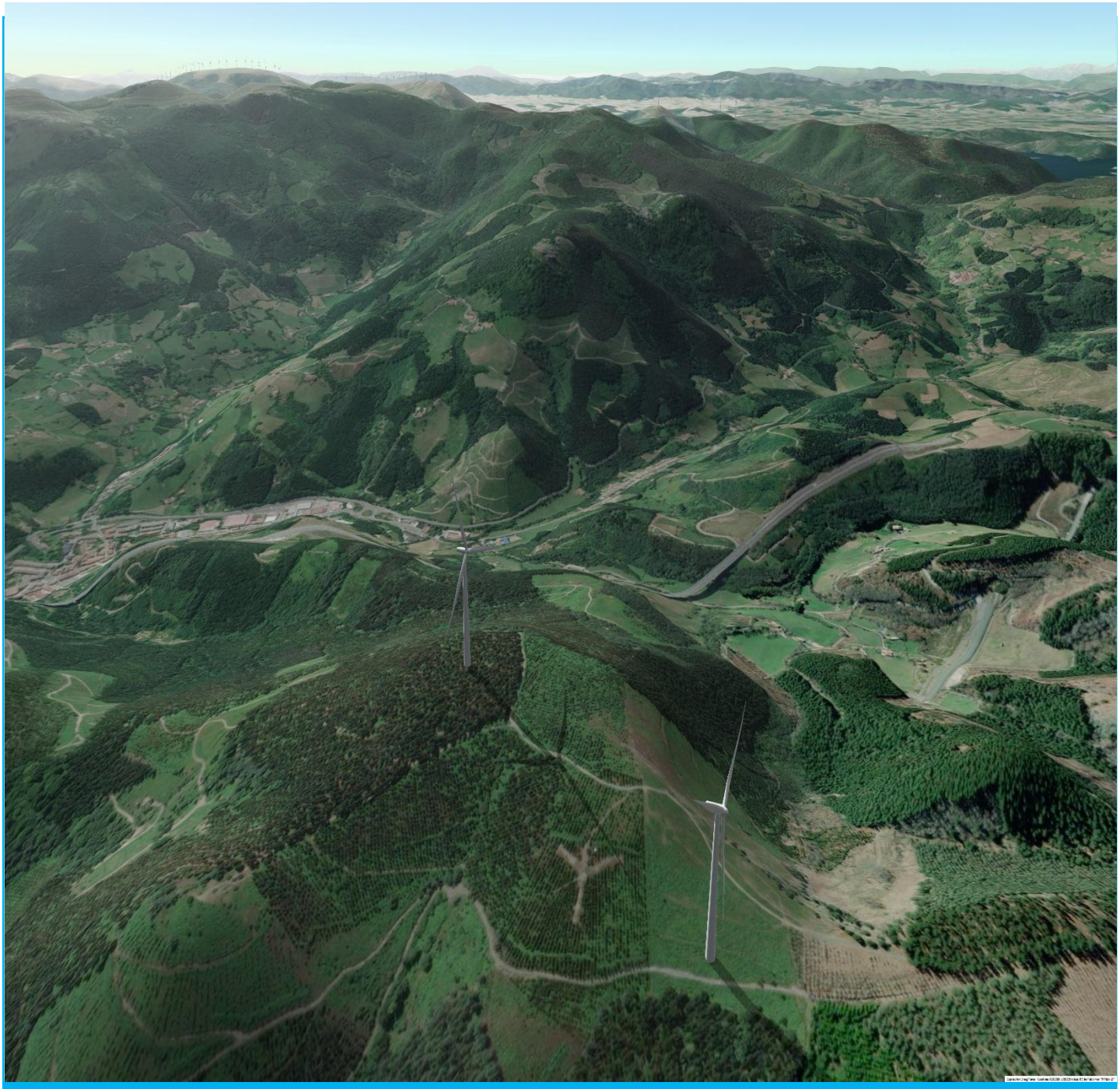
ALERIONCLEANPOWER



PROYECTO TÉCNICO ADMINISTRATIVO DE LOS PARQUES EÓLICOS DE SUBERO Y DURAKOGAIN 9,9 MW Y SUS INFRAESTRUCTURAS DE EVACUACIÓN.

Anejo nº 2. Estudio de Recurso Eólico

saitec engineering

Noviembre 2025

ÍNDICE

1. DESCRIPCIÓN DEL PARQUE EÓLICO 1
2. RECURSO EÓLICO 2
2.1 Modelización NEWA 2

1. DESCRIPCIÓN DEL PARQUE EÓLICO

En el presente documento se presenta la evaluación del recurso eólico correspondiente a los parques eólicos de Subero y Durakogain, ubicados en los términos municipales de Eskoriatza y Aramaio en las provincias de Gipuzkoa y Araba.

El objetivo principal del documento es el análisis optimización del recurso eólico mediante el diseño de los parques y la actualización del modelo de aerogenerador de acuerdo con las nuevas tecnologías para obtener finalmente la estimación de la producción.

El parque eólico de Subero consiste en 1 aerogenerador de 7,2 MW de potencia nominal pero limitado a una potencia de 4,95 MW, el parque eólico de Durakogain también consiste en 1 aerogenerador de 7,2 MW de potencia nominal pero limitado a una potencia de 4,95 MW.

Además, también se incluye el estudio del recurso eólico realizado por la empresa Alerion, en el anejo 1 del presente documento.

2. RECURSO EÓLICO

Se han realizado dos modelizaciones para la estimación del recurso eólico de la zona de estudio.

- Newa

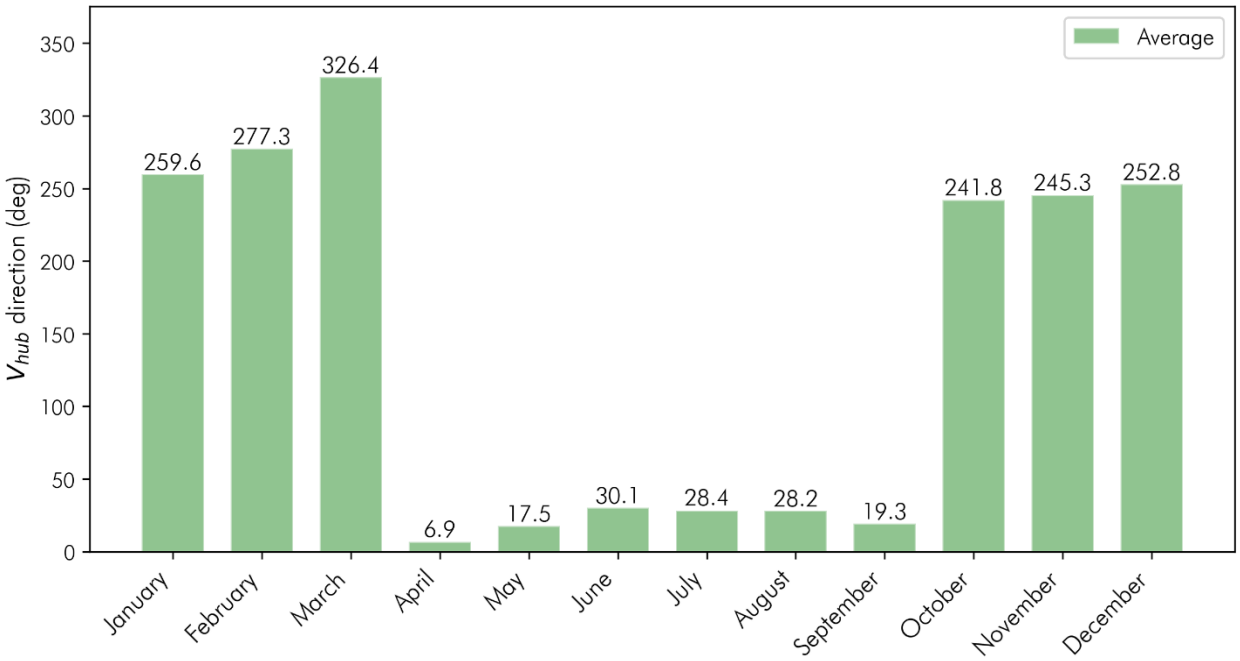
2.1 Modelización NEWA

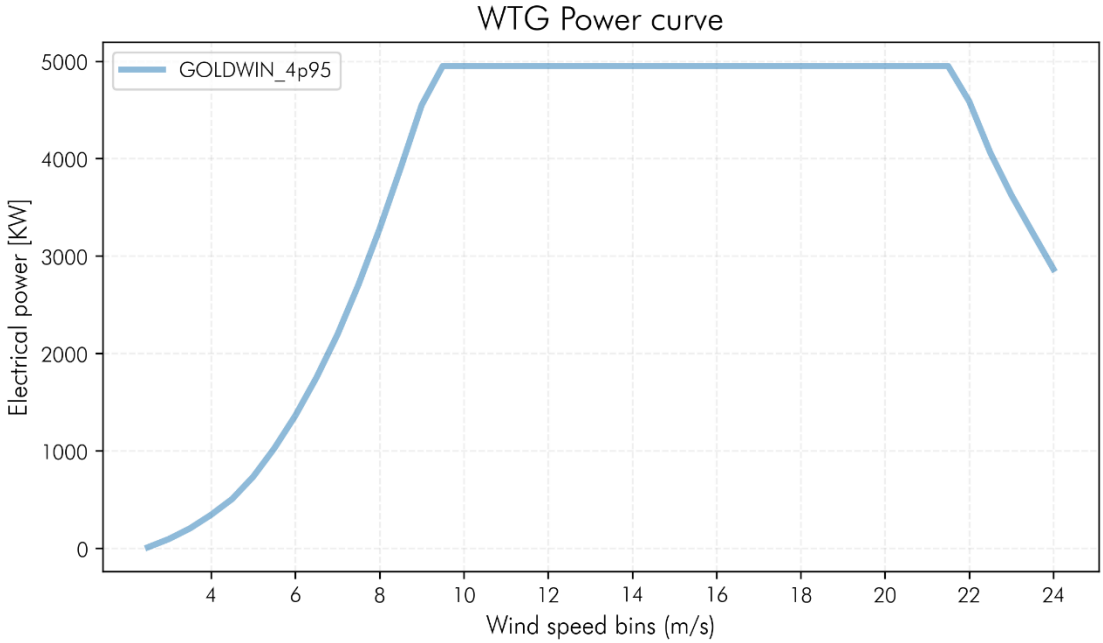
El New European Wind Atlas (NEWA) es un proyecto conjunto de la Unión Europea y el Centro de Investigación Atmosférica de Dinamarca (DTU Wind Energy). Su objetivo principal es proporcionar una base de datos de alta resolución sobre el potencial eólico en Europa.

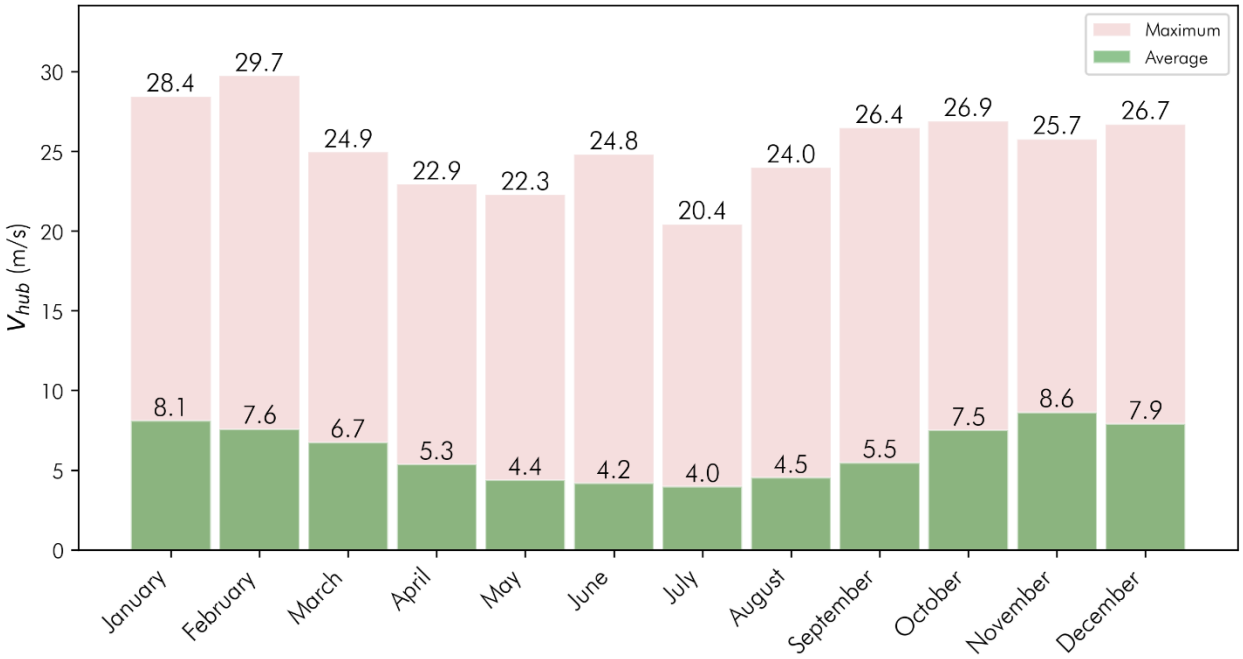
El atlas utiliza tecnologías avanzadas de modelado computacional para simular los patrones de viento en Europa a una resolución mucho más fina que los atlas eólicos anteriores. Esto permite una mejor comprensión del comportamiento del viento en áreas específicas y una predicción más precisa del potencial energético eólico en esas ubicaciones.

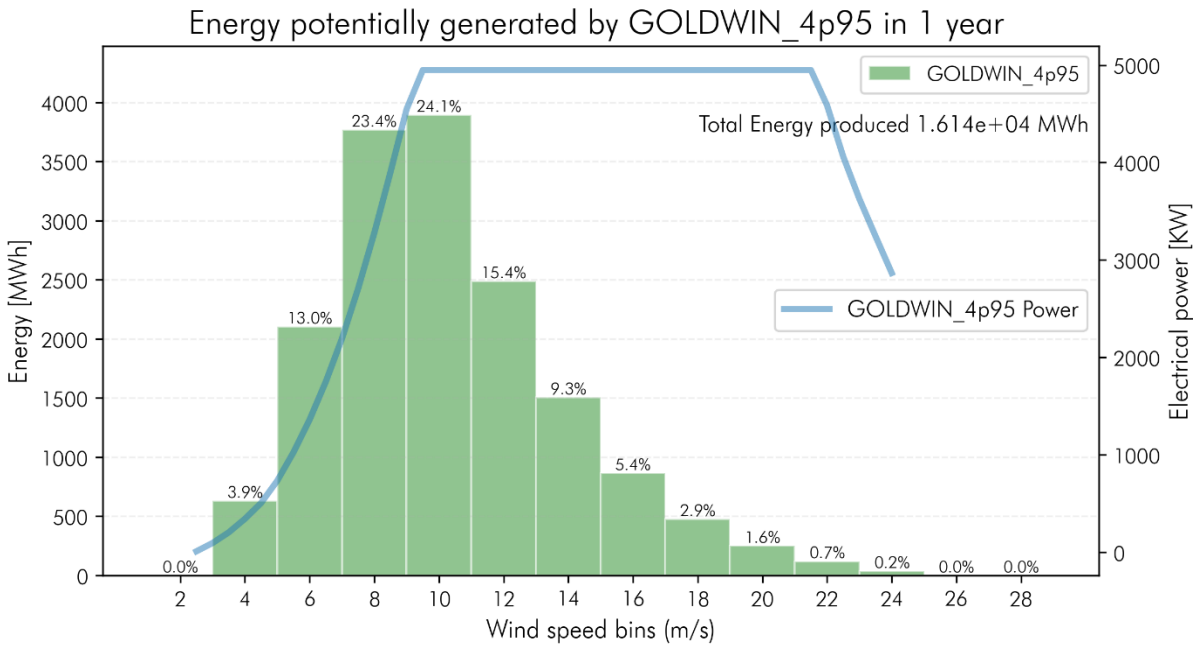
Hemos optado por utilizar esta herramienta para el cálculo del recurso eólico debido a su fiabilidad. Para ello, hemos descargado los datos de viento en la ubicación de estudio y a la altura deseada. En este caso, dado que hemos empleado el aerogenerador de Goldwind de 7,2 MW, que tiene una altura aproximada de 110 metros, los datos se han descargado a esa altura.

Para calcular el recurso eólico, se requieren dos curvas: la curva de potencia de la máquina y la distribución de viento de la ubicación. Ya disponemos de la primera, y calculamos la segunda a partir de los datos descargados. Esta última curva representa la cantidad de horas en las que el viento sopla a cada velocidad. Por lo tanto, al multiplicar ambas curvas, obtenemos la energía anual generada (Annual Energy Production AEP) y, a partir de ahí, el factor de capacidad.




WTG Power curve
GOLDWIN_4p95
Electrical power [KW]
5000
4000
3000
2000
1000
0
4
6
8
10
12
14
16
18
20
22
24
Wind speed bins (m/s)


Maximum
Average
V_{hub} (m/s)
30
25
20
15
10
5
0
28.4
29.7
24.9
22.9
22.3
24.8
20.4
24.0
26.4
26.9
25.7
26.7
8.1
7.6
6.7
5.3
4.4
4.2
4.0
4.5
5.5
7.5
8.6
7.9
January
February
March
April
May
June
July
August
September
October
November
December



Localidad	Potencia Nominal [MW]	Velocidad Media de Viento [m/s]	Energía Generada Anual [MWh]	Factor de Capacidad	Horas de Producción Anuales [h]
Subero y Durakogain	4,95	6,193548761	43362	0,37211608	3259,73

Anejo 1: Estudio recurso eólico Alerión

Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

Calculated:
19/09/2025 10:30/4.2.264

PARK - Main Result

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest

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

Calculation performed in UTM (north)-WGS84 Zone: 30
At the site centre the difference between grid north and true north is: 0,3°

Power curve correction method
New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>
Air density calculation method
Height dependent, temperature from climate station
Station: BILBAO SPAIN V3 2014
Base temperature: 15,2 °C at 16,0 m
Base pressure: 1013,3 hPa at 0,0 m
Air density for Site center in key hub height: 768,9 m + 110,0 m = 1,124 kg/m³ -> 91,7 % of Std
Relative humidity: 0,0 %

Wake Model Parameters
Wake decay constant 0,090 DTU default onshore
Hub height independent

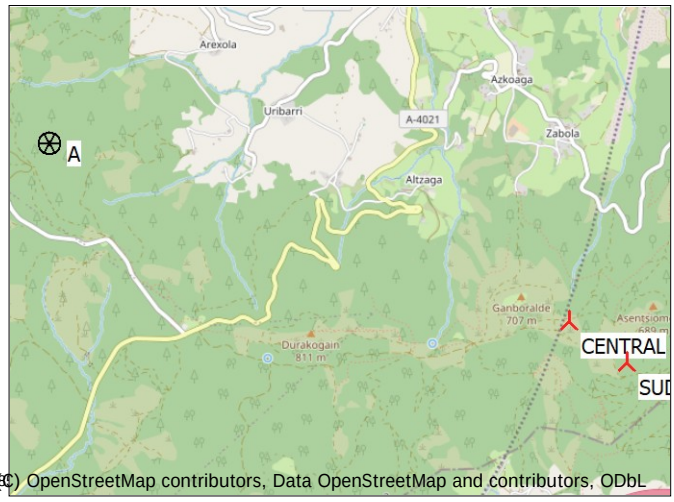
Displacement heights from Forest map

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0,5	360,0	1,0	0,5	30,5	1,0

Wind statistics ES New European Wind Atlas (NEWA)_N43,03796_W002,59466

WAsP version WAsP 12 Version 12.10.0018



Scale 1:50.000

New WTG Site Data

Key results for height 110,0 m above ground level

Terrain UTM (north)-WGS84 Zone: 30

	Easting	Northing	Name of wind distribution	Type	Wind energy [kWh/m²]	Mean wind speed [m/s]	Equivalent roughness
A	533.003	4.765.110	Site data for e.c.: NEWA ovest@100m	WAsP (WAsP 12 Version 12.10.0018)	2.719	6,3	1,6

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	Result-10,0% [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Wake loss [%]	Specific results¤) Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	39.207,0	35.286,3	39.844,1	1,6	28,0	17.643,2	2.450	7,5

¤) Based on Result-10,0%

Calculated Annual Energy for each of 2 new WTGs with total 14,4 MW rated power

	Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Displacement height [m]	Power curve Creator	Name	Annual Energy Result [MWh/y]	Result-10,0% [MWh/y]	Wake loss [%]	Free mean wind speed [m/s]
CENTRAL	A	Yes	Goldwind	GWH170/7200-7.200	7.200	170,0	110,0	Sector wise	USER	GWH170-7200 25.06.2024 lim 4.95MW	19.524,4	17.572	0,2	7,41
SUDESTE	A	Yes	Goldwind	GWH170/7200-7.200	7.200	170,0	110,0	Sector wise	USER	GWH170-7200 25.06.2024 lim 4.95MW	19.682,7	17.714	3,0	7,62

WTG siting

UTM (north)-WGS84 Zone: 30

		Easting	Northing	Z [m]	Row data/Description
CENTRAL	New	536.447	4.763.952	663,4	CENTRAL
SUDESTE	New	536.838	4.763.682	674,7	SUDESTE

Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

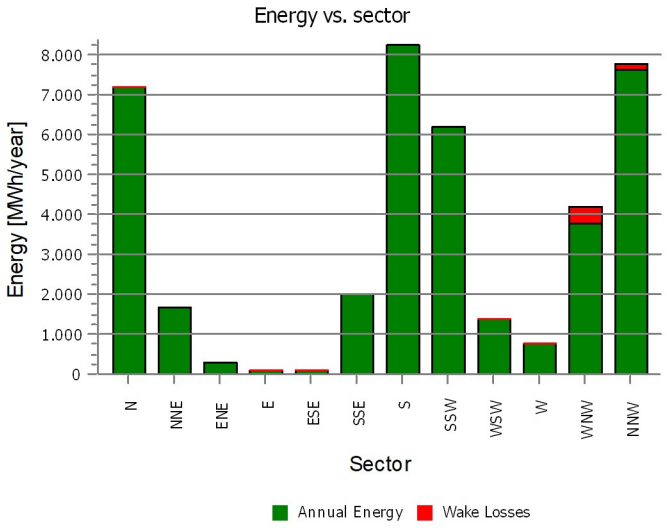
Calculated:
19/09/2025 10:30/4.2.264

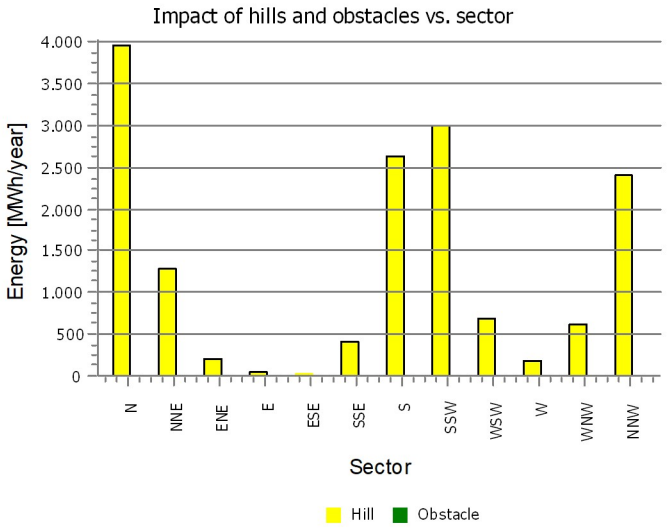
PARK - Production Analysis

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest WTG: All new WTGs, Air density varies with WTG position 1,134 kg/m³ - 1,135 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
Roughness based energy	[MWh]	3.217,7	405,5	91,0	53,9	79,4	1.597,8	5.581,8	3.181,1	701,4	577,7	3.570,1	5.361,1	24.418,6
+Increase due to hills	[MWh]	3.954,9	1.281,2	211,6	38,6	30,1	406,2	2.639,3	2.985,1	683,5	179,1	621,1	2.394,8	15.425,5
-Decrease due to wake losses	[MWh]	0,0	0,0	0,0	0,4	13,0	24,3	0,0	0,0	0,0	3,4	449,4	146,6	637,1
Resulting energy	[MWh]	7.172,6	1.686,7	302,5	92,1	96,5	1.979,8	8.221,1	6.166,2	1.385,0	753,5	3.741,9	7.609,2	39.207,0
Specific energy	[kWh/m²]													864
Specific energy	[kWh/kW]													2.723
Increase due to hills	[%]	122,9	315,9	232,6	71,6	37,9	25,4	47,3	93,8	97,4	31,0	17,4	44,7	63,17
Decrease due to wake losses	[%]	0,0	0,0	0,0	0,4	11,8	1,2	0,0	0,0	0,0	0,4	10,7	1,9	1,60
Utilization	[%]	22,2	40,4	38,7	36,5	24,5	9,6	11,8	19,9	32,6	32,4	19,5	15,6	16,8
Operational	[Hours/year]	1.627	932	451	203	102	305	1.018	985	364	236	684	1.278	8.184
Full Load Equivalent	[Hours/year]	498	117	21	6	7	137	571	428	96	52	260	528	2.723





Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

Calculated:
19/09/2025 10:30/4.2.264

PARK - Power Curve Analysis

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest WTG: CENTRAL - Goldwind GWH170/7200 7200 170.0 !O!, Hub height: 110,0 m

Name: GWH170-7200 25.06.2024 lim 4.95MW
Source: GWI-15SS.a0005

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
25/06/2024	USER	24/04/2024	30/04/2025	24,0	Pitch	User defined	Variable	0,32

GWI-15SS.a0005_GWH170-7.2MW Calculated Power Curve and Thrust Coefficient(GW83.3 Blade, Rated Power 7.2MW)_A con data 25.06.2024 AV

HP curve comparison - Note: For standard air density

Vmean	[m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013)	[MWh]	11.600	17.777	23.805	29.217	33.809	37.503
Goldwind GWH170/7200 7200 170.0 !O! GWH170-7200 25.06.2024 lim 4.95MW	[MWh]	10.961	15.886	20.273	23.913	26.763	28.833
Check value	[%]	6	12	17	22	26	30

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/m^2) 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

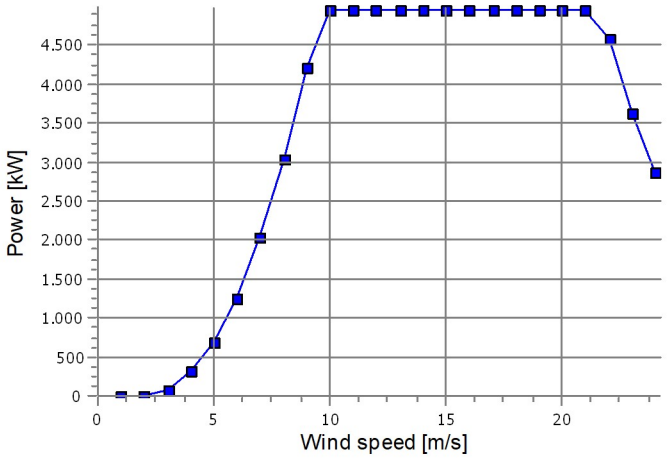
Original data, Air density: 1,225 kg/m³

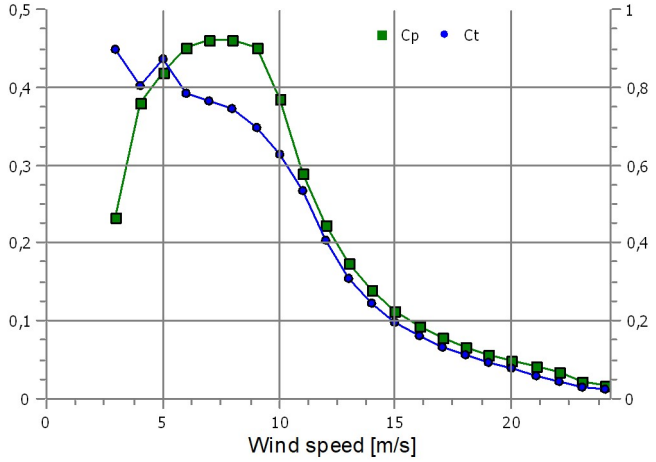
Wind speed [m/s]	Power [kW]	Cp	Wind speed [m/s]	Ct curve
2,5	9,1	0,04	0,0	0,00
3,0	94,6	0,25	0,5	0,00
3,5	203,6	0,34	1,0	0,00
4,0	342,6	0,39	1,5	0,00
4,5	505,2	0,40	2,0	0,00
5,0	734,2	0,42	2,5	1,00
5,5	1.024,7	0,44	3,0	0,90
6,0	1.360,8	0,45	3,5	0,82
6,5	1.750,3	0,46	4,0	0,81
7,0	2.192,8	0,46	4,5	0,87
7,5	2.706,4	0,46	5,0	0,87
8,0	3.277,9	0,46	5,5	0,81
8,5	3.901,9	0,46	6,0	0,79
9,0	4.549,3	0,45	6,5	0,78
9,5	4.950,0	0,42	7,0	0,77
10,0	4.950,0	0,36	7,5	0,76
10,5	4.950,0	0,31	8,0	0,75
11,0	4.950,0	0,27	8,5	0,72
11,5	4.950,0	0,23	9,0	0,70
12,0	4.950,0	0,21	9,5	0,66
12,5	4.950,0	0,18	10,0	0,63
13,0	4.950,0	0,16	10,5	0,59
13,5	4.950,0	0,14	11,0	0,53
14,0	4.950,0	0,13	11,5	0,47
14,5	4.950,0	0,12	12,0	0,41
15,0	4.950,0	0,11	12,5	0,36
15,5	4.950,0	0,10	13,0	0,31
16,0	4.950,0	0,09	13,5	0,28
16,5	4.950,0	0,08	14,0	0,24
17,0	4.950,0	0,07	14,5	0,22
17,5	4.950,0	0,07	15,0	0,20
18,0	4.950,0	0,06	15,5	0,18
18,5	4.950,0	0,06	16,0	0,16
19,0	4.950,0	0,05	16,5	0,15
19,5	4.950,0	0,05	17,0	0,13
20,0	4.950,0	0,04	17,5	0,12
20,5	4.950,0	0,04	18,0	0,11
21,0	4.950,0	0,04	18,5	0,10
21,5	4.950,0	0,04	19,0	0,10
22,0	4.587,7	0,03	19,5	0,09
22,5	4.061,5	0,03	20,0	0,08
23,0	3.626,9	0,02	20,5	0,07
23,5	3.243,6	0,02	21,0	0,06
24,0	2.866,2	0,01	21,5	0,05
			22,0	0,04
			22,5	0,04
			23,0	0,03
			23,5	0,03
			24,0	0,02

Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,135 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Cp	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50- 1,50	0,0	0,0	0,0
2,0	0,0	0,00	1,50- 2,50	0,0	0,0	0,0
3,0	81,3	0,23	2,50- 3,50	77,5	77,5	0,4
4,0	313,9	0,38	3,50- 4,50	274,2	351,8	1,8
5,0	675,0	0,42	4,50- 5,50	571,3	923,1	4,7
6,0	1.256,6	0,45	5,50- 6,50	966,1	1.889,2	9,7
7,0	2.032,8	0,46	6,50- 7,50	1.417,4	3.306,6	16,9
8,0	3.040,2	0,46	7,50- 8,50	1.882,9	5.189,5	26,6
9,0	4.226,3	0,45	8,50- 9,50	2.259,8	7.449,3	38,2
10,0	4.950,0	0,38	9,50-10,50	2.282,9	9.732,2	49,8
11,0	4.950,0	0,29	10,50-11,50	1.991,9	11.724,1	60,0
12,0	4.950,0	0,22	11,50-12,50	1.670,7	13.394,8	68,6
13,0	4.950,0	0,17	12,50-13,50	1.381,6	14.776,4	75,7
14,0	4.950,0	0,14	13,50-14,50	1.127,2	15.903,6	81,5
15,0	4.950,0	0,11	14,50-15,50	907,5	16.811,0	86,1
16,0	4.950,0	0,09	15,50-16,50	721,0	17.532,0	89,8
17,0	4.950,0	0,08	16,50-17,50	565,2	18.097,1	92,7
18,0	4.950,0	0,07	17,50-18,50	436,9	18.534,1	94,9
19,0	4.950,0	0,06	18,50-19,50	332,9	18.867,0	96,6
20,0	4.950,0	0,05	19,50-20,50	249,9	19.116,9	97,9
21,0	4.950,0	0,04	20,50-21,50	184,7	19.301,6	98,9
22,0	4.587,7	0,03	21,50-22,50	124,3	19.425,9	99,5
23,0	3.626,9	0,02	22,50-23,50	72,3	19.498,2	99,9
24,0	2.866,2	0,02	23,50-24,50	26,1	19.524,4	100,0





Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

PARK - Terrain

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest Site Data: A - Site data for e.c.: NEWA ovest@100m

Obstacles:

0 Obstacles used

Roughness:

Terrain data files used in calculation:
\\pc147\WINDPRO_SYNC\ESP - Subero-Durakogain\ROUGHNESSLINE_ONLINEDATA_0.wpo
Min X: 505.009, Max X: 565.042, Min Y: 4.733.674, Max Y: 4.794.239, Width: 60.033 m, Height: 60.565 m

Orography:

Terrain data files used in calculation:
\\pc147\WINDPRO_SYNC\ESP - Subero-Durakogain\ESP-Subero-Durakogain_EMDGrid_0.wpg
Min X: 524.994, Max X: 545.125, Min Y: 4.753.889, Max Y: 4.773.919, Width: 20.131 m, Height: 20.030 m

Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

Calculated:
19/09/2025 10:30/4.2.264

PARK - Wind Data Analysis

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest Wind data: A - Site data for e.c.: NEWA ovest@100m; Hub height: 50,0

Site coordinates

UTM (north)-WGS84 Zone: 30
East: 533.003 North: 4.765.110

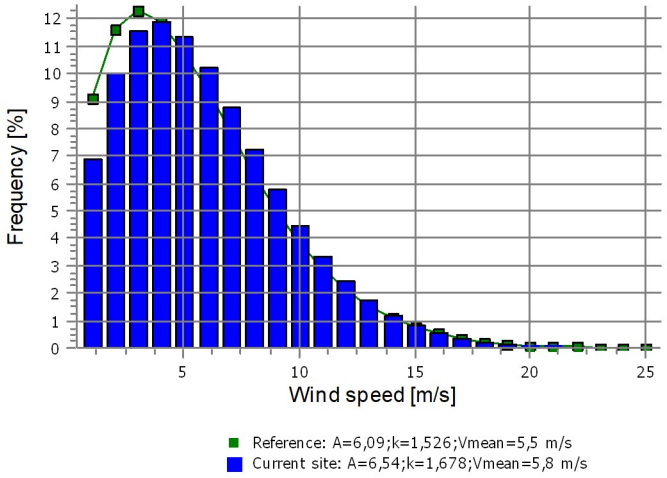
Wind statistics

ES New European Wind Atlas (NEWA)_N43,03796_W002,59485 (2) ovest - 100.00 m.w.s.

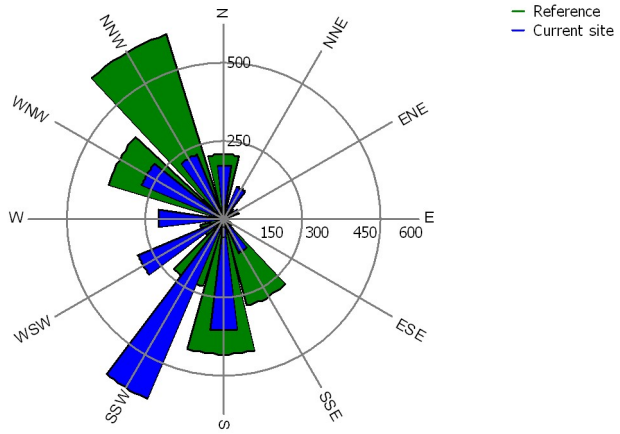
Weibull Data

Sector	Current site A-parameter [m/s]	Wind speed [m/s]	k-parameter	Frequency [%]	Reference: Roughness class 1 A-parameter [m/s]	k-parameter	Frequency [%]
0 N	5,24	4,68	1,654	13,2	5,04	1,529	15,8
1 NNE	4,66	4,14	1,787	13,6	3,57	1,697	10,6
2 ENE	4,30	3,81	2,123	9,4	2,99	2,123	7,3
3 E	3,43	3,09	1,537	2,7	2,78	1,947	3,8
4 ESE	4,23	4,08	1,100	1,6	2,43	1,396	1,7
5 SSE	7,89	7,01	1,838	3,1	9,47	1,736	4,0
6 S	8,95	7,93	2,275	7,9	8,70	2,287	10,4
7 SSW	8,97	7,94	2,174	13,2	6,73	2,080	10,9
8 WSW	8,01	7,10	1,971	8,1	5,60	1,982	5,8
9 W	7,81	6,92	2,029	6,2	5,41	1,854	3,6
10 WNW	7,66	6,79	2,045	9,1	8,58	2,170	9,3
11 NNW	6,04	5,38	1,729	12,0	7,68	1,783	16,8
All	6,54	5,84	1,678	100,0	6,09	1,526	100,0

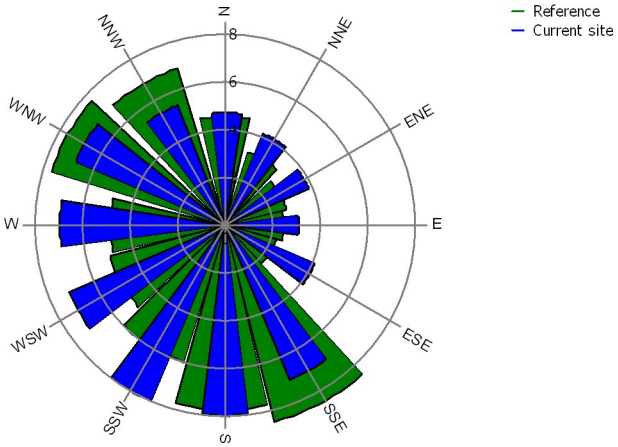
Weibull Distribution



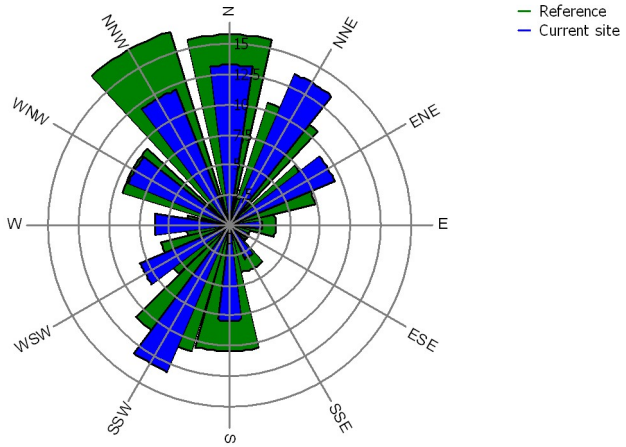
Energy Rose (kWh/m²/year)



Mean wind speed (m/s)



Frequency (%)



Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

Calculated:
19/09/2025 10:30/4.2.264

PARK - Wind Data Analysis

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest Wind data: A - Site data for e.c.: NEWA ovest@100m; Hub height: 110,0

Site coordinates

UTM (north)-WGS84 Zone: 30
East: 533.003 North: 4.765.110

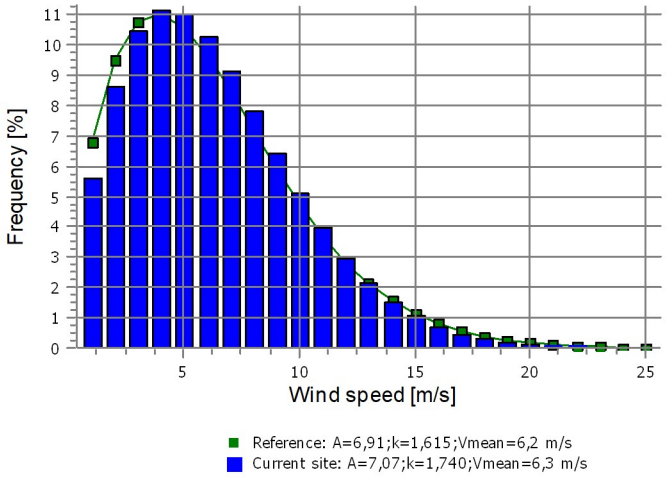
Wind statistics

ES New European Wind Atlas (NEWA)_N43,03796_W002,59485 (2) ovest - 100.00 m.w.s.

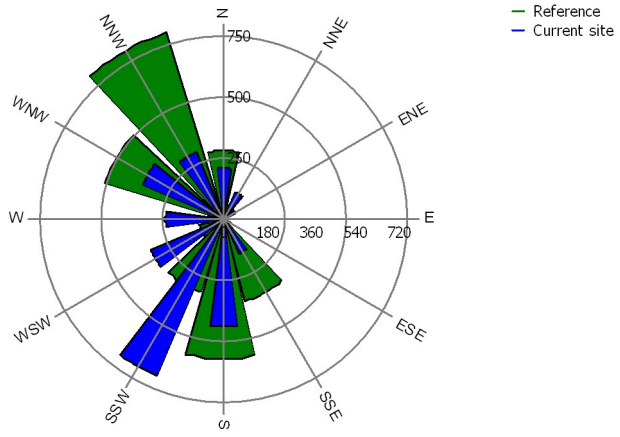
Weibull Data

Sector	Current site A-parameter [m/s]	Wind speed [m/s]	k-parameter	Frequency [%]	Reference: Roughness class 1 A-parameter [m/s]	k-parameter	Frequency [%]
0 N	5,69	5,07	1,729	13,5	5,78	1,626	15,8
1 NNE	4,95	4,40	1,873	13,2	4,08	1,808	10,6
2 ENE	4,48	3,96	2,240	9,0	3,40	2,263	7,3
3 E	3,64	3,26	1,631	2,8	3,17	2,076	3,8
4 ESE	4,53	4,35	1,115	1,6	2,79	1,484	1,7
5 SSE	8,69	7,71	1,936	3,2	10,41	1,850	4,0
6 S	9,63	8,54	2,420	8,3	9,76	2,450	10,4
7 SSW	9,55	8,46	2,291	12,9	7,67	2,217	10,9
8 WSW	8,55	7,57	2,080	7,7	6,39	2,111	5,8
9 W	8,41	7,45	2,115	6,0	6,18	1,976	3,6
10 WNW	8,42	7,46	2,170	9,3	9,62	2,327	9,3
11 NNW	6,69	5,95	1,818	12,6	8,64	1,912	16,8
All	7,07	6,29	1,740	100,0	6,91	1,615	100,0

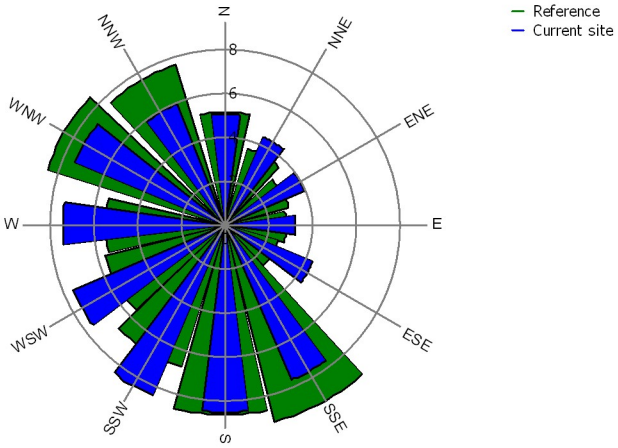
Weibull Distribution



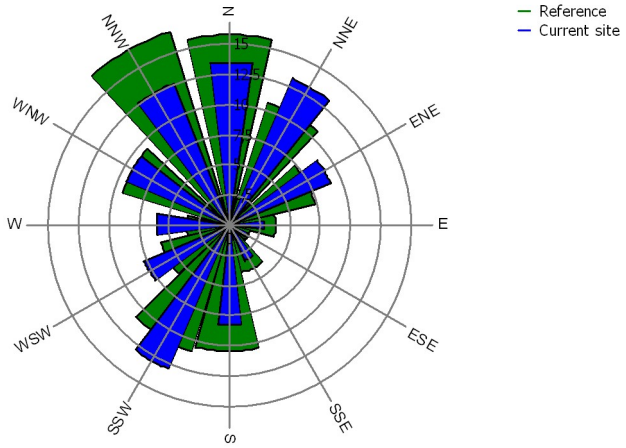
Energy Rose (kWh/m²/year)



Mean wind speed (m/s)



Frequency (%)



Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

Calculated:
19/09/2025 10:30/4.2.264

PARK - Park power curve

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest

Wind speed [m/s]	Power Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]
0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3,5	367	347	367	367	367	364	230	337	367	367	367	364	230	337
4,5	934	892	934	934	934	927	655	872	934	934	934	927	655	872
5,5	1.883	1.807	1.883	1.883	1.883	1.869	1.386	1.767	1.883	1.883	1.883	1.869	1.387	1.767
6,5	3.237	3.120	3.237	3.237	3.237	3.216	2.456	3.064	3.237	3.237	3.237	3.216	2.457	3.064
7,5	5.012	4.843	5.012	5.012	5.012	4.981	3.883	4.761	5.012	5.012	5.012	4.981	3.885	4.761
8,5	7.236	7.012	7.236	7.236	7.236	7.197	5.738	6.908	7.236	7.236	7.236	7.197	5.740	6.909
9,5	9.450	9.224	9.450	9.450	9.450	9.424	7.878	9.148	9.450	9.450	9.450	9.424	7.877	9.147
10,5	9.900	9.831	9.900	9.900	9.900	9.900	9.306	9.865	9.900	9.900	9.900	9.900	9.303	9.865
11,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
12,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
13,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
14,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
15,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
16,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
17,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
18,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
19,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
20,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
21,5	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900	9.900
22,5	8.123	8.146	8.123	8.123	8.123	8.127	8.279	8.155	8.123	8.123	8.123	8.127	8.279	8.155
23,5	6.487	6.500	6.487	6.487	6.487	6.489	6.574	6.505	6.487	6.487	6.487	6.489	6.574	6.505
24,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Description:
The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes wake losses, but do NOT include terrain given variations in the wind speed over the park area.
Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in windPRO.

The park power curve can be used for:

1. Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
2. Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
3. Calculation of wind energy index based on the PARK production (see below).
4. Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in windPRO (PPV-model).

Note:
From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

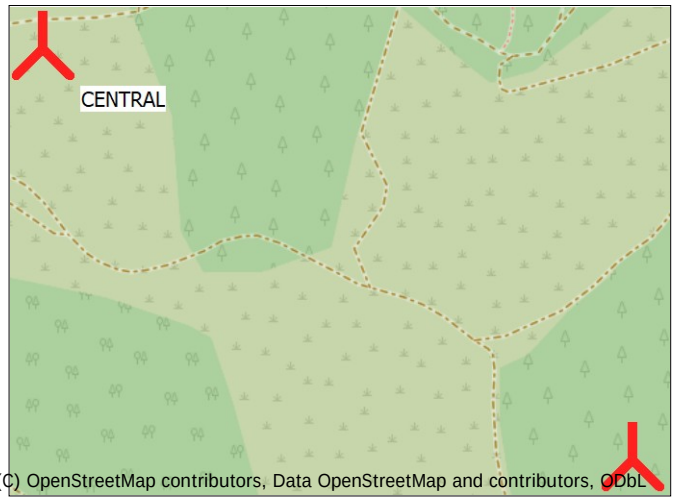
Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

PARK - WTG distances

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest

WTG distances

	Z	Nearest WTG	Z	Horizontal distance	Distance in rotor diameters
	[m]		[m]	[m]	
CENTRAL	663,4	SUDESTE	674,7	475	2,8
SUDESTE	674,7	CENTRAL	663,4	475	2,8
Min	663,4		663,4	475	2,8
Max	674,7		674,7	475	2,8



Scale 1:5.000

New WTG

Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

PARK - Wind statistics info

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest

Main data for wind statistic

File	\\pc147\WINDPRO_SYNC\ESP - Subero-Durakogain\ES New European Wind Atlas (NEWA)_N43,03796_W002,59485 (2) ovest - 100.00 m.wws
Name	New European Wind Atlas (NEWA)_N43,03796_W002,59485 (2) ovest - 100.00 m
Country	Spain
Source	USER
Mast coordinates	UTM (north)-WGS84 Zone: 30 East: 533.003 North: 4.765.110
Created	24/04/2025
Edited	14/05/2025
Sectors	12
WAsP version	WAsP 12 Version 12.10.0018
Coordinate system	UTM (north)-WGS84 Zone: 30
Displacement height	None

Additional info for wind statistic

Source data	New European Wind Atlas (NEWA)_N43,03796_W002,59485 (2) ovest
Data from	01/01/2009
Data to	01/01/2019
Measurement length	120,0 Months
Recovery rate	100,0 %
Effective measurement length	120,0 Months

Note

To get the most correct calculation results, wind statistics shall be calculated with the SAME model and model parameters, as currently chosen in calculation. For WAsP versions before 10.0, the model is unchanged, but thereafter more model changes affecting the wind statistic is seen. Likewise WAsP CFD should always use WAsP CFD calculated wind statistics.

Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

PARK - Displacement height

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest

Sector-wise from calculator: Forest map
Forest description is based on height grid object

WTG displacement height set to 1,00 of forest height.
WTG displacement height are adjusted to a factor of 50,0 of forest height in up wind direction.
WTG displacement height are adjusted to a factor of 25,0 of forest height in down wind direction.

Sector wise displacement heights for WTGs

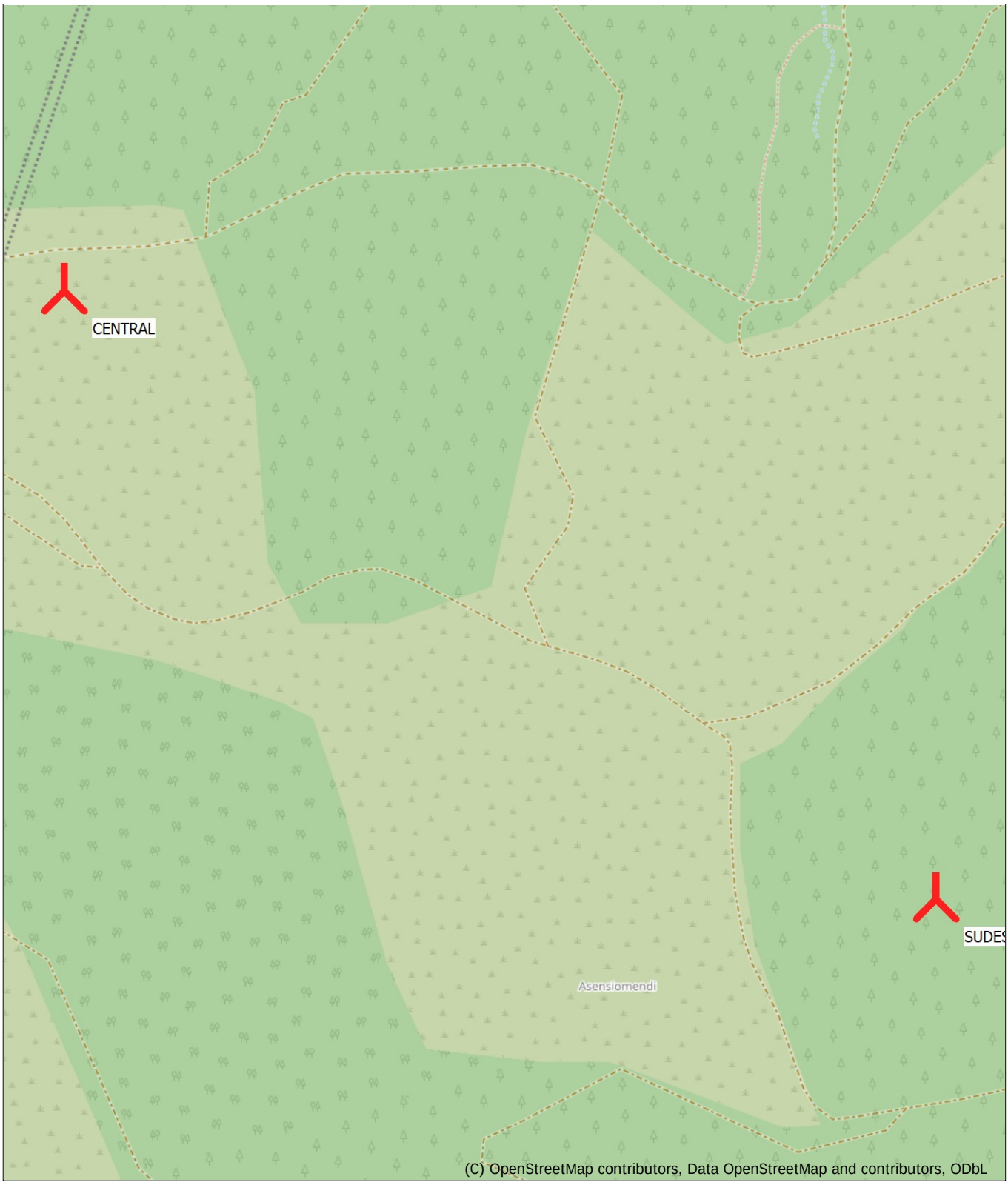
	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	DH (0) [m]	DH (1) [m]	DH (2) [m]	DH (3) [m]	DH (4) [m]	DH (5) [m]	DH (6) [m]	DH (7) [m]	DH (8) [m]	DH (9) [m]	DH (10) [m]	DH (11) [m]
CENTRAL	Yes	Goldwind	GWH170/7200-7.200	7.200	170,0	110,0	24,62	24,12	22,65	18,22	20,31	22,50	23,32	23,03	21,63	18,16	21,24	23,86
SUDESTE	Yes	Goldwind	GWH170/7200-7.200	7.200	170,0	110,0	20,00	20,00	20,00	20,00	20,00	20,04	20,21	20,25	20,00	20,00	20,00	20,00

Licensed user:
FRI-EL S.p.A
Piazza della Rotonda, n. 2
IT-00186 Roma
+39 (0)471 324210
Enrico / enrico.fois@fri-el.it

Calculated:
19/09/2025 10:30/4.2.264

PARK - Map

Calculation: 2025.09.15 - Durakogain - 2XGW170 7.2MW lim 4.95MW@110m NEWA ovest@100m (CS) with forest



0 25 50 75 100m

Map: EMD OpenStreetMap , Print scale 1:2.500, Map center UTM (north)-WGS84 Zone: 30 East: 536.643 North: 4.763.817

New WTG