

Project:

Exam_16.01

Licensed user:

Hochschule Flensburg, University of Applied Sciences
Darf nur für Zwecke der Lehre verwendet werden

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Calculated:

1/16/2025 3:53 PM/4.0.547

PARK - Main Result

Calculation: AEP_Vestas_Nornal_5WTG

Setup

AEP scaled to a full year based on number of samples
Scaling factor from 31.0 years to 1 year: 0.032

Calculation performed in UTM (north)-WGS84 Zone: 32

At the site centre the difference between grid north and true north is: 0.6°

Wake

Wake Model: N.O. Jensen (RISØ/EMD) Park 2 2018

Wake decay constant

Reference WTG: 01_VESTAS V150-4.5 4500 150.0 IO! hub: 125.0 m (TOT: 200.0 m) (1)

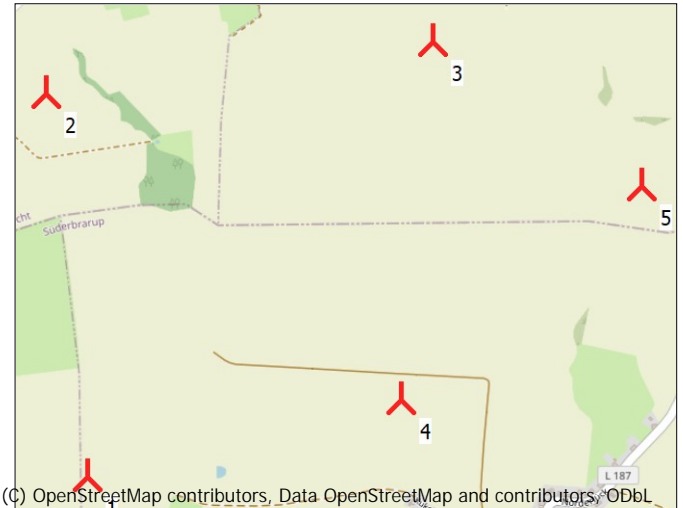
Scaler/wind data

Name EMD Default Measurement Mast Scaler
 Terrain scaling Measured Data Scaling (WASP Stability / A-Parameter)
 Micro terrain flow model WASP IBZ from Site Data
 Used period 1/1/1994 1:00:00 AM - 1/1/2025
 Meteo object(s) MCP LT - MCP session (1) - [Neural Network] (3), 125.00m - MCP LT - MCP session (1) - [Neural Network]
 Displacement height Omnidirectional from objects
 WASP version WASP 11 Version 11.04.0026

Power correction

Power curve correction (adjusted IEC method, improved to match turbine control)

	Min	Max	Avg	Corr.	Neg. corr.	Pos. corr.
				[%]	[%]	[%]
Air density						
From air density settings	[°C]	7.6	7.6	7.6		
From air density settings	[hPa]	990.7	990.7	990.7		
Resulting air density	[kg/m³]	1.229	1.229	1.229		
Relative to 15°C at sea level	[%]	100.4	100.4	100.4	0.2	0.0



Calculated Annual Energy for Wind Farm

WTG combination	Result PARK	Result-10.0%	GROSS (no loss) Free WTGs	Wake loss	Specific results ^{a)}			Wind speed		
					Capacity factor	Mean WTG result	Full load hours	free	wake	reduced
	[MWh/y]	[MWh/y]	[MWh/y]	[%]	[%]	[MWh/y]	[Hours/year]	[m/s]		[m/s]
Wind farm	82,810.9	74,529.8	86,235.4	4.0	37.8	14,906.0	3,312	7.0		6.9

^{a)} Based on Result-10.0%

Calculated Annual Energy for each of 5 new WTGs with total 22.5 MW rated power

WTG type	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Power curve Creator	Name	Annual Energy			Wind speed		
									Result	Result-10.0%	Wake loss	free	reduced	
				[kW]	[m]	[m]			[MWh/y]	[MWh/y]	[%]	[m/s]		[m/s]
1 Yes	VESTAS	V150-4.5-4,500	4,500	150.0	125.0	USER	Level 0 - Calculated - PO4-OS & PO4 - 12-2021		16,970.7	15,274	1.7	7.01		6.95
2 Yes	VESTAS	V150-4.5-4,500	4,500	150.0	125.0	USER	Level 0 - Calculated - PO4-OS & PO4 - 12-2021		16,798.0	15,118	2.8	7.02		6.92
3 Yes	VESTAS	V150-4.5-4,500	4,500	150.0	125.0	USER	Level 0 - Calculated - PO4-OS & PO4 - 12-2021		16,265.3	14,639	5.2	6.99		6.81
4 Yes	VESTAS	V150-4.5-4,500	4,500	150.0	125.0	USER	Level 0 - Calculated - PO4-OS & PO4 - 12-2021		16,514.1	14,863	3.8	6.99		6.86
5 Yes	VESTAS	V150-4.5-4,500	4,500	150.0	125.0	USER	Level 0 - Calculated - PO4-OS & PO4 - 12-2021		16,262.8	14,637	6.2	7.03		6.81

WTG siting

UTM (north)-ETRS89 Zone: 32

Easting Northing Z Row data/Description

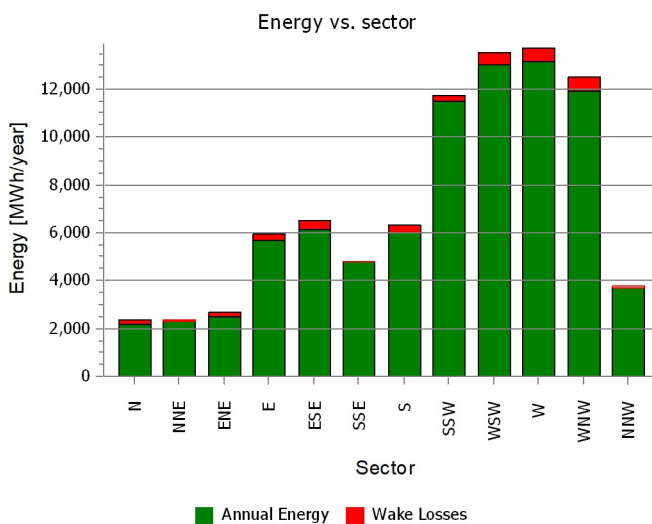
Calculation period
Start End

1 New	547,816	6,060,703	60.0	01_VESTAS V150-4.5 4500 150.0 IO! hub: 125.0 m (TOT: 200.0 m) (1)	1/1/1994	1/1/2025
2 New	547,696	6,061,714	60.0	02_VESTAS V150-4.5 4500 150.0 IO! hub: 125.0 m (TOT: 200.0 m) (7)	1/1/1994	1/1/2025
3 New	548,720	6,061,864	60.0	03_VESTAS V150-4.5 4500 150.0 IO! hub: 125.0 m (TOT: 200.0 m) (8)	1/1/1994	1/1/2025
4 New	548,648	6,060,915	60.0	04_VESTAS V150-4.5 4500 150.0 IO! hub: 125.0 m (TOT: 200.0 m) (9)	1/1/1994	1/1/2025
5 New	549,277	6,061,489	60.0	05_VESTAS V150-4.5 4500 150.0 IO! hub: 125.0 m (TOT: 200.0 m) (10)	1/1/1994	1/1/2025

PARK - Production Analysis

Calculation: AEP_Vestas_Nornal_5WTG WTG: All new WTGs, Air density 1.229 kg/m³
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Model based energy	[MWh]	2,330.0	2,373.4	2,670.7	5,958.0	6,510.9	4,815.4	6,293.0	11,748.9	13,553.6	13,720.9	12,503.1	3,757.6	86,235.4
-Decrease due to wake losses	[MWh]	129.7	81.0	178.1	300.7	411.2	49.4	289.8	275.9	532.6	547.4	585.6	42.9	3,424.5
Resulting energy	[MWh]	2,200.3	2,292.4	2,492.6	5,657.3	6,099.6	4,766.0	6,003.3	11,473.0	13,021.0	13,173.5	11,917.4	3,714.7	82,810.9
Specific energy	[kWh/m ²]													937
Specific energy	[kWh/kW]													3,680
Decrease due to wake losses	[%]	5.6	3.4	6.7	5.0	6.3	1.0	4.6	2.3	3.9	4.0	4.7	1.1	3.97
Full Load Equivalent	[Hours/year]	98	102	111	251	271	212	267	510	579	585	530	165	3,680



PARK - Power Curve Analysis

Calculation: AEP_Vestas_Nornal_5WTG WTG: 1 - VESTAS V150-4.5 4500 150.0 !O!, Hub height: 125.0 m

Name: Level 0 - Calculated - PO4-OS & PO4 - 12-2021

Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m ²
12/3/2021	USER	8/30/2022	8/30/2022	24.5	Pitch	User defined	Variable	0.25

Based on Document no.: 0067-7057.V04.

HP curve comparison - Note: For standard air density

Vmean

HP value Pitch, variable speed (2013)

VESTAS V150-4.5 4500 150.0 !O! Level 0 - Calculated - PO4-OS & PO4 - 12-2021

Check value

[m/s]	5	6	7	8	9	10
[MWh]	8,677	12,863	16,760	20,128	22,908	25,089
[MWh]	8,804	12,992	16,852	20,105	22,641	24,450
[%]	-1	-1	-1	0	1	3

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m²) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.

For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see the windPRO manual.

The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.

Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

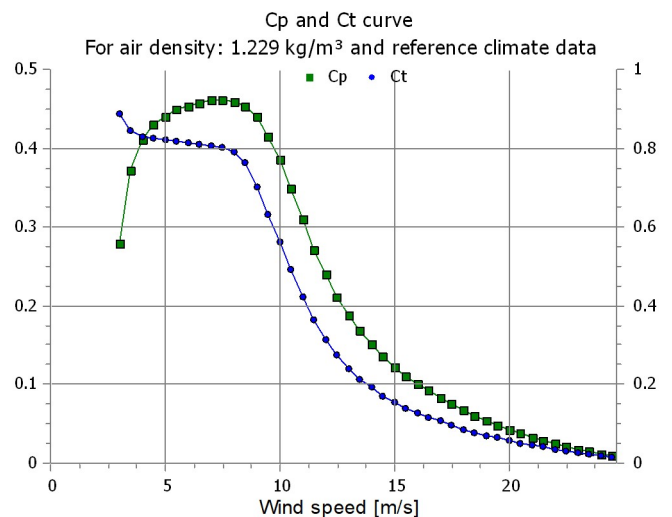
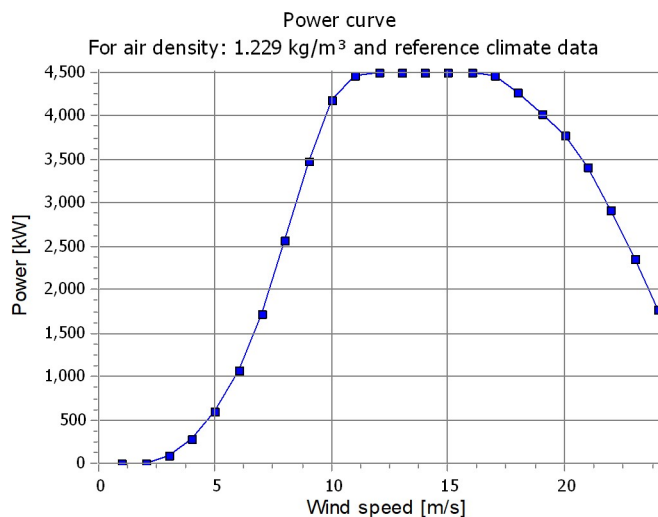
Original data, Air density: 1.225 kg/m³

Wind speed [m/s]	Power [kW]	Cp	Wind speed [m/s]	Ct curve
3.0	81.0	0.28	3.0	0.89
3.5	172.0	0.37	3.5	0.85
4.0	285.0	0.41	4.0	0.83
4.5	424.0	0.43	4.5	0.83
5.0	596.0	0.44	5.0	0.82
5.5	808.0	0.45	5.5	0.82
6.0	1,061.0	0.45	6.0	0.81
6.5	1,360.0	0.46	6.5	0.81
7.0	1,710.0	0.46	7.0	0.81
7.5	2,106.0	0.46	7.5	0.80
8.0	2,549.0	0.46	8.0	0.79
8.5	3,021.0	0.45	8.5	0.76
9.0	3,471.0	0.44	9.0	0.70
9.5	3,861.0	0.42	9.5	0.63
10.0	4,180.0	0.39	10.0	0.56
10.5	4,372.0	0.35	10.5	0.49
11.0	4,470.0	0.31	11.0	0.42
11.5	4,494.0	0.27	11.5	0.36
12.0	4,500.0	0.24	12.0	0.31
12.5	4,500.0	0.21	12.5	0.27
13.0	4,500.0	0.19	13.0	0.24
13.5	4,500.0	0.17	13.5	0.22
14.0	4,500.0	0.15	14.0	0.19
14.5	4,500.0	0.14	14.5	0.17
15.0	4,500.0	0.12	15.0	0.16
15.5	4,500.0	0.11	15.5	0.14
16.0	4,500.0	0.10	16.0	0.13
16.5	4,498.0	0.09	16.5	0.12
17.0	4,473.0	0.08	17.0	0.11
17.5	4,394.0	0.08	17.5	0.10
18.0	4,268.0	0.07	18.0	0.09
18.5	4,139.0	0.06	18.5	0.08
19.0	4,031.0	0.05	19.0	0.07
19.5	3,909.0	0.05	19.5	0.06
20.0	3,771.0	0.04	20.0	0.06
20.5	3,607.0	0.04	20.5	0.05
21.0	3,408.0	0.03	21.0	0.05
21.5	3,180.0	0.03	21.5	0.04
22.0	2,917.0	0.03	22.0	0.04
22.5	2,645.0	0.02	22.5	0.03
23.0	2,363.0	0.02	23.0	0.03
23.5	2,070.0	0.01	23.5	0.02
24.0	1,782.0	0.01	24.0	0.02
24.5	1,561.0	0.01	24.5	0.02

Power and efficiency vs. wind speed

Data used in calculation, Mean air density: 1.229 kg/m³

Wind speed [m/s]	Power [kW]	Cp
1.0	0.0	0.00
2.0	0.0	0.00
3.0	81.6	0.28
4.0	286.3	0.41
5.0	598.5	0.44
6.0	1,065.2	0.45
7.0	1,716.5	0.46
8.0	2,557.8	0.46
9.0	3,479.6	0.44
10.0	4,185.1	0.39
11.0	4,470.6	0.31
12.0	4,500.0	0.24
13.0	4,500.0	0.19
14.0	4,500.0	0.15
15.0	4,500.0	0.12
16.0	4,499.9	0.10
17.0	4,473.0	0.08
18.0	4,268.0	0.07
19.0	4,031.0	0.05
20.0	3,771.0	0.04
21.0	3,408.0	0.03
22.0	2,917.0	0.03
23.0	2,363.0	0.02
24.0	1,782.0	0.01

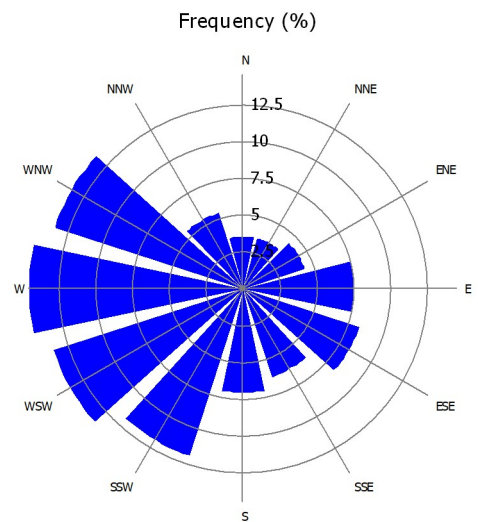
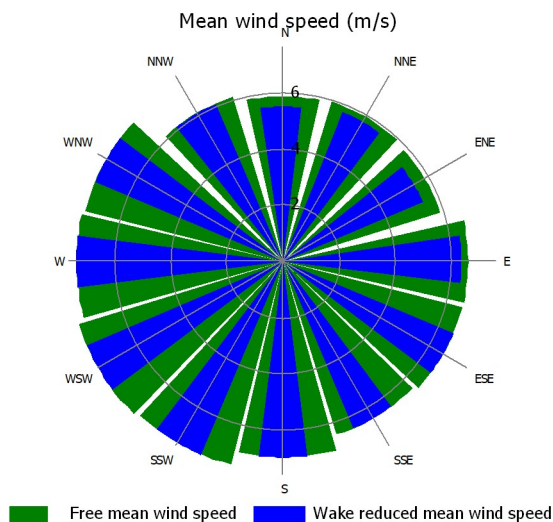
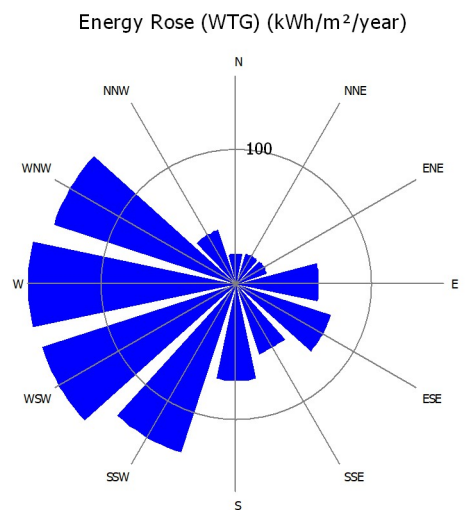
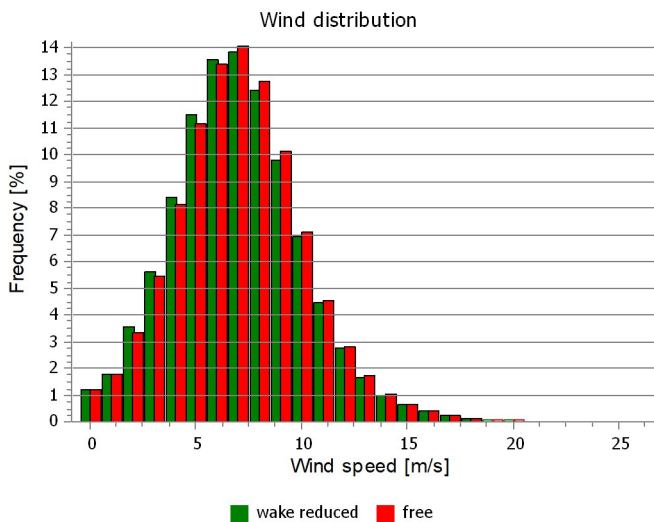


PARK - Wind Data Analysis

Calculation: AEP_Vestas_Nornal_5WTG Wind data: 1 - 01_VESTAS V150-4.5 4500 150.0 !O! hub: 125.0 m (TOT: 200.0 m) (1); Hub height: 125.0
Site coordinates
UTM (north)-ETRS89 Zone: 32
East: 547,816 North: 6,060,703
01_VESTAS V150-4.5 4500 150.0 !O! hub: 125.0 m (TOT: 200.0 m) (1)
Masts used
Take nearest

Winddata for site

Sector	Free mean wind speed [m/s]	Wake reduced mean wind speed [m/s]	Frequency [%]	
0 N	5.9	5.6	3.6	
1 NNE	6.0	5.8	3.6	
2 ENE	5.9	5.5	4.4	
3 E	6.7	6.4	7.5	
4 ESE	6.6	6.6	8.3	
5 SSE	6.5	6.5	6.3	
6 S	7.0	7.0	7.1	
7 SSW	7.5	7.5	12.0	
8 WSW	7.7	7.7	13.6	
9 W	7.4	7.4	14.6	
10 WNW	7.3	7.3	13.5	
11 NNW	6.2	6.2	5.5	
All	7.0	7.0	100.0	

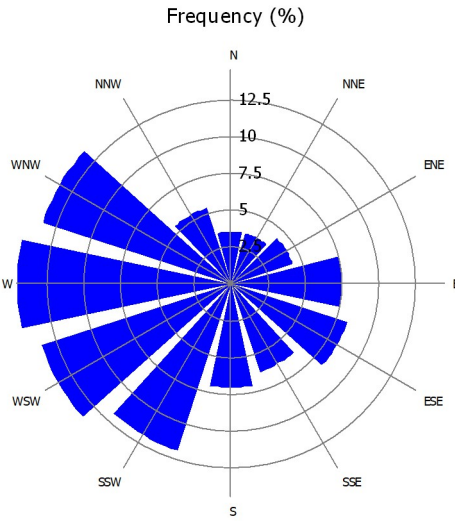
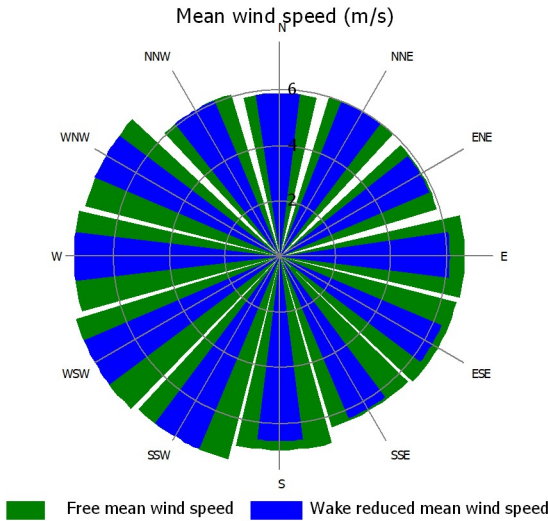
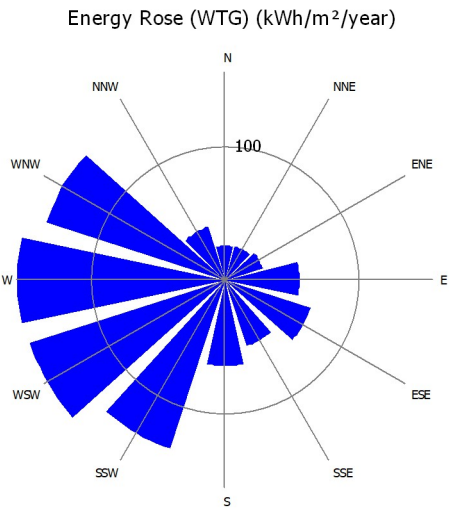
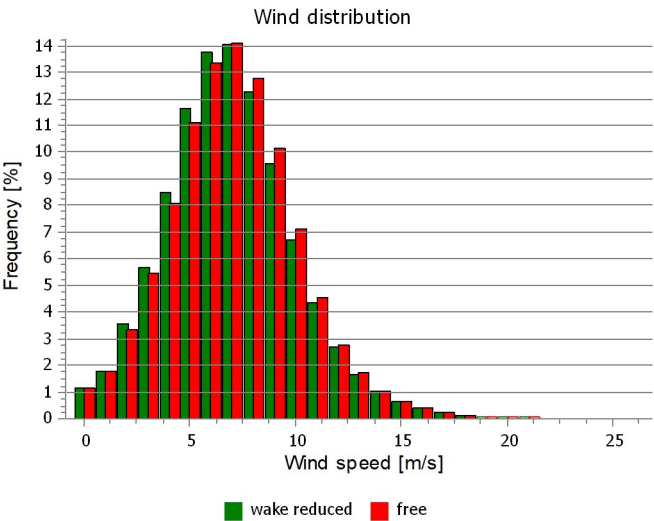


PARK - Wind Data Analysis

Calculation: AEP_Vestas_Nornal_5WTG Wind data: 2 - 02_VESTAS V150-4.5 4500 150.0 !O! hub: 125.0 m (TOT: 200.0 m) (7); Hub height: 125.0
Site coordinates
UTM (north)-ETRS89 Zone: 32
East: 547,696 North: 6,061,714
02_VESTAS V150-4.5 4500 150.0 !O! hub: 125.0 m (TOT: 200.0 m) (7)
Masts used
Take nearest

Winddata for site

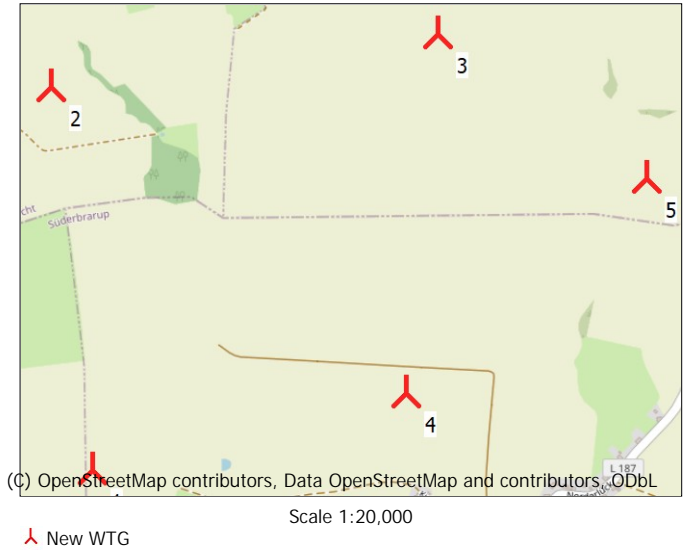
Sector	Free mean wind speed [m/s]	Wake reduced mean wind speed [m/s]	Frequency [%]
0 N	5.9	5.9	3.6
1 NNE	6.0	6.0	3.6
2 ENE	6.0	5.9	4.4
3 E	6.7	6.2	7.5
4 ESE	6.6	6.4	8.3
5 SSE	6.5	6.4	6.3
6 S	7.0	6.7	7.1
7 SSW	7.6	7.6	12.0
8 WSW	7.7	7.7	13.6
9 W	7.5	7.5	14.6
10 WNW	7.3	7.3	13.5
11 NNW	6.1	6.1	5.5
All	7.0	6.9	100.0



PARK - WTG distances

Calculation: AEP_Vestas_Nornal_5WTG
WTG distances

	Z	Nearest WTG	Z	Horizontal distance	Distance in
	[m]		[m]	[m]	rotor diameters
1	60.0	4	60.0	859	5.7
2	60.0	1	60.0	1,019	6.8
3	60.0	5	60.0	672	4.5
4	60.0	5	60.0	852	5.7
5	60.0	3	60.0	672	4.5
Min	60.0		60.0	672	4.5
Max	60.0		60.0	1,019	6.8



PARK - Time varying AEP

Calculation: AEP_Vestas_Nornal_5WTG

Windfarm: 22.5 MW based on 5 turbines of type VESTAS V150-4.5 4500 150.0 !O!.

Selection: All new WTGs

Calculated mean yield per month and hour [MWh]. The result includes wake losses and any curtailment losses.

Values are scaled to a full year, see correction factors at main result page.

Hour/Month [MWh]	1	2	3	4	5	6	7	8	9	10	11	12	Grand Total
0	394	354	347	286	277	253	243	243	282	348	348	375	3,749
1	389	352	346	283	266	243	233	247	272	331	352	371	3,685
2	388	349	345	284	262	242	237	242	272	329	347	381	3,678
3	385	349	335	275	268	233	239	239	268	333	349	369	3,642
4	394	350	340	280	263	237	235	237	273	330	344	372	3,655
5	387	353	337	270	262	235	230	230	270	327	331	374	3,606
6	385	344	332	262	246	220	215	228	264	333	328	367	3,524
7	376	340	328	249	220	212	203	201	246	322	324	360	3,382
8	372	334	303	214	212	200	196	188	234	311	311	350	3,227
9	359	323	293	213	196	200	200	183	216	290	298	343	3,114
10	360	310	292	216	199	204	201	194	237	287	299	336	3,135
11	349	302	293	218	204	201	197	190	225	282	277	326	3,065
12	342	314	298	231	222	222	216	209	245	295	298	330	3,220
13	352	323	315	249	234	237	226	222	262	310	297	332	3,359
14	353	322	327	258	246	250	240	234	253	312	308	332	3,436
15	357	331	331	259	250	249	238	226	264	315	298	335	3,454
16	354	318	318	258	245	238	225	225	255	305	306	335	3,382
17	356	313	312	249	241	232	219	218	250	298	310	343	3,340
18	356	318	317	247	230	217	213	205	244	304	314	347	3,312
19	375	329	326	254	240	215	209	209	247	325	323	344	3,395
20	376	337	339	267	256	211	214	212	255	328	327	357	3,478
21	381	346	352	273	254	231	220	223	273	340	340	356	3,589
22	383	352	354	287	270	235	227	234	272	353	347	368	3,681
23	382	347	345	287	269	242	235	244	292	353	341	367	3,702
Grand Total	8,905	8,009	7,825	6,165	5,833	5,460	5,310	5,283	6,171	7,662	7,718	8,470	82,811

Hour/Month [MW]	1	2	3	4	5	6	7	8	9	10	11	12	Grand Total
0	12.7	12.6	11.2	9.5	8.9	8.4	7.8	7.8	9.4	11.2	11.6	12.1	10.3
1	12.6	12.6	11.2	9.4	8.6	8.1	7.5	8.0	9.1	10.7	11.7	12.0	10.1
2	12.5	12.5	11.1	9.5	8.5	8.1	7.6	7.8	9.1	10.6	11.6	12.3	10.1
3	12.4	12.5	10.8	9.2	8.6	7.8	7.7	7.7	8.9	10.7	11.6	11.9	10.0
4	12.7	12.5	11.0	9.3	8.5	7.9	7.6	7.7	9.1	10.7	11.5	12.0	10.0
5	12.5	12.6	10.9	9.0	8.5	7.8	7.4	7.4	9.0	10.6	11.0	12.1	9.9
6	12.4	12.3	10.7	8.7	7.9	7.3	6.9	7.4	8.8	10.8	10.9	11.8	9.7
7	12.1	12.1	10.6	8.3	7.1	7.1	6.5	6.5	8.2	10.4	10.8	11.6	9.3
8	12.0	11.9	9.8	7.1	6.8	6.7	6.3	6.1	7.8	10.0	10.4	11.3	8.8
9	11.6	11.5	9.4	7.1	6.3	6.7	6.4	5.9	7.2	9.4	9.9	11.1	8.5
10	11.6	11.1	9.4	7.2	6.4	6.8	6.5	6.3	7.9	9.3	10.0	10.8	8.6
11	11.3	10.8	9.5	7.3	6.6	6.7	6.3	6.1	7.5	9.1	9.2	10.5	8.4
12	11.0	11.2	9.6	7.7	7.2	7.4	7.0	6.8	8.2	9.5	9.9	10.6	8.8
13	11.4	11.5	10.2	8.3	7.6	7.9	7.3	7.2	8.7	10.0	9.9	10.7	9.2
14	11.4	11.5	10.6	8.6	7.9	8.3	7.7	7.6	8.4	10.1	10.3	10.7	9.4
15	11.5	11.8	10.7	8.6	8.1	8.3	7.7	7.3	8.8	10.1	9.9	10.8	9.5
16	11.4	11.4	10.3	8.6	7.9	7.9	7.3	7.3	8.5	9.8	10.2	10.8	9.3
17	11.5	11.2	10.1	8.3	7.8	7.7	7.1	7.0	8.3	9.6	10.3	11.1	9.1
18	11.5	11.4	10.2	8.2	7.4	7.2	6.9	6.6	8.1	9.8	10.5	11.2	9.1
19	12.1	11.7	10.5	8.5	7.7	7.2	6.7	6.7	8.2	10.5	10.8	11.1	9.3
20	12.1	12.0	10.9	8.9	8.3	7.0	6.9	6.8	8.5	10.6	10.9	11.5	9.5
21	12.3	12.4	11.4	9.1	8.2	7.7	7.1	7.2	9.1	11.0	11.3	11.5	9.8
22	12.4	12.6	11.4	9.6	8.7	7.8	7.3	7.5	9.1	11.4	11.6	11.9	10.1
23	12.3	12.4	11.1	9.6	8.7	8.1	7.6	7.9	9.7	11.4	11.4	11.8	10.1
Grand Total	12.0	11.9	10.5	8.6	7.8	7.6	7.1	7.1	8.6	10.3	10.7	11.4	9.5

PARK - Time varying AEP

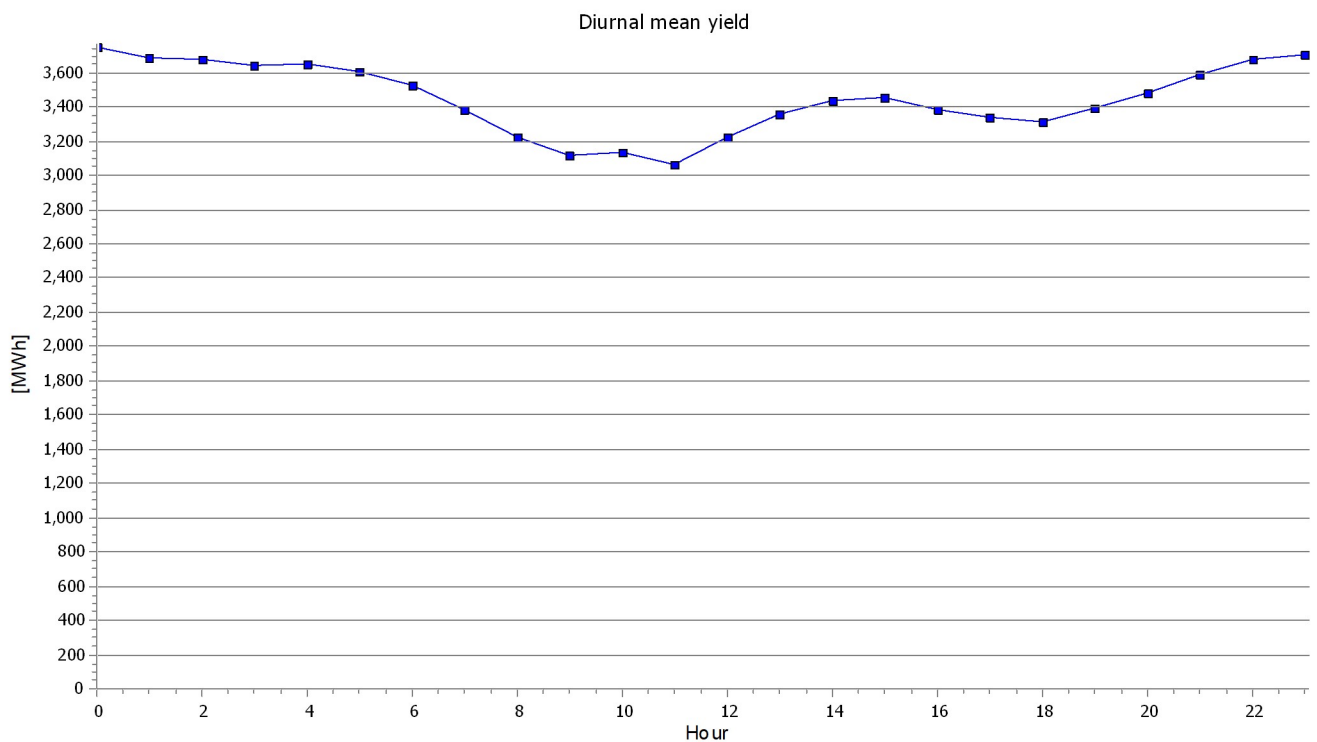
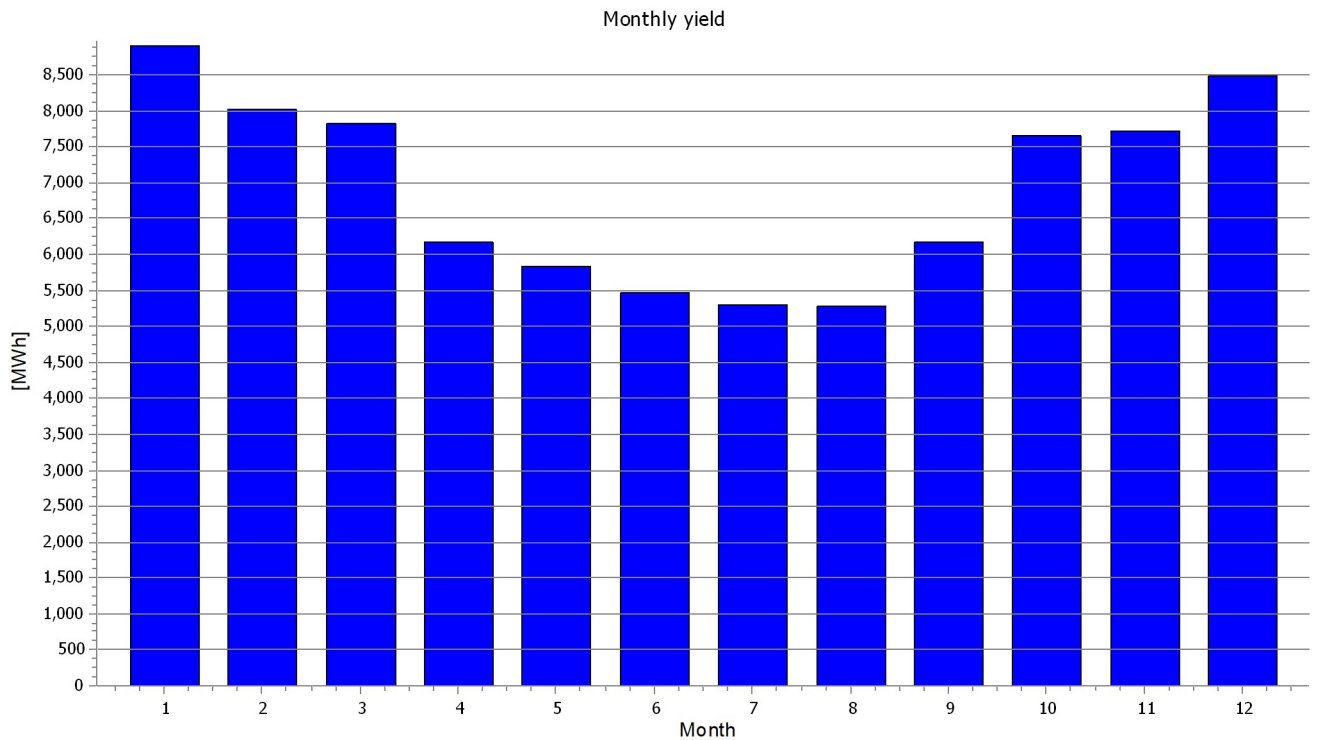
Calculation: AEP_Vestas_Nornal_5WTG

Windfarm: 22.5 MW based on 5 turbines of type VESTAS V150-4.5 4500 150.0 !O!.

Selection: All new WTGs

Calculated mean yield per month and hour [MWh]. The result includes wake losses and any curtailment losses.

Values are scaled to a full year, see correction factors at main result page.



PARK - Time varying AEP

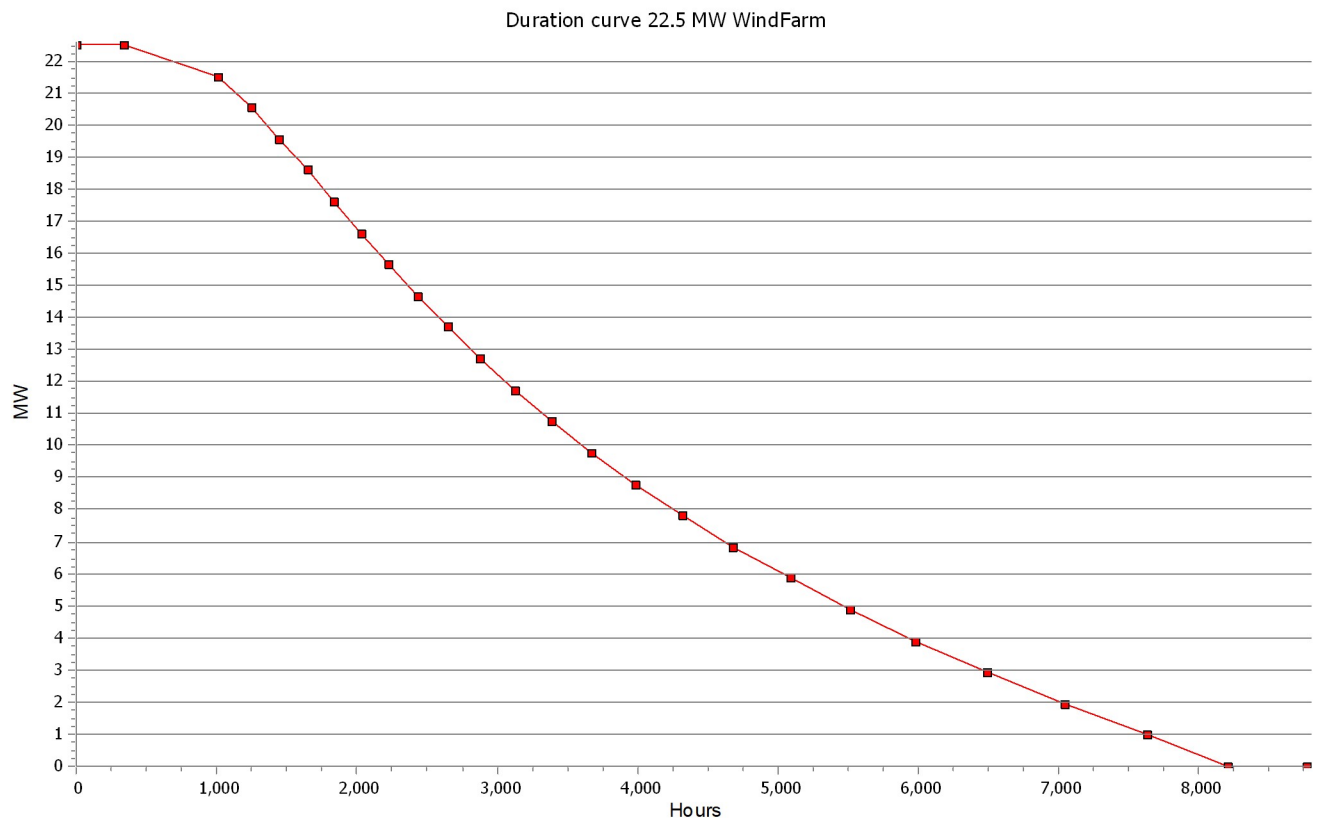
Calculation: AEP_Vestas_Nornal_5WTG

Windfarm: 22.5 MW based on 5 turbines of type VESTAS V150-4.5 4500 150.0 !O!.

Selection: All new WTGs

Calculated mean yield per month and hour [MWh]. The result includes wake losses and any curtailment losses.

Hours	Hours [%]	Hours accumulated	Power [MW]	Power (MW/WTG)
335	3.8	335	22.5	4.5
674	7.7	1009	21.5 - 22.5	4.3 - 4.5
239	2.7	1248	20.5 - 21.5	4.1 - 4.3
199	2.3	1447	19.6 - 20.5	3.9 - 4.1
198	2.3	1645	18.6 - 19.6	3.7 - 3.9
190	2.2	1835	17.6 - 18.6	3.5 - 3.7
194	2.2	2028	16.6 - 17.6	3.3 - 3.5
195	2.2	2223	15.7 - 16.6	3.1 - 3.3
207	2.4	2430	14.7 - 15.7	2.9 - 3.1
220	2.5	2650	13.7 - 14.7	2.7 - 2.9
227	2.6	2876	12.7 - 13.7	2.5 - 2.7
243	2.8	3120	11.7 - 12.7	2.3 - 2.5
264	3.0	3383	10.8 - 11.7	2.2 - 2.3
284	3.2	3668	9.8 - 10.8	2.0 - 2.2
310	3.5	3977	8.8 - 9.8	1.8 - 2.0
336	3.8	4313	7.8 - 8.8	1.6 - 1.8
368	4.2	4681	6.8 - 7.8	1.4 - 1.6
403	4.6	5083	5.9 - 6.8	1.2 - 1.4
425	4.8	5508	4.9 - 5.9	1.0 - 1.2
470	5.4	5978	3.9 - 4.9	0.8 - 1.0
511	5.8	6489	2.9 - 3.9	0.6 - 0.8
549	6.3	7038	2.0 - 2.9	0.4 - 0.6
584	6.7	7622	1.0 - 2.0	0.2 - 0.4
579	6.6	8202	0.0 - 1.0	0.0 - 0.2
564	6.4	8766	0.0	0.0



Project:

Exam_16.01

Licensed user:

Hochschule Flensburg, University of Applied Sciences
Darf nur für Zwecke der Lehre verwendet werden

--

student / weti-lab-vt10@hs-flensburg.de

Calculated:

1/16/2025 3:53 PM/4.0.547

PARK - Scaling info

Calculation: AEP_Vestas_Nornal_5WTG

Scaler settings

Name	EMD Default Measurement Mast Scaler
Terrain scaling	Measured Data Scaling (WASP Stability / A-Parameter)
RIX correction	No RIX correction
Displacement height	from objects
Micro terrain flow model	Site data: RESGEN (5)

Site Data: Site data: RESGEN (5)

Obstacles:

All obstacles used

Roughness:

Terrain data files used in calculation:

C:\Users\student\Desktop\Exam_16_01_2025\Windpro_exam_16.01\ROUGHNESSLINE_ONLINEDATA_0.wpo
Min X: 518,359, Max X: 578,403, Min Y: 6,030,681, Max Y: 6,091,978, Width: 60,044 m, Height: 61,297 m

Orography:

Terrain data files used in calculation:

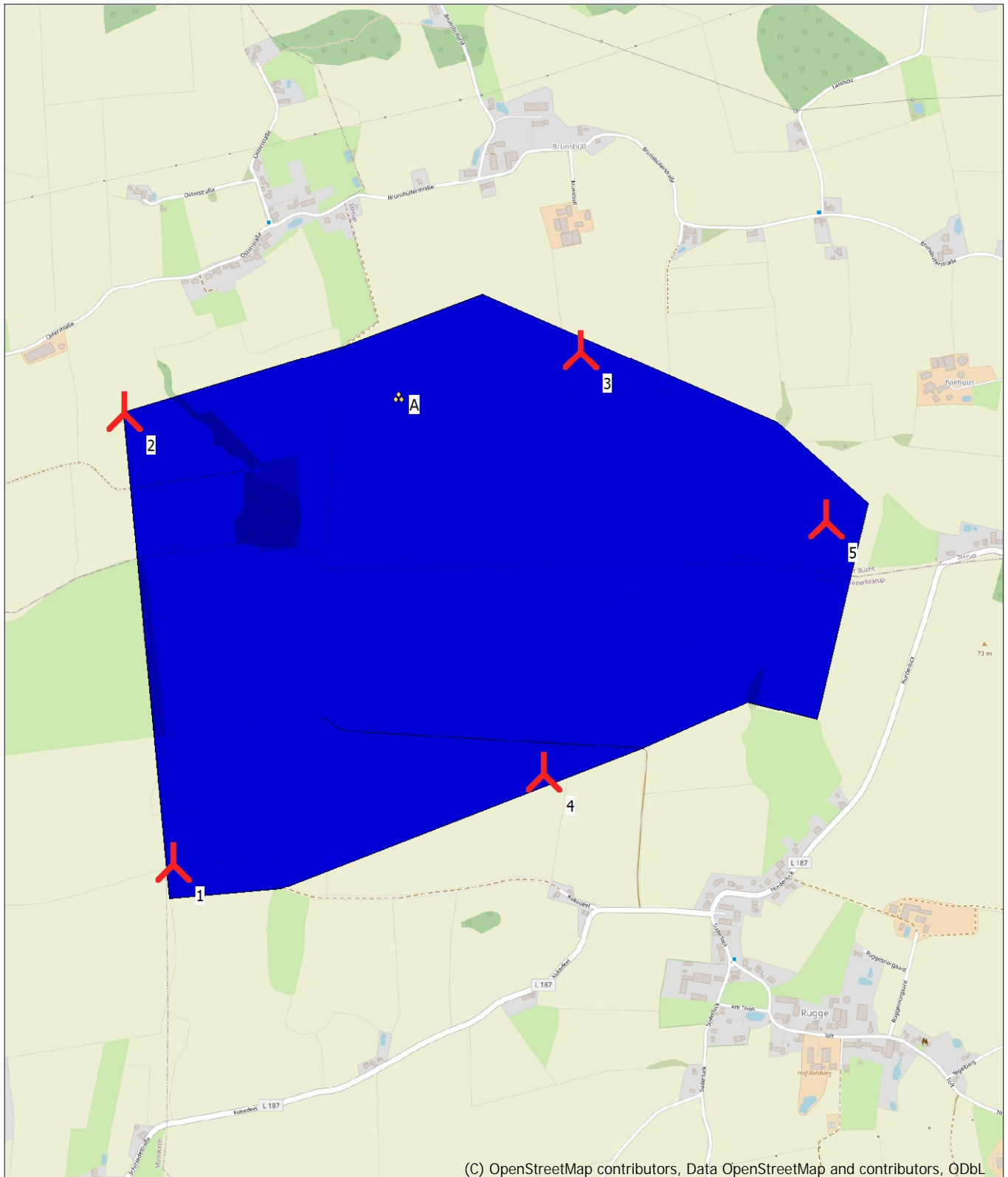
C:\Users\student\Desktop\Exam_16_01_2025\Windpro_exam_16.01\CONTOURLINE_ONLINEDATA_0.wpo
Min X: 538,612, Max X: 558,177, Min Y: 6,051,218, Max Y: 6,071,644, Width: 19,565 m, Height: 20,426 m

Post calibration

Overall factor	1.0000
Overall offset	0.0000
By sector	No
By month	No
By hour	No
By wind speed	No

PARK - Map

Calculation: AEP_Vestas_Nornal_5WTG



0 250 500 750 1000m

Map: EMD OpenStreetMap , Print scale 1:12,500, Map center UTM (north)-ETRS89 Zone: 32 East: 548,534 North: 6,061,313
 New WTG WTG area