

Appendix M

P50 and P90 Turbine Production

Probability of Exceedance for Wind Speed Calculation

Uncertainties

Inter-Annual Variability of Wind Speeds, U_i

13 Duration of Long Term Data Set (Years)
 $U_i = 1.66 \%$

Cup Anemometer (NRG #40), U_M

$U_M = 0.00 \%$

Wind Shear Calculation, U_s

60 Lower Anemometer Height (m)
80 Upper Anemometer Height (m)
 $U_s = 2.3 \%$

MCP Algorithm Calculation, U_{MCP}

N/A R^2 Value
 $U_{MCP} = 0.00 \%$

Long Term Corrected Annual Average Wind Speeds

Height	Wind Speed
(m)	(m/s)
50	5.40
60	5.83
70	6.22
80	6.58
100	7.22

Wind Speed Probability Exceedance Calculation

Hub Height (m)	LTC Wind Speed (m/s)	Total Uncertainty (%)		P90 Wind Speed (m/s)	P50 Wind Speed (m/s)
50	5.4	3.964101	0.214061	5.13	5.4
60	5.83	3.964101	0.231107	5.53	5.83
70	6.22	3.964101	0.246567	5.90	6.22
80	6.58	3.964101	0.260838	6.25	6.58
100	7.22	3.964101	0.286208	6.85	7.22

600 kW

P50 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0

Square Root Sum of Losses 3.326034 %

Hub Height (m)	Long Term Average (m/s)	P50 Wind Speed (m/s)	Wiebull Shape (α)	P50 Gross Annual Production	Total Uncertainty (%)	Total (kWh)	P50 Net Production (kWh)
50	5.4	5.4	3.2831	874808.22	3.32603367	29096.42	874808
60	5.83	5.83	3.2851	1100911.70	3.32603367	36616.69	1100912
70	6.22	6.22	3.2817	1327149.23	3.32603367	44141.43	1327149
80	6.58	6.58	3.2813	1548644.27	3.32603367	51508.43	1548644
100	7.22	5.40	3.2702	871811.17	3.32603367	28996.73	871811

600 kW

P90 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0

Square Root Sum of Losses 3.326034 %

Hub Height (m)	Long Term Av. Speed (m/s)	P90 Wind Speed (m/s)	Wiebull Shape (α)	P90 Gross Annual Production	Total Uncertainty (%)	P90 Net Production (kWh)
50	5.4	5.13	3.2831	744553.49	3.32603367	24764.1 712817
60	5.83	5.53	3.2851	941584.14	3.32603367	31317.41 901449
70	6.22	5.90	3.2817	1141856.24	3.32603367	37978.52 1093185
80	6.58	6.25	3.2813	1341498.58	3.32603367	44618.69 1284317
100	7.22	5.40	3.2702	871811.17	3.32603367	28996.73 834650

750 kW

P50 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0

Square Root Sum of Losses 3.326034 %

Hub Height (m)	Long Term Average (m/s)	P50 Wind Speed (m/s)	Wiebull Shape (α)	P50 Gross Annual Production	Total Uncertainty (%)	Total (kWh)	P50 Net Production (kWh)
50	5.4	5.4	3.2831	1042427.65	3.32603367	34671.49	1042428
60	5.83	5.83	3.2851	1317973.16	3.32603367	43836.23	1317973
70	6.22	6.22	3.2817	1597301.36	3.32603367	53126.78	1597301
80	6.58	6.58	3.2813	1873257.19	3.32603367	62305.16	1873257
100	7.22	5.40	3.2702	1039041.99	3.32603367	34558.89	1039042

750 kW

P90 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0
Square Root Sum of Losses	3.326034 %

Hub Height (m)	Long Term Av. Speed (m/s)	P90 Wind Speed (m/s)	Wiebull Shape (α)	P90 Gross Annual Production	Total Uncertainty (%)	P90 Net Production (kWh)
50	5.4	5.13	3.2831	885651.54	3.32603367	29457.07
60	5.83	5.53	3.2851	1123380.75	3.32603367	37364.02
70	6.22	5.90	3.2817	1368360.37	3.32603367	45512.13
80	6.58	6.25	3.2813	1615163.14	3.32603367	53720.87
100	7.22	5.40	3.2702	1039041.99	3.32603367	34558.89

900 kW

P50 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0

Square Root Sum of Losses 3.326034 %

Hub Height (m)	Long Term Average (m/s)	P50 Wind Speed (m/s)	Wiebull Shape (α)	P50 Gross Annual Production	Total Uncertainty (%)	P50 Net Production (kWh)
50	5.4	5.4	3.2831	1060666.41	3.32603367	1060666
60	5.83	5.83	3.2851	1334778.06	3.32603367	1334778
70	6.22	6.22	3.2817	1610996.27	3.32603367	1610996
80	6.58	6.58	3.2813	1884778.60	3.32603367	1884779
100	7.22	5.40	3.2702	1057041.41	3.32603367	1057041

900 kW

P90 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0

Square Root Sum of Losses 3.326034 %

Hub Height (m)	Long Term Av. Speed (m/s)	P90 Wind Speed (m/s)	Wiebull Shape (α)	P90 Gross Annual Production	Total Uncertainty (%)	Total (kWh)	P90 Net Production (kWh)
50	5.4	5.13	3.2831	902843.59	3.32603367	30028.88	864360
60	5.83	5.53	3.2851	1141537.91	3.32603367	37967.94	1092880
70	6.22	5.90	3.2817	1384585.12	3.32603367	46051.77	1325567
80	6.58	6.25	3.2813	1628640.56	3.32603367	54169.13	1559220
100	7.22	5.40	3.2702	1057041.41	3.32603367	35157.55	1011985

1500 kW

P50 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0

Square Root Sum of Losses 3.326034 %

Hub Height (m)	Long Term Average (m/s)	P50 Wind Speed (m/s)	Wiebull Shape (α)	P50 Gross Annual Production	Total Uncertainty (%)		P50 Net Production (kWh)
50	5.4	5.4	3.2831	2008079.03	3.32603367	66789.38	2008079
60	5.83	5.83	3.2851	2599673.79	3.32603367	86466.03	2599674
70	6.22	6.22	3.2817	3192391.34	3.32603367	106180	3192391
80	6.58	6.58	3.2813	3770887.42	3.32603367	125421	3770887
100	7.22	5.40	3.2702	2002016.91	3.32603367	66587.76	2002017

1500 kW

P90 Power Production Calculation

Site/Turbine Losses (%)

Topography	0.5
Site Obstructions/Waking	0
Grid Availability	0.25
WTG Availability	2
Electrical Losses	2.5
Cold Temp Shut Down	0.5
Blade Contamination	0.5
Wind Farm Waking Effect	0
High Wind Hysteresis	0
Square Root Sum of Losses	3.326034 %

Hub Height (m)	Long Term Av. Speed (m/s)	P90 Wind Speed (m/s)	Wiebull Shape (α)	P90 Gross Annual Production	Total Uncertainty (%)	Total (kWh)	P90 Net Production (kWh)
50	5.4	5.13	3.2831	1669479.39	3.32603367	55527.45	1598318
60	5.83	5.53	3.2851	2182638.60	3.32603367	72595.29	2089604
70	6.22	5.90	3.2817	2707277.87	3.32603367	90044.97	2591881
80	6.58	6.25	3.2813	3230184.76	3.32603367	107437	3092499
100	7.22	5.40	3.2702	2002016.91	3.32603367	66587.76	1916681

Hub Height (m)	Wind Speed		Elecon 600 kW		Unison 750 kW		EWT 900 kW		GE Energy 1.5MW	
	P50 Wind Speed (m/s)	P90 Wind Speed (m/s)	P50 Net Production (kWh)	P90 Net Production (kWh)	P50 Net Production (kWh)	P90 Net Production (kWh)	P50 Net Production (kWh)	P90 Net Production (kWh)	P50 Net Production (kWh)	P90 Net Production (kWh)
50	5.40	5.13	874,808	712,817	1,042,428	847,901	1,060,666	864,360	2,008,079	1,598,318
60	5.83	5.53	1,100,912	901,449	1,317,973	1,075,497	1,334,778	1,092,880	2,599,674	2,089,604
70	6.22	5.90	1,327,149	1,093,185	1,597,301	1,310,034	1,610,996	1,325,567	3,192,391	2,591,881
80	6.58	6.25	1,548,644	1,284,317	1,873,257	1,546,317	1,884,779	1,559,220	3,770,887	3,092,499
100	7.22	6.85	871,811	834,650	1,039,042	994,753	1,057,041	1,011,985	2,002,017	1,916,681