at Selawik AWOS, 1995-2006

POTENTIAL POWER PRODUCTION FROM WIND TURBINES IN SELAWIK

The power curves from various wind turbines were used to calculate potential energy production in Selawik. 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 January 2006 at the AWOS weather station in Selawik, Alaska. The long-term annual average wind speed at the site is 4.7 m/s at a height of 9 meters above ground level. Taking the local air density into account, the average wind power density for the site is 130 W/m^2. Selawik has a Class 2 wind resource, which is rated “marginal” for wind power development. The net capacity factor for wind turbines would range from 13% to 21%.

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	1,504	7,126	10,255	20,569	16,807	48,068	43,886	157,623
Feb	1,393	6,563	9,454	19,002	15,521	44,102	40,394	144,839
Mar	1,331	6,412	8,955	18,076	14,700	42,701	38,865	140,924
Apr	961	4,825	6,316	12,979	10,393	31,645	28,419	104,590
May	721	3,698	4,441	9,498	7,465	23,873	21,242	78,398
Jun	883	4,410	5,610	11,715	9,345	28,567	25,720	94,702
July	737	3,811	4,637	9,854	7,737	24,596	21,849	80,587
Aug	726	3,735	4,513	9,627	7,566	24,036	21,389	78,763
Sep	786	3,975	4,915	10,372	8,232	25,487	22,823	84,196
Oct	777	3,940	4,821	10,235	8,083	25,474	22,754	84,070
Nov	1,455	6,928	9,960	19,983	16,306	46,656	42,610	153,131
Dec	1,568	7,415	10,751	21,534	17,604	49,945	45,676	163,704
Annual	12,842	62,839	84,627	173,442	139,760	415,147	375,626	1,365,524
Annual Average Capacity Factor								
Gross CF	15%	24%	15%	20%	16%	19%	19%	24%
Net CF	13%	22%	13%	18%	14%	17%	17%	21%

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.