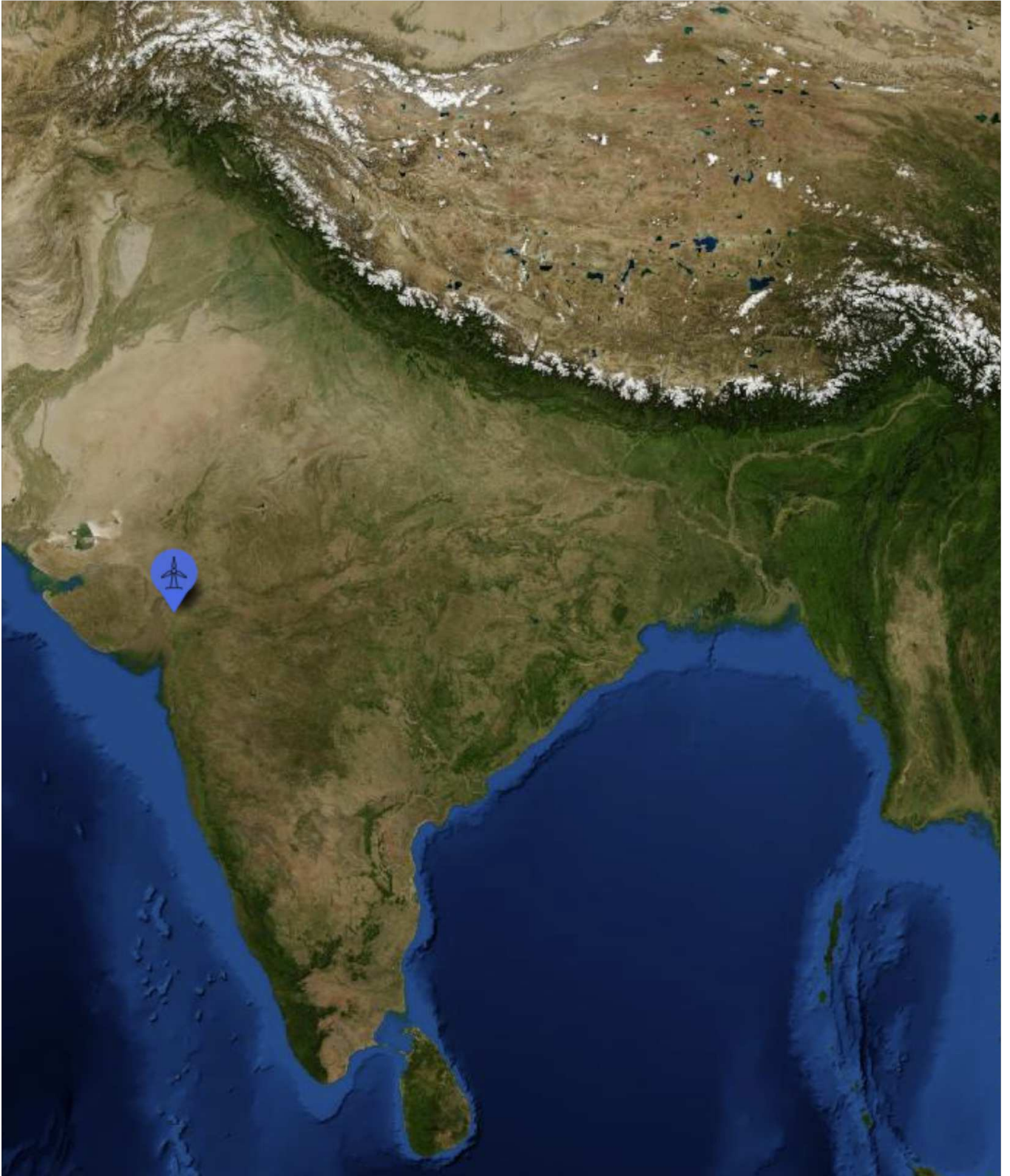


Yield Assessment - Arnod, Gujarat



Project:

Site Analysis contract 81274134

Description:

Preliminary energy yield assessment based on meso-scale data. Consult with expert prior to investment decision. This report extract is subject to confidentiality and liability limitation clause of the main report.

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Mathias Thamhain / mth@emd.dk

Calculated:

22/2/2022 09:56/3.5.508

PARK - Main Result

Calculation: 22-459-006 Arnod Gujarat

Setup

AEP scaled to a full year based on number of samples
Scaling factor from 20,0 years to 1 year: 0,050

Calculation performed in UTM (north)-WGS84 Zone: 43

At the site centre the difference between grid north and true north is: -0,8°

Wake

Wake Model: N.O. Jensen (RISØ/EMD)

Wake decay constant:

Wake decay constant: 0,075 DTU default onshore

Reference WTG: 4*VESTAS V150-4.2 4200 150,0 IO! hub: 105,0 m (TOT: 180,0 m) dist: 750 m (5,0 RD

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: 1/1/2002 04:30:00 - 1/1/2022 04:30:00

Meteo object(s): EmdWrf_N21.920_E072.925 - Gujarat

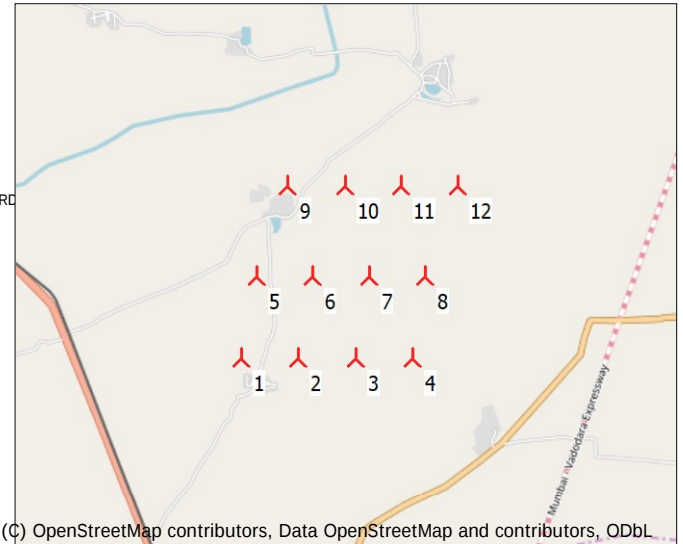
Displacement height: Omnidirectional from objects

WASP version: WASP 11 Version 11.06.0028

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]	24,7	24,7	24,7		
From air density settings	[hPa]	999,1	999,4	999,3		
Resulting air density	[kg/m³]	1,169	1,169	1,169		
Relative to 15°C at sea level	[%]	95,4	95,4	95,4	-3,8	-3,8
						0,0



Calculated Annual Energy for Wind Farm

WTG combination	Result PARK	Result-8,0% [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Wake loss [%]	Specific results ^{a)}		Full load hours [Hours/year]	Wind speed	
					Capacity factor [%]	Mean WTG result [MWh/y]		free [m/s]	wake reduced [m/s]
Wind farm	122.513,4	112.712,4	131.701,1	7,0	25,5	9.392,7	2.236	5,6	5,5

a) Based on Result-8,0%

Calculated Annual Energy for each of 12 new WTGs with total 50,4 MW rated power

WTG type	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy		Wake loss [%]	Wind speed	
									Result	Result-8,0%		free	reduced
									[MWh/y]	[MWh/y]		[m/s]	[m/s]
1 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		10.486,5	9.648	4,7	5,64	5,51
2 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		10.407,6	9.575	5,5	5,64	5,48
3 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		10.544,9	9.701	5,0	5,66	5,51
4 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		10.610,8	9.762	3,3	5,63	5,53
5 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		10.428,5	9.594	4,9	5,63	5,50
6 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		9.956,1	9.160	9,3	5,63	5,40
7 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		9.835,8	9.049	10,1	5,62	5,37
8 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		9.936,9	9.142	9,0	5,62	5,39
9 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		10.541,0	9.698	4,1	5,63	5,54
10 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		10.057,3	9.253	8,6	5,63	5,43
11 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		9.825,6	9.040	9,9	5,61	5,38
12 Yes	VESTAS	V150-4.2-4.200	4.200	150,0	105,0	EMD	Level 00 - Calculated - Modes PO1 & PO1-OS - 08-2019		9.882,3	9.092	9,4	5,61	5,40

WTG siting

	Geo [deg]-WGS84			Row data/Description	Calculation period	
	Longitude	Latitude	Z [m]		Start	End
1 New	72,922955° E	21,913267° N	16,0	90,0°, 750,0 m	1/1/2002	1/1/2022
2 New	72,930212° E	21,913267° N	16,9		1/1/2002	1/1/2022
3 New	72,937469° E	21,913267° N	18,0		1/1/2002	1/1/2022
4 New	72,944727° E	21,913267° N	16,0		1/1/2002	1/1/2022
5 New	72,924782° E	21,923037° N	16,3	90,0°, 750,0 m	1/1/2002	1/1/2022
6 New	72,932040° E	21,923037° N	16,0		1/1/2002	1/1/2022
7 New	72,939297° E	21,923037° N	15,5		1/1/2002	1/1/2022
8 New	72,946556° E	21,923037° N	15,6		1/1/2002	1/1/2022
9 New	72,928840° E	21,933603° N	16,0	90,0°, 750,0 m	1/1/2002	1/1/2022
10 New	72,936099° E	21,933603° N	16,0		1/1/2002	1/1/2022
11 New	72,943357° E	21,933603° N	15,0		1/1/2002	1/1/2022
12 New	72,950616° E	21,933603° N	15,2		1/1/2002	1/1/2022

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Mathias Thamhain / mth@emd.dk

Calculated:

22/2/2022 09:56/3.5.508

PARK - Wind Data Analysis

Calculation: 22-459-006 Arnod GujaratWind data: 1 - 4*VESTAS V150-4.2 4200 150.0 !O! hub: 105,0 m (TOT: 180,0 m) dist: 750 m (5,0 RD) angle: 90° (14); Hub height: 105,0

Site coordinates

Geo WGS84

East: 72,922955° E North: 21,913267° N

4*VESTAS V150-4.2 4200 150.0 !O! hub: 105,0 m (TOT: 180,0 m) dist: 750 m (5,0 RD) angle: 90° (14)

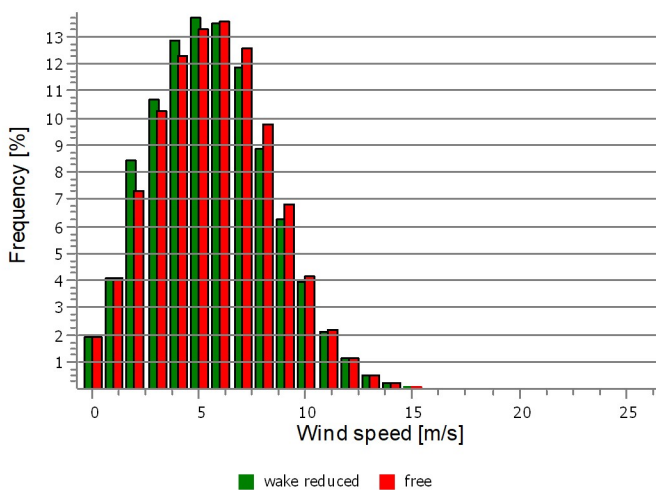
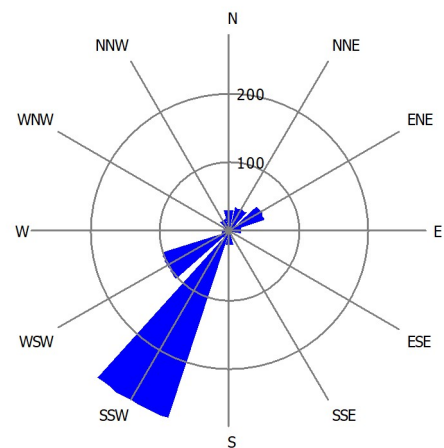
Masts used

Take nearest

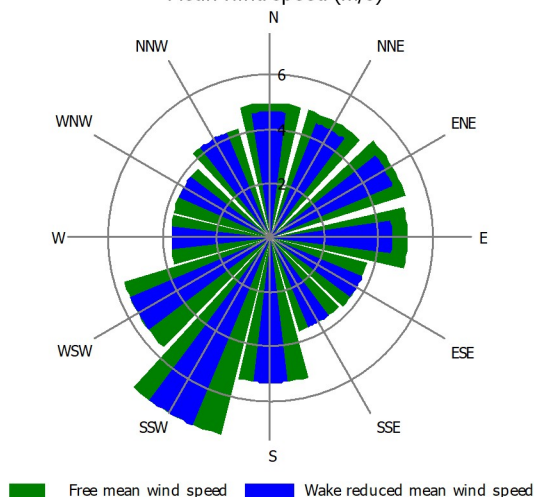
Winddata for site

Sector	Free mean wind speed [m/s]	Wake reduced mean wind speed [m/s]	Frequency [%]	
0 N	5,0	4,7	8,4	
1 NNE	4,9	4,6	10,3	
2 ENE	5,3	5,0	12,1	
3 E	5,1	4,5	4,4	
4 ESE	3,7	3,7	1,2	
5 SSE	3,6	3,6	1,0	
6 S	5,4	5,4	3,6	
7 SSW	7,5	7,5	26,5	
8 WSW	5,7	5,7	16,8	
9 W	3,7	3,7	4,7	
10 WNW	3,7	3,7	4,6	
11 NNW	4,2	4,2	6,3	
All	5,6	5,5	100,0	

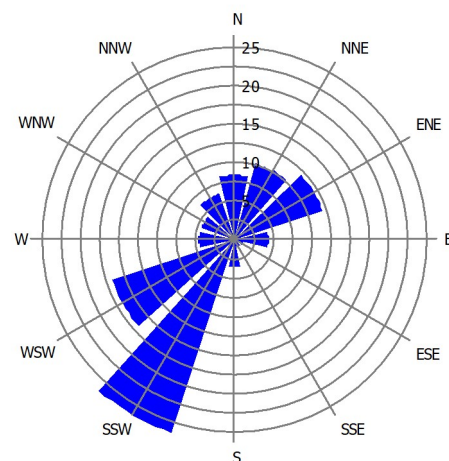
Wind distribution

Energy Rose (WTG) (kWh/m²/year)

Mean wind speed (m/s)



Frequency (%)



Project:

Site Analysis contract 81274134

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Mathias Thamhain / mth@emd.dk

Calculated:

22/2/2022 09:56/3.5.508

PARK - Time varying AEP

Calculation: 22-459-006 Arnod Gujarat

Windfarm: 50,4 MW based on 12 turbines of type VESTAS V150-4.2 4200 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	594	487	502	489	709	817	808	718	443	296	403	515	6.781
1	558	459	451	414	605	677	689	633	371	296	398	508	6.058
2	548	416	392	355	488	600	623	573	351	290	402	506	5.545
3	502	386	353	320	418	487	519	479	281	266	401	470	4.882
4	503	385	324	322	389	454	500	466	238	253	432	480	4.745
5	482	363	315	284	353	439	496	446	243	264	453	515	4.653
6	455	334	277	231	330	395	511	444	218	274	472	491	4.432
7	452	314	249	171	289	401	475	414	193	249	438	471	4.118
8	343	231	138	113	282	424	487	421	188	134	264	344	3.370
9	158	121	94	101	251	437	487	434	195	74	100	146	2.599
10	118	98	88	97	233	456	516	432	194	74	90	119	2.516
11	106	89	81	83	271	495	561	468	204	66	73	93	2.591
12	83	73	66	92	297	528	601	467	191	60	65	76	2.602
13	84	67	61	99	349	591	638	521	229	69	66	72	2.845
14	80	66	64	128	433	702	762	611	264	83	66	73	3.332
15	71	68	82	148	464	752	818	663	282	100	77	74	3.597
16	88	95	100	223	620	896	965	773	352	117	85	87	4.401
17	135	119	152	332	864	1.072	1.073	896	399	141	135	137	5.454
18	278	224	264	506	1.067	1.173	1.124	943	506	222	219	278	6.805
19	426	353	439	717	1.184	1.199	1.164	1.046	591	281	328	427	8.154
20	516	424	535	790	1.180	1.223	1.169	1.040	656	315	386	505	8.739
21	539	461	594	798	1.110	1.138	1.106	996	603	325	407	556	8.634
22	574	470	586	730	1.005	1.037	1.053	913	543	316	406	547	8.180
23	570	501	550	610	878	923	936	805	461	306	402	541	7.482
Grand Total	8.260	6.606	6.756	8.155	14.071	17.315	18.084	15.602	8.197	4.870	6.570	8.029	122.513

Hour/Month [MW]	1	2	3	4	5	6	7	8	9	10	11	12	Grand Total
0	19,2	17,4	16,2	16,3	22,9	27,2	26,1	23,1	14,8	9,5	13,4	16,6	18,6
1	18,0	16,4	14,5	13,8	19,5	22,6	22,2	20,4	12,4	9,6	13,3	16,4	16,6
2	17,7	14,9	12,6	11,8	15,8	20,0	20,1	18,5	11,7	9,4	13,4	16,3	15,2
3	16,2	13,8	11,4	10,7	13,5	16,2	16,8	15,4	9,4	8,6	13,4	15,2	13,4
4	16,2	13,7	10,5	10,7	12,5	15,1	16,1	15,0	7,9	8,2	14,4	15,5	13,0
5	15,5	13,0	10,2	9,5	11,4	14,6	16,0	14,4	8,1	8,5	15,1	16,6	12,7
6	14,7	11,9	8,9	7,7	10,7	13,2	16,5	14,3	7,3	8,8	15,7	15,8	12,1
7	14,6	11,2	8,0	5,7	9,3	13,4	15,3	13,4	6,4	8,0	14,6	15,2	11,3
8	11,1	8,3	4,4	3,8	9,1	14,1	15,7	13,6	6,3	4,3	8,8	11,1	9,2
9	5,1	4,3	3,0	3,4	8,1	14,6	15,7	14,0	6,5	2,4	3,3	4,7	7,1
10	3,8	3,5	2,8	3,2	7,5	15,2	16,6	13,9	6,5	2,4	3,0	3,8	6,9
11	3,4	3,2	2,6	2,8	8,7	16,5	18,1	15,1	6,8	2,1	2,4	3,0	7,1
12	2,7	2,6	2,1	3,1	9,6	17,6	19,4	15,1	6,4	1,9	2,2	2,5	7,1
13	2,7	2,4	2,0	3,3	11,3	19,7	20,6	16,8	7,6	2,2	2,2	2,3	7,8
14	2,6	2,3	2,1	4,3	14,0	23,4	24,6	19,7	8,8	2,7	2,2	2,4	9,1
15	2,3	2,4	2,6	4,9	15,0	25,1	26,4	21,4	9,4	3,2	2,6	2,4	9,9
16	2,8	3,4	3,2	7,4	20,0	29,9	31,1	24,9	11,7	3,8	2,8	2,8	12,1
17	4,4	4,2	4,9	11,1	27,9	35,7	34,6	28,9	13,3	4,5	4,5	4,4	14,9
18	9,0	8,0	8,5	16,9	34,4	39,1	36,2	30,4	16,9	7,2	7,3	9,0	18,6
19	13,7	12,6	14,1	23,9	38,2	40,0	37,5	33,7	19,7	9,1	10,9	13,8	22,3
20	16,6	15,1	17,3	26,3	38,1	40,8	37,7	33,6	21,9	10,2	12,9	16,3	23,9
21	17,4	16,5	19,2	26,6	35,8	37,9	35,7	32,1	20,1	10,5	13,6	17,9	23,7
22	18,5	16,8	18,9	24,3	32,4	34,6	34,0	29,4	18,1	10,2	13,5	17,6	22,4
23	18,4	17,9	17,7	20,3	28,3	30,8	30,2	26,0	15,4	9,9	13,4	17,4	20,5
Grand Total	11,1	9,8	9,1	11,3	18,9	24,0	24,3	21,0	11,4	6,5	9,1	10,8	14,0

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PARK - Time varying AEP

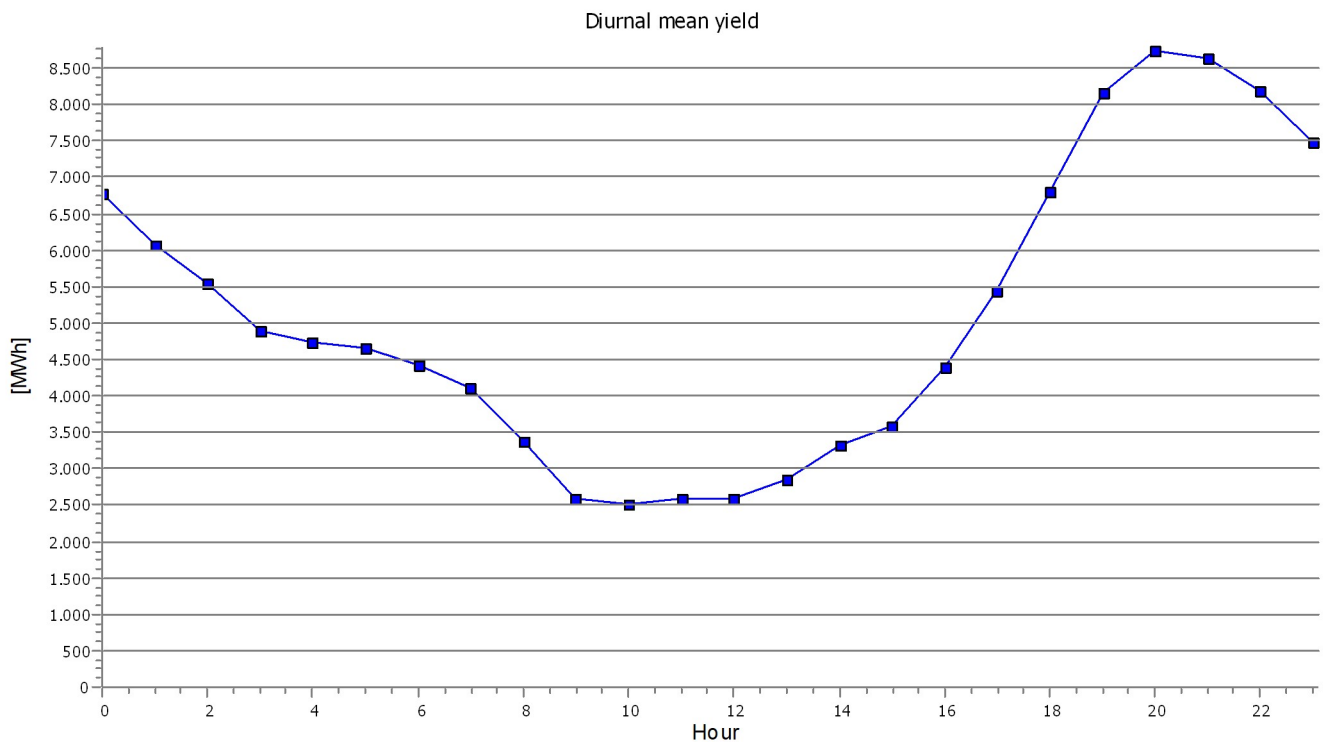
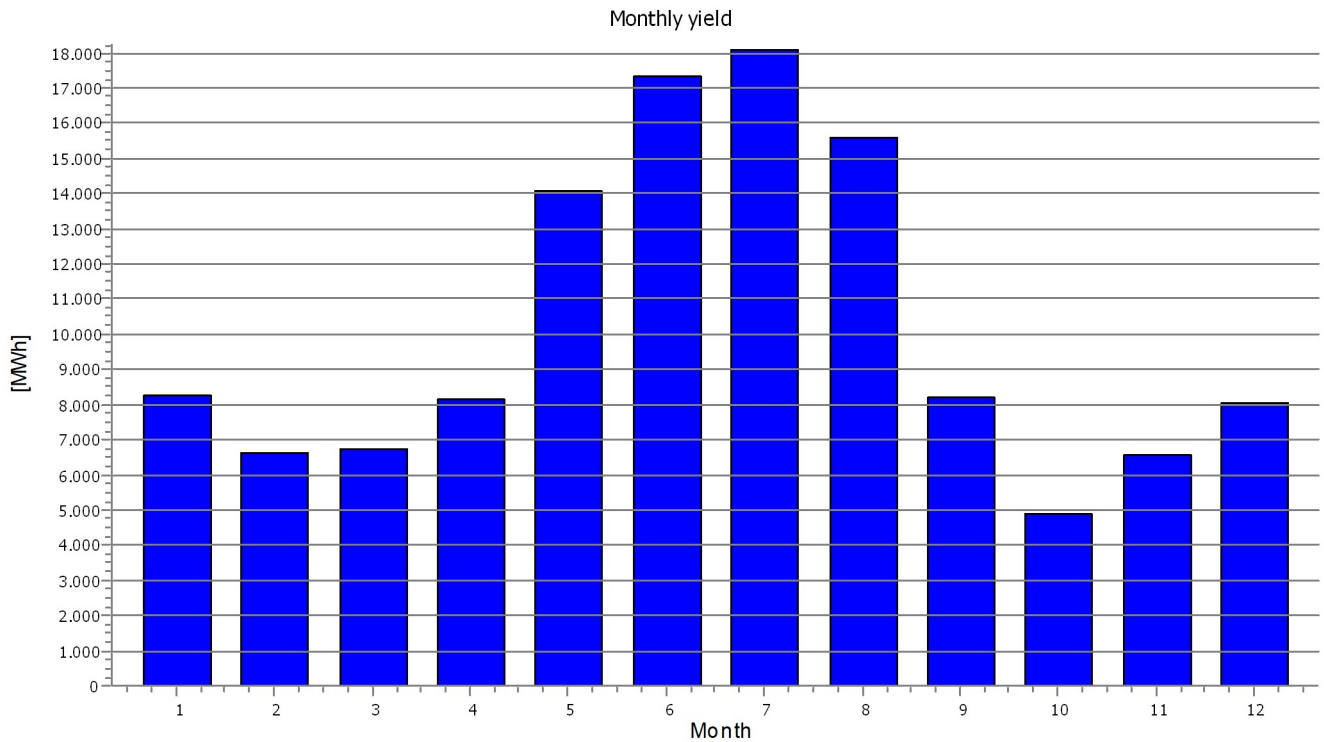
Calculation: 22-459-006 Arnod Gujarat

Windfarm: 50,4 MW based on 12 turbines of type VESTAS V150-4.2 4200 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.



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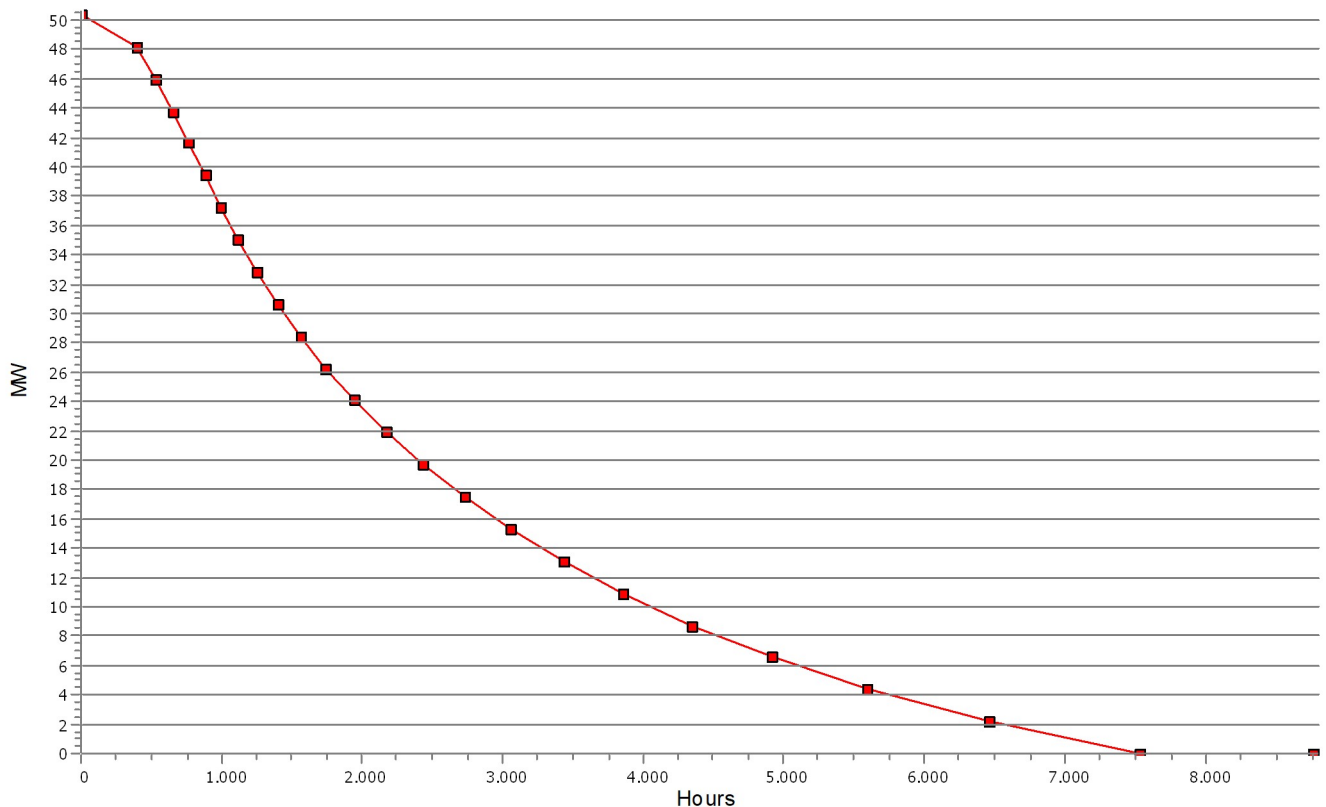
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Windfarm: 50,4 MW based on 12 turbines of type VESTAS V150-4.2 4200 150.0 !O!.

Selection: All new WTGs

Hours	Hours [%]	Hours accumulated	Power [MW]	Power (MW/WTG)
0	0,0	0	50,4	4,2
399	4,6	399	48,2 - 50,4	4,0 - 4,2
133	1,5	532	46,0 - 48,2	3,8 - 4,0
120	1,4	653	43,8 - 46,0	3,7 - 3,8
111	1,3	764	41,6 - 43,8	3,5 - 3,7
114	1,3	878	39,4 - 41,6	3,3 - 3,5
117	1,3	995	37,3 - 39,4	3,1 - 3,3
121	1,4	1117	35,1 - 37,3	2,9 - 3,1
134	1,5	1251	32,9 - 35,1	2,7 - 2,9
143	1,6	1393	30,7 - 32,9	2,6 - 2,7
162	1,8	1555	28,5 - 30,7	2,4 - 2,6
180	2,1	1735	26,3 - 28,5	2,2 - 2,4
200	2,3	1935	24,1 - 26,3	2,0 - 2,2
230	2,6	2165	21,9 - 24,1	1,8 - 2,0
260	3,0	2424	19,7 - 21,9	1,6 - 1,8
299	3,4	2723	17,5 - 19,7	1,5 - 1,6
327	3,7	3050	15,3 - 17,5	1,3 - 1,5
379	4,3	3430	13,1 - 15,3	1,1 - 1,3
418	4,8	3848	11,0 - 13,1	0,9 - 1,1
494	5,6	4342	8,8 - 11,0	0,7 - 0,9
572	6,5	4914	6,6 - 8,8	0,5 - 0,7
678	7,7	5592	4,4 - 6,6	0,4 - 0,5
863	9,8	6455	2,2 - 4,4	0,2 - 0,4
1073	12,2	7528	0,0 - 2,2	0,0 - 0,2
1238	14,1	8766	0,0	0,0

Duration curve 50,4 MW WindFarm



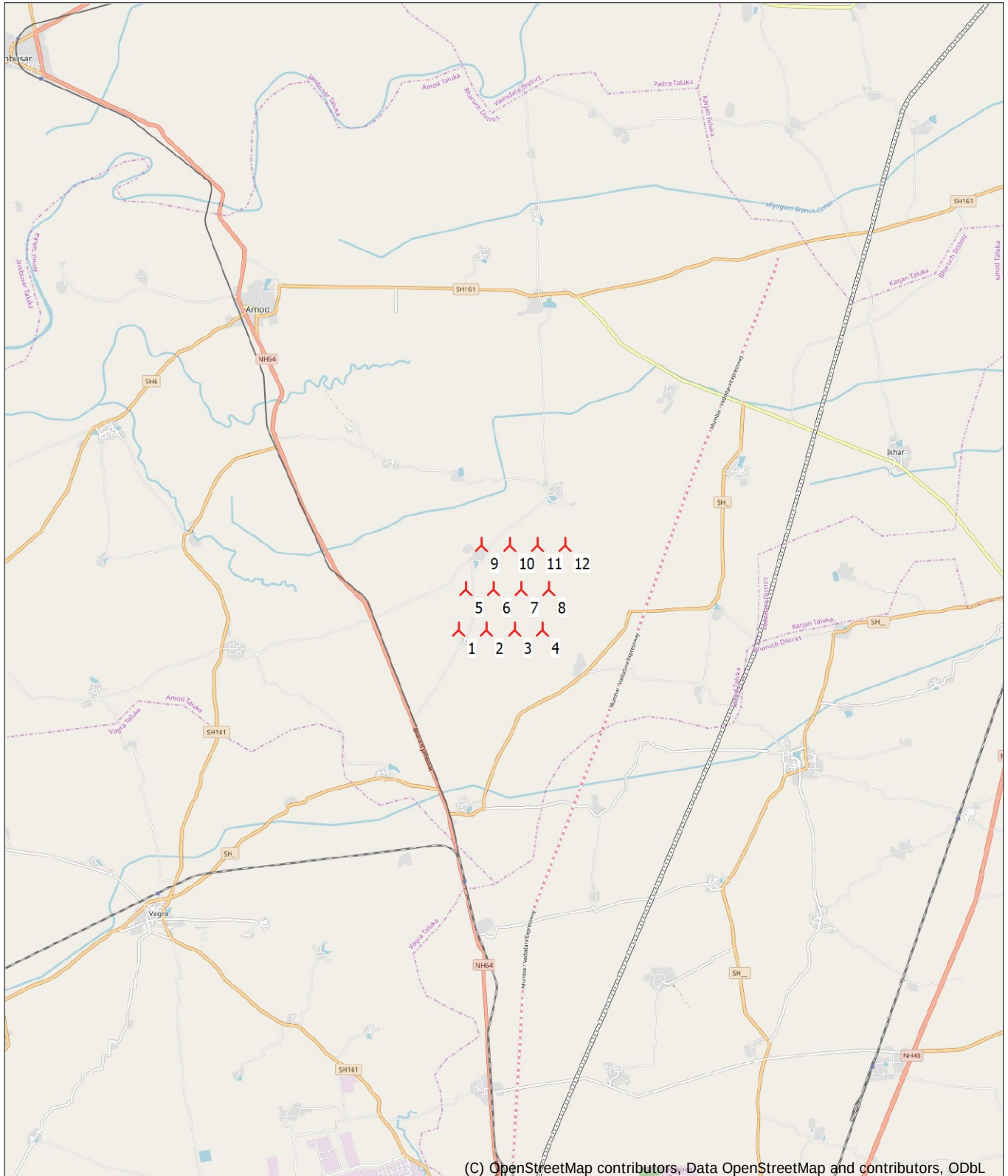
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Calculated:
22/2/2022 09:56/3.5.508

PARK - Map

Calculation: 22-459-006 Arnod Gujarat



0 2,5 5 7,5 10km

Map: EMD OpenStreetMap , Print scale 1:150.000, Map center Geo WGS84 East: 72,936785° E North: 21,923435° N

 New WTG

Heat Maps - Arnod, Gujarat

AEP [MWh]							
Hour/Month	00:00 - 04:00	04:00 - 08:00	08:00 - 12:00	12:00 - 16:00	16:00 - 20:00	20:00 - 00:00	TOTAL
1	2,026	1,740	667	292	853	2,023	7,599
2	1,609	1,284	497	252	728	1,708	6,077
3	1,562	1,072	368	251	878	2,084	6,216
4	1,453	928	363	430	1,635	2,694	7,502
5	2,043	1,252	954	1,420	3,436	3,839	12,945
6	2,374	1,554	1,667	2,367	3,993	3,975	15,930
7	2,428	1,824	1,887	2,594	3,980	3,924	16,638
8	2,210	1,628	1,615	2,081	3,365	3,454	14,353
9	1,330	821	719	889	1,701	2,081	7,541
10	1,056	957	320	287	700	1,160	4,480
11	1,475	1,651	486	252	706	1,473	6,044
12	1,839	1,800	645	271	854	1,977	7,386
Total	21,405	16,512	10,189	11,386	22,829	30,392	1,12,712

Capacity factor [Per cent]							
Hour/Month	00:00 - 04:00	04:00 - 08:00	08:00 - 12:00	12:00 - 16:00	16:00 - 20:00	20:00 - 00:00	TOTAL
1	32.4%	27.8%	10.7%	4.7%	13.6%	32.4%	20.3%
2	28.5%	22.7%	8.8%	4.5%	12.9%	30.3%	17.9%
3	25.0%	17.2%	5.9%	4.0%	14.1%	33.4%	16.6%
4	24.0%	15.4%	6.0%	7.1%	27.0%	44.5%	20.7%
5	32.7%	20.0%	15.3%	22.7%	55.0%	61.4%	34.5%
6	39.3%	25.7%	27.6%	39.1%	66.0%	65.7%	43.9%
7	38.9%	29.2%	30.2%	41.5%	63.7%	62.8%	44.4%
8	35.4%	26.0%	25.8%	33.3%	53.9%	55.3%	38.3%
9	22.0%	13.6%	11.9%	14.7%	28.1%	34.4%	20.8%
10	16.9%	15.3%	5.1%	4.6%	11.2%	18.6%	11.9%
11	24.4%	27.3%	8.0%	4.2%	11.7%	24.4%	16.7%
12	29.4%	28.8%	10.3%	4.3%	13.7%	31.6%	19.7%
Total	29.1%	22.4%	13.8%	15.5%	31.0%	41.3%	25.5%