

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung

Voraussetzungen für Berechnung des Schattenwurfs

Beschattungsbereich der WEA

Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt

Siehe WEA-Tabelle

Minimale relevante Sonnenhöhe über Horizont 3 °
Tage zwischen Berechnungen 1 Tag(e)
Berechnungszeitsprung 1 Minuten

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsstunden ermittelt aus WEA in Berechnung und Windverteilung:

Terraindaten: WAsP (30)

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:

Verwendete Höhenlinien: Höhenlinien: ORO_SG1510_rev0_RBR.wpo (1)

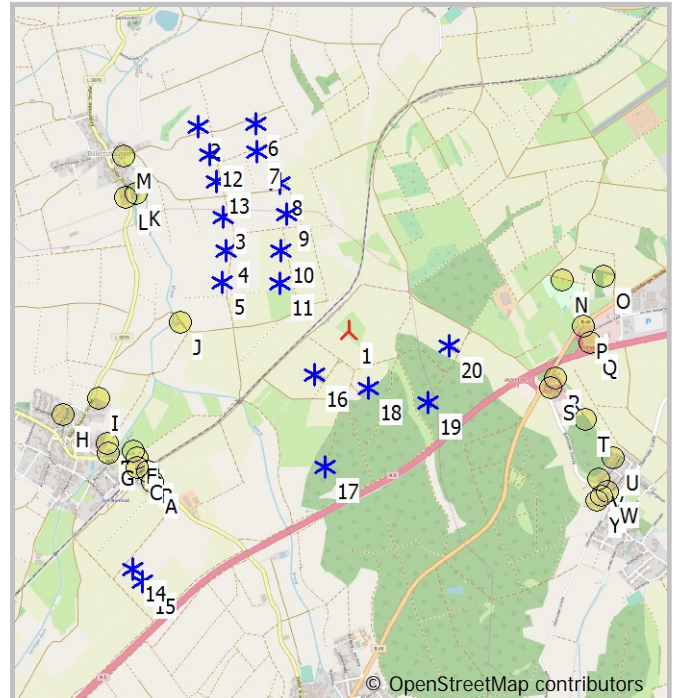
Hindernisse in Berechnung nicht verwendet

Berechnungshöhe ü.Gr. für Karte: 1,5 m

Rasterauflösung: 10,0 m

Alle Koordinatenangaben in:

ETRS 89 Zone: 32



▲ Neue WEA
● Schattenrezeptor

Maßstab 1:50.000

* Existierende WEA

WEA

	X(Ost)	Y(Nord)	Z	Beschreibung	Aktuell	Hersteller	Typ	Nennleistung	Rotor-durchmesser	Nabenhöhe	Schattendaten	
											Beschatt.-Bereich	U/min
	[m]						[kW]	[m]	[m]	[m]	[U/min]	
1	515.664,05	5.620.611,53	320,0	ENERCON E-...	Ja	ENERCON	E-138 EP3 TES-3.500	3.500	138,3	160,0	1.679	10,6
2	514.662,00	5.621.962,00	328,1	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
3	514.831,50	5.621.369,33	325,0	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
4	514.850,00	5.621.147,00	325,5	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
5	514.823,00	5.620.935,00	323,5	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
6	515.043,82	5.621.983,99	327,5	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
7	515.051,22	5.621.797,94	324,2	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
8	515.202,63	5.621.590,33	322,0	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
9	515.253,02	5.621.384,19	324,7	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
10	515.214,00	5.621.143,00	325,6	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
11	515.205,00	5.620.928,00	324,7	DEWIND D6/...	Ja	DEWIND	D6/62-1MW-1.000	1.000	62,0	68,5	1.027	20,7
12	514.736,89	5.621.781,06	330,0	ANBONUS AN...	Nein	ANBONUS	AN 1MW / 54-1.000/200	1.000	54,0	70,0	880	22,0
13	514.781,57	5.621.605,00	329,6	ANBONUS AN...	Nein	ANBONUS	AN 600kW / 44-3-600/120	600	44,0	58,0	771	27,0
14	514.237,81	5.619.029,98	329,5	ANBONUS AN...	Nein	ANBONUS	AN 150-150/30	150	23,0	30,0	2.500	40,0
15	514.302,86	5.618.947,18	328,5	ANBONUS AN...	Nein	ANBONUS	AN 300kW-300	300	33,0	40,0	765	31,0
16	515.441,00	5.620.328,00	325,0	ENERCON E-...	Ja	ENERCON	E-115 TES-3.000	3.000	115,7	149,0	2.114	12,8
17	515.512,00	5.619.713,00	327,2	ENERCON E-...	Ja	ENERCON	E-115 TES-3.000	3.000	115,7	149,0	2.114	12,8
18	515.798,00	5.620.238,00	317,9	ENERCON E-...	Ja	ENERCON	E-115 TES-3.000	3.000	115,7	149,0	2.114	12,8
19	516.192,00	5.620.142,00	325,5	ENERCON E-...	Ja	ENERCON	E-115 TES-3.000	3.000	115,7	149,0	2.114	12,8
20	516.331,00	5.620.518,00	326,7	ENERCON E-...	Ja	ENERCON	E-115 TES-3.000	3.000	115,7	149,0	2.114	12,8

Schattenrezeptor-Eingabe

Nr.	Name	X(Ost)	Y(Nord)	Z	Breite	Höhe	Höhe ü.Gr.	Neigung des Fensters	Ausrichtungsmodus	Augenhöhe (ZVI) ü.Gr.
		[m]	[m]	[m]	[m]	[m]	[m]	[°]		[m]
A	IP01 - Bahnhofstr. 28, 36329 Romrod-Zell	514.370,00	5.619.613,00	313,9	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
B	IP01/1 - Bahnhofstr. 20, 36329 Romrod-Zell	514.339,00	5.619.682,00	309,3	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
C	IP01/2 - Bahnhofstr. 18, 36329 Romrod-Zell	514.266,00	5.619.703,00	307,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0

(Fortsetzung nächste Seite)...

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Nr.	Name	X(Ost)	Y(Nord)	Z	Breite	Höhe	Höhe ü.Gr.	Neigung des Fensters	Ausrichtungsmodus	Augenhöhe (ZVI) ü.Gr.
				[m]	[m]	[m]	[m]	[°]		[m]
D	IP01/3 - Bahnhofstr. 14A, 36329 Romrod-Zell	514.267,00	5.619.767,00	305,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
E	IP01/4 - Brückengarten 10, 36329 Romrod-Zell	514.242,00	5.619.813,00	305,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
F	IP01/5 - Bahnhofstr. 4, 36329 Romrod-Zell	514.065,00	5.619.865,00	305,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
G	IP01/6 - Bahnhofstr. 8, 36329 Romrod-Zell	514.076,00	5.619.802,00	305,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
H	IP02 - Frohnhofstr. 4, 36329 Romrod-Zell	513.776,00	5.620.053,00	320,6	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
I	IP02/1 - Billertshäuser Str. 21, 36329 Romrod-Zell	514.010,00	5.620.161,00	312,1	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
J	IP03 - Steineshof 1, 36329 Romrod-Zell	514.553,00	5.620.665,00	303,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
K	IP04 - Zeller Str. 28, 36304 Alsfeld-Billertshausen	514.255,00	5.621.521,00	300,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
L	IP04/1 - Zeller Str. 25, 36304 Alsfeld-Billertshausen	514.185,00	5.621.492,00	303,8	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
M	IP04/2 - Leuseler Weg 5, 36304 Alsfeld-Billertshausen	514.170,00	5.621.766,00	300,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
N	IP06 - Auf dem Kreisch 1 (Familiensportgemeinschaft Oberhessen), 36304 Alsfeld	517.079,00	5.620.953,00	340,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
O	IP06/1 - Grünbergerstr. 131, 36304 Alsfeld	517.356,00	5.620.982,00	321,8	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
P	IP07 - Disröder Feld (Gewerbegebiet), 36304 Alsfeld	517.220,00	5.620.651,00	320,5	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
Q	IP07/1 - Disröder Feld Süd (Gewerbegebiet), 36304 Alsfeld	517.265,00	5.620.539,00	316,3	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
R	IP08 - Pfefferhöhe 2, 36304 Alsfeld	517.039,00	5.620.306,00	340,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
S	IP08/1 - Pfefferhöhe 19 (MC Donalds), 36304 Alsfeld	517.006,00	5.620.241,00	340,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
T	IP09 - Am Holzberg 100, 36304 Alsfeld	517.238,00	5.620.032,00	340,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
U	IP09/1 - Am Holzberg 31, 36304 Alsfeld-Liederbach	517.425,00	5.619.781,00	315,5	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
V	IP10 - Am Holzberg 45, 36304 Alsfeld-Liederbach	517.327,00	5.619.636,00	307,1	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
W	IP10/1 - Romröder Str. 4, 36304 Alsfeld-Liederbach	517.384,00	5.619.554,00	300,0	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
X	IP10/2 - An der Huth 3, 36304 Alsfeld-Liederbach	517.345,00	5.619.522,00	302,3	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0
Y	IP10/3 - An der Huth 6, 36304 Alsfeld-Liederbach	517.317,00	5.619.492,00	304,4	0,1	0,1	2,0	0,0	"Gewächshaus-Modus"	2,0

Berechnungsergebnisse

Schattenrezeptor

Nr.	Name	astron.	max. mögl.	Beschattungsdauer	met. wahrsch. Beschattungsdauer
		Stunden/Jahr	Schatten-tage/Jahr	Max.Schatten-dauer/Tag	Stunden/Jahr
		[h/a]	[d/a]	[h/d]	[h/a]
A	IP01 - Bahnhofstr. 28, 36329 Romrod-Zell	22:32	91	0:23	5:15
B	IP01/1 - Bahnhofstr. 20, 36329 Romrod-Zell	32:29	127	0:23	7:22
C	IP01/2 - Bahnhofstr. 18, 36329 Romrod-Zell	44:04	137	0:38	10:06
D	IP01/3 - Bahnhofstr. 14A, 36329 Romrod-Zell	52:47	149	0:39	12:07
E	IP01/4 - Brückengarten 10, 36329 Romrod-Zell	49:36	154	0:36	11:27
F	IP01/5 - Bahnhofstr. 4, 36329 Romrod-Zell	18:01	79	0:19	3:52
G	IP01/6 - Bahnhofstr. 8, 36329 Romrod-Zell	19:16	84	0:19	4:15
H	IP02 - Frohnhofstr. 4, 36329 Romrod-Zell	10:51	57	0:16	2:02
I	IP02/1 - Billertshäuser Str. 21, 36329 Romrod-Zell	14:44	64	0:19	2:38
J	IP03 - Steineshof 1, 36329 Romrod-Zell	60:36	182	0:41	9:06
K	IP04 - Zeller Str. 28, 36304 Alsfeld-Billertshausen	80:47	262	0:36	12:10
L	IP04/1 - Zeller Str. 25, 36304 Alsfeld-Billertshausen	74:18	232	0:34	12:34
M	IP04/2 - Leuseler Weg 5, 36304 Alsfeld-Billertshausen	76:29	267	0:29	13:23
N	IP06 - Auf dem Kreisch 1 (Familiensportgemeinschaft Oberhessen), 36304 Alsfeld	52:17	132	0:43	6:53
O	IP06/1 - Grünbergerstr. 131, 36304 Alsfeld	17:33	63	0:24	2:26
P	IP07 - Disröder Feld (Gewerbegebiet), 36304 Alsfeld	42:43	118	0:49	7:12
Q	IP07/1 - Disröder Feld Süd (Gewerbegebiet), 36304 Alsfeld	41:13	114	0:46	7:23
R	IP08 - Pfefferhöhe 2, 36304 Alsfeld	79:03	185	0:50	15:05
S	IP08/1 - Pfefferhöhe 19 (MC Donalds), 36304 Alsfeld	92:23	191	0:58	17:26
T	IP09 - Am Holzberg 100, 36304 Alsfeld	51:45	152	0:39	9:55
U	IP09/1 - Am Holzberg 31, 36304 Alsfeld-Liederbach	0:00	0	0:00	0:00
V	IP10 - Am Holzberg 45, 36304 Alsfeld-Liederbach	32:30	122	0:23	6:21
W	IP10/1 - Romröder Str. 4, 36304 Alsfeld-Liederbach	32:19	118	0:22	6:13
X	IP10/2 - An der Huth 3, 36304 Alsfeld-Liederbach	30:58	112	0:22	5:56
Y	IP10/3 - An der Huth 6, 36304 Alsfeld-Liederbach	27:42	108	0:20	5:19

Gesamtmenge der max. mögl. Beschattung an Rezeptoren pro WEA

Nr.	Name	Maximal	Erwartet
		[h/a]	[h/a]
1	ENERCON E-138 EP3 TES 3500 138.3 !-! NH: 160,0 m (Ges:229,1 m) (28)	83:23	16:46
2	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (1)	32:31	7:45
3	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (2)	22:16	3:03
4	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (3)	23:03	2:18
5	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (4)	24:34	1:38
6	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (5)	19:22	4:34
7	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (6)	12:30	2:51
8	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (7)	5:31	1:06
9	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (8)	3:15	0:31

(Fortsetzung nächste Seite)...

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- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

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SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung

...(Fortsetzung von letzter Seite)

Nr.	Name	Maximal [h/a]	Erwartet [h/a]
10	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (9)	0:00	0:00
11	DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (10)	12:41	3:12
12	ANBONUS AN 1MW / 54 1000-200 54.0 !O! NH: 70,0 m (Ges:97,0 m) (11)	22:44	5:05
13	ANBONUS AN 600kW / 44-3 600-120 44.0 !O! NH: 58,0 m (Ges:80,0 m) (12)	14:19	2:51
14	ANBONUS AN 150 150-30 23.0 !O! NH: 30,0 m (Ges:41,5 m) (22)	0:00	0:00
15	ANBONUS AN 300kW 300 33.0 !O! NH: 40,0 m (Ges:56,5 m) (23)	0:00	0:00
16	ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (40)	133:18	24:11
17	ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (41)	81:25	12:24
18	ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (42)	105:40	19:42
19	ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (43)	136:44	23:21
20	ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (44)	152:49	28:13

Summen in Rezeptortabelle und WEA-Tabelle können sich unterscheiden, da eine WEA gleichzeitig an zwei oder mehr Rezeptoren Beschattung verursachen kann und/oder ein Rezeptor gleichzeitig von zwei oder mehr WEA beschattet werden kann.

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SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: A - IP01 - Bahnhofstr. 28, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26	08:01	07:10	07:02	06:00	05:17
	16:28	17:14	18:03	19:55	20:43	21:27
2	08:26	07:59	07:08	07:00	05:58	05:16
	16:29	17:16	18:05	19:56	20:45	21:28
3	08:26	07:58	07:06	06:57	05:56	05:15
	16:30	17:18	18:07	19:58	20:46	21:29
4	08:25	07:56	07:04	06:55	05:54	05:15
	16:32	17:20	18:09	20:00	20:48	21:30
5	08:25	07:55	07:01	06:53	05:52	05:14
	16:33	17:21	18:10	20:01	20:49	21:31
6	08:25	07:53	06:59	06:51	07:28 (17)	05:51
	16:34	17:23	18:12	20:03	6 07:34 (17)	20:51
7	08:25	07:52	06:57	06:49	07:25 (17)	05:49
	16:35	17:25	18:14	20:05	12 07:37 (17)	20:53
8	08:24	07:50	06:55	06:47	07:22 (17)	05:47
	16:36	17:27	18:15	20:06	17 07:39 (17)	20:54
9	08:24	07:48	06:53	06:44	07:20 (17)	05:46
	16:38	17:28	18:17	20:08	19 07:39 (17)	20:56
10	08:23	07:47	06:51	06:42	07:19 (17)	05:44
	16:39	17:30	18:19	20:09	21 07:40 (17)	20:57
11	08:23	07:45	06:49	06:40	07:18 (17)	05:42
	16:40	17:32	18:20	20:11	22 07:40 (17)	20:59
12	08:22	07:43	06:46	06:38	07:18 (17)	05:41
	16:42	17:34	18:22	20:13	22 07:40 (17)	21:00
13	08:22	07:41	06:44	06:36	07:17 (17)	05:39
	16:43	17:36	18:24	20:14	23 07:40 (17)	21:02
14	08:21	07:39	06:42	06:34	07:17 (17)	05:38
	16:45	17:37	18:25	20:16	23 07:40 (17)	21:03
15	08:20	07:38	06:40	06:32	07:17 (17)	05:36
	16:46	17:39	18:27	20:17	23 07:40 (17)	21:05
16	08:19	07:36	06:38	06:29	07:17 (17)	05:35
	16:48	17:41	18:29	20:19	22 07:39 (17)	21:06
17	08:19	07:34	06:35	06:27	07:17 (17)	05:33
	16:49	17:43	18:30	20:21	21 07:38 (17)	21:08
18	08:18	07:32	06:33	06:25	07:18 (17)	05:32
	16:51	17:44	18:32	20:22	19 07:37 (17)	21:09
19	08:17	07:30	06:31	06:23	07:19 (17)	05:31
	16:52	17:46	18:34	20:24	17 07:36 (17)	21:10
20	08:16	07:28	06:29	06:21	07:20 (17)	05:29
	16:54	17:48	18:35	20:26	14 07:34 (17)	21:12
21	08:15	07:26	06:26	06:19	07:22 (17)	05:28
	16:56	17:50	18:37	20:27	9 07:31 (17)	21:13
22	08:14	07:24	06:24	06:17	06:41 (19)	05:27
	16:57	17:51	18:39	20:29	5 06:46 (19)	21:15
23	08:13	07:22	06:22	06:15	06:38 (19)	05:26
	16:59	17:53	18:40	20:30	10 06:48 (19)	21:16
24	08:11	07:20	06:20	06:13	06:37 (19)	05:25
	17:00	17:55	18:42	20:32	12 06:49 (19)	21:17
25	08:10	07:18	06:17	06:11	06:36 (19)	05:23
	17:02	17:57	18:43	20:34	13 06:49 (19)	21:18
26	08:09	07:16	06:15	06:09	06:35 (19)	05:22
	17:04	17:58	18:45	20:35	14 06:49 (19)	21:20
27	08:08	07:14	06:13	06:07	06:35 (19)	05:21
	17:06	18:00	18:47	20:37	14 06:49 (19)	21:21
28	08:06	07:12	06:11	06:05	06:35 (19)	05:20
	17:07	18:02	18:48	20:38	15 06:50 (19)	21:22
29	08:05		07:09	06:03	06:35 (19)	05:19
	17:09		19:50	20:40	14 06:49 (19)	21:23
30	08:04		07:06	06:02	06:36 (19)	05:18
	17:11		19:52	20:42	12 06:48 (19)	21:24
31	08:02		07:04			05:18
	17:12		19:53			21:26
Sonnenscheinstunden	264	280	367	414	480	492
astr. max. mögl. Beschattung				399	273	
Red. Sonnenscheinwahrsch.				0,40	0,44	
Reduktion Betriebsdauer				0,83	0,83	
Reduktion Windrichtung				0,63	0,68	
Gesamte Reduktion				0,21	0,25	
Met. wahrsch. Beschattung				83	68	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: A - IP01 - Bahnhofstr. 28, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14 21:40	05:49 21:10	06:21 (18) 20:11	06:36 20:11	07:17 (17) 19:04	07:22 17:00
2	05:15 21:40	05:50 21:09	06:22 (18) 20:09	06:38 20:09	07:18 (17) 19:02	07:24 16:59
3	05:16 21:40	05:52 21:07	06:22 (18) 20:06	06:39 20:06	07:18 (17) 18:59	07:26 16:57
4	05:16 21:39	05:53 21:05	06:24 (18) 20:04	06:41 20:04	07:19 (17) 18:57	07:27 16:55
5	05:17 21:39	05:55 21:04	06:26 (18) 20:02	06:42 20:02	07:21 (17) 18:55	07:29 16:53
6	05:18 21:38	05:56 21:02	06:31 (18) 20:00	06:44 20:00	07:24 (17) 18:53	07:22 16:52
7	05:19 21:38	05:58 21:00	06:45 19:58	06:45 19:58	07:30 (17) 18:51	07:30 16:50
8	05:20 21:37	05:59 20:59	06:47 19:55	06:47 19:55	07:34 18:48	07:26 16:49
9	05:21 21:36	06:01 20:57	06:48 19:53	06:48 19:53	07:35 18:46	07:27 16:47
10	05:22 21:36	06:02 20:55	06:50 19:51	06:50 19:51	07:37 18:44	07:29 16:45
11	05:22 21:35	06:04 20:53	06:51 19:49	06:51 19:49	07:39 18:42	07:31 16:44
12	05:24 21:34	06:05 20:51	06:53 19:47	06:53 19:47	07:40 18:40	07:32 16:43
13	05:25 21:33	06:07 20:50	06:55 19:44	06:55 19:44	07:42 18:38	07:34 16:41
14	05:26 21:33	06:08 20:48	06:56 19:42	06:56 19:42	07:43 18:36	07:36 16:40
15	05:27 21:32	06:10 20:46	06:58 19:40	06:58 19:40	07:45 18:33	07:37 16:38
16	05:28 21:31	06:11 20:44	06:59 19:38	06:59 19:38	07:47 18:31	07:39 16:37
17	05:29 21:30	06:13 20:42	07:01 19:35	07:01 19:35	07:48 18:29	07:41 16:36
18	05:30 21:29	06:14 20:40	07:02 19:33	07:02 19:33	07:50 18:27	07:42 16:34
19	05:31 21:28	06:16 20:38	07:04 19:31	07:04 19:31	07:52 18:25	07:44 16:33
20	05:33 21:27	06:18 20:36	07:05 19:29	07:05 19:29	07:53 18:23	07:46 16:32
21	05:34 21:25	06:19 20:34	07:07 19:26	07:07 19:26	07:55 18:21	07:47 16:31
22	05:35 21:24	06:22 (18) 20:32	07:08 19:24	07:08 19:24	07:57 18:19	07:49 16:30
23	05:36 21:23	06:21 (18) 20:30	07:10 19:22	07:10 19:22	07:58 18:17	07:50 16:29
24	05:38 21:22	06:20 (18) 20:28	07:12 19:20	07:12 19:20	08:00 18:15	07:52 16:28
25	05:39 21:20	06:20 (18) 20:26	07:13 19:17	07:13 19:17	07:54 18:13	07:54 16:27
26	05:40 21:19	06:20 (18) 20:24	07:15 19:15	07:15 19:15	07:55 18:11	07:55 16:26
27	05:42 21:18	06:20 (18) 20:22	07:16 19:13	07:16 19:13	07:57 18:09	07:57 16:25
28	05:43 21:16	06:20 (18) 20:19	07:18 (17) 19:11	07:18 (17) 19:11	07:58 18:07	07:58 16:24
29	05:45 21:15	06:20 (18) 20:17	07:19 (17) 19:08	07:19 (17) 19:08	08:00 18:05	08:00 16:23
30	05:46 21:13	06:20 (18) 20:15	07:21 (17) 19:06	07:21 (17) 19:06	08:01 18:03	08:01 16:22
31	05:47 21:12	06:20 (18) 20:13	07:21 (17) 19:04	07:21 (17) 19:04	08:02 18:01	08:02 16:21
Sonnenscheinstunden 496 450 380 333 271 250						
astr. max.mögl. Beschattung 209 374 97						
Red. Sonnenscheinwahrsch. 0,47 0,46 0,38						
Reduktion Betriebsdauer 0,83 0,83 0,83						
Reduktion Windrichtung 0,68 0,64 0,62						
Gesamte Reduktion 0,26 0,24 0,19						
Met. wahrsch. Beschattung 55 91 19						

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: B - IP01/1 - Bahnhofstr. 20, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	07:39 (17) 07:48 (17)	06:00 20:43
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	07:36 (17) 07:51 (17)	05:58 20:45
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	07:33 (17) 07:51 (17)	05:56 20:46
4	08:25 16:32	07:56 17:20	07:04 18:09	06:55 20:00	07:32 (17) 07:52 (17)	05:54 20:48
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	07:31 (17) 07:52 (17)	05:52 20:49
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	07:31 (17) 07:53 (17)	05:51 20:51
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	07:30 (17) 07:53 (17)	05:49 20:53
8	08:24 16:36	07:50 17:27	06:55 18:15	06:47 20:06	07:30 (17) 07:53 (17)	05:47 20:54
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	07:29 (17) 07:51 (17)	05:46 20:56
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	07:29 (17) 07:51 (17)	05:44 20:57
11	08:23 16:40	07:45 17:32	06:49 18:20	06:40 20:11	07:30 (17) 07:50 (17)	05:42 20:59
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	07:31 (17) 07:49 (17)	05:41 21:00
13	08:22 16:43	07:41 17:36	06:44 18:24	06:36 20:14	07:32 (17) 07:47 (17)	05:39 21:02
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	07:33 (17) 07:45 (17)	05:38 21:03
15	08:20 16:46	07:38 17:39	06:40 18:27	06:32 20:18	07:37 (17) 07:41 (17)	05:36 21:05
16	08:19 16:48	07:36 17:41	06:38 18:29	06:29 20:19	05:35 21:06	06:22 (18) 05:10
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	05:33 21:08	06:24 (18) 05:10
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	06:50 (19) 06:54 (19)	05:32 21:09
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	06:47 (19) 06:56 (19)	05:31 21:10
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	06:45 (19) 06:57 (19)	05:29 21:12
21	08:15 16:56	07:26 17:50	06:26 18:37	06:19 20:27	06:44 (19) 06:58 (19)	05:28 21:13
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	06:44 (19) 06:58 (19)	05:27 21:15
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	06:43 (19) 06:58 (19)	05:26 21:16
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	06:43 (19) 06:57 (19)	05:25 21:17
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	06:43 (19) 06:56 (19)	05:23 21:18
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	06:44 (19) 06:55 (19)	05:22 21:20
27	08:08 17:06	07:14 18:00	06:13 18:47	06:07 20:37	06:45 (19) 06:54 (19)	05:21 21:21
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	06:48 (19) 06:52 (19)	05:20 21:22
29	08:05 17:09		07:09 19:50	06:03 20:40	05:19 21:23	05:19 21:41
30	08:04 17:11		07:06 19:52	06:02 20:42	05:18 21:24	05:14 21:40
31	08:02 17:12		07:04 19:53		05:18 21:26	06:00 (16) 06:03 (16)
Sonnenscheinstunden	264	280	367	414	480	492
astr. max. mögl. Beschattung				383	224	552
Red. Sonnenscheinwahrsch.				0,40	0,44	0,38
Reduktion Betriebsdauer				0,83	0,83	0,83
Reduktion Windrichtung				0,62	0,67	0,70
Gesamte Reduktion				0,21	0,25	0,22
Met. wahrsch. Beschattung				79	55	121

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	Schattenanfang (WEA mit erstem Schatten)	Schattende (WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: B - IP01/1 - Bahnhofstr. 20, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober	November	Dezember
1	05:14	05:58 (16)	05:49	06:30 (18)	06:36	07:29 (17)	07:22	07:14	08:02
	21:40	06:17 (16)	21:10	06:47 (18)	20:11	07:49 (17)	19:04	17:00	16:22
2	05:15	05:58 (16)	05:50	06:30 (18)	06:38	07:28 (17)	07:24	07:15	08:04
	21:40	06:17 (16)	21:09	06:47 (18)	20:09	07:50 (17)	19:02	16:59	16:22
3	05:16	05:59 (16)	05:52	06:29 (18)	06:39	07:27 (17)	07:26	07:17	08:05
	21:40	06:17 (16)	21:07	06:47 (18)	20:06	07:49 (17)	18:59	16:57	16:21
4	05:16	05:59 (16)	05:53	06:30 (18)	06:41	07:27 (17)	07:27	07:19	08:06
	21:39	06:17 (16)	21:05	06:47 (18)	20:04	07:50 (17)	18:57	16:55	16:21
5	05:17	05:59 (16)	05:55	06:29 (18)	06:42	07:26 (17)	07:29	07:21	08:08
	21:39	06:16 (16)	21:04	06:47 (18)	20:02	07:49 (17)	18:55	16:53	16:20
6	05:18	06:00 (16)	05:56	06:30 (18)	06:44	07:27 (17)	07:30	07:22	08:09
	21:38	06:16 (16)	21:02	06:47 (18)	20:00	07:49 (17)	18:53	16:52	16:20
7	05:19	06:01 (16)	05:58	06:30 (18)	06:45	07:26 (17)	07:32	07:24	08:10
	21:38	06:16 (16)	21:00	06:46 (18)	19:58	07:48 (17)	18:51	16:50	16:19
8	05:20	06:02 (16)	05:59	06:30 (18)	06:47	07:27 (17)	07:34	07:26	08:11
	21:37	06:16 (16)	20:59	06:45 (18)	19:55	07:47 (17)	18:48	16:49	16:19
9	05:21	06:03 (16)	06:01	06:32 (18)	06:48	07:27 (17)	07:35	07:27	08:12
	21:36	06:16 (16)	20:57	06:44 (18)	19:53	07:45 (17)	18:46	16:47	16:19
10	05:22	06:04 (16)	06:02	06:33 (18)	06:50	07:29 (17)	07:37	07:29	08:14
	21:36	06:15 (16)	20:55	06:42 (18)	19:51	07:44 (17)	18:44	16:45	16:19
11	05:22	06:05 (16)	06:04		06:51	07:30 (17)	07:39	07:31	08:15
	21:35	06:14 (16)	20:53		19:49	07:41 (17)	18:42	16:44	16:18
12	05:24	06:07 (16)	06:05		06:53		07:40	07:32	08:16
	21:34	06:13 (16)	20:51		19:47		18:40	16:43	16:18
13	05:25		06:07		06:55		07:42	07:34	08:17
	21:33		20:50		19:44		18:38	16:41	16:18
14	05:26		06:08		06:56		07:43	07:36	08:17
	21:33		20:48		19:42		18:36	16:40	16:18
15	05:27		06:10		06:58		07:45	07:37	08:18
	21:32		20:46	5	06:59 (19)	19:40	18:33	16:38	16:18
16	05:28		06:11		06:59		07:47	07:39	08:19
	21:31		20:44	10	07:02 (19)	19:38	18:31	16:37	16:19
17	05:29		06:13		06:50 (19)	07:01	07:48	07:41	08:20
	21:30		20:42	12	07:02 (19)	19:35	18:29	16:36	16:19
18	05:30		06:14		06:50 (19)	07:02	07:50	07:42	08:21
	21:29		20:40	13	07:03 (19)	19:33	18:27	16:34	16:19
19	05:31		06:16		06:49 (19)	07:04	07:52	07:44	08:21
	21:28		20:38	14	07:03 (19)	19:31	18:25	16:33	16:19
20	05:33		06:18		06:49 (19)	07:05	07:53	07:46	08:22
	21:27		20:36	14	07:03 (19)	19:29	18:23	16:32	16:20
21	05:34		06:19		06:49 (19)	07:07	07:55	07:47	08:23
	21:25		20:34	13	07:02 (19)	19:26	18:21	16:31	16:20
22	05:35		06:21		06:49 (19)	07:08	07:57	07:49	08:23
	21:24		20:32	13	07:02 (19)	19:24	18:19	16:30	16:21
23	05:36		06:22		06:49 (19)	07:10	07:58	07:50	08:24
	21:23		20:30	12	07:01 (19)	19:22	18:17	16:29	16:21
24	05:38		06:24		06:51 (19)	07:12	08:00	07:52	08:24
	21:22		20:28	9	07:00 (19)	19:20	18:15	16:28	16:22
25	05:39		06:25		06:54 (19)	07:13	07:02	07:54	08:25
	21:20		20:26	2	06:56 (19)	19:17	17:13	16:27	16:22
26	05:40	06:36 (18)	06:27			07:15	07:03	07:55	08:25
	21:19	06:41 (18)	20:24	5		19:15	17:11	16:26	16:23
27	05:42	06:34 (18)	06:28			07:16	07:05	07:57	08:25
	21:18	06:43 (18)	20:22	9		19:13	17:09	16:25	16:24
28	05:43	06:32 (18)	06:30		07:37 (17)	07:18	07:07	07:58	08:25
	21:16	06:44 (18)	20:19	6	07:43 (17)	19:11	17:08	16:24	16:25
29	05:45	06:32 (18)	06:31		07:34 (17)	07:19	07:09	08:00	08:26
	21:15	06:46 (18)	20:17	12	07:46 (17)	19:08	17:06	16:24	16:25
30	05:46	06:31 (18)	06:33		07:31 (17)	07:21	07:10	08:01	08:26
	21:13	06:46 (18)	20:15	16	07:47 (17)	19:06	17:04	16:23	16:26
31	05:47	06:30 (18)	06:34		07:30 (17)		07:12		08:26
	21:12	06:46 (18)	20:13	19	07:49 (17)		17:02		16:27
Sonnenscheinstunden	496		450		380		333	271	250
astr. max. mögl. Beschattung		246		326		218			
Red. Sonnenscheinwahrsch.		0,47		0,46		0,38			
Reduktion Betriebsdauer		0,83		0,83		0,83			
Reduktion Windrichtung		0,69		0,65		0,61			
Gesamte Reduktion		0,27		0,25		0,19			
Met. wahrsch. Beschattung		65		80		42			

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattende
			(WEA mit letztem Schatten)

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: C - IP01/2 - Bahnhofstr. 18, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni						
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	07:37 (17) 07:54 (17)	06:00 20:43	06:27 (18) 06:40 (18)	05:17 21:27	05:59 (16) 06:19 (16)			
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	07:36 (17) 07:55 (17)	05:58 20:45	06:27 (18) 06:42 (18)	05:16 21:28	05:59 (16) 06:20 (16)			
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	07:34 (17) 07:55 (17)	05:56 20:46	06:26 (18) 06:42 (18)	05:15 21:29	05:59 (16) 06:20 (16)			
4	08:25 16:32	07:56 17:20	07:04 18:09	06:55 20:00	07:34 (17) 07:55 (17)	05:54 20:48	06:25 (18) 06:42 (18)	05:15 21:30	05:59 (16) 06:20 (16)			
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	07:34 (17) 07:55 (17)	05:52 20:50	06:25 (18) 06:42 (18)	05:14 21:31	05:48 (1) 06:20 (16)			
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	07:34 (17) 07:55 (17)	05:51 20:51	06:25 (18) 06:42 (18)	05:13 21:32	05:45 (1) 06:20 (16)			
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	07:34 (17) 07:54 (17)	05:49 20:53	06:25 (18) 06:41 (18)	05:13 21:32	05:45 (1) 06:21 (16)			
8	08:24 16:36	07:50 17:27	06:55 18:15	06:47 20:06	07:34 (17) 07:53 (17)	05:47 20:54	06:26 (18) 06:41 (18)	05:12 21:33	05:45 (1) 06:21 (16)			
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	07:34 (17) 07:51 (17)	05:46 20:56	06:26 (18) 06:40 (18)	05:12 21:34	05:44 (1) 06:21 (16)			
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	07:35 (17) 07:50 (17)	05:44 20:57	06:27 (18) 06:40 (18)	05:11 21:35	05:44 (1) 06:21 (16)			
11	08:23 16:40	07:45 17:32	06:49 18:20	06:40 20:11	07:36 (17) 07:48 (17)	05:42 20:59	06:27 (18) 06:38 (18)	05:11 21:36	05:44 (1) 06:22 (16)			
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	07:40 (17) 07:44 (17)	05:41 21:00	06:29 (18) 06:37 (18)	05:11 21:36	05:43 (1) 06:21 (16)			
13	08:22 16:43	07:41 17:36	06:44 18:24	06:36 20:14		05:39 21:02		05:11 21:37	05:43 (1) 06:22 (16)			
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16		05:38 21:03		05:10 21:37	05:43 (1) 06:22 (16)			
15	08:20 16:46	07:38 17:39	06:40 18:27	06:32 20:18		05:36 21:05		05:10 21:38	05:43 (1) 06:22 (16)			
16	08:19 16:48	07:36 17:41	06:38 18:29	06:29 20:19	06:54 (19) 06:57 (19)	05:35 21:06		05:10 21:39	05:43 (1) 06:22 (16)			
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	06:51 (19) 07:00 (19)	05:33 21:08		05:10 21:39	05:43 (1) 06:22 (16)			
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	06:49 (19) 07:01 (19)	05:32 21:09		05:10 21:39	05:43 (1) 06:23 (16)			
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	06:48 (19) 07:01 (19)	05:31 21:10		05:10 21:40	05:44 (1) 06:23 (16)			
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	06:48 (19) 07:01 (19)	05:29 21:12		05:10 21:40	05:44 (1) 06:23 (16)			
21	08:15 16:56	07:26 17:50	06:26 18:37	06:19 20:27	06:47 (19) 07:01 (19)	05:28 21:13		05:10 21:40	05:45 (1) 06:24 (16)			
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	06:47 (19) 07:01 (19)	05:27 21:15		05:10 21:41	05:45 (1) 06:24 (16)			
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	06:48 (19) 07:00 (19)	05:26 21:16	06:04 (16) 06:12 (16)	05:11 21:41	05:45 (1) 06:24 (16)			
24	08:11 17:01	07:20 17:55	06:20 18:42	06:13 20:32	06:48 (19) 06:58 (19)	05:25 21:17	06:03 (16) 06:14 (16)	05:11 21:41	05:44 (1) 06:24 (16)			
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	06:50 (19) 06:56 (19)	05:23 21:18	06:02 (16) 06:15 (16)	05:11 21:41	05:45 (1) 06:25 (16)			
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35		05:22 21:20	06:01 (16) 06:16 (16)	05:12 21:41	05:45 (1) 06:24 (16)			
27	08:08 17:06	07:14 18:00	06:13 18:47	06:07 20:37		05:21 21:21	06:00 (16) 06:16 (16)	05:12 21:41	05:46 (1) 06:25 (16)			
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38		05:20 21:22	06:00 (16) 06:17 (16)	05:13 21:41	05:46 (1) 06:25 (16)			
29	08:05 17:09		07:09 19:50	06:03 20:40	06:31 (18) 06:38 (18)	05:19 21:23	05:59 (16) 06:17 (16)	05:13 21:41	05:47 (1) 06:26 (16)			
30	08:04 17:11		07:06 19:52	06:02 20:42	06:29 (18) 06:39 (18)	05:18 21:24	06:00 (16) 06:19 (16)	05:14 21:40	05:47 (1) 06:25 (16)			
31	08:02 17:12		07:04 19:53	06:02 20:42		05:18 21:26	06:00 (16) 06:19 (16)	05:14 21:40	05:47 (1) 06:25 (16)			
	Sonnenscheinstunden	264	280	367	414	480		492				
	astr. max.mögl. Beschattung			24	330	309		997				
	Red. Sonnenscheinwahrsch.			0,31	0,40	0,44		0,38				
	Reduktion Betriebsdauer			0,83	0,83	0,83		0,83				
	Reduktion Windrichtung			0,61	0,62	0,68		0,70				
	Gesamte Reduktion			0,15	0,21	0,25		0,22				
	Met. wahrsch. Beschattung			4	68	77		218				

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	Schattenanfang (WEA mit erstem Schatten)	Schattenende (WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: C - IP01/2 - Bahnhofstr. 18, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember		
1	05:14 21:40	05:48 (1) 21:10	05:49 21:00	06:39 (18) 06:36	06:36 20:11	07:35 (17) 07:23	07:14 17:00	08:02 16:22
2	05:15 21:40	05:48 (1) 06:26 (16)	05:50 21:09	06:37 (18) 06:49 (18)	06:38 20:09	07:34 (17) 07:49 (17)	07:24 19:02	08:04 16:22
3	05:16 21:40	05:49 (1) 06:26 (16)	05:52 21:07	06:36 (18) 06:50 (18)	06:39 20:06	07:32 (17) 07:49 (17)	07:26 18:59	08:05 16:21
4	05:16 21:39	05:50 (1) 06:27 (16)	05:53 21:05	06:36 (18) 06:51 (18)	06:41 20:04	07:31 (17) 07:50 (17)	07:27 18:57	08:06 16:21
5	05:17 21:39	05:51 (1) 06:27 (16)	05:55 21:04	06:35 (18) 06:51 (18)	06:42 20:02	07:30 (17) 07:50 (17)	07:29 18:55	08:08 16:20
6	05:18 21:38	05:51 (1) 06:26 (16)	05:56 21:02	06:35 (18) 06:52 (18)	06:44 20:00	07:30 (17) 07:51 (17)	07:30 18:53	08:09 16:20
7	05:19 21:38	05:53 (1) 06:27 (16)	05:58 21:00	06:34 (18) 06:51 (18)	06:45 19:58	07:29 (17) 07:50 (17)	07:32 18:51	08:10 16:19
8	05:20 21:37	06:06 (16) 06:27 (16)	05:59 20:59	06:34 (18) 06:51 (18)	06:47 19:55	07:29 (17) 07:50 (17)	07:34 18:48	08:11 16:19
9	05:21 21:36	06:06 (16) 06:27 (16)	06:01 20:57	06:35 (18) 06:51 (18)	06:48 19:53	07:29 (17) 07:49 (17)	07:35 18:46	08:12 16:19
10	05:22 21:36	06:07 (16) 06:27 (16)	06:02 20:55	06:34 (18) 06:50 (18)	06:50 19:51	07:29 (17) 07:48 (17)	07:37 18:44	08:14 16:19
11	05:22 21:35	06:07 (16) 06:27 (16)	06:04 20:53	06:35 (18) 06:50 (18)	06:51 19:49	07:29 (17) 07:47 (17)	07:39 18:42	08:15 16:18
12	05:24 21:34	06:07 (16) 06:27 (16)	06:05 20:51	06:36 (18) 06:48 (18)	06:53 19:47	07:31 (17) 07:45 (17)	07:40 18:40	08:16 16:18
13	05:25 21:34	06:08 (16) 06:27 (16)	06:07 20:50	06:38 (18) 06:47 (18)	06:55 19:44	07:32 (17) 07:42 (17)	07:42 18:38	08:17 16:18
14	05:26 21:33	06:08 (16) 06:27 (16)	06:08 20:48	06:40 (18) 06:44 (18)	06:56 19:42	07:43 18:36	07:43 16:40	08:18 16:18
15	05:27 21:32	06:09 (16) 06:27 (16)	06:10 20:46	06:58 19:40	06:58 19:40	07:45 18:33	07:37 16:38	08:18 16:18
16	05:28 21:31	06:09 (16) 06:26 (16)	06:11 20:44	06:59 19:38	06:59 19:38	07:47 18:31	07:39 16:37	08:19 16:19
17	05:29 21:30	06:10 (16) 06:26 (16)	06:13 20:42	07:01 19:35	07:01 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	05:30 21:29	06:11 (16) 06:25 (16)	06:14 20:40	07:02 19:33	07:02 19:33	07:50 18:27	07:42 16:34	08:21 16:19
19	05:31 21:28	06:12 (16) 06:24 (16)	06:16 20:38	07:04 (19) 19:31	07:04 19:31	07:52 18:25	07:44 16:33	08:21 16:19
20	05:33 21:27	06:13 (16) 06:22 (16)	06:18 20:36	07:05 (19) 19:29	07:05 19:29	07:53 18:23	07:46 16:32	08:22 16:20
21	05:34 21:25	06:16 (16) 06:21 (16)	06:19 20:34	07:06 (19) 19:26	07:07 19:26	07:55 18:21	07:47 16:31	08:23 16:20
22	05:35 21:24	06:21 (16) 06:22	06:19 20:32	07:07 (19) 19:24	07:08 19:24	07:57 18:19	07:49 16:30	08:23 16:21
23	05:36 21:23	06:22 20:30	06:22 20:30	07:06 (19) 19:22	07:10 19:22	07:58 18:17	07:50 16:29	08:24 16:21
24	05:38 21:22	06:24 20:28	06:24 20:28	07:05 (19) 19:20	07:12 19:20	08:00 18:15	07:52 16:28	08:24 16:22
25	05:39 21:20	06:25 20:26	06:25 20:26	07:05 (19) 19:17	07:13 19:17	07:02 17:13	07:54 16:27	08:25 16:22
26	05:40 21:19	06:27 20:24	06:27 20:24	07:03 (19) 19:15	07:15 19:15	07:03 17:11	07:55 16:26	08:25 16:23
27	05:42 21:18	06:28 20:22	06:28 20:22	07:02 (19) 19:13	07:16 19:13	07:05 17:09	07:57 16:25	08:25 16:24
28	05:43 21:16	06:30 20:19	06:30 20:19	07:06 (19) 19:11	07:18 19:11	07:07 17:08	07:58 16:24	08:25 16:25
29	05:45 21:15	06:31 20:17	06:31 20:17	07:07 (19) 19:08	07:19 19:08	07:09 17:06	08:00 16:24	08:26 16:25
30	05:46 21:13	06:33 20:15	06:33 20:15	07:08 (19) 19:06	07:21 19:06	07:10 17:04	08:01 16:23	08:26 16:26
31	05:47 21:12	06:41 (18) 06:45 (18)	06:34 20:13	07:40 (17) 07:44 (17)	07:15 19:06	07:12 17:02	07:56 16:27	08:26 16:27
Sonnenscheinstunden	496	450	380	333	271	250		
astr. max. mögl. Beschattung	458	299	227					
Red. Sonnenscheinwahrsch.	0,47	0,46	0,38					
Reduktion Betriebsdauer	0,83	0,83	0,83					
Reduktion Windrichtung	0,70	0,65	0,61					
Gesamte Reduktion	0,27	0,25	0,19					
Met. wahrsch. Beschattung	123	74	43					

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenende (WEA mit letztem Schatten)

Projekt:

SW19001 Zell

TurboWind Energie GmbH
 Vahrenwalder Str. 245-247
 30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
 Zusatzbelastung:
 - 1x ENERCON E-138, 3.500 kW, NH: 160 m
 Vorbelastung:
 - 5x ENERCON E-115, 3.000 kW, NH: 149 m
 - 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
 - 1x AN BONUS, 1.000 kW, NH: 70,0 m
 - 1x AN BONUS, 600 kW, NH: 58,0 m
 - 1x AN BONUS, 150 kW, NH: 30,0 m
 - 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
 Frimmersdorfer Straße 73a
 DE-41517 Grevenbroich
 +49 2181 2278 0
 lasma.pikuma@windtest-nrw.de
 Berechnet:
 22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: D - IP01/3 - Bahnhofstr. 14A, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni						
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	07:44 (17) 20:43	06:00 17	06:32 (18)	05:17			05:49 (1)	
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	07:45 (17) 20:45	05:58 17	06:33 (18)	05:16	34	06:28 (16)		
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	07:44 (17) 20:46	05:56 16	06:33 (18)	05:15	35	06:29 (16)		
4	08:25 16:32	07:56 17:20	07:04 18:09	06:55 20:00	07:45 (17) 20:46	05:54 15	06:33 (18)	05:15	37	06:29 (16)		
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	07:46 (17) 20:50	05:52 14	06:34 (18)	05:14	37	06:29 (16)		
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	07:47 (17) 20:51	05:51 12	06:35 (18)	05:13	37	06:28 (16)		
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	07:50 (17) 20:53	05:49 10	06:35 (18)	05:13	39	06:29 (16)		
8	08:24 16:36	07:50 17:27	06:55 18:15	06:47 20:06	07:56 (17) 20:54	05:47 5	06:38 (18)	05:12	38	06:29 (16)		
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56			05:12	37	06:28 (16)		
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	05:44 20:57			05:11	38	06:29 (16)		
11	08:23 16:40	07:45 17:32	06:49 18:20	06:40 20:11	05:42 20:59			05:11	37	06:29 (16)		
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00			05:11	37	06:28 (16)		
13	08:22 16:43	07:41 17:36	06:44 18:24	06:36 20:14	07:00 (19) 21:02			05:11	36	06:28 (16)		
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	07:04 (19) 21:03			05:10	36	06:28 (16)		
15	08:20 16:46	07:38 17:39	06:40 18:27	06:32 20:18	07:06 (19) 21:05			05:10	35	06:28 (16)		
16	08:19 16:48	07:36 17:41	06:38 18:29	06:29 20:19	07:08 (19) 21:06		06:15 (16)	05:10	35	06:28 (16)		
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	07:08 (19) 21:08		06:12 (16)	05:10	36	06:28 (16)		
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	07:08 (19) 21:09		06:11 (16)	05:10	36	06:29 (16)		
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	07:08 (19) 21:09		06:10 (16)	05:10	36	06:29 (16)		
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	07:07 (19) 21:10		06:08 (16)	05:10	36	06:29 (16)		
21	08:15 16:56	07:26 17:50	06:26 18:37	06:19 20:27	07:06 (19) 21:12		06:08 (16)	05:10	35	06:29 (16)		
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	07:05 (19) 21:13		06:08 (16)	05:10	35	06:30 (16)		
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	07:03 (19) 21:15		06:07 (16)	05:11	35	06:30 (16)		
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	07:03 (19) 21:17		06:07 (16)	05:11	36	06:30 (16)		
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	07:04 (17) 20:34		06:07 (16)	05:11	36	06:31 (16)		
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	07:00 (17) 20:35		06:06 (16)	05:12	36	06:31 (16)		
27	08:08 17:06	07:14 18:00	06:13 18:47	06:07 20:37	07:03 (17) 20:37		06:06 (16)	05:12	35	06:31 (16)		
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	07:04 (17) 20:37		06:06 (16)	05:13	36	06:31 (16)		
29	08:05 17:09	07:09 19:50	06:09 18:48	06:03 20:40	07:05 (17) 20:38		06:06 (16)	05:13	37	06:32 (16)		
30	08:04 17:11	07:06 19:52	06:06 18:49	06:02 20:42	07:45 (17) 20:42		06:06 (16)	05:14	37	06:32 (16)		
31	08:02 17:12	07:04 19:53	06:04 18:50	06:01 20:44	07:45 (17) 20:44		06:06 (16)	05:14	37	06:32 (16)		
Sonnenscheinstunden	264	280	367	414	480			492				
astr.max.mögl.Beschattung			113	294	417			1087				
Red.Sonnenscheinwahrsch.			0,31	0,40	0,44			0,38				
Reduktion Betriebsdauer			0,83	0,83	0,83			0,83				
Reduktion Windrichtung			0,60	0,63	0,68			0,69				
Gesamte Reduktion			0,15	0,21	0,25			0,22				
Met.wahrsch.Beschattung			17	61	104			237				

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang (WEA mit erstem Schatten)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattende (WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: D - IP01/3 - Bahnhofstr. 14A, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Table with columns for months (Juli, August, September, Oktober, November, Dezember) and rows for days, showing sunrise/sunset times and solar hours.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat Sonnenaufgang (SS:MM) Sonnenuntergang (SS:MM) Minuten mit Schatten Zeitpunkt (SS:MM) Schattenanfang Zeitpunkt (SS:MM) Schattende (WEA mit erstem Schatten) (WEA mit letztem Schatten)



Projekt:

SW19001 Zelle

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: GesamtbelastungSchattenrezeptor: E - IP01/4 - Brückengarten 10, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28 17:14 18:03	08:01 17:14 18:03	07:10 18:03	07:02 19:55	07:53 (17) 06:00	05:17 06:40 (18) 21:27
2	08:26 16:29 17:16 18:05	07:59 17:16 18:05	07:08 18:05	07:00 19:56	07:54 (17) 05:58	05:16 06:41 (18) 21:28
3	08:26 16:30 17:18 18:07	07:58 17:18 18:07	07:06 18:07	06:57 19:58	07:57 (17) 05:56	05:15 06:42 (18) 21:29
4	08:25 16:32 17:20 18:09	07:56 17:20 18:09	07:04 18:09	06:55 20:00	08:04 (17) 20:46	05:15 06:46 (18) 21:30
5	08:25 16:33 17:21 18:10	07:55 17:21 18:10	07:01 18:10	06:53 20:01	05:52 20:50	05:14 21:31 27
6	08:25 16:34 17:23 18:12	07:53 17:23 18:12	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:32 23
7	08:25 16:35 17:25 18:14	07:52 17:25 18:14	06:57 18:14	06:49 20:05	05:49 20:53	05:13 21:32 21
8	08:24 16:36 17:27 18:15	07:50 17:27 18:15	06:55 18:15	06:47 20:06	05:47 20:54	05:12 21:33 21
9	08:24 16:38 17:28 18:17	07:48 17:28 18:17	06:53 18:17	06:44 20:08	05:46 20:56	05:12 21:34 21
10	08:23 16:39 17:30 18:19	07:47 17:30 18:19	06:51 18:19	06:42 20:09	05:44 20:57	05:11 21:35 21
11	08:23 16:40 17:32 18:20	07:45 17:32 18:20	06:49 18:20	06:40 20:11	07:03 (19) 05:42	05:11 06:20 (16) 21:36
12	08:22 16:42 17:34 18:22	07:43 17:34 18:22	06:46 18:22	06:38 20:13	07:11 (19) 20:59	05:11 06:29 (16) 21:36
13	08:22 16:43 17:36 18:24	07:41 17:36 18:24	06:44 18:24	06:36 20:14	07:00 (19) 05:39	05:11 06:17 (16) 21:37
14	08:21 16:45 17:37 18:25	07:39 17:37 18:25	06:42 18:25	06:34 20:16	07:13 (19) 21:02	05:10 06:32 (16) 21:37
15	08:20 16:46 17:39 18:27	07:38 17:39 18:27	06:40 18:27	06:32 20:18	07:00 (19) 05:38	05:10 06:16 (16) 21:38
16	08:19 16:48 17:41 18:29	07:36 17:41 18:29	06:38 18:29	06:29 20:19	06:59 (19) 05:35	05:10 06:14 (16) 21:39
17	08:19 16:49 17:43 18:30	07:34 17:43 18:30	06:35 18:30	06:27 20:21	07:12 (19) 21:08	05:10 06:14 (16) 21:39
18	08:18 16:51 17:44 18:32	07:32 17:44 18:32	06:33 18:32	06:25 20:22	07:12 (19) 21:08	05:10 06:14 (16) 21:39
19	08:17 16:52 17:46 18:34	07:30 17:46 18:34	06:31 18:34	06:23 20:24	07:02 (19) 05:31	05:10 06:14 (16) 21:40
20	08:16 16:54 17:48 18:35	07:28 17:48 18:35	06:29 18:35	06:21 20:26	07:08 (19) 21:10	05:10 06:13 (16) 21:40
21	08:15 16:56 17:50 18:37	07:26 17:50 18:37	06:26 18:37	06:19 20:27	05:28 21:13	05:10 06:14 (16) 21:40
22	08:14 16:57 17:51 18:39	07:24 17:51 18:39	06:24 18:39	06:17 20:29	06:44 (18) 05:27	05:10 06:14 (16) 21:41
23	08:13 16:59 17:53 18:40	07:22 17:53 18:40	06:22 18:40	06:15 20:30	06:53 (18) 21:15	05:11 06:35 (16) 21:41
24	08:11 17:00 17:55 18:42	07:20 17:55 18:42	06:20 18:42	06:13 20:32	06:42 (18) 05:26	05:11 06:35 (16) 21:41
25	08:10 17:02 17:57 18:43	07:18 17:57 18:43	06:17 18:43	06:11 20:34	06:54 (18) 21:16	05:11 06:35 (16) 21:41
26	08:09 17:04 17:58 18:45	07:16 17:58 18:45	06:15 18:45	06:09 20:35	06:41 (18) 05:25	05:12 06:35 (16) 21:41
27	08:08 17:06 18:00 18:47	07:14 18:00 18:47	06:13 18:47	06:07 20:37	06:55 (18) 21:17	05:12 06:35 (16) 21:41
28	08:06 17:07 18:02 18:48	07:12 18:02 18:48	06:11 18:48	06:05 20:38	06:40 (18) 05:23	05:13 06:34 (16) 21:41
29	08:05 17:09 18:04 18:49	07:10 18:04 18:49	06:09 18:49	06:03 20:40	06:55 (18) 21:23	05:13 06:34 (16) 21:41
30	08:04 17:11 18:06 18:50	07:06 18:06 18:50	06:06 18:50	06:02 20:42	06:39 (18) 05:18	05:14 06:34 (16) 21:41
31	08:02 17:12 18:07 18:51	07:04 18:07 18:51	06:04 18:51	06:00 20:44	06:55 (18) 21:24	05:14 06:34 (16) 21:41
	Sonnenscheinstunden	264	280	367	414	492
	astr. max.mögl. Beschattung			176	269	668
	Red. Sonnenscheinwahrsch.			0,31	0,40	0,38
	Reduktion Betriebsdauer			0,83	0,83	0,83
	Reduktion Windrichtung			0,59	0,63	0,70
	Gesamte Reduktion			0,15	0,21	0,22
	Met. wahrsch. Beschattung			26	56	146

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang (WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM) Schattende (WEA mit letztem Schatten)



Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: E - IP01/4 - Brückengarten 10, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Tag	Juli		August		September		Oktober		November		Dezember	
	Beginn (SS:MM)	Ende (SS:MM)	Beginn (SS:MM)	Ende (SS:MM)	Beginn (SS:MM)	Ende (SS:MM)	Beginn (SS:MM)	Ende (SS:MM)	Beginn (SS:MM)	Ende (SS:MM)	Beginn (SS:MM)	Ende (SS:MM)
1	05:14	05:58 (1)	05:49	06:29 (16)	06:36	07:02 (19)	07:23	07:14	08:02			
2	05:15	05:57 (1)	05:50	06:41 (16)	06:38	07:09 (19)	19:04	17:00	16:22			
3	05:16	05:58 (1)	05:52	06:38 (16)	20:09		19:02	16:59	16:22			
4	05:16	05:58 (1)	05:53	06:31 (16)	06:38		07:24	07:15	08:04			
5	05:17	05:58 (1)	05:55	06:38 (16)	20:09		19:02	16:59	16:22			
6	05:18	05:58 (1)	05:56	06:31 (16)	06:38		07:24	07:15	08:04			
7	05:19	05:59 (1)	05:58	06:38 (16)	20:09		19:02	16:59	16:22			
8	05:20	05:59 (1)	05:59	06:31 (16)	06:38		07:24	07:15	08:04			
9	05:21	05:59 (1)	06:01	06:38 (16)	20:09		19:02	16:59	16:22			
10	05:22	06:00 (1)	06:02	06:31 (16)	06:38		07:24	07:15	08:04			
11	05:22	06:00 (1)	06:04	06:38 (16)	20:09		19:02	16:59	16:22			
12	05:24	06:00 (1)	06:05	06:31 (16)	06:38		07:24	07:15	08:04			
13	05:25	06:01 (1)	06:07	06:38 (16)	20:09		19:02	16:59	16:22			
14	05:26	06:01 (1)	06:08	06:31 (16)	06:38		07:24	07:15	08:04			
15	05:27	06:02 (1)	06:10	06:38 (16)	20:09		19:02	16:59	16:22			
16	05:28	06:02 (1)	06:11	06:31 (16)	06:38		07:24	07:15	08:04			
17	05:29	06:03 (1)	06:13	06:38 (16)	20:09		19:02	16:59	16:22			
18	05:30	06:04 (1)	06:14	06:31 (16)	06:38		07:24	07:15	08:04			
19	05:31	06:05 (1)	06:16	06:38 (16)	20:09		19:02	16:59	16:22			
20	05:33	06:06 (1)	06:18	06:31 (16)	06:38		07:24	07:15	08:04			
21	05:34	06:09 (1)	06:19	06:38 (16)	20:09		19:02	16:59	16:22			
22	05:35	06:10 (1)	06:20	06:31 (16)	06:38		07:24	07:15	08:04			
23	05:36	06:11 (1)	06:21	06:38 (16)	20:09		19:02	16:59	16:22			
24	05:38	06:12 (1)	06:22	06:31 (16)	06:38		07:24	07:15	08:04			
25	05:39	06:13 (1)	06:23	06:38 (16)	20:09		19:02	16:59	16:22			
26	05:40	06:14 (1)	06:24	06:31 (16)	06:38		07:24	07:15	08:04			
27	05:42	06:15 (1)	06:25	06:38 (16)	20:09		19:02	16:59	16:22			
28	05:43	06:16 (1)	06:26	06:31 (16)	06:38		07:24	07:15	08:04			
29	05:45	06:17 (1)	06:27	06:38 (16)	20:09		19:02	16:59	16:22			
30	05:46	06:18 (1)	06:28	06:31 (16)	06:38		07:24	07:15	08:04			
31	05:47	06:19 (1)	06:29	06:38 (16)	20:09		19:02	16:59	16:22			
	21:12	15	06:42 (16)	20:13	11	07:12 (19)	07:12	16:27	16:27			
	Sonnenscheinstunden	496		450		380		333	271			250
	astr.max.mögl.Beschattung		799		286		224					
	Red.Sonnenscheinwahrsch.		0,47		0,46		0,38					
	Reduktion Betriebsdauer		0,83		0,83		0,83					
	Reduktion Windrichtung		0,69		0,64		0,59					
	Gesamte Reduktion		0,26		0,24		0,18					
	Met.wahrsch.Beschattung		211		70		41					

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	Schattenanfang (WEA mit erstem Schatten)	Schattenende (WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	--------------------------------	--	---

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: F - IP01/5 - Bahnhofstr. 4, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:04	07:02 19:55	06:00 20:43	05:17 21:27
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28
3	08:26 16:31	07:58 17:18	07:06 18:07	06:58 19:58	05:56 20:46	05:15 21:29
4	08:25 16:32	07:56 17:20	07:04 18:09	06:55 20:00	05:54 20:48	05:15 21:30
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:53 20:50	05:14 21:31
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:32
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	05:49 20:53	05:13 21:32
8	08:24 16:36	07:50 17:27	06:55 18:15	06:47 20:06	05:47 20:54	05:12 21:33
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	05:12 21:34
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	05:44 20:57	05:11 21:35
11	08:23 16:40	07:45 17:32	06:49 18:20	06:40 20:11	05:42 20:59	05:11 21:36
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00	05:11 21:36
13	08:22 16:43	07:41 17:36	06:44 18:24	06:36 20:14	05:39 21:02	05:11 21:37
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	05:38 21:03	05:10 21:38
15	08:20 16:46	07:38 17:39	06:40 18:27	06:32 20:18	05:36 21:05	05:10 21:38
16	08:19 16:48	07:36 17:41	06:38 18:29	06:29 20:19	05:35 21:06	05:10 21:39
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	05:33 21:08	05:10 21:39
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:10 21:39
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:10 21:40
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	05:29 21:12	05:10 21:40
21	08:15 16:56	07:26 17:50	06:26 18:37	06:19 20:27	05:28 21:13	05:10 21:40
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15	05:10 21:41
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 21:41
24	08:11 17:01	07:20 17:55	06:20 18:42	06:13 20:32	05:25 21:17	05:11 21:41
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18	05:11 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	05:12 21:41
27	08:08 17:06	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 21:41
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:13 21:41
29	08:05 17:09	07:09 19:50	06:03 08:07 (17)	06:03 20:40	05:19 21:23	05:13 21:41
30	08:04 17:11	07:06 19:52	06:02 19:53	06:02 20:42	05:18 21:24	05:14 21:40
31	08:02 17:13	07:04 19:53			05:18 21:26	
Sonnenscheinstunden	264	280	367	414	480	492
astr.max.mögl.Beschattung			164	142	235	
Red.Sonnenscheinwahrsch.			0,31	0,40	0,44	
Reduktion Betriebsdauer			0,83	0,83	0,83	
Reduktion Windrichtung			0,58	0,64	0,66	
Gesamte Reduktion			0,15	0,21	0,24	
Met.wahrsch.Beschattung			24	30	56	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: F - IP01/5 - Bahnhofstr. 4, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli	August	September	Oktober	November	Dezember					
1	05:14 21:40	05:49 21:10	06:41 (16) 20:11	06:36 20:11	07:23 19:04	07:14 17:00	08:02 16:22				
2	05:15 21:40	05:50 21:09	06:40 (16) 20:09	06:38 20:09	07:24 19:02	07:15 16:59	08:04 16:22				
3	05:16 21:40	05:52 21:07	06:39 (16) 20:06	06:39 20:06	07:26 18:59	07:17 16:57	08:05 16:21				
4	05:16 21:39	05:53 21:05	06:39 (16) 20:04	06:41 20:04	07:27 18:57	07:19 16:55	08:06 16:21				
5	05:17 21:39	05:55 21:04	06:38 (16) 20:02	06:42 20:02	07:29 18:55	07:21 16:53	08:08 16:20				
6	05:18 21:38	05:56 21:02	06:39 (16) 20:00	06:44 20:00	07:30 18:53	07:22 16:52	08:09 16:20				
7	05:19 21:38	05:58 21:00	06:38 (16) 19:58	06:45 19:58	07:32 18:51	07:24 16:50	08:10 16:19				
8	05:20 21:37	05:59 20:59	06:38 (16) 19:55	06:47 19:55	07:34 18:48	07:26 16:49	08:11 16:19				
9	05:21 21:37	06:01 20:57	06:39 (16) 19:53	06:48 19:53	07:35 18:46	07:27 16:47	08:12 16:19				
10	05:22 21:36	06:02 20:55	06:39 (16) 19:51	06:50 19:51	07:37 18:44	07:29 16:45	08:14 16:19				
11	05:23 21:35	06:04 20:53	06:40 (16) 19:49	06:51 19:49	07:39 18:42	07:31 16:44	08:15 16:18				
12	05:24 21:34	06:05 20:51	06:41 (16) 19:47	06:53 19:47	07:40 18:40	07:32 16:43	08:16 16:18				
13	05:25 21:34	06:07 20:50	06:43 (16) 19:44	06:55 19:44	07:42 18:38	07:34 16:41	08:17 16:18				
14	05:26 21:33	06:08 20:48	06:56 19:42	06:56 19:42	07:52 (17) 07:57 (17)	07:43 18:36	07:36 16:40	08:18 16:18			
15	05:27 21:32	06:10 20:46	06:58 19:40	06:58 19:40	07:48 (17) 07:59 (17)	07:45 18:34	07:38 16:38	08:18 16:18			
16	05:28 21:31	06:11 20:44	06:59 19:38	06:59 19:38	07:47 (17) 08:01 (17)	07:47 18:31	07:39 16:37	08:19 16:19			
17	05:29 21:30	06:13 20:42	07:01 19:35	07:01 19:35	07:45 (17) 08:01 (17)	07:48 18:29	07:41 16:36	08:20 16:19			
18	05:30 21:29	06:14 20:40	06:59 (18) 19:33	07:02 19:33	07:44 (17) 08:02 (17)	07:50 18:27	07:42 16:34	08:21 16:19			
19	05:31 21:28	06:16 20:38	06:56 (18) 19:31	07:04 19:31	07:43 (17) 08:01 (17)	07:52 18:25	07:44 16:33	08:21 16:19			
20	05:33 21:27	06:18 20:36	06:56 (18) 19:29	07:05 19:29	07:43 (17) 08:01 (17)	07:53 18:23	07:46 16:32	08:22 16:20			
21	05:34 21:25	06:19 20:34	06:55 (18) 19:26	07:07 19:26	07:43 (17) 08:00 (17)	07:55 18:21	07:47 16:31	08:23 16:20			
22	05:35 21:24	06:21 20:32	06:55 (18) 19:24	07:08 19:24	07:43 (17) 08:00 (17)	07:57 18:19	07:49 16:30	08:23 16:21			
23	05:36 21:23	06:22 20:30	06:54 (18) 19:22	07:10 19:22	07:43 (17) 07:58 (17)	07:58 18:17	07:51 16:29	08:24 16:21			
24	05:38 21:22	06:24 20:28	06:54 (18) 19:20	07:12 19:20	07:45 (17) 07:57 (17)	08:00 18:15	07:52 16:28	08:24 16:22			
25	05:39 21:20	06:25 20:26	06:54 (18) 19:17	07:13 19:17	07:46 (17) 07:53 (17)	07:02 17:13	07:54 16:27	08:25 16:22			
26	05:40 21:19	06:27 20:24	06:55 (18) 19:15	07:15 19:15	07:03 17:11	07:03 16:26	07:55 16:27	08:25 16:23			
27	05:42 21:18	06:28 20:22	06:56 (18) 19:13	07:16 19:13	07:05 17:10	07:05 16:25	07:57 16:25	08:25 16:24			
28	05:43 21:16	06:30 20:19	06:59 (18) 19:11	07:18 19:11	07:07 17:08	07:07 16:24	07:58 16:24	08:25 16:25			
29	05:45 21:15	06:44 (16) 06:52 (16)	06:31 20:17	07:19 19:08	07:09 17:06	08:00 16:24	08:00 16:25	08:26 16:25			
30	05:46 21:13	06:42 (16) 06:54 (16)	06:33 20:15	07:21 19:06	07:10 17:04	08:01 16:23	08:01 16:26	08:26 16:26			
31	05:47 21:12	06:41 (16) 06:54 (16)	06:35 20:13	07:23 19:06	07:12 17:02	08:02 16:27	08:02 16:27	08:26 16:27			
Sonnenscheinstunden	496	450	380	333	271	250					
astr. max. mögl. Beschattung	33	339	168								
Red. Sonnenscheinwahrsch.	0,47	0,46	0,38								
Reduktion Betriebsdauer	0,83	0,83	0,83								
Reduktion Windrichtung	0,66	0,65	0,58								
Gesamte Reduktion	0,25	0,25	0,18								
Met. wahrsch. Beschattung	8	83	30								

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	Schattenanfang (WEA mit erstem Schatten)	Schattende (WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

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- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: G - IP01/6 - Bahnhofstr. 8, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:04	07:02 19:55	07:49 (17) 20:43	05:17 21:27
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	07:51 (17) 20:45	05:16 21:28
3	08:26 16:31	07:58 17:18	07:06 18:07	06:58 19:58	07:59 (17) 20:46	05:15 21:29
4	08:25 16:32	07:56 17:20	07:04 18:09	06:55 20:00	05:54 20:48	06:29 (16) 21:30
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:53 20:50	06:26 (16) 21:31
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	06:24 (16) 21:32
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	05:49 20:53	06:22 (16) 21:32
8	08:24 16:36	07:50 17:27	06:55 18:15	06:47 20:06	05:47 20:54	06:22 (16) 21:33
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	06:21 (16) 21:34
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	05:44 20:57	06:21 (16) 21:35
11	08:23 16:40	07:45 17:32	06:49 18:20	06:40 20:11	05:42 20:59	06:20 (16) 21:36
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00	06:20 (16) 21:36
13	08:22 16:43	07:41 17:36	06:44 18:24	06:36 20:14	05:39 21:02	06:20 (16) 21:37
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	05:38 21:03	06:20 (16) 21:37
15	08:20 16:46	07:38 17:39	06:40 18:27	06:32 20:18	05:36 21:05	06:21 (16) 21:38
16	08:19 16:48	07:36 17:41	06:38 18:29	06:29 20:19	05:35 21:06	06:20 (16) 21:39
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	05:33 21:08	06:21 (16) 21:39
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	06:22 (16) 21:39
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	06:23 (16) 21:40
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	05:29 21:12	06:23 (16) 21:40
21	08:15 16:56	07:26 17:50	06:26 18:37	06:19 20:27	05:28 21:13	06:25 (16) 21:40
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15	06:27 (16) 21:41
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	06:32 (16) 21:41
24	08:11 17:01	07:20 17:55	06:20 18:42	06:13 20:32	05:25 21:17	06:42 (18) 21:41
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18	06:48 (18) 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	06:58 (18) 21:41
27	08:08 17:06	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	06:42 (18) 21:41
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	06:56 (18) 21:41
29	08:05 17:09	07:09 19:50	06:09 19:50	06:03 20:40	05:19 21:23	06:45 (18) 21:41
30	08:04 17:11	07:06 19:52	06:06 19:52	06:02 20:42	05:18 21:24	06:53 (18) 21:41
31	08:02 17:13	07:04 19:53	06:04 19:53	06:00 20:44	05:17 21:26	07:48 (17) 21:41
Sonnenscheinstunden	264	280	367	414	480	492
astr.max.mögl.Beschattung			148	158	272	
Red.Sonnenscheinwahrsch.			0,31	0,40	0,44	
Reduktion Betriebsdauer			0,83	0,83	0,83	
Reduktion Windrichtung			0,59	0,63	0,67	
Gesamte Reduktion			0,15	0,21	0,24	
Met.wahrsch.Beschattung			22	33	66	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	--------------------------------	---------------------------	----------------------------

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: G - IP01/6 - Bahnhofstr. 8, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember	
1	05:14 21:40	05:49 21:10	06:31 (16) 20:11	06:36 20:11	07:23 19:04	07:14 17:00	08:02 16:22
2	05:15 21:40	05:50 21:09	06:30 (16) 20:09	06:38 20:09	07:24 19:02	07:15 16:59	08:04 16:22
3	05:16 21:40	05:52 21:07	06:30 (16) 20:06	06:39 20:06	07:26 18:59	07:17 16:57	08:05 16:21
4	05:16 21:39	05:53 21:05	06:31 (16) 20:04	06:41 20:04	07:27 18:57	07:19 16:55	08:06 16:21
5	05:17 21:39	05:55 21:04	06:32 (16) 20:02	06:42 20:02	07:29 18:55	07:21 16:53	08:08 16:20
6	05:18 21:38	05:56 21:02	06:33 (16) 20:00	06:44 20:00	07:30 18:53	07:22 16:52	08:09 16:20
7	05:19 21:38	05:58 21:00	06:34 (16) 19:58	06:45 19:58	07:32 18:51	07:24 16:50	08:10 16:19
8	05:20 21:37	05:59 20:59	06:35 (16) 19:55	06:47 19:55	07:34 18:48	07:26 16:49	08:11 16:19
9	05:21 21:37	06:01 20:57	06:43 (16) 19:53	06:48 19:53	07:35 18:46	07:27 16:47	08:12 16:19
10	05:22 21:36	06:02 20:55	06:50 19:51	06:50 19:51	07:37 18:44	07:29 16:45	08:14 16:19
11	05:23 21:35	06:04 20:53	06:51 19:49	7 07:45 (17) 07:52 (17)	07:37 18:44	07:31 16:44	08:15 16:18
12	05:24 21:34	06:05 20:51	06:53 19:47	12 07:54 (17) 07:41 (17)	07:39 07:40	07:31 07:32	08:16 16:18
13	05:25 21:34	06:07 20:50	06:56 (18) 19:44	14 07:55 (17) 07:39 (17)	07:42 07:42	07:34 16:41	08:17 16:18
14	05:26 21:33	06:08 20:48	3 06:59 (18) 06:53 (18)	16 07:55 (17) 07:38 (17)	18 07:56 (17) 07:43	16:41 16:40	16:18 16:18
15	05:27 21:32	06:10 20:46	8 07:01 (18) 06:51 (18)	18 07:56 (17) 07:37 (17)	18 07:55 (17) 18:34	07:38 16:38	08:18 16:18
16	05:28 21:31	06:11 20:44	11 07:02 (18) 06:50 (18)	18 07:55 (17) 06:59	19 07:56 (17) 07:47	16:38 07:39	16:18 08:19
17	05:29 21:30	06:13 20:42	13 07:03 (18) 06:49 (18)	19 07:56 (17) 07:01	19 07:56 (17) 07:48	16:37 07:41	16:19 08:20
18	05:30 21:29	06:14 20:40	14 07:03 (18) 06:49 (18)	17 07:54 (17) 07:02	17 07:54 (17) 18:27	16:36 16:34	16:19 16:19
19	05:31 21:28	06:16 20:38	15 07:04 (18) 06:48 (18)	17 07:54 (17) 07:37 (17)	18 07:54 (17) 07:52	16:34 07:44	16:19 08:21
20	05:33 21:27	06:18 20:36	15 07:03 (18) 06:49 (18)	15 07:52 (17) 07:39 (17)	18 07:52 (17) 07:53	16:33 07:46	16:19 08:22
21	05:34 21:25	06:19 20:34	14 07:03 (18) 06:48 (18)	12 07:51 (17) 07:07	12 07:51 (17) 07:55	16:32 07:47	16:20 08:23
22	05:35 21:24	06:21 20:32	14 07:02 (18) 06:49 (18)	6 07:47 (17) 07:08	6 07:47 (17) 07:57	16:31 07:49	16:20 08:23
23	05:36 21:23	06:22 20:30	13 07:02 (18) 06:50 (18)	7 06:43 (16) 07:10	7 06:43 (16) 07:58	16:30 07:51	16:21 08:24
24	05:38 21:22	06:24 20:28	10 07:00 (18) 06:52 (18)	10 07:00 (18) 07:12	10 06:45 (16) 08:00	16:29 07:52	16:21 08:24
25	05:39 21:20	06:25 20:26	6 06:58 (18) 07:13	13 06:58 (18) 07:13	13 06:46 (16) 07:02	16:22 07:54	16:22 08:25
26	05:40 21:19	06:27 20:24	15 06:47 (16) 06:32 (16)	15 06:47 (16) 06:27	15 06:47 (16) 07:03	16:27 07:55	16:22 08:25
27	05:42 21:18	06:28 20:22	16 06:48 (16) 06:31 (16)	16 06:48 (16) 06:27	16 06:48 (16) 07:11	16:26 07:56	16:23 08:25
28	05:43 21:16	06:30 20:19	17 06:48 (16) 06:31 (16)	17 06:48 (16) 06:28	17 06:48 (16) 07:10	16:25 07:57	16:24 08:25
29	05:45 21:15	06:31 (16) 20:17	17 06:48 (16) 06:31 (16)	17 06:48 (16) 06:28	17 06:48 (16) 07:19	16:25 08:00	16:25 08:26
30	05:46 21:13	06:31 (16) 20:15	18 06:49 (16) 06:33	18 06:49 (16) 06:33	18 06:49 (16) 07:21	16:25 08:01	16:25 08:26
31	05:47 21:12	06:30 (16) 20:13	18 06:49 (16) 20:15	18 06:49 (16) 20:15	18 06:49 (16) 19:06	16:24 16:23	08:26 16:26
Sonnenscheinstunden	496	450	380	333	271	250	
astr.max.mögl.Beschattung	150	257	171				
Red.Sonnenscheinwahrsch.	0,47	0,46	0,38				
Reduktion Betriebsdauer	0,83	0,83	0,83				
Reduktion Windrichtung	0,67	0,65	0,59				
Gesamte Reduktion	0,26	0,25	0,18				
Met.wahrsch.Beschattung	39	64	31				

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenende
			(WEA mit letztem Schatten)

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziertes Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: H - IP02 - Frohnhofstr. 4, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:04	07:02 19:55	06:00 20:43	05:17 21:27
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	07:22 (18) 05:58	05:16 21:28
3	08:26 16:31	07:58 17:18	07:06 18:07	06:58 19:58	07:20 (18) 05:56	05:15 21:29
4	08:26 16:32	07:56 17:20	07:04 18:09	06:55 20:00	07:17 (18) 05:54	05:15 21:30
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	07:15 (18) 05:53	05:14 21:31
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	07:14 (18) 05:51	05:13 21:32
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	07:14 (18) 05:49	05:13 21:33
8	08:24 16:36	07:50 17:27	06:55 18:15	06:47 20:06	07:14 (18) 05:47	05:12 21:33
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	07:15 (18) 05:46	05:12 21:34
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	07:16 (18) 05:44	05:11 21:35
11	08:23 16:40	07:45 17:32	06:49 18:20	06:40 20:11	07:20 (18) 05:42	05:11 21:36
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	07:24 (18) 05:41	05:11 21:36
13	08:22 16:43	07:41 17:36	06:44 18:24	06:36 20:14	07:26 (18) 05:39	05:11 21:37
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	07:13 (17) 05:38	05:10 21:38
15	08:20 16:46	07:38 17:39	06:40 18:27	06:32 20:18	07:15 (16) 05:36	05:10 21:38
16	08:19 16:48	07:36 17:41	06:38 18:29	06:29 20:19	06:59 (16) 05:35	05:10 21:39
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	07:15 (16) 05:34	05:10 21:39
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	07:14 (16) 05:32	05:10 21:39
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	07:01 (16) 05:31	05:10 21:40
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	07:12 (16) 05:29	05:10 21:40
21	08:15 16:56	07:26 17:50	06:26 18:37	06:19 20:27	07:10 (16) 05:28	05:10 21:40
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:28 05:27	05:10 21:41
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 05:25	05:11 21:41
24	08:11 17:01	07:20 17:55	06:20 18:42	06:13 20:32	05:25 05:23	05:11 21:41
25	08:10 17:02	07:18 17:57	06:18 18:44	06:11 20:34	05:23 05:22	05:11 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 05:21	05:12 21:41
27	08:08 17:06	07:14 18:00	06:13 18:47	06:07 20:37	05:21 05:21	05:12 21:41
28	08:07 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 05:20	05:13 21:41
29	08:05 17:09	07:09 19:50	07:09 19:50	06:03 20:40	05:19 05:18	05:13 21:41
30	08:04 17:11	07:06 19:52	07:06 19:52	06:02 20:42	05:18 05:18	05:14 21:41
31	08:02 17:13	07:04 19:53	07:04 19:53	06:02 20:42	05:18 05:18	05:14 21:41
Sonnenscheinstunden	264	280	367	414	480	492
astr. max. mögl. Beschattung			109	214		
Red. Sonnenscheinwahrsch.			0,31	0,40		
Reduktion Betriebsdauer			0,83	0,83		
Reduktion Windrichtung			0,56	0,63		
Gesamte Reduktion			0,14	0,21		
Met. wahrsch. Beschattung			15	44		

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang (WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM) Schattende (WEA mit letztem Schatten)
	Minuten mit Schatten	

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: H - IP02 - Frohnhofstr. 4, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

| Juli | August | September | Oktober | November | Dezember

1	05:14 21:40	05:49 21:10	06:36 21:10	10	07:02 (16) 07:12 (16)	07:23 19:04	07:52 (17) 08:07 (17)	07:14 17:00	08:02 16:22
2	05:15 21:40	05:50 21:09	06:38 20:09	8	07:05 (16) 07:19 (18)	07:24 19:02	07:52 (17) 08:07 (17)	07:15 16:59	08:04 16:22
3	05:16 21:40	05:52 21:07	06:39 20:07	9	07:12 (18) 07:21 (18)	07:26 18:59	07:52 (17) 08:06 (17)	07:17 16:57	08:05 16:21
4	05:16 21:39	05:53 21:05	06:41 20:04	12	07:11 (18) 07:23 (18)	07:27 18:57	07:53 (17) 08:05 (17)	07:19 16:55	08:06 16:21
5	05:17 21:39	05:55 21:04	06:42 20:02	12	07:10 (18) 07:22 (18)	07:29 18:55	07:54 (17) 08:02 (17)	07:21 16:53	08:08 16:20
6	05:18 21:38	05:56 21:02	06:44 20:00	13	07:10 (18) 07:23 (18)	07:30 18:53	07:22 16:52	08:09 16:20	08:09 16:20
7	05:19 21:38	05:58 21:00	06:45 19:58	12	07:10 (18) 07:22 (18)	07:32 18:51	07:24 16:50	08:10 16:19	08:10 16:19
8	05:20 21:37	05:59 20:59	06:47 19:56	10	07:12 (18) 07:22 (18)	07:34 18:48	07:26 16:49	08:11 16:19	08:11 16:19
9	05:21 21:37	06:01 20:57	06:48 19:53	7	07:13 (18) 07:20 (18)	07:35 18:46	07:27 16:47	08:12 16:19	08:12 16:19
10	05:22 21:36	06:02 20:55	06:50 19:51	3	07:15 (18) 07:18 (18)	07:37 18:44	07:29 16:46	08:14 16:19	08:14 16:19
11	05:23 21:35	06:04 20:53	06:51 19:49			07:39 18:42	07:31 16:44	08:15 16:18	08:15 16:18
12	05:24 21:34	06:05 20:51	06:53 19:47			07:40 18:40	07:32 16:43	08:16 16:18	08:16 16:18
13	05:25 21:34	06:07 20:50	06:55 19:44			07:42 18:38	07:34 16:41	08:17 16:18	08:17 16:18
14	05:26 21:33	06:08 20:48	06:56 19:42			07:43 18:36	07:36 16:40	08:18 16:18	08:18 16:18
15	05:27 21:32	06:10 20:46	06:58 19:40			07:45 18:34	07:38 16:38	08:18 16:18	08:18 16:18
16	05:28 21:31	06:11 20:44	06:59 19:38			07:47 18:31	07:39 16:37	08:19 16:19	08:19 16:19
17	05:29 21:30	06:13 20:42	07:01 19:35			07:48 18:29	07:41 16:36	08:20 16:19	08:20 16:19
18	05:30 21:29	06:14 20:40	07:02 19:33			07:50 18:27	07:43 16:34	08:21 16:19	08:21 16:19
19	05:31 21:28	06:16 20:38	07:04 19:31			07:52 18:25	07:44 16:33	08:21 16:19	08:21 16:19
20	05:33 21:27	06:18 20:36	07:05 19:29			07:53 18:23	07:46 16:32	08:22 16:20	08:22 16:20
21	05:34 21:25	06:19 20:34	07:07 19:26			07:55 18:21	07:47 16:31	08:23 16:20	08:23 16:20
22	05:35 21:24	06:21 20:32	07:08 19:24			07:57 18:19	07:49 16:30	08:23 16:21	08:23 16:21
23	05:36 21:23	06:22 20:30	07:06 (16) 07:14 (16)	8	07:10 07:14 (16)	07:58 18:17	07:51 16:29	08:24 16:21	08:24 16:21
24	05:38 21:22	06:24 20:28	07:04 (16) 07:16 (16)	12	07:12 07:16 (16)	08:00 18:15	07:52 16:28	08:24 16:22	08:24 16:22
25	05:39 21:20	06:25 20:26	07:03 (16) 07:16 (16)	13	07:13 07:16 (16)	07:02 17:13	07:54 16:27	08:25 16:22	08:25 16:22
26	05:41 21:19	06:27 20:24	07:02 (16) 07:17 (16)	15	07:15 07:17 (16)	07:03 17:11	07:55 16:26	08:25 16:23	08:25 16:23
27	05:42 21:18	06:28 20:22	07:01 (16) 07:17 (16)	16	07:16 07:17 (16)	07:05 08:05 (17)	07:57 16:25	08:25 16:24	08:25 16:24
28	05:43 21:16	06:30 20:19	07:01 (16) 07:17 (16)	16	07:18 07:17 (16)	07:07 08:06 (17)	07:58 16:24	08:25 16:25	08:25 16:25
29	05:45 21:15	06:31 20:17	07:01 (16) 07:16 (16)	15	07:19 07:16 (16)	07:09 08:07 (17)	08:00 16:24	08:26 16:25	08:26 16:25
30	05:46 21:13	06:33 20:15	07:00 (16) 07:15 (16)	15	07:21 07:15 (16)	07:10 08:07 (17)	08:01 16:23	08:26 16:26	08:26 16:26
31	05:47 21:12	06:35 20:13	07:02 (16) 07:14 (16)	12	07:12 07:14 (16)	07:12 17:02		08:26 16:27	08:26 16:27
Sonnenscheinstunden		496	450		380	333	271	250	
astr. max.mögl. Beschattung			122		142	64			
Red. Sonnenscheinwahrsch.			0,46		0,38	0,26			
Reduktion Betriebsdauer			0,83		0,83	0,83			
Reduktion Windrichtung			0,63		0,60	0,56			
Gesamte Reduktion			0,24		0,19	0,12			
Met. wahrsch. Beschattung			29		26	8			

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	Schattenanfang (WEA mit erstem Schatten)	Schattenende (WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	--------------------------------	--	---

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziertes Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: I - IP02/1 - Billertshäuser Str. 21, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:04	07:38 (17) 19:55	07:26 (18) 19:55	06:00 20:43
2	08:26 16:29	07:59 17:16	07:08 18:05	07:37 (17) 19:56	07:25 (18) 19:56	05:58 20:45
3	08:26 16:30	07:58 17:18	07:06 18:07	07:34 (17) 19:58	07:25 (18) 19:58	05:56 20:46
4	08:25 16:32	07:56 17:20	07:04 18:09	07:34 (17) 20:00	07:24 (18) 20:00	05:54 20:48
5	08:25 16:33	07:55 17:21	07:01 18:10	07:33 (17) 20:01	07:24 (18) 20:01	05:52 20:50
6	08:25 16:34	07:53 17:23	06:59 18:12	07:33 (17) 20:03	07:25 (18) 20:03	05:51 20:51
7	08:25 16:35	07:52 17:25	06:57 18:14	07:34 (17) 20:05	07:19 (16) 20:05	05:49 20:53
8	08:24 16:36	07:50 17:27	06:55 18:15	07:33 (17) 20:06	07:16 (16) 20:06	05:47 20:54
9	08:24 16:38	07:48 17:28	06:53 18:17	07:34 (17) 20:08	07:14 (16) 20:08	05:46 20:56
10	08:23 16:39	07:47 17:30	06:51 18:19	07:36 (17) 20:09	07:12 (16) 20:09	05:44 20:57
11	08:23 16:40	07:45 17:32	06:49 18:20	06:40 20:11	07:11 (16) 20:11	05:42 20:59
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	07:10 (16) 21:00	05:41 21:00
13	08:22 16:43	07:41 17:36	06:44 18:24	06:36 20:14	07:10 (16) 21:02	05:39 21:02
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	07:10 (16) 21:03	05:38 21:03
15	08:20 16:46	07:38 17:39	06:40 18:27	06:32 20:18	07:10 (16) 21:05	05:36 21:05
16	08:19 16:48	07:36 17:41	06:38 18:29	06:29 20:19	07:11 (16) 21:06	05:35 21:06
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	07:11 (16) 21:08	05:33 21:08
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	07:13 (16) 21:09	05:32 21:09
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	07:15 (16) 21:10	05:31 21:10
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	07:21 (16) 21:10	05:29 21:10
21	08:15 16:56	07:26 17:50	06:26 18:37	06:19 20:27	05:29 21:13	05:10 21:40
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15	05:10 21:41
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 21:41
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:25 21:17	05:11 21:41
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18	05:11 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	05:12 21:41
27	08:08 17:06	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 21:41
28	08:07 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:13 21:41
29	08:05 17:09	07:09 19:50	06:09 19:50	06:03 20:40	05:19 21:23	05:13 21:41
30	08:04 17:11	07:06 19:52	06:06 19:52	06:02 07:28 (18) 20:42	05:18 21:24	05:14 21:40
31	08:02 17:12	07:04 19:53	06:04 19:53	07:27 (18) 07:38 (18)	05:18 21:26	05:14 21:40
Sonnenscheinstunden	264	280	367	414	480	492
astr. max. mögl. Beschattung			160	275		
Red. Sonnenscheinwahrsch.			0,31	0,40		
Reduktion Betriebsdauer			0,83	0,83		
Reduktion Windrichtung			0,54	0,62		
Gesamte Reduktion			0,14	0,21		
Met. wahrsch. Beschattung			22	56		

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	Schattenanfang (WEA mit erstem Schatten)	Schattenende (WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: I - IP02/1 - Billertshäuser Str. 21, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14 21:40	05:49 21:10	06:36 18 07:10 (16)	07:23 19:04	07:14 17:00	08:02 16:22
2	05:15 21:40	05:50 21:09	06:38 16 07:27 (16)	07:24 19:02	07:15 16:59	08:04 16:22
3	05:16 21:40	05:52 21:07	06:39 14 07:25 (16)	07:26 18:59	08:15 (17) 16:57	08:05 16:21
4	05:16 21:39	05:53 21:05	06:41 11 07:24 (16)	07:27 18:57	08:13 (17) 16:55	08:06 16:21
5	05:17 21:39	05:55 21:04	06:42 12 07:30 (18)	07:29 18:55	08:11 (17) 16:53	08:08 16:20
6	05:18 21:38	05:56 21:02	06:44 11 07:32 (18)	07:30 18:53	08:10 (17) 16:52	08:09 16:20
7	05:19 21:38	05:58 21:00	06:45 14 07:33 (18)	07:32 18:51	08:10 (17) 16:50	08:10 16:19
8	05:20 21:37	05:59 20:59	06:47 14 07:33 (18)	07:34 18:48	08:08 (17) 16:49	08:11 16:19
9	05:21 21:37	06:01 20:57	06:48 15 07:33 (18)	07:35 18:46	08:09 (17) 16:47	08:12 16:19
10	05:22 21:36	06:02 20:55	06:50 15 07:33 (18)	07:37 18:44	08:09 (17) 16:45	08:14 16:19
11	05:22 21:35	06:04 20:53	06:51 14 07:32 (18)	07:39 18:42	08:09 (17) 16:44	08:15 16:18
12	05:24 21:34	06:05 20:51	06:53 12 07:31 (18)	07:40 18:40	08:10 (17) 16:43	08:16 16:18
13	05:25 21:34	06:07 20:50	06:55 10 07:29 (18)	07:42 18:38	08:13 (17) 16:41	08:17 16:18
14	05:26 21:33	06:08 20:48	06:56 2 07:25 (18)	07:43 18:36	08:20 (17) 16:40	08:18 16:18
15	05:27 21:32	06:10 20:46	06:58 19:40	07:45 18:34	07:38 16:38	08:18 16:18
16	05:28 21:31	06:11 20:44	06:59 19:38	07:47 18:31	07:39 16:37	08:19 16:19
17	05:29 21:30	06:13 20:42	07:01 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	05:30 21:29	06:14 20:40	07:02 19:33	07:50 18:27	07:42 16:34	08:21 16:19
19	05:31 21:28	06:16 20:38	07:04 19:31	07:52 18:25	07:44 16:33	08:21 16:19
20	05:33 21:27	06:18 20:36	07:05 19:29	07:53 18:23	07:46 16:32	08:22 16:20
21	05:34 21:25	06:19 20:34	07:07 19:26	07:55 18:21	07:47 16:31	08:23 16:20
22	05:35 21:24	06:21 20:32	07:08 19:24	07:57 18:19	07:49 16:30	08:23 16:21
23	05:36 21:23	06:22 20:30	07:10 19:22	07:58 18:17	07:51 16:29	08:24 16:21
24	05:38 21:22	06:24 20:28	07:12 7 07:25 (16)	08:00 18:15	07:52 16:28	08:24 16:22
25	05:39 21:20	06:25 20:26	07:13 12 07:27 (16)	07:02 17:13	07:54 16:27	08:25 16:22
26	05:40 21:19	06:27 20:24	07:15 15 07:29 (16)	07:03 17:11	07:55 16:26	08:25 16:23
27	05:42 21:18	06:28 20:22	07:16 17 07:29 (16)	07:05 17:10	07:57 16:25	08:25 16:24
28	05:43 21:16	06:30 20:19	07:18 18 07:29 (16)	07:07 17:08	07:58 16:24	08:25 16:25
29	05:45 21:15	06:31 20:17	07:19 18 07:29 (16)	07:09 17:06	08:00 16:24	08:26 16:25
30	05:46 21:13	06:33 20:15	07:21 19 07:29 (16)	07:21 17:04	08:01 16:23	08:26 16:26
31	05:47 21:12	06:35 20:13	07:10 (16) 19 07:29 (16)	07:12 17:02		08:26 16:27
Sonnenscheinstunden	496	450	380	333	271	250
astr. max.mögl. Beschattung		125	178	146		
Red. Sonnenscheinwahrsch.		0,46	0,38	0,26		
Reduktion Betriebsdauer		0,83	0,83	0,83		
Reduktion Windrichtung		0,63	0,62	0,53		
Gesamte Reduktion		0,24	0,19	0,11		
Met. wahrsch. Beschattung		29	34	17		

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: J - IP03 - Steineshof 1, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:03	07:39 (19) 18:15 (16)	07:02 19:55	07:45 (1) 20:43
2	08:26 16:29	07:59 17:16	07:08 18:05	07:38 (19) 08:17 (16)	07:00 19:56	07:45 (1) 20:45
3	08:26 16:30	07:58 17:18	07:06 18:07	07:37 (19) 08:17 (16)	06:57 19:58	07:44 (1) 20:46
4	08:25 16:32	07:56 17:19	07:04 18:09	07:37 (19) 08:18 (16)	06:55 20:00	07:44 (1) 20:48
5	08:25 16:33	09:11 (17) 09:16 (17)	07:55 17:21	07:01 18:10	06:53 20:01	07:44 (1) 20:50
6	08:25 16:34	09:10 (17) 09:18 (17)	07:53 17:23	06:59 18:12	06:51 20:03	07:44 (1) 20:51
7	08:25 16:35	09:10 (17) 09:20 (17)	07:52 17:25	06:57 18:14	06:49 20:05	07:45 (1) 20:53
8	08:24 16:36	09:09 (17) 09:21 (17)	07:50 17:27	06:55 18:15	06:47 20:06	07:46 (1) 20:54
9	08:24 16:38	09:09 (17) 09:22 (17)	07:48 17:28	06:53 18:17	06:44 20:08	07:46 (1) 20:56
10	08:23 16:39	09:08 (17) 09:23 (17)	07:47 17:30	06:51 18:19	06:42 20:09	07:47 (1) 20:57
11	08:23 16:40	09:08 (17) 09:24 (17)	07:45 17:32	06:48 18:20	06:40 20:11	07:50 (1) 20:59
12	08:22 16:42	09:07 (17) 09:24 (17)	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00
13	08:22 16:43	09:08 (17) 09:26 (17)	07:41 17:35	06:44 18:24	06:36 20:14	05:39 21:02
14	08:21 16:45	09:08 (17) 09:27 (17)	07:39 17:37	06:42 18:25	06:34 20:16	05:38 21:03
15	08:20 16:46	09:08 (17) 09:27 (17)	07:38 17:39	06:40 18:27	06:32 20:18	05:36 21:05
16	08:19 16:48	09:08 (17) 09:28 (17)	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06
17	08:19 16:49	09:08 (17) 09:28 (17)	07:34 17:43	06:35 18:30	06:27 20:21	05:33 21:08
18	08:18 16:51	09:08 (17) 09:29 (17)	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09
19	08:17 16:52	09:09 (17) 09:29 (17)	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10
20	08:16 16:54	09:09 (17) 09:30 (17)	07:28 17:48	06:29 18:35	06:21 20:26	05:29 21:12
21	08:15 16:56	09:10 (17) 09:30 (17)	07:26 17:50	06:26 18:37	06:19 20:27	05:28 21:13
22	08:14 16:57	09:09 (17) 09:29 (17)	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15
23	08:13 16:59	09:10 (17) 09:30 (17)	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16
24	08:11 17:00	09:11 (17) 09:30 (17)	07:20 17:55	06:20 18:42	06:13 20:32	05:25 21:17
25	08:10 17:02	09:11 (17) 09:29 (17)	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18
26	08:09 17:04	09:13 (17) 09:29 (17)	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20
27	08:08 17:06	09:14 (17) 09:28 (17)	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21
28	08:06 17:07	09:15 (17) 09:26 (17)	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22
29	08:05 17:09	09:19 (17) 09:24 (17)	33 08:13 (16)	07:09	07:48 (1)	06:03
30	08:04 17:11			19:50	08:13 (1)	20:40
31	08:02 17:12			07:06	07:46 (1)	20:42
				19:52	08:12 (1)	20:42
				07:04	07:45 (1)	20:42
				19:53	08:13 (1)	21:26
Sonnenscheinstunden	264	280	367	414	480	492
astr.max.mögl.Beschattung						
Red.Sonnenscheinwahrsch.	0,15	0,28	0,31	0,40	0,44	
Reduktion Betriebsdauer	0,83	0,83	0,83	0,83	0,83	
Reduktion Windrichtung	0,51	0,54	0,56	0,60	0,67	
Gesamte Reduktion	0,06	0,12	0,14	0,19	0,24	
Met.wahrsch.Beschattung	25	7	97	49	92	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:
SW19001 Zell
 TurboWind Energie GmbH
 Vahrenwalder Str. 245-247
 30179 Hannover

Beschreibung:
 Schattenwurfberechnung für den Standort Zell
 Zusatzbelastung:
 - 1x ENERCON E-138, 3.500 kW, NH: 160 m
 Vorbelastung:
 - 5x ENERCON E-115, 3.000 kW, NH: 149 m
 - 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
 - 1x AN BONUS, 1.000 kW, NH: 70,0 m
 - 1x AN BONUS, 600 kW, NH: 58,0 m
 - 1x AN BONUS, 150 kW, NH: 30,0 m
 - 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
 windtest grevenbroich gmbh
 Frimmersdorfer Straße 73a
 DE-41517 Grevenbroich
 +49 2181 2278 0
 lasma.pikuma@windtest-nrw.de
 Berechnet:
 22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: J - IP03 - Steineshof 1, 36329 Romrod-Zell

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
 472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
 Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli	August	September	Oktober	November	Dezember
1	05:14 21:40	05:49 21:10	06:30 (11) 20:11	07:49 (1) 19:04	07:22 19:04	08:31 (16) 17:00
2	05:15 21:40	05:50 21:09	06:30 (11) 20:09	07:46 (1) 19:02	07:24 19:02	08:30 (16) 16:59
3	05:16 21:40	05:52 21:07	06:31 (11) 20:06	07:44 (1) 18:59	07:26 18:59	08:26 (18) 16:57
4	05:16 21:39	05:53 21:05	06:32 (11) 20:04	07:43 (1) 18:57	07:27 18:57	08:23 (18) 16:55
5	05:17 21:39	05:55 21:04	06:34 (11) 20:02	07:41 (1) 18:55	07:29 18:55	08:20 (18) 16:53
6	05:18 21:38	05:56 21:02	06:44 20:00	07:40 (1) 18:53	07:30 18:53	08:17 (19) 16:52
7	05:19 21:38	05:58 21:00	06:45 19:58	07:39 (1) 18:51	07:32 18:51	08:15 (19) 16:50
8	05:20 21:37	05:59 20:59	06:47 19:55	07:39 (1) 18:48	07:34 18:48	08:13 (19) 16:49
9	05:21 21:37	06:01 20:57	06:48 19:53	07:38 (1) 18:46	07:35 18:46	08:12 (19) 16:47
10	05:21 21:36	06:02 20:55	06:50 19:51	07:38 (1) 18:44	07:37 18:44	08:12 (19) 16:45
11	05:22 21:35	06:04 20:53	06:51 19:49	07:37 (1) 18:42	07:39 18:42	08:11 (19) 16:44
12	05:23 21:34	06:05 20:51	06:53 19:47	07:38 (1) 18:40	07:40 18:40	08:12 (19) 16:42
13	05:25 21:34	06:07 20:50	06:54 19:44	07:37 (1) 18:38	07:42 18:38	08:12 (19) 16:41
14	05:26 21:33	06:36 (11) 06:40 (11)	06:56 19:42	07:38 (1) 18:36	07:43 18:36	08:13 (19) 16:40
15	05:27 21:32	06:34 (11) 06:42 (11)	06:58 19:40	07:38 (1) 18:33	07:45 18:33	08:15 (19) 16:38
16	05:28 21:31	06:33 (11) 06:44 (11)	06:59 19:38	07:40 (1) 18:31	07:47 18:31	08:31 (18) 16:38
17	05:29 21:30	06:32 (11) 06:45 (11)	07:01 19:35	07:40 (1) 18:29	07:48 18:29	07:39 16:37
18	05:30 21:29	06:31 (11) 06:46 (11)	07:02 19:33	07:39 (20) 18:27	07:50 18:27	07:42 16:36
19	05:31 21:28	06:30 (11) 06:46 (11)	07:04 19:31	07:38 (20) 18:25	07:52 18:25	07:44 16:33
20	05:33 21:27	06:29 (11) 06:47 (11)	07:05 19:29	07:38 (20) 18:23	07:53 18:23	16:32 20:09
21	05:34 21:25	06:29 (11) 06:47 (11)	07:07 19:26	07:37 (20) 18:21	07:55 18:21	07:47 16:31
22	05:35 21:24	06:29 (11) 06:48 (11)	07:08 19:24	07:38 (20) 18:19	07:57 18:19	07:49 16:30
23	05:36 21:23	06:29 (11) 06:49 (11)	07:10 19:22	07:38 (20) 18:17	07:58 18:17	07:51 16:29
24	05:38 21:22	06:28 (11) 06:49 (11)	07:11 19:20	07:40 (20) 18:15	08:00 18:15	07:52 16:28
25	05:39 21:20	06:28 (11) 06:49 (11)	07:13 19:17	07:42 (20) 18:13	08:02 18:13	07:54 16:27
26	05:40 21:19	06:28 (11) 06:50 (11)	07:15 19:15	07:43 (16) 18:11	08:04 18:11	07:55 16:26
27	05:42 21:18	06:28 (11) 06:49 (11)	07:16 19:13	08:43 (16) 17:09	07:05 17:09	07:57 16:25
28	05:43 21:16	06:28 (11) 06:49 (11)	07:18 19:11	08:37 (16) 17:08	07:07 17:08	07:58 16:24
29	05:45 21:15	06:29 (11) 06:49 (11)	07:19 19:08	08:35 (16) 17:06	07:09 17:06	08:00 16:24
30	05:46 21:13	06:29 (11) 06:49 (11)	07:21 19:06	08:32 (16) 17:04	07:10 17:04	08:01 16:23
31	05:47 21:12	06:29 (11) 06:48 (11)	07:23 19:04	08:33 (16) 17:02	07:12 17:02	08:02 16:22
Sonnenscheinstunden	496	450	380	333	271	250
astr.max.mögl.Beschattung	307	72	540	505	320	81
Red.Sonnenscheinwahrsch.	0,47	0,46	0,38	0,26	0,18	0,14
Reduktion Betriebsdauer	0,83	0,83	0,83	0,83	0,83	0,83
Reduktion Windrichtung	0,67	0,67	0,59	0,54	0,51	0,51
Gesamte Reduktion	0,25	0,25	0,18	0,11	0,07	0,06
Met.wahrsch.Beschattung	77	18	96	57	23	5

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	Schattenanfang (WEA mit erstem Schatten)	Schattenende (WEA mit letztem Schatten)
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Projekt:

SW19001 Zelle

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zelle
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: K - IP04 - Zeller Str. 28, 36304 Alsfeld-Billertshausen

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni													
1	08:26 16:28	09:04 (16) 08:01 09:21 (5) 17:14	08:01 07:10 18:03	07:02 19:55	06:00 20:43	06:30 (7) 05:17	05:51 (6)												
2	08:26 16:29	09:05 (16) 07:59 09:22 (5) 17:16	07:08 18:05	07:00 19:56	05:58 20:45	06:29 (7) 05:16	05:52 (6)												
3	08:26 16:30	09:04 (16) 07:58 09:22 (5) 17:18	07:06 18:07	06:57 19:58	05:56 20:46	06:28 (7) 05:15	05:51 (6)												
4	08:26 16:32	09:05 (16) 07:56 09:23 (5) 17:19	07:04 18:09	06:55 20:00	05:54 20:48	06:27 (7) 05:15	05:50 (6)												
5	08:25 16:33	09:05 (16) 07:55 09:24 (5) 17:21	08:35 (4) 07:01 18:09	06:53 20:00	05:52 20:48	06:26 (7) 05:14	05:51 (6)												
6	08:25 16:34	09:05 (16) 07:53 09:24 (5) 17:23	08:32 (4) 06:59 18:12	06:51 20:01	05:51 20:50	06:26 (7) 05:13	05:50 (6)												
7	08:25 16:35	09:05 (16) 07:52 09:26 (5) 17:25	08:31 (4) 06:57 18:14	07:39 (3) 06:49 20:03	05:49 20:51	06:26 (7) 05:13	05:51 (6)												
8	08:24 16:36	09:05 (16) 07:50 09:26 (5) 17:27	08:30 (4) 06:55 18:15	07:33 (3) 06:44 20:05	05:47 20:53	06:27 (7) 05:12	05:50 (6)												
9	08:24 16:38	09:06 (16) 07:48 09:27 (5) 17:28	08:30 (4) 06:53 18:17	07:49 (3) 06:06 20:06	05:46 20:54	06:26 (7) 05:12	05:51 (6)												
10	08:23 16:39	09:06 (16) 07:47 09:27 (5) 17:30	08:29 (4) 06:51 18:19	07:32 (3) 06:42 20:07	05:44 20:57	06:27 (7) 05:11	05:51 (6)												
11	08:23 16:40	09:06 (16) 07:45 09:27 (5) 17:32	08:29 (4) 06:49 18:20	07:31 (3) 06:40 20:08	05:42 20:59	06:27 (7) 05:11	05:51 (6)												
12	08:22 16:42	09:07 (16) 07:43 09:28 (5) 17:34	08:28 (4) 06:46 18:22	07:29 (3) 06:36 20:13	05:41 21:00	06:28 (7) 05:11	05:51 (6)												
13	08:22 16:43	08:51 (18) 07:41 09:29 (5) 17:35	08:28 (4) 06:44 18:24	07:29 (3) 06:36 20:14	05:39 21:02	06:29 (7) 05:10	05:51 (6)												
14	08:21 16:45	08:49 (18) 07:39 09:29 (5) 17:37	08:28 (4) 06:42 18:25	07:07 (9) 06:34 20:16	05:38 21:03	06:31 (7) 05:10	05:52 (6)												
15	08:20 16:46	08:49 (18) 07:38 09:29 (5) 17:39	08:29 (4) 06:40 18:27	07:05 (9) 06:32 20:18	05:36 21:05	06:38 (7) 05:10	05:52 (6)												
16	08:19 16:48	08:48 (18) 07:36 09:29 (5) 17:41	08:29 (4) 06:38 18:29	07:04 (9) 06:29 20:19	05:35 21:06	06:28 (7) 05:10	05:52 (6)												
17	08:19 16:49	08:48 (18) 07:34 09:29 (5) 17:43	08:29 (4) 06:36 18:30	07:02 (9) 06:27 20:21	05:33 21:08	06:28 (7) 05:10	05:52 (6)												
18	08:18 16:51	08:48 (18) 07:32 09:29 (5) 17:45	08:28 (4) 06:33 18:32	07:02 (9) 06:25 20:22	05:32 21:09	07:12 (13) 05:32	06:27 (7) 05:10	05:52 (6)											
19	08:17 16:52	08:48 (18) 07:30 09:29 (5) 17:46	08:45 (4) 06:43 18:34	07:49 (3) 06:22 20:23	05:31 21:13	07:24 (13) 05:31	06:27 (7) 05:10	05:53 (6)											
20	08:16 16:54	08:49 (18) 07:28 09:29 (5) 17:48	08:43 (4) 06:41 18:35	07:48 (3) 06:21 20:24	05:29 21:14	07:11 (13) 05:31	06:28 (7) 05:10	05:53 (6)											
21	08:15 16:55	08:49 (18) 07:26 09:28 (5) 17:50	08:35 (4) 06:39 18:37	07:03 (9) 06:19 20:26	05:28 21:16	07:09 (13) 05:29	06:28 (7) 05:10	05:53 (6)											
22	08:14 16:57	08:49 (18) 07:24 09:26 (5) 17:51	08:34 (4) 06:38 18:39	07:42 (3) 06:17 20:27	05:27 21:17	07:09 (13) 05:29	06:28 (7) 05:10	05:54 (6)											
23	08:13 16:59	08:49 (18) 07:22 09:23 (5) 17:53	08:33 (4) 06:36 18:40	07:05 (9) 06:15 20:29	05:26 21:18	07:10 (13) 05:29	06:29 (7) 05:10	05:54 (6)											
24	08:11 17:00	08:50 (18) 07:20 09:03 (18) 17:55	08:32 (4) 06:34 18:42	06:13 20:30	07:07 (13) 05:24	07:26 (13) 05:28	06:29 (7) 05:11	05:53 (6)											
25	08:10 17:02	08:52 (18) 07:18 09:03 (18) 17:57	08:31 (4) 06:33 18:43	06:11 20:31	07:07 (13) 05:23	07:26 (13) 05:27	06:29 (7) 05:11	05:54 (6)											
26	08:09 17:04	08:52 (18) 07:16 09:01 (18) 17:58	08:30 (4) 06:32 18:45	06:09 20:32	07:07 (13) 05:22	07:25 (13) 05:26	06:29 (7) 05:11	05:54 (6)											
27	08:08 17:06	08:54 (18) 07:14 09:00 (18) 18:00	08:29 (4) 06:31 18:47	06:07 20:33	07:07 (13) 05:21	07:25 (13) 05:25	06:29 (7) 05:11	05:54 (6)											
28	08:07 17:07	08:54 (18) 07:12 09:00 (18) 18:02	08:28 (4) 06:30 18:49	06:05 20:34	07:09 (13) 05:20	07:24 (13) 05:24	06:29 (7) 05:11	05:55 (6)											
29	08:05 17:09	08:54 (18) 07:10 09:03 (18) 18:04	08:27 (4) 06:29 18:51	06:03 20:35	07:10 (13) 05:19	07:24 (13) 05:23	05:55 (6) 05:13	06:29 (7) 05:11	05:55 (6)										
30	08:04 17:11	08:54 (18) 07:08 09:04 (18) 18:06	08:26 (4) 06:28 18:53	06:01 20:36	07:22 (13) 05:18	07:10 (13) 05:18	06:00 (6) 05:14	06:29 (7) 05:11	05:56 (6)										
31	08:02 17:12	08:54 (18) 07:06 09:05 (18) 18:08	08:25 (4) 06:27 18:55	06:00 20:37	07:23 (13) 05:17	07:11 (13) 05:17	06:03 (6) 05:14	06:29 (7) 05:11	05:57 (6)										
							Sonnenscheinstunden	264		280		367		414		480		492	
							astr.max.mögl.Beschattung	581	244	373	334	236	811						
							Red.Sonnenscheinwahrsch.	0,15	0,28	0,31	0,40	0,44	0,38						
							Reduktion Betriebsdauer	0,83	0,83	0,83	0,83	0,83	0,83						
							Reduktion Windrichtung	0,52	0,54	0,54	0,63	0,67	0,70						
							Gesamte Reduktion	0,06	0,12	0,13	0,20	0,24	0,21						
							Met.wahrsch.Beschattung	36	29	49	67	55	171						

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: GesamtbelastungSchattenrezeptor: K - IP04 - Zeller Str. 28, 36304 Alsfeld-Billertshausen

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Table with 12 columns (Jan-Dec) and 1 row of values: 1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

Table with 13 columns (N, NNO, ONO, O, OSO, SSO, S, SSW, WSW, W, WNW, NNW, Summe) and 1 row of values: 472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Main table with columns for months (Juli-Dezember) and rows for each day of the month (1-31), containing sunrise/sunset times and shadow metrics.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Table with 5 columns: Tag im Monat, Sonnenaufgang (SS:MM), Sonnenuntergang (SS:MM), Minuten mit Schatten, Zeitpunkt (SS:MM) Schattenanfang, Zeitpunkt (SS:MM) Schattende, (WEA mit erstem Schatten), (WEA mit letztem Schatten)

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: L - IP04/1 - Zeller Str. 25, 36304 Alsfeld-Billertshausen

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni			
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:27	05:50 (6)		
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	05:51 (6)		
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	05:51 (6)		
4	08:26 16:32	07:56 17:19	07:04 18:09	06:55 20:00	05:54 20:48	05:15 21:30	05:50 (6)		
5	08:25 16:33	09:02 (16) 17:21	07:55 18:10	07:01 20:01	06:53 20:50	05:14 21:31	05:51 (6)		
6	08:25 16:34	09:00 (16) 17:23	07:53 18:12	07:01 20:03	06:51 20:51	05:13 21:32	05:51 (6)		
7	08:25 16:35	09:00 (16) 17:25	07:52 18:14	06:57 20:05	05:49 20:53	05:13 21:33	05:51 (6)		
8	08:24 16:36	08:59 (16) 17:27	07:50 18:15	06:57 20:06	05:47 20:54	05:12 21:33	05:51 (6)		
9	08:24 16:38	09:09 (16) 17:28	07:48 18:17	06:53 20:08	05:46 20:56	05:12 21:34	05:52 (6)		
10	08:23 16:39	08:59 (16) 17:30	07:47 18:19	06:51 20:09	05:44 20:57	05:11 21:35	05:52 (6)		
11	08:23 16:40	09:11 (16) 17:32	07:45 18:20	06:49 20:11	05:42 20:59	05:11 21:36	05:53 (6)		
12	08:22 16:42	09:12 (16) 17:34	08:17 (4) 18:22	07:22 (3) 20:13	06:38 20:13	05:11 21:36	05:52 (6)		
13	08:22 16:43	08:56 (5) 17:35	08:15 (4) 18:24	07:18 (3) 20:14	06:36 20:14	05:10 21:37	05:53 (6)		
14	08:21 16:45	08:55 (5) 17:37	08:13 (4) 18:25	07:17 (3) 20:16	06:34 20:16	05:10 21:38	05:53 (6)		
15	08:20 16:46	09:14 (16) 17:39	08:28 (4) 18:27	07:34 (3) 20:18	20:16 20:18	05:10 21:38	05:54 (6)		
16	08:19 16:48	08:55 (5) 17:41	08:12 (4) 18:29	07:15 (3) 20:19	06:29 20:19	05:10 21:39	05:54 (6)		
17	08:19 16:49	09:15 (16) 17:43	08:30 (4) 18:30	07:35 (3) 20:21	20:19 21:08	05:10 21:39	05:54 (6)		
18	08:18 16:51	08:45 (18) 17:44	08:12 (4) 18:32	07:35 (3) 20:22	05:32 20:22	05:10 21:39	05:55 (6)		
19	08:17 16:52	08:44 (18) 17:46	08:12 (4) 18:34	07:14 (3) 20:24	06:23 20:24	05:10 21:40	05:55 (6)		
20	08:16 16:54	09:16 (16) 17:48	08:31 (4) 18:35	07:35 (3) 20:26	06:21 20:26	05:10 21:40	05:55 (6)		
21	08:15 16:55	08:43 (18) 17:50	08:12 (4) 18:37	07:34 (3) 20:27	06:20 20:27	05:10 21:41	05:55 (6)		
22	08:14 16:57	09:17 (16) 17:51	08:29 (4) 18:39	07:33 (3) 20:29	06:19 20:29	05:10 21:41	05:56 (6)		
23	08:13 16:59	08:42 (18) 17:53	08:14 (4) 18:40	07:31 (3) 20:30	06:18 20:30	05:10 21:41	05:56 (6)		
24	08:12 17:00	09:15 (16) 17:55	08:27 (4) 18:42	07:30 (3) 20:32	06:17 20:32	05:10 21:41	05:56 (6)		
25	08:10 17:02	08:43 (18) 17:57	08:24 (4) 18:43	07:28 (3) 20:34	06:16 20:34	05:10 21:42	05:56 (6)		
26	08:09 17:04	09:14 (16) 17:58	08:43 (18) 18:07	07:15 (13) 20:35	06:09 20:35	05:10 21:42	05:56 (6)		
27	08:08 17:06	08:44 (18) 18:00	08:44 (18) 18:07	07:14 (13) 20:37	06:07 20:37	05:10 21:42	05:56 (6)		
28	08:07 17:07	09:12 (5) 18:02	08:44 (18) 18:07	07:13 (13) 20:38	06:05 20:38	05:10 21:42	05:57 (6)		
29	08:05 17:09	08:46 (18) 19:10 (5)	09:11 (5) 18:02	07:02 (13) 20:39	06:03 20:39	05:10 21:42	05:57 (6)		
30	08:04 17:11	08:47 (18) 19:07 (5)	09:10 (5) 18:02	07:10 (13) 20:40	06:02 20:40	05:10 21:42	05:57 (6)		
31	08:02 17:12	07:06 19:52	07:06 19:52	06:02 20:42	05:18 21:25	05:10 21:40	05:57 (6)		
	Sonnenscheinstunden	264	280	367	414	480	492	994	
	astr.max.mögl.Beschattung	544	200	225	276	289			
	Red.Sonnenscheinwahrsch.	0,15	0,28	0,31	0,40	0,44		0,38	
	Reduktion Betriebsdauer	0,83	0,83	0,83	0,83	0,83		0,83	
	Reduktion Windrichtung	0,52	0,54	0,56	0,63	0,68		0,69	
	Gesamte Reduktion	0,06	0,12	0,14	0,20	0,24		0,21	
	Met.wahrsch.Beschattung	34	24	31	56	69		210	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	--------------------------------	---------------------------	----------------------------

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: L - IP04/1 - Zeller Str. 25, 36304 Alsfeld-Billertshausen

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober		November		Dezember	
1	05:14		05:57 (6)	05:49		06:39 (7)	06:36		07:13 (8)	07:23		08:02 (16)
	21:40	34	06:31 (12)	21:10	7	06:46 (7)	20:11	10	07:23 (8)	19:04	12	08:11 (3)
2	05:15		05:57 (6)	05:50		06:37 (7)	06:38		07:12 (8)	07:24		08:03 (3)
	21:40	33	06:30 (12)	21:09	10	06:47 (7)	20:09	12	07:24 (8)	19:02	4	08:07 (3)
3	05:16		05:57 (6)	05:52		06:35 (7)	06:39		07:11 (8)	07:26		07:17
	21:40	34	06:31 (12)	21:07	13	06:48 (7)	20:07	13	07:24 (8)	18:59		16:57
4	05:16		05:57 (6)	05:53		06:35 (7)	06:41		07:11 (8)	07:27		07:19
	21:39	34	06:31 (12)	21:05	14	06:49 (7)	20:04	14	07:25 (8)	18:57		16:55
5	05:17		05:57 (6)	05:55		06:34 (7)	06:42		07:10 (8)	07:29		07:21
	21:39	33	06:30 (12)	21:04	15	06:49 (7)	20:02	14	07:24 (8)	18:55		16:53
6	05:18		05:57 (6)	05:56		06:34 (7)	06:44		07:11 (8)	07:30		07:22
	21:38	34	06:31 (12)	21:02	16	06:50 (7)	20:00	13	07:24 (8)	18:53		16:52
7	05:19		05:57 (6)	05:58		06:34 (7)	06:45		07:10 (8)	07:32		07:24
	21:38	34	06:31 (12)	21:00	16	06:50 (7)	19:58	12	07:22 (8)	18:51		16:50
8	05:20		05:58 (6)	05:59		06:33 (7)	06:47		07:12 (8)	07:34		07:26
	21:37	33	06:31 (12)	20:59	16	06:49 (7)	19:55	9	07:21 (8)	18:48		16:49
9	05:20		05:58 (6)	06:01		06:34 (7)	06:48		07:15 (8)	07:35		07:27
	21:37	32	06:31 (12)	20:57	16	06:50 (7)	19:53	1	07:16 (8)	18:46		16:47
10	05:21		05:58 (6)	06:02		06:34 (7)	06:50		07:37			07:29
	21:36	32	06:30 (12)	20:55	15	06:49 (7)	19:51		18:44			16:45
11	05:22		05:59 (6)	06:04		06:35 (7)	06:51		07:39			07:31
	21:35	30	06:30 (12)	20:53	13	06:48 (7)	19:49		18:42			16:44
12	05:23		05:59 (6)	06:05		06:35 (7)	06:53		07:40			07:33
	21:34	29	06:30 (12)	20:51	12	06:47 (7)	19:47		18:40		11	08:39 (5)
13	05:24		05:59 (6)	06:07		06:37 (7)	06:55		07:42			07:34
	21:34	27	06:29 (12)	20:50	9	06:46 (7)	19:44		18:38		19	08:42 (5)
14	05:26		06:00 (6)	06:08		07:10 (13)	06:56		07:43			07:36
	21:33	24	06:28 (12)	20:48	9	07:19 (13)	19:42		18:36		24	08:44 (5)
15	05:27		06:00 (6)	06:10		07:08 (13)	06:58		07:45			07:38
	21:32	19	06:26 (12)	20:46	12	07:20 (13)	19:40		18:33		26	08:44 (5)
16	05:28		06:01 (6)	06:11		07:07 (13)	06:59		07:47			07:39
	21:31	12	06:13 (6)	20:44	14	07:21 (13)	19:38		18:31		29	08:45 (5)
17	05:29		06:01 (6)	06:13		07:06 (13)	07:01		07:48			16:37
	21:30	11	06:12 (6)	20:42	15	07:21 (13)	19:35		18:29		2	08:51 (4)
18	05:30		06:02 (6)	06:14		07:06 (13)	07:02		07:50			07:41
	21:29	9	06:11 (6)	20:40	16	07:22 (13)	19:33		18:27		11	08:57 (4)
19	05:31		06:03 (6)	06:16		07:05 (13)	07:04		08:05 (3)			07:52
	21:28	7	06:10 (6)	20:38	17	07:22 (13)	19:31	8	08:13 (3)		14	08:58 (4)
20	05:33			06:17		07:05 (13)	07:05		08:02 (3)			07:53
	21:27			20:36	17	07:22 (13)	19:29	14	08:16 (3)		17	09:00 (4)
21	05:34			06:19		07:05 (13)	07:07		08:00 (3)			07:55
	21:25			20:34	16	07:21 (13)	19:26	17	08:17 (3)		18	09:01 (4)
22	05:35			06:21		07:05 (13)	07:08		07:59 (3)			07:57
	21:24			20:32	16	07:21 (13)	19:24	19	08:18 (3)		19	09:00 (4)
23	05:36			06:22		07:06 (13)	07:10		07:58 (3)			07:58
	21:23			20:30	13	07:19 (13)	19:22	20	08:18 (3)		19	09:00 (4)
24	05:38			06:24		07:07 (13)	07:12		07:57 (3)			08:00
	21:22			20:28	12	07:19 (13)	19:20	21	08:18 (3)		20	09:01 (4)
25	05:39			06:25		07:08 (13)	07:13		07:56 (3)			07:02
	21:20			20:26	8	07:16 (13)	19:17	21	08:17 (3)		18	08:00 (4)
26	05:40			06:27			07:15		07:56 (3)			07:03
	21:19			20:24			19:15	22	08:18 (3)		18	08:00 (4)
27	05:42			06:28			07:16		07:57 (3)			07:05
	21:18			20:22			19:13	20	08:17 (3)		17	07:59 (4)
28	05:43			06:30			07:18		07:56 (3)			07:07
	21:16			20:19			19:11	20	08:16 (3)		15	07:58 (4)
29	05:45			06:31			07:19		07:57 (3)			07:09
	21:15			20:17			19:08	18	08:15 (3)		11	07:56 (4)
30	05:46			06:33			07:21		07:57 (3)			07:10
	21:13			20:15			19:06	16	08:13 (3)		7	07:54 (4)
31	05:47			06:34			07:16 (8)		07:12			07:12
	21:12			20:13	6		07:22 (8)		17:02			17:02
Sonnenscheinstunden	496			450			380		333			270
astr.max.mögl.Beschattung		501		343			314		222			485
Red.Sonnenscheinwahrsch.		0,47		0,46			0,38		0,26			0,18
Reduktion Betriebsdauer		0,83		0,83			0,83		0,83			0,83
Reduktion Windrichtung		0,70		0,65			0,58		0,54			0,52
Gesamte Reduktion		0,26		0,24			0,17		0,11			0,07
Met.wahrsch.Beschattung		130		82			55		25			36

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM) Schattenende	(WEA mit letztem Schatten)
	Minuten mit Schatten		

Projekt: SW19001 Zell TurboWind Energie GmbH Vahrenwalder Str. 245-247 30179 Hannover	Beschreibung: Schattenwurfberechnung für den Standort Zell Zusatzbelastung: - 1x ENERCON E-138, 3.500 kW, NH: 160 m Vorbelastung: - 5x ENERCON E-115, 3.000 kW, NH: 149 m - 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m - 1x AN BONUS, 1.000 kW, NH: 70,0 m - 1x AN BONUS, 600 kW, NH: 58,0 m - 1x AN BONUS, 150 kW, NH: 30,0 m - 1x AN BONUS, 300 kW, NH: 40,0 m	Lizenzierter Anwender: windtest grevenbroich gmbh Frimmersdorfer Straße 73a DE-41517 Grevenbroich +49 2181 2278 0 lasma.pikuma@windtest-nrw.de Berechnet: 22.04.2020 13:02/3.3.274	
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SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: M - IP04/2 - Leuseler Weg 5, 36304 Alsfeld-Billertshausen

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
 472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
 Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni					
1	08:26	09:15 (16) 08:01	07:10	07:02	07:30 (7) 06:00	06:47 (6) 05:17					06:24 (2)
1	16:28	13 09:28 (16) 17:14	18:03	19:55	13 07:43 (7) 20:43	8 06:55 (6) 21:27					28 06:52 (2)
2	08:26	09:16 (16) 08:00	07:08	07:00	07:29 (7) 05:58	05:16					06:25 (2)
2	16:29	13 09:29 (16) 17:16	18:05	19:56	14 07:43 (7) 20:45	21:28					28 06:53 (2)
3	08:26	09:16 (16) 07:58	07:06	06:57	07:27 (7) 05:56	05:15					06:25 (2)
3	16:30	12 09:28 (16) 17:18	18:07	19:58	16 07:43 (7) 20:46	21:29					27 06:52 (2)
4	08:26	09:17 (16) 07:56	07:04	06:55	07:27 (7) 05:54	05:14					06:25 (2)
4	16:32	12 09:29 (16) 17:19	18:09	20:00	16 07:43 (7) 20:48	21:30					27 06:52 (2)
5	08:25	09:19 (16) 07:55	07:01	06:53	07:27 (7) 05:52	05:14					06:26 (2)
5	16:33	10 09:29 (16) 17:21	18:10	20:01	25 07:52 (12) 20:50	21:31					26 06:52 (2)
6	08:25	09:19 (16) 07:53	08:29 (3) 06:59	06:51	07:27 (7) 05:51	05:13					06:26 (2)
6	16:34	9 09:28 (16) 17:23	7 08:36 (3) 18:12	20:03	27 07:54 (12) 20:51	21:32					26 06:52 (2)
7	08:25	09:21 (16) 07:52	08:27 (3) 06:57	06:49	07:28 (7) 05:49	05:13					06:26 (2)
7	16:35	7 09:28 (16) 17:25	11 08:38 (3) 18:14	20:05	27 07:55 (12) 20:53	21:33					26 06:52 (2)
8	08:24	09:01 (4) 07:50	08:25 (3) 06:55	07:35 (13) 06:47	07:29 (7) 05:47	05:12					06:26 (2)
8	16:36	8 09:27 (16) 17:27	15 08:40 (3) 18:15	9 07:44 (13) 20:06	27 07:56 (12) 20:54	21:33					26 06:52 (2)
9	08:24	09:00 (4) 07:48	08:25 (3) 06:53	07:33 (13) 06:44	07:30 (7) 05:46	05:12					06:27 (2)
9	16:38	7 09:07 (4) 17:28	16 08:41 (3) 18:17	13 07:46 (13) 20:08	25 07:55 (12) 20:56	21:34					25 06:52 (2)
10	08:23	08:59 (4) 07:47	08:24 (3) 06:51	07:32 (13) 06:42	07:34 (12) 05:44	05:11					06:28 (2)
10	16:39	9 09:08 (4) 17:30	18 08:42 (3) 18:19	15 07:47 (13) 20:09	21 07:55 (12) 20:57	21:35					24 06:52 (2)
11	08:23	08:58 (4) 07:45	08:24 (3) 06:49	07:32 (13) 06:40	07:34 (12) 05:42	05:11					06:28 (2)
11	16:40	11 09:09 (4) 17:32	18 08:42 (3) 18:20	15 07:47 (13) 20:11	21 07:55 (12) 20:59	21:36					24 06:52 (2)
12	08:22	08:58 (4) 07:43	08:24 (3) 06:46	07:31 (13) 06:38	07:34 (12) 05:41	05:11					06:28 (2)
12	16:42	13 09:11 (4) 17:34	18 08:42 (3) 18:22	16 07:47 (13) 20:13	21 07:55 (12) 21:00	1 06:37 (2) 05:11					24 06:52 (2)
13	08:22	08:58 (4) 07:41	08:23 (3) 06:44	07:30 (13) 06:36	07:34 (12) 05:39	06:31 (2) 05:10					06:28 (2)
13	16:43	13 09:11 (4) 17:35	19 08:42 (3) 18:24	16 07:46 (13) 20:14	21 07:55 (12) 21:02	11 06:42 (2) 21:37					24 06:52 (2)
14	08:21	08:58 (4) 07:39	08:24 (3) 06:42	07:31 (13) 06:34	07:34 (12) 05:38	06:30 (2) 05:10					06:29 (2)
14	16:45	14 09:12 (4) 17:37	18 08:42 (3) 18:25	14 07:45 (13) 20:16	20 07:54 (12) 21:03	15 06:45 (2) 21:38					23 06:52 (2)
15	08:20	08:58 (4) 07:38	08:24 (3) 06:40	07:32 (13) 06:32	07:34 (12) 05:36	06:29 (2) 05:10					06:29 (2)
15	16:46	15 09:13 (4) 17:39	17 08:41 (3) 18:27	12 07:44 (13) 20:18	19 07:53 (12) 21:05	17 06:46 (2) 21:38					23 06:52 (2)
16	08:19	08:58 (4) 07:36	08:24 (3) 06:38	07:33 (13) 06:29	07:35 (12) 05:35	06:27 (2) 05:10					06:30 (2)
16	16:48	15 09:13 (4) 17:41	17 08:41 (3) 18:29	10 07:43 (13) 20:19	17 07:52 (12) 21:06	20 06:47 (2) 21:39					22 06:52 (2)
17	08:19	08:58 (4) 07:34	08:26 (3) 06:35	07:36 (13) 06:27	07:36 (12) 05:33	06:26 (2) 05:10					06:30 (2)
17	16:49	16 09:14 (4) 17:43	14 08:40 (3) 18:30	2 07:38 (13) 20:21	14 07:50 (12) 21:08	22 06:48 (2) 21:39					22 06:52 (2)
18	08:18	08:58 (4) 07:32	08:28 (3) 06:33	06:25	07:38 (12) 05:32	06:26 (2) 05:10					06:30 (2)
18	16:51	16 09:14 (4) 17:44	11 08:39 (3) 18:32	20:22	10 07:48 (12) 21:09	23 06:49 (2) 21:39					22 06:52 (2)
19	08:17	08:58 (4) 07:30	08:31 (3) 06:31	06:23	05:31	06:24 (2) 05:10					06:30 (2)
19	16:52	17 09:15 (4) 17:46	4 08:35 (3) 18:34	20:24	21:10	25 06:49 (2) 21:40					22 06:52 (2)
20	08:16	08:59 (4) 07:28	06:29	06:21	06:51 (6) 05:29	06:24 (2) 05:10					06:30 (2)
20	16:54	16 09:15 (4) 17:48	18:35	20:26	6 06:57 (6) 21:12	26 06:50 (2) 21:40					23 06:53 (2)
21	08:15	09:00 (4) 07:26	06:26	06:19	06:49 (6) 05:28	06:24 (2) 05:10					06:30 (2)
21	16:55	15 09:15 (4) 17:50	18:37	20:27	10 06:59 (6) 21:13	26 06:50 (2) 21:40					23 06:53 (2)
22	08:14	08:59 (4) 07:24	06:24	06:17	06:47 (6) 05:27	06:24 (2) 05:10					06:31 (2)
22	16:57	16 09:15 (4) 17:51	18:39	20:29	13 07:00 (6) 21:15	27 06:51 (2) 21:41					23 06:54 (2)
23	08:13	09:00 (4) 07:22	06:22	06:15	06:46 (6) 05:26	06:24 (2) 05:11					06:31 (2)
23	16:59	15 09:15 (4) 17:53	18:40	20:30	14 07:00 (6) 21:16	27 06:51 (2) 21:41					23 06:54 (2)
24	08:12	09:02 (4) 07:20	06:20	06:13	06:45 (6) 05:24	06:24 (2) 05:11					06:31 (2)
24	17:00	13 09:15 (4) 17:55	18:42	20:32	16 07:01 (6) 21:17	27 06:51 (2) 21:41					22 06:53 (2)
25	08:10	09:03 (4) 07:18	06:17	06:11	06:44 (6) 05:23	06:23 (2) 05:11					06:32 (2)
25	17:02	11 09:14 (4) 17:57	18:43	20:34	17 07:01 (6) 21:19	28 06:51 (2) 21:41					22 06:54 (2)
26	08:09	09:04 (4) 07:16	06:15	06:09	06:44 (6) 05:22	06:23 (2) 05:12					06:32 (2)
26	17:04	8 09:12 (4) 17:58	18:45	20:35	16 07:00 (6) 21:20	29 06:52 (2) 21:41					22 06:54 (2)
27	08:08	09:08 (4) 07:14	06:13	06:07	06:44 (6) 05:21	06:23 (2) 05:12					06:31 (2)
27	17:06	2 09:10 (4) 18:00	18:47	20:37	16 07:00 (6) 21:21	29 06:52 (2) 21:41					23 06:54 (2)
28	08:07	07:12	06:11	06:05	06:45 (6) 05:20	06:23 (2) 05:13					06:32 (2)
28	17:07	18:02	18:48	20:38	15 07:00 (6) 21:22	29 06:52 (2) 21:41					23 06:55 (2)
29	08:05		07:09	06:03	06:45 (6) 05:19	06:23 (2) 05:13					06:31 (2)
29	17:09		19:50	20:40	14 06:59 (6) 21:23	29 06:52 (2) 21:41					24 06:55 (2)
30	08:04		07:06	06:01	06:46 (6) 05:18	06:24 (2) 05:14					06:32 (2)
30	17:11		19:52	20:42	11 06:57 (6) 21:25	28 06:52 (2) 21:41					24 06:56 (2)
31	08:02		07:04			05:18					06:24 (2)
31	17:12		19:53	9 07:32 (7) 07:41 (7)		21:26 28 06:52 (2)					492
Sonnenscheinstunden											
astr.max.mögl.Beschattung											
Red.Sonnenscheinwahrsch.											
Reduktion Betriebsdauer											
Reduktion Windrichtung											
Gesamte Reduktion											
Met.wahrsch.Beschattung											

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	--------------------------------	---------------------------	----------------------------

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: M - IP04/2 - Leuseler Weg 5, 36304 Alsfeld-Billertshausen

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Table with columns for months (Juli to Dezember) and rows for hourly data (1 to 31). Includes summary rows for Sonnenscheinstunden, astr. max. mögl. Beschattung, Red. Sonnenscheinwahrsch., Reduktion Betriebsdauer, Reduktion Windrichtung, Gesamte Reduktion, and Met. wahrsch. Beschattung.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Table with columns: Tag im Monat, Sonnenaufgang (SS:MM), Sonnenuntergang (SS:MM), Minuten mit Schatten, Zeitpunkt (SS:MM) Schattenanfang, Zeitpunkt (SS:MM) Schattende, (WEA mit erstem Schatten), (WEA mit letztem Schatten)

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: N - IP06 - Auf dem Kreisch 1 (Familiensportgemeinschaft Oberhessen), 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	15:59 (19) 07:10	16:35 (20) 07:02	05:59 05:17	05:17 21:27
2	08:26 16:29	07:59 17:16	16:04 (19) 07:08	16:43 (20) 07:00	19:55 05:58	20:43 05:16
3	08:26 16:30	07:58 17:18	18:05 07:06	18:05 07:06	20:45 20:45	21:28 05:15
4	08:25 16:31	07:56 17:19	18:07 07:03	3 17:38 (1) 17:41 (1)	06:57 19:58	05:56 20:46 21:29
5	08:25 16:33	07:55 17:21	18:08 07:01	9 17:34 (1) 17:43 (1)	06:55 20:00	05:54 20:48 21:30
6	08:25 16:34	07:53 17:23	18:08 06:59	13 17:32 (1) 17:45 (1)	06:53 20:01	05:52 20:49 05:13
7	08:25 16:35	07:51 17:25	18:12 06:57	17 17:30 (1) 17:47 (1)	06:51 20:03	05:51 20:51 21:31
8	08:24 16:36	07:50 17:26	18:14 06:55	19 17:30 (1) 17:49 (1)	06:49 20:04	05:49 20:52 21:32
9	08:24 16:38	07:48 17:28	18:15 06:53	21 17:28 (1) 17:49 (1)	06:46 20:06	05:47 20:54 21:33
10	08:23 16:39	07:46 17:30	21 06:51	21 17:28 (1) 17:49 (1)	06:44 20:08	05:46 20:56 21:34
11	08:23 16:40	07:45 17:32	21 06:48	21 17:28 (1) 17:49 (1)	06:42 20:09	05:44 20:57 21:35
12	08:22 16:42	07:43 17:34	21 06:46	21 17:27 (1) 17:48 (1)	06:38 20:10	05:41 21:00 21:36
13	08:21 16:43	07:41 17:35	21 06:44	19 17:28 (1) 17:47 (1)	06:36 20:14	05:39 21:02 21:37
14	08:21 16:44	07:39 17:37	21 06:42	17 17:29 (1) 17:46 (1)	06:33 20:16	05:38 21:03 21:37
15	08:20 16:46	07:37 17:39	21 06:40	14 17:30 (1) 17:44 (1)	06:31 20:17	05:36 21:05 21:38
16	08:19 16:47	07:36 17:41	21 06:37	10 17:32 (1) 17:42 (1)	06:29 20:19	05:35 21:06 21:38
17	08:18 16:49	07:34 17:42	21 06:35	10 17:32 (1) 17:42 (1)	06:27 20:21	05:33 21:07 21:39
18	08:18 16:51	07:32 17:44	21 06:33	19 17:28 (1) 17:47 (1)	06:25 20:22	05:32 21:09 21:39
19	08:17 16:52	07:30 17:46	21 06:31	19 17:29 (1) 17:46 (1)	06:23 20:24	05:31 21:10 21:40
20	08:16 16:54	07:28 17:48	21 06:28	19 17:29 (1) 17:46 (1)	06:21 20:25	05:29 21:12 21:40
21	08:15 16:55	07:26 17:49	21 06:26	19 17:30 (1) 17:44 (1)	06:19 20:27	05:28 21:13 21:40
22	08:14 16:57	07:24 17:51	21 06:24	19 17:31 (1) 17:45 (1)	06:17 20:29	05:27 21:14 21:40
23	08:12 16:59	07:22 17:53	21 06:22	19 17:32 (1) 17:46 (1)	06:15 20:30	05:26 21:16 21:41
24	08:11 17:00	07:20 17:55	21 06:20	19 17:33 (1) 17:47 (1)	06:13 20:32	05:24 21:17 21:41
25	08:10 17:02	07:18 17:56	21 06:17	19 17:34 (1) 17:48 (1)	06:11 20:33	05:23 21:18 21:41
26	08:09 17:04	07:16 17:58	21 06:15	19 17:35 (1) 17:49 (1)	06:09 20:35	05:22 21:20 21:41
27	08:08 17:05	07:14 18:00	21 06:13	19 17:36 (1) 17:50 (1)	06:07 20:37	05:21 21:21 21:41
28	08:06 17:07	07:12 18:02	21 06:11	19 17:37 (1) 17:51 (1)	06:05 20:38	05:20 21:22 21:41
29	08:05 17:09	07:10 18:04	21 06:08	19 17:38 (1) 17:52 (1)	06:03 20:40	05:19 21:23 21:40
30	08:04 17:11	07:08 18:06	21 06:06	19 17:39 (1) 17:53 (1)	06:01 20:41	05:18 21:24 21:40
31	08:02 17:12	07:06 18:08	21 06:04	19 17:40 (1) 17:54 (1)	05:17 21:25	05:17 21:25 21:40
Sonnenscheinstunden	264	280	367	414	480	492
astr. max. mögl. Beschattung	587	738	234			
Red. Sonnenscheinwahrsch.	0,15	0,28	0,31			
Reduktion Betriebsdauer	0,83	0,83	0,83			
Reduktion Windrichtung	0,71	0,69	0,64			
Gesamte Reduktion	0,09	0,16	0,16			
Met. wahrsch. Beschattung	52	118	38			

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziertes Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: N - IP06 - Auf dem Kreisch 1 (Familiensportgemeinschaft Oberhessen), 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs: Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14 21:40	05:49 21:10	06:36 20:11	07:22 19:04	18:07 (1) 18:27 (1)	07:14 17:00
2	05:15 21:40	05:50 21:09	06:37 20:09	07:24 19:01	18:06 (1) 18:27 (1)	07:15 16:58
3	05:15 21:39	05:52 21:07	06:39 20:06	07:26 18:59	18:05 (1) 18:27 (1)	07:17 16:57
4	05:16 21:39	05:53 21:05	06:40 20:04	07:27 18:57	18:05 (1) 18:27 (1)	07:19 16:55
5	05:17 21:39	05:55 21:04	06:42 20:02	07:29 18:55	18:05 (1) 18:26 (1)	07:20 16:53
6	05:18 21:38	05:56 21:02	06:44 20:00	07:30 18:53	18:05 (1) 18:26 (1)	07:22 16:52
7	05:19 21:38	05:58 21:00	06:45 19:58	07:32 18:50	18:06 (1) 18:24 (1)	07:24 16:50
8	05:19 21:37	05:59 20:58	06:47 19:55	07:34 18:48	18:06 (1) 18:21 (1)	07:26 16:48
9	05:20 21:36	06:01 20:57	06:48 19:53	07:35 18:46	18:08 (1) 18:19 (1)	07:27 16:47
10	05:21 21:36	06:02 20:55	06:50 19:51	07:37 18:44	18:09 (1) 18:16 (1)	07:29 16:45
11	05:22 21:35	06:04 20:53	06:51 19:49	07:38 18:42	07:31 16:44	15:29 (19) 15:38 (19)
12	05:23 21:34	06:05 20:51	06:53 19:46	07:40 18:40	07:32 16:42	08:13 15:40 (19)
13	05:24 21:33	06:07 20:49	06:54 19:44	07:42 18:38	17:07 (20) 17:56 (16)	07:34 16:41
14	05:25 21:33	06:08 20:48	06:56 19:42	07:43 18:35	17:03 (20) 17:58 (16)	07:36 16:39
15	05:27 21:32	06:10 20:46	06:57 19:40	07:45 18:33	17:01 (20) 17:59 (16)	07:37 16:38
16	05:28 21:31	06:11 20:44	06:59 19:37	07:47 18:31	17:00 (20) 18:00 (16)	07:39 16:37
17	05:29 21:30	06:13 20:42	07:01 19:35	07:48 18:29	16:58 (20) 17:59 (16)	07:41 16:36
18	05:30 21:29	06:14 20:40	07:02 19:33	07:50 18:27	16:57 (20) 17:59 (16)	07:42 16:34
19	05:31 21:28	06:16 20:38	07:04 19:31	07:52 18:25	16:56 (20) 17:57 (16)	07:44 16:33
20	05:32 21:26	06:17 20:36	07:05 19:28	07:53 18:23	16:56 (20) 17:56 (16)	07:46 16:32
21	05:34 21:25	06:19 20:34	07:07 19:26	07:55 18:21	16:54 (20) 17:53 (16)	07:47 16:31
22	05:35 21:24	06:20 20:32	07:08 19:24	07:57 18:19	16:54 (20) 17:51 (16)	07:49 16:30
23	05:36 21:23	06:22 20:30	07:10 19:22	07:58 18:17	16:54 (20) 17:25 (20)	07:50 16:29
24	05:38 21:22	06:24 20:28	07:11 19:19	08:00 18:15	16:55 (20) 17:25 (18)	07:52 16:28
25	05:39 21:20	06:25 20:26	07:13 19:17	07:02 17:13	15:55 (20) 16:28 (18)	07:53 16:27
26	05:40 21:19	06:27 20:23	07:14 19:15	07:03 17:11	15:54 (20) 16:29 (18)	07:55 16:26
27	05:42 21:18	06:28 20:21	07:16 19:13	18:14 (1) 18:21 (1)	07:05 17:09	07:57 16:25
28	05:43 21:16	06:30 20:19	07:18 19:10	18:12 (1) 18:24 (1)	07:07 17:07	07:58 16:24
29	05:44 21:15	06:31 20:17	07:19 19:08	18:10 (1) 18:26 (1)	07:08 17:06	07:59 16:23
30	05:46 21:13	06:33 20:15	07:21 19:06	18:08 (1) 18:26 (1)	07:10 17:04	08:01 16:23
31	05:47 21:12	06:34 20:13		07:12 17:02	16:00 (20) 16:31 (18)	08:26 16:27
Sonnenscheinstunden	496	450	380	333	271	250
astr. max. mögl. Beschattung			53	832	632	61
Red. Sonnenscheinwahrsch.			0,38	0,26	0,18	0,14
Reduktion Betriebsdauer			0,83	0,83	0,83	0,83
Reduktion Windrichtung			0,64	0,68	0,71	0,71
Gesamte Reduktion			0,20	0,15	0,10	0,08
Met. wahrsch. Beschattung			11	124	66	5

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	Schattenanfang (WEA mit erstem Schatten)	Schattende (WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: O - IP06/1 - Grünbergerstr. 131, 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	16:16 (19) 16:35 (19)	07:10 18:03	16:50 (20) 17:11 (20)	07:02 19:55
2	08:26 16:29	07:59 17:16	16:16 (19) 16:35 (19)	07:08 18:05	16:50 (20) 17:10 (20)	07:00 19:56
3	08:26 16:30	07:58 17:18	16:17 (19) 16:36 (19)	07:06 18:07	16:51 (20) 17:08 (20)	06:57 19:58
4	08:25 16:31	07:56 17:19	16:17 (19) 16:36 (19)	07:03 18:08	16:53 (20) 17:07 (20)	06:55 20:00
5	08:25 16:33	07:55 17:21	16:17 (19) 16:35 (19)	07:01 18:10	16:56 (20) 17:03 (20)	06:53 20:01
6	08:25 16:34	07:53 17:23	16:18 (19) 16:35 (19)	06:59 18:12	06:51 20:03	05:51 20:51
7	08:25 16:35	07:51 17:25	16:19 (19) 16:34 (19)	06:57 18:14	06:49 20:04	05:49 20:52
8	08:24 16:36	07:50 17:26	16:20 (19) 16:33 (19)	06:55 18:15	06:46 20:06	05:47 20:54
9	08:24 16:38	07:48 17:28	16:21 (19) 16:31 (19)	06:53 18:17	06:44 20:08	05:45 20:56
10	08:23 16:39	07:46 17:30	16:26 (19) 16:29 (19)	06:51 18:19	06:42 20:09	05:44 20:57
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 18:20	06:40 20:11	05:42 20:59
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 18:22	06:38 20:13	05:41 21:00
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 18:24	06:36 20:14	05:39 21:02
14	08:21 16:44	07:39 17:37	06:42 18:25	06:33 18:25	06:33 20:16	05:38 21:03
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 18:27	06:31 20:17	05:36 21:05
16	08:19 16:47	07:36 17:41	06:37 18:29	06:29 18:29	06:29 20:19	05:35 21:06
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 18:30	06:27 20:21	05:33 21:07
18	08:18 16:51	07:32 17:44	16:58 (20) 17:04 (20)	06:33 18:32	06:25 20:22	05:32 21:09
19	08:17 16:52	07:30 17:46	16:55 (20) 17:07 (20)	06:31 18:34	06:23 20:24	05:31 21:10
20	08:16 16:54	07:28 17:48	16:53 (20) 17:09 (20)	06:28 18:35	06:21 20:25	05:29 21:12
21	08:15 16:55	07:26 17:49	16:52 (20) 17:10 (20)	06:26 18:37	06:19 20:27	05:28 21:13
22	08:14 16:57	07:24 17:51	16:51 (20) 17:11 (20)	06:24 18:38	06:17 20:29	05:27 21:14
23	08:12 16:59	07:22 17:53	16:50 (20) 17:12 (20)	06:22 18:40	06:15 20:30	05:26 21:16
24	08:11 17:00	07:20 17:55	16:49 (20) 17:12 (20)	06:20 18:42	06:13 20:32	05:24 21:17
25	08:10 17:02	07:18 17:56	16:49 (20) 17:13 (20)	06:17 18:43	06:11 20:33	05:23 21:18
26	08:09 17:04	07:16 16:21 (19) 17:58	16:49 (20) 17:13 (20)	06:15 18:45	06:09 20:35	05:22 21:20
27	08:08 17:05	07:14 16:31 (19) 18:00	16:49 (20) 17:12 (20)	06:13 18:47	06:07 20:37	05:21 21:21
28	08:06 17:07	07:12 16:18 (19) 18:02	16:50 (20) 17:12 (20)	06:11 18:48	06:05 20:38	05:20 21:22
29	08:05 17:09	07:10 16:18 (19) 16:33 (19)	07:08 19:50	07:08 19:50	06:03 20:40	05:19 21:23
30	08:04 17:11	07:08 16:17 (19) 16:34 (19)	07:06 19:51	07:06 19:51	06:01 20:41	05:18 21:24
31	08:02 17:12	07:06 16:17 (19) 16:35 (19)	07:04 19:53	07:04 19:53	05:17 21:25	05:17 21:25
Sonnenscheinstunden	264	280	367	414	480	492
astr. max. mögl. Beschattung	82	362	79			
Red. Sonnenscheinwahrsch.	0,15	0,28	0,31			
Reduktion Betriebsdauer	0,83	0,83	0,83			
Reduktion Windrichtung	0,71	0,69	0,68			
Gesamte Reduktion	0,09	0,16	0,17			
Met. wahrsch. Beschattung	7	58	14			

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: O - IP06/1 - Grünbergerstr. 131, 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14	05:49	06:36	07:22	07:14	08:02
	21:40	21:10	20:11	19:04	17:00	16:22
2	05:15	05:50	06:37	07:24	07:15	08:04
	21:40	21:09	20:09	19:01	16:58	16:21
3	05:15	05:52	06:39	07:26	07:17	08:05
	21:39	21:07	20:06	18:59	16:57	16:21
4	05:16	05:53	06:40	07:27	07:19	08:06
	21:39	21:05	20:04	18:57	16:55	16:20
5	05:17	05:55	06:42	07:29	07:20	08:08
	21:39	21:04	20:02	18:55	16:53	16:20
6	05:18	05:56	06:44	07:30	07:22	08:09
	21:38	21:02	20:00	18:53	16:52	16:19
7	05:19	05:58	06:45	07:32	07:24	08:10
	21:38	21:00	19:58	18:50	16:50	16:19
8	05:19	05:59	06:47	07:33	07:26	08:11
	21:37	20:58	19:55	18:48	16:48	16:19
9	05:20	06:01	06:48	07:35	17:29 (20)	08:12
	21:36	20:57	19:53	18:46	16:47	16:19
10	05:21	06:02	06:50	07:37	17:26 (20)	08:13
	21:36	20:55	19:51	18:44	16:45	16:18
11	05:22	06:04	06:51	07:38	17:25 (20)	08:14
	21:35	20:53	19:49	18:42	16:44	16:18
12	05:23	06:05	06:53	07:40	17:24 (20)	08:15
	21:34	20:51	19:46	18:40	16:42	16:18
13	05:24	06:07	06:54	07:42	17:23 (20)	08:16
	21:33	20:49	19:44	18:38	16:41	16:18
14	05:25	06:08	06:56	07:43	17:22 (20)	08:17
	21:33	20:48	19:42	18:35	16:39	16:18
15	05:27	06:10	06:57	07:45	17:21 (20)	08:18
	21:32	20:46	19:40	18:33	16:38	16:18
16	05:28	06:11	06:59	07:47	17:21 (20)	08:19
	21:31	20:44	19:37	18:31	16:37	16:18
17	05:29	06:13	07:00	07:48	17:20 (20)	08:20
	21:30	20:42	19:35	18:29	16:36	16:19
18	05:30	06:14	07:02	07:50	17:21 (20)	08:21
	21:29	20:40	19:33	18:27	16:34	16:19
19	05:31	06:16	07:04	07:51	17:21 (20)	08:21
	21:28	20:38	19:31	18:25	16:33	16:19
20	05:32	06:17	07:05	07:53	17:22 (20)	08:22
	21:26	20:36	19:28	18:23	16:32	16:19
21	05:34	06:19	07:07	07:55	17:22 (20)	08:23
	21:25	20:34	19:26	18:21	16:31	16:20
22	05:35	06:20	07:08	07:57	17:24 (20)	08:23
	21:24	20:32	19:24	18:19	16:30	16:20
23	05:36	06:22	07:10	07:58	17:26 (20)	08:24
	21:23	20:30	19:22	18:17	16:29	16:21
24	05:38	06:23	07:11	08:00	07:52	08:24
	21:22	20:28	19:19	18:15	16:28	16:21
25	05:39	06:25	07:13	07:02	07:53	08:24
	21:20	20:26	19:17	17:13	16:27	16:22
26	05:40	06:27	07:14	07:03	07:55	08:25
	21:19	20:23	19:15	17:11	16:26	16:23
27	05:42	06:28	07:16	07:05	07:56	08:25
	21:18	20:21	19:13	17:09	16:25	16:24
28	05:43	06:30	07:18	07:07	07:58	08:25
	21:16	20:19	19:10	17:07	16:24	16:24
29	05:44	06:31	07:19	07:08	07:59	08:25
	21:15	20:17	19:08	17:06	16:23	16:25
30	05:46	06:33	07:21	07:10	08:01	08:26
	21:13	20:15	19:06	17:04	16:23	16:26
31	05:47	06:34	07:22	07:12		08:26
	21:12	20:13	19:05	17:02		16:27
Sonnenscheinstunden	496	450	380	333	271	250
astr. max. mögl. Beschattung				290	240	
Red. Sonnenscheinwahrsch.				0,26	0,18	
Reduktion Betriebsdauer				0,83	0,83	
Reduktion Windrichtung				0,68	0,71	
Gesamte Reduktion				0,15	0,10	
Met. wahrsch. Beschattung				43	25	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: P - IP07 - Disröder Feld (Gewerbegebiet), 36304 Aلسfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:03	16:49 (19) 17:36 (18)	07:02 19:55	18:26 (20) 19:18 (1)
2	08:26 16:29	07:59 17:16	07:08 18:05	17:25 (18) 17:37 (18)	07:00 19:56	18:27 (20) 19:17 (1)
3	08:25 16:30	07:58 17:18	07:06 18:07	17:23 (18) 17:39 (18)	06:57 19:58	18:28 (20) 19:15 (1)
4	08:25 16:31	07:56 17:19	07:03 18:08	17:23 (18) 17:39 (18)	06:55 20:00	18:32 (20) 19:13 (1)
5	08:25 16:33	07:55 17:21	07:01 18:10	17:22 (18) 17:40 (18)	06:53 20:01	19:04 (1) 20:49
6	08:25 16:34	07:53 17:23	16:53 (17) 18:12	06:59 18:12	17:22 (18) 17:40 (18)	06:51 20:03
7	08:25 16:35	07:51 17:25	16:50 (17) 18:14	06:57 18:14	17:22 (18) 17:40 (18)	06:49 20:04
8	08:24 16:36	07:50 17:26	16:48 (17) 18:15	06:55 18:15	17:21 (18) 17:38 (18)	06:46 20:06
9	08:24 16:38	07:48 17:28	16:48 (17) 18:17	06:53 18:17	17:22 (18) 17:37 (18)	06:44 20:08
10	08:23 16:39	07:46 17:30	16:48 (17) 18:19	06:51 18:19	17:23 (18) 17:54 (16)	06:42 20:09
11	08:23 16:40	07:45 17:32	16:48 (17) 18:20	06:48 18:20	17:25 (18) 17:56 (16)	06:40 20:11
12	08:22 16:42	07:43 17:34	16:48 (17) 18:22	06:46 18:22	17:42 (16) 17:56 (16)	06:38 20:13
13	08:21 16:43	07:41 17:35	16:48 (17) 18:24	06:44 18:24	17:42 (16) 17:56 (16)	06:36 20:14
14	08:21 16:45	07:39 17:37	16:48 (17) 18:25	06:42 18:25	17:42 (16) 17:56 (16)	06:33 20:16
15	08:20 16:46	07:37 17:39	16:50 (17) 18:27	06:40 18:27	17:42 (16) 17:56 (16)	06:31 20:17
16	08:19 16:47	07:36 17:41	16:48 (19) 18:29	06:37 18:29	17:43 (16) 17:55 (16)	06:29 20:19
17	08:18 16:49	07:34 17:42	16:46 (19) 18:30	06:35 18:30	17:43 (16) 17:53 (16)	06:27 20:21
18	08:18 16:51	07:32 17:44	16:45 (19) 18:32	06:33 18:32	17:35 (20) 17:51 (16)	06:25 20:22
19	08:17 16:52	07:30 17:46	16:44 (19) 18:34	06:31 18:34	17:32 (20) 17:50 (20)	06:23 20:24
20	08:16 16:54	07:28 17:48	16:44 (19) 18:35	06:28 18:35	17:30 (20) 17:52 (20)	06:21 20:25
21	08:15 16:55	07:26 17:49	16:43 (19) 18:37	06:26 18:37	17:28 (20) 17:52 (20)	06:19 20:27
22	08:14 16:57	07:24 17:51	16:43 (19) 18:38	06:24 18:38	17:27 (20) 17:53 (20)	06:17 20:29
23	08:12 16:59	07:22 17:53	16:43 (19) 18:40	06:22 18:40	17:26 (20) 17:53 (20)	06:15 20:30
24	08:11 17:00	07:20 17:55	16:43 (19) 18:42	06:20 18:42	17:26 (20) 18:16 (1)	06:13 20:32
25	08:10 17:02	07:18 17:56	16:44 (19) 18:43	06:17 18:43	17:24 (20) 18:17 (1)	06:11 20:33
26	08:09 17:04	07:16 17:58	16:45 (19) 18:45	06:15 18:45	17:24 (20) 18:18 (1)	06:09 20:35
27	08:08 17:05	07:14 18:00	16:46 (19) 18:47	06:13 18:47	17:24 (20) 18:19 (1)	06:07 20:37
28	08:06 17:07	07:12 18:02	16:47 (19) 18:48	06:11 18:48	17:24 (20) 18:20 (1)	06:05 20:38
29	08:05 17:09		07:08 19:50	07:08 19:51	18:24 (20) 19:19 (1)	06:03 20:40
30	08:04 17:11		07:06 19:51	07:06 19:19 (1)	18:24 (20) 19:19 (1)	06:01 20:41
31	08:02 17:12		07:04 19:53	07:04 19:19 (1)	18:25 (20) 19:19 (1)	05:17 21:25
Sonnenscheinstunden	264	280	367	414	480	492
astr. max.mögl. Beschattung		368	762	137		
Red. Sonnenscheinwahrsch.		0,28	0,31	0,40		
Reduktion Betriebsdauer		0,83	0,83	0,83		
Reduktion Windrichtung		0,69	0,63	0,62		
Gesamte Reduktion		0,16	0,16	0,21		
Met. wahrsch. Beschattung		58	122	28		

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

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- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziertes Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: P - IP07 - Disröder Feld (Gewerbegebiet), 36304 Aلسfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14 21:40	05:49 21:10	06:36 20:11	07:22 19:04	18:22 (16) 18:36 (16)	07:14 17:00
2	05:15 21:40	05:50 21:09	06:37 20:09	07:24 19:01	18:05 (18) 18:34 (16)	07:15 16:58
3	05:15 21:39	05:52 21:07	06:39 20:06	07:26 18:59	18:02 (18) 18:32 (16)	07:17 16:57
4	05:16 21:39	05:53 21:05	06:40 20:04	07:27 18:57	18:01 (18) 18:31 (16)	07:19 16:55
5	05:17 21:39	05:55 21:04	06:42 20:02	07:29 18:55	17:59 (18) 18:15 (18)	07:20 16:53
6	05:18 21:38	05:56 21:02	06:44 20:00	07:30 18:53	17:58 (18) 18:15 (18)	07:22 16:52
7	05:19 21:38	05:58 21:00	06:45 19:58	18:59 (1) 19:05 (1)	07:32 18:50	17:57 (18) 16:50
8	05:19 21:37	05:59 20:58	06:47 19:55	18:27 (20) 19:08 (1)	07:34 18:48	17:57 (18) 16:48
9	05:20 21:36	06:01 20:57	06:48 19:53	18:23 (20) 19:09 (1)	07:35 18:46	17:57 (18) 16:47
10	05:21 21:36	06:02 20:55	06:50 19:51	18:21 (20) 19:10 (1)	07:37 18:44	17:57 (18) 16:45
11	05:22 21:35	06:04 20:53	06:51 19:49	18:18 (20) 19:10 (1)	07:38 18:42	17:58 (18) 16:44
12	05:23 21:34	06:05 20:51	06:53 19:46	18:17 (20) 19:11 (1)	07:40 18:40	17:24 (19) 16:42
13	05:24 21:33	06:07 20:49	06:54 19:44	18:16 (20) 19:10 (1)	07:42 18:38	17:21 (19) 16:41
14	05:25 21:33	06:08 20:48	06:56 19:42	18:15 (20) 19:10 (1)	07:43 18:35	17:18 (19) 16:39
15	05:27 21:32	06:10 20:46	06:57 19:40	18:14 (20) 19:09 (1)	07:45 18:33	17:17 (19) 16:38
16	05:28 21:31	06:11 20:44	06:59 19:37	18:14 (20) 19:09 (1)	07:47 18:31	17:16 (19) 16:37
17	05:29 21:30	06:13 20:42	07:00 19:35	18:13 (20) 19:07 (1)	07:48 18:29	17:15 (19) 16:36
18	05:30 21:29	06:14 20:40	07:02 19:33	18:13 (20) 19:06 (1)	07:50 18:27	17:15 (19) 16:34
19	05:31 21:28	06:16 20:38	07:04 19:31	18:12 (20) 19:03 (1)	07:51 18:25	17:14 (19) 16:33
20	05:32 21:26	06:17 20:36	07:05 19:28	18:13 (20) 18:40 (20)	07:53 18:23	17:15 (19) 16:32
21	05:34 21:25	06:19 20:34	07:07 19:26	18:12 (20) 18:39 (20)	07:55 18:21	17:14 (19) 16:31
22	05:35 21:24	06:20 20:32	07:08 19:24	18:13 (20) 18:38 (20)	07:57 18:19	17:14 (19) 16:30
23	05:36 21:23	06:22 20:30	07:10 19:22	18:13 (20) 18:36 (20)	07:58 18:17	17:15 (19) 16:29
24	05:38 21:22	06:24 20:28	07:11 19:19	18:15 (20) 18:34 (20)	08:00 18:15	17:16 (19) 16:28
25	05:39 21:20	06:25 20:26	07:13 19:17	18:16 (20) 18:32 (16)	07:02 17:13	16:17 (19) 16:27
26	05:40 21:19	06:27 20:23	07:14 19:15	18:20 (20) 18:35 (16)	07:03 17:11	16:18 (19) 16:26
27	05:42 21:18	06:28 20:21	07:16 19:13	18:24 (16) 18:36 (16)	07:05 17:09	16:19 (17) 16:25
28	05:43 21:16	06:30 20:19	07:18 19:10	18:23 (16) 18:37 (16)	07:07 17:07	16:18 (17) 16:24
29	05:44 21:15	06:31 20:17	07:19 19:08	18:23 (16) 18:37 (16)	07:08 17:06	16:17 (17) 16:23
30	05:46 21:13	06:33 20:15	07:21 19:06	18:22 (16) 18:36 (16)	07:10 17:04	16:17 (17) 16:22
31	05:47 21:12	06:34 20:13		07:12 17:02	16:17 (17) 16:31 (17)	08:26 16:27
Sonnenscheinstunden	496	450	380	333	271	250
astr. max. mögl. Beschattung			699	556	41	
Red. Sonnenscheinwahrsch.			0,38	0,26	0,18	
Reduktion Betriebsdauer			0,83	0,83	0,83	
Reduktion Windrichtung			0,63	0,67	0,70	
Gesamte Reduktion			0,20	0,15	0,10	
Met. wahrsch. Beschattung			137	82	4	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenende
			(WEA mit letztem Schatten)

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: Q - IP07/1 - Disröder Feld Süd (Gewerbegebiet), 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:03	17:03 (19) 19:55	07:02 19:28 (1)	05:17 20:43
2	08:26 16:29	07:59 17:16	07:08 18:05	17:01 (19) 19:56	07:00 19:29 (1)	05:16 20:45
3	08:25 16:30	07:58 17:18	07:06 18:07	17:01 (19) 19:58	06:57 19:29 (1)	05:15 20:46
4	08:25 16:31	07:56 17:19	07:03 18:08	17:01 (19) 20:00	06:55 19:29 (1)	05:14 20:48
5	08:25 16:33	07:55 17:21	07:01 18:10	17:01 (19) 20:01	06:53 19:30 (1)	05:14 20:49
6	08:25 16:34	07:53 17:23	06:59 18:12	17:01 (19) 20:03	06:51 19:29 (1)	05:13 20:51
7	08:25 16:35	07:51 17:25	06:57 18:14	17:02 (19) 20:04	06:49 19:29 (1)	05:13 20:52
8	08:24 16:36	07:50 17:26	06:55 18:15	17:02 (19) 20:06	06:46 19:27 (1)	05:12 20:54
9	08:24 16:38	07:48 17:28	06:53 18:17	17:03 (19) 20:08	06:44 19:26 (1)	05:12 20:56
10	08:23 16:39	07:46 17:30	06:51 18:19	17:04 (19) 20:09	06:42 19:25 (1)	05:11 20:57
11	08:23 16:40	07:45 17:32	06:48 18:20	17:07 (19) 20:11	06:40 19:23 (1)	05:11 20:59
12	08:22 16:42	07:43 17:34	06:46 18:22	17:34 (18) 20:13	06:38 19:08 (20)	05:11 21:00
13	08:21 16:43	07:41 17:35	17:03 (17) 18:24	06:44 18:24	17:34 (18) 20:14	05:10 21:02
14	08:21 16:45	07:39 17:37	17:01 (17) 18:25	06:42 18:25	17:34 (18) 20:16	05:10 21:03
15	08:20 16:46	07:37 17:39	17:00 (17) 18:27	06:40 18:27	17:34 (18) 20:17	05:10 21:05
16	08:19 16:47	07:36 17:41	17:12 (17) 18:29	06:37 18:29	17:35 (18) 20:19	05:10 21:06
17	08:18 16:49	07:34 17:42	16:59 (17) 18:30	06:35 18:30	17:35 (18) 20:21	05:10 21:07
18	08:18 16:51	07:32 17:44	16:59 (17) 18:32	06:33 18:32	17:37 (18) 20:22	05:10 21:09
19	08:17 16:52	07:30 17:46	17:12 (17) 18:34	06:31 18:34	17:41 (18) 20:24	05:10 21:10
20	08:16 16:54	07:28 17:48	16:59 (17) 18:35	06:28 18:35	17:52 (16) 20:25	05:10 21:12
21	08:15 16:55	07:26 17:49	17:00 (17) 18:37	06:26 18:37	17:51 (16) 20:27	05:10 21:13
22	08:14 16:57	07:24 17:51	17:03 (17) 18:38	06:24 18:38	17:52 (16) 20:29	05:10 21:14
23	08:12 16:59	07:22 17:53	17:08 (17) 18:40	06:22 18:40	17:53 (16) 20:30	05:11 21:16
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 18:00 (16)	06:13 20:32	05:11 21:17
25	08:10 17:02	07:18 17:56	17:10 (19) 18:43	06:11 18:43	06:11 20:33	05:11 21:18
26	08:09 17:04	07:16 17:58	17:07 (19) 18:45	06:15 18:45	06:09 20:35	05:12 21:20
27	08:08 17:05	07:14 18:00	17:05 (19) 18:47	06:13 18:47	06:07 20:37	05:12 21:21
28	08:06 17:07	07:12 18:02	17:04 (19) 18:48	06:11 18:48	06:05 20:38	05:12 21:22
29	08:05 17:09		07:08 19:50	06:03 19:04 (20)	06:03 20:40	05:13 21:23
30	08:04 17:11		07:06 19:51	06:01 19:07 (20)	06:01 20:41	05:13 21:24
31	08:02 17:12		07:04 19:53	06:00 19:27 (1)	06:00 20:42	05:13 21:25
Sonnenscheinstunden	264	280	367	414	480	492
astr. max.mögl. Beschattung		161	525	541		
Red. Sonnenscheinwahrsch.		0,28	0,31	0,40		
Reduktion Betriebsdauer		0,83	0,83	0,83		
Reduktion Windrichtung		0,68	0,64	0,61		
Gesamte Reduktion		0,16	0,16	0,20		
Met. wahrsch. Beschattung		25	86	110		

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	------------------------------	---------------------------	----------------------------

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: Q - IP07/1 - Disröder Feld Süd (Gewerbegebiet), 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

| Juli | August | September | Oktober | November | Dezember

1	05:14	05:49	06:36	18:43 (20)	07:22	18:14 (18)	07:14	08:02
	21:40	21:10	19:22 (1)	19:04	17	18:31 (18)	17:00	16:22
2	05:15	05:50	06:37	18:42 (20)	07:24	17:47 (19)	07:15	08:04
	21:40	21:09	20:09	19:24 (1)	19:01	20	18:30 (18)	16:58
3	05:15	05:52	06:39	18:41 (20)	07:26	17:43 (19)	07:17	08:05
	21:39	21:07	20:06	19:24 (1)	18:59	27	18:29 (18)	16:57
4	05:16	05:53	06:40	18:41 (20)	07:27	17:41 (19)	07:19	08:06
	21:39	21:05	20:04	19:25 (1)	18:57	28	18:28 (18)	16:55
5	05:17	05:55	06:42	18:40 (20)	07:29	17:39 (19)	07:20	08:08
	21:39	21:04	20:02	19:25 (1)	18:55	27	18:25 (18)	16:53
6	05:18	05:56	06:44	18:40 (20)	07:30	17:38 (19)	07:22	08:09
	21:38	21:02	20:00	19:25 (1)	18:53	21	17:59 (19)	16:52
7	05:19	05:58	06:45	18:39 (20)	07:32	17:37 (19)	07:24	08:10
	21:38	21:00	19:58	19:25 (1)	18:50	21	17:58 (19)	16:50
8	05:19	05:59	06:47	18:40 (20)	07:34	17:36 (19)	07:26	08:11
	21:37	20:58	19:55	19:25 (1)	18:48	23	17:59 (19)	16:48
9	05:20	06:01	06:48	18:39 (20)	07:35	17:36 (19)	07:27	08:12
	21:36	20:57	19:53	19:23 (1)	18:46	23	17:59 (19)	16:47
10	05:21	06:02	06:50	18:40 (20)	07:37	17:35 (19)	07:29	08:13
	21:36	20:55	19:51	19:23 (1)	18:44	23	17:58 (19)	16:45
11	05:22	06:04	06:51	18:41 (20)	07:38	17:35 (19)	07:31	08:14
	21:35	20:53	19:49	19:21 (1)	18:42	23	17:58 (19)	16:44
12	05:23	06:05	06:53	18:42 (20)	07:40	17:36 (19)	07:32	08:15
	21:34	20:51	19:46	19:19 (1)	18:40	21	17:57 (19)	16:42
13	05:24	06:07	06:54	18:43 (20)	07:42	17:37 (19)	07:34	08:16
	21:33	20:49	19:44	19:15 (1)	18:38	20	17:57 (19)	16:41
14	05:25	06:08	06:56	18:46 (20)	07:43	17:37 (19)	07:36	08:17
	21:33	20:48	19:42	18:56 (20)	18:35	18	17:55 (19)	16:39
15	05:27	06:10	06:57	18:47 (20)	07:45	17:38 (19)	07:37	08:18
	21:32	20:46	19:40	18:33	16	17:54 (19)	16:38	16:18
16	05:28	06:11	06:59	18:48 (20)	07:47	17:40 (19)	07:39	08:19
	21:31	20:44	19:37	18:31	12	17:52 (19)	16:37	16:18
17	05:29	06:13	07:00	18:49 (20)	07:48	17:41 (19)	07:41	08:20
	21:30	20:42	19:35	18:29	16	17:51 (19)	16:36	16:19
18	05:30	06:14	07:02	18:50 (20)	07:50	17:42 (19)	07:42	08:21
	21:29	20:40	19:33	18:27	16	17:50 (19)	16:34	16:19
19	05:31	06:16	07:04	18:44 (16)	07:51	17:43 (19)	07:44	08:21
	21:28	20:38	19:31	18:45 (16)	18:25	17:44 (19)	16:33	16:19
20	05:32	06:17	07:05	18:40 (16)	07:53	17:33 (17)	07:46	08:22
	21:26	20:36	19:28	18:49 (16)	18:23	7	17:40 (17)	16:32
21	05:34	06:19	07:07	18:38 (16)	07:55	17:30 (17)	07:47	08:23
	21:25	20:34	19:26	18:49 (16)	18:21	11	17:41 (17)	16:31
22	05:35	06:20	07:08	18:37 (16)	07:57	17:30 (17)	07:49	08:23
	21:24	20:32	19:24	18:50 (16)	18:19	12	17:42 (17)	16:30
23	05:36	06:22	07:10	18:36 (16)	07:58	17:29 (17)	07:50	08:24
	21:23	20:30	19:22	18:50 (16)	18:17	14	17:43 (17)	16:29
24	05:38	06:24	07:11	18:36 (16)	08:00	17:29 (17)	07:52	08:24
	21:22	20:28	19:19	18:50 (16)	18:15	14	17:43 (17)	16:28
25	05:39	06:25	07:13	18:20 (18)	07:02	16:29 (17)	07:53	08:24
	21:20	20:26	19:17	18:49 (16)	17:13	14	16:43 (17)	16:27
26	05:40	06:27	07:14	18:18 (18)	07:03	16:29 (17)	07:55	08:25
	21:19	20:23	19:15	18:48 (16)	17:11	13	16:42 (17)	16:26
27	05:42	06:28	07:16	18:16 (18)	07:05	16:30 (17)	07:56	08:25
	21:18	20:21	19:13	18:46 (16)	17:09	11	16:41 (17)	16:25
28	05:43	06:30	07:18	18:15 (18)	07:07	16:31 (17)	07:58	08:25
	21:16	20:19	19:03 (20)	18:43 (16)	17:07	8	16:39 (17)	16:24
29	05:44	06:31	07:19	18:15 (18)	07:08	16:34 (17)	07:59	08:25
	21:15	20:17	19:06 (20)	18:32 (18)	17:06	3	16:37 (17)	16:23
30	05:46	06:33	07:21	18:14 (18)	07:10	16:38 (17)	08:01	08:26
	21:13	20:15	19:06 (20)	18:31 (18)	17:04	16:23	16:26	16:26
31	05:47	06:34	07:22	18:13 (18)	07:11	16:24	08:26	16:27
	21:12	20:13	19:19 (1)	17:02	16:27	16:27	16:27	16:27
Sonnenscheinstunden	496	450	380	333	271	250		
astr. max. mögl. Beschattung		82	717	447				
Red. Sonnenscheinwahrsch.		0,46	0,38	0,26				
Reduktion Betriebsdauer		0,83	0,83	0,83				
Reduktion Windrichtung		0,61	0,61	0,67				
Gesamte Reduktion		0,23	0,19	0,15				
Met. wahrsch. Beschattung		19	138	65				

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	Schattenanfang (WEA mit erstem Schatten)	Schattenende (WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	--------------------------------	--	---

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziertes Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: R - IP08 - Pfefferhöhe 2, 36304 Aلسfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 17:14 (17)	06:00 18:56 (18)	05:00 19:34 (20)	04:00 19:57 (20)	03:00 19:32 (20)	02:00 19:58 (20)	01:00 19:32 (20)	00:00 19:57 (20)	00:00 19:36 (20)
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 18:59 (18)	04:58 19:26 (16)	03:58 20:45	02:58 19:32 (20)	01:58 19:58 (20)	00:58 19:32 (20)	00:00 19:57 (20)	00:00 19:36 (20)
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 19:10 (16)	04:56 19:24 (16)	03:56 20:46	02:56 19:30 (20)	01:56 20:00 (20)	00:56 19:30 (20)	00:00 19:57 (20)	00:00 19:38 (20)
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 20:00	05:54 19:11 (16)	04:54 19:23 (16)	03:54 20:48	02:54 19:13 (16)	01:54 20:52	00:54 19:29 (20)	00:00 20:00 (20)	00:00 19:40 (20)
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 19:13 (16)	04:52 20:49	03:52 20:49	02:52 20:01 (20)	01:52 20:20 (20)	00:52 19:29 (20)	00:00 20:01 (20)	00:00 19:55 (20)
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	04:51 20:51	03:51 20:02 (20)	02:51 19:29 (20)	01:51 20:20 (20)	00:51 19:29 (20)	00:00 20:02 (20)	00:00 19:41 (20)
7	08:25 16:35	07:51 17:25	06:57 18:14	06:49 20:04	05:49 20:52	04:49 20:52	03:49 20:02 (20)	02:49 19:28 (20)	01:49 20:20 (20)	00:49 19:28 (20)	00:00 20:02 (20)	00:00 19:53 (20)
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 20:06	05:47 20:54	04:47 20:54	03:47 20:03 (20)	02:47 19:29 (20)	01:47 20:20 (20)	00:47 19:29 (20)	00:00 20:03 (20)	00:00 19:53 (20)
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	04:46 20:56	03:46 20:03 (20)	02:46 19:29 (20)	01:46 20:20 (20)	00:46 19:29 (20)	00:00 20:03 (20)	00:00 19:51 (20)
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 20:09	05:44 20:57	04:44 20:57	03:44 20:03 (20)	02:44 19:29 (20)	01:44 20:20 (20)	00:44 19:29 (20)	00:00 20:03 (20)	00:00 19:51 (20)
11	08:23 16:40	07:45 17:32	06:48 18:20	17:36 (19) 06:40	06:40 17:40 (19)	05:42 20:11	04:42 20:59	03:42 20:03 (20)	02:42 20:20 (20)	01:42 19:29 (20)	00:42 20:03 (20)	00:00 19:51 (20)
12	08:22 16:42	07:43 17:34	06:46 18:22	17:30 (19) 06:38	06:38 17:44 (19)	05:41 20:13	04:41 21:00	03:41 20:04 (20)	02:41 20:20 (20)	01:41 19:29 (20)	00:41 20:03 (20)	00:00 19:51 (20)
13	08:21 16:43	07:41 17:35	06:44 18:24	17:28 (19) 06:36	06:36 17:47 (19)	05:39 20:14	04:39 21:02	03:39 20:03 (20)	02:39 20:20 (20)	01:39 19:29 (20)	00:39 20:03 (20)	00:00 19:51 (20)
14	08:21 16:45	07:39 17:37	06:42 18:25	17:26 (19) 06:33	06:33 17:48 (19)	05:38 20:16	04:38 21:03	03:38 20:04 (20)	02:38 20:20 (20)	01:38 19:29 (20)	00:38 20:03 (20)	00:00 19:51 (20)
15	08:20 16:46	07:37 17:39	06:40 18:27	17:25 (19) 06:31	06:31 17:49 (19)	05:36 20:17	04:36 21:05	03:36 20:03 (20)	02:36 20:20 (20)	01:36 19:29 (20)	00:36 20:03 (20)	00:00 19:51 (20)
16	08:19 16:48	07:36 17:41	06:37 18:29	17:24 (19) 06:29	06:29 17:50 (19)	05:35 20:19	04:35 21:06	03:35 20:03 (20)	02:35 20:20 (20)	01:35 19:29 (20)	00:35 20:03 (20)	00:00 19:51 (20)
17	08:18 16:49	07:34 17:42	06:35 18:30	17:22 (19) 06:27	06:27 17:50 (19)	05:33 20:21	04:33 21:07	03:33 20:03 (20)	02:33 20:20 (20)	01:33 19:29 (20)	00:33 20:03 (20)	00:00 19:51 (20)
18	08:18 16:51	07:32 17:44	06:33 18:32	17:21 (19) 06:25	06:25 17:51 (19)	05:32 20:22	04:32 21:09	03:32 20:04 (20)	02:32 20:20 (20)	01:32 19:29 (20)	00:32 20:03 (20)	00:00 19:51 (20)
19	08:17 16:52	07:30 17:46	17:16 (17) 06:31	06:31 17:19 (17)	06:23 18:34	05:31 20:24	04:31 21:10	03:31 20:03 (20)	02:31 20:20 (20)	01:31 19:29 (20)	00:31 20:03 (20)	00:00 19:51 (20)
20	08:16 16:54	07:28 17:48	17:13 (17) 06:28	06:28 17:13 (17)	06:21 18:35	05:29 20:25	04:29 21:12	03:29 20:03 (20)	02:29 20:20 (20)	01:29 19:29 (20)	00:29 20:03 (20)	00:00 19:51 (20)
21	08:15 16:55	07:26 17:49	17:12 (17) 06:26	06:26 17:23 (17)	06:19 18:37	05:28 20:27	04:28 21:13	03:28 20:03 (20)	02:28 20:20 (20)	01:28 19:29 (20)	00:28 20:03 (20)	00:00 19:51 (20)
22	08:14 16:57	07:24 17:51	17:11 (17) 06:24	06:24 17:25 (17)	06:17 18:38	05:27 20:29	04:27 21:14	03:27 20:03 (20)	02:27 20:20 (20)	01:27 19:29 (20)	00:27 20:03 (20)	00:00 19:51 (20)
23	08:12 16:59	07:22 17:53	17:10 (17) 06:22	06:22 17:26 (17)	06:15 18:40	05:26 20:30	04:26 21:16	03:26 20:03 (20)	02:26 20:20 (20)	01:26 19:29 (20)	00:26 20:03 (20)	00:00 19:51 (20)
24	08:11 17:00	07:20 17:55	17:10 (17) 06:20	06:20 17:10 (17)	06:13 18:42	05:24 20:32	04:24 21:17	03:24 20:03 (20)	02:24 20:20 (20)	01:24 19:29 (20)	00:24 20:03 (20)	00:00 19:51 (20)
25	08:10 17:02	07:18 17:56	17:10 (17) 06:17	06:17 17:20 (19)	06:11 18:43	05:23 20:33	04:23 21:18	03:23 20:03 (20)	02:23 20:20 (20)	01:23 19:29 (20)	00:23 20:03 (20)	00:00 19:51 (20)
26	08:09 17:04	07:16 17:58	17:10 (17) 06:15	06:15 17:21 (19)	06:09 18:45	05:22 20:35	04:22 21:20	03:22 20:03 (20)	02:22 20:20 (20)	01:22 19:29 (20)	00:22 20:03 (20)	00:00 19:51 (20)
27	08:08 17:05	07:14 18:00	17:11 (17) 06:13	06:13 17:25 (17)	06:07 18:47	05:21 20:37	04:21 21:21	03:21 20:03 (20)	02:21 20:20 (20)	01:21 19:29 (20)	00:21 20:03 (20)	00:00 19:51 (20)
28	08:06 17:07	07:12 18:02	17:12 (17) 06:11	06:11 17:24 (17)	06:05 18:48	05:20 20:38	04:20 21:22	03:20 20:03 (20)	02:20 20:20 (20)	01:20 19:29 (20)	00:20 20:03 (20)	00:00 19:51 (20)
29	08:05 17:09	07:11 18:04	07:08 19:50	07:08 18:26 (19)	06:03 19:24 (16)	05:19 20:40	04:19 21:23	03:19 20:03 (20)	02:19 20:20 (20)	01:19 19:29 (20)	00:19 20:03 (20)	00:00 19:51 (20)
30	08:04 17:11	07:09 18:04	07:06 19:51	07:06 18:30 (19)	06:01 19:26 (16)	05:18 20:41	04:18 21:24	03:18 20:03 (20)	02:18 20:20 (20)	01:18 19:29 (20)	00:18 20:03 (20)	00:00 19:51 (20)
31	08:02 17:12	07:07 18:02	07:04 19:53	07:04 18:55 (18)	06:00 19:27 (16)	05:17 21:25	04:17 22:25	03:17 20:03 (20)	02:17 20:20 (20)	01:17 19:29 (20)	00:17 20:03 (20)	00:00 19:51 (20)
Sonnenscheinstunden 264 280 367 414 480 492												
astr. max. mögl. Beschattung												
Red. Sonnenscheinwahrsch. 0,28 0,31 0,40 0,44 0,38												
Reduktion Betriebsdauer 0,83 0,83 0,83 0,83 0,83												
Reduktion Windrichtung 0,67 0,63 0,56 0,53 0,53												
Gesamte Reduktion 0,16 0,16 0,19 0,20 0,17												
Met. wahrsch. Beschattung 20 115 73 199 21												

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang (WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Schattenende (WEA mit letztem Schatten)

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: R - IP08 - Pfefferhöhe 2, 36304 Aلسfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14 21:40	05:49 21:10	19:37 (20) 20:14 (20)	06:36 20:11	07:22 18:09 (19)	08:02 17:00
2	05:15 21:40	05:50 21:09	19:37 (20) 20:14 (20)	06:37 20:09	07:24 18:11 (19)	08:04 16:21
3	05:15 21:39	05:52 21:07	19:37 (20) 20:13 (20)	06:39 20:06	07:26 18:21 (19)	08:05 16:58
4	05:16 21:39	19:52 (20) 21:05	05:53 20:13 (20)	06:40 20:04	07:27 18:57	08:06 16:20
5	05:17 21:39	19:49 (20) 21:04	05:55 20:12 (20)	06:42 20:02	07:29 18:55	08:08 16:20
6	05:18 21:38	19:48 (20) 21:02	05:56 20:11 (20)	06:44 20:00	07:30 18:53	08:09 16:20
7	05:19 21:38	19:47 (20) 21:00	05:58 20:11 (20)	06:45 19:58	07:32 19:08 (16)	08:10 18:50
8	05:19 21:37	19:46 (20) 20:58	05:59 20:10 (20)	06:47 19:55	07:34 19:18 (16)	08:11 18:48
9	05:20 21:36	19:46 (20) 20:57	06:01 20:09 (20)	06:48 19:53	07:35 19:18 (16)	08:12 18:46
10	05:21 21:36	19:45 (20) 20:55	06:02 20:08 (20)	06:50 19:51	07:37 18:52 (18)	08:13 18:44
11	05:22 21:35	19:44 (20) 20:53	06:04 20:07 (20)	06:51 19:49	07:38 18:49 (18)	08:14 18:42
12	05:23 21:34	19:43 (20) 20:51	06:05 20:05 (20)	06:53 19:46	07:40 18:48 (18)	08:15 18:40
13	05:24 21:33	19:42 (20) 20:49	06:07 20:02 (20)	06:54 19:44	07:42 18:46 (18)	08:16 17:47 (17)
14	05:25 21:33	19:41 (20) 20:48	06:08 20:01 (1)	06:56 19:42 (1)	07:43 18:17 (19)	08:17 17:56 (17)
15	05:27 21:32	20:07 (20) 20:46	06:48 20:09 (20)	19:42 (1) 19:40	18:35 18:14 (19)	16:40 17:43 (17)
16	05:28 21:31	19:41 (20) 20:44	06:11 20:03 (1)	06:59 19:37	07:45 18:12 (19)	08:18 17:43 (17)
17	05:29 21:30	19:41 (20) 20:42	06:13 20:03 (1)	07:01 19:35	07:48 18:10 (19)	08:20 17:41 (17)
18	05:30 21:29	19:40 (20) 20:40	06:14 20:04 (1)	07:02 19:33	07:50 18:09 (19)	08:21 17:41 (17)
19	05:31 21:28	19:40 (20) 20:38	06:16 20:03 (1)	07:04 19:31	07:52 18:07 (19)	08:21 17:42 (17)
20	05:32 21:26	19:39 (20) 20:36	06:17 20:04 (1)	07:05 19:28	07:53 18:07 (19)	08:22 17:42 (17)
21	05:34 21:25	19:38 (20) 20:34	06:19 20:03 (1)	07:07 19:26	07:55 18:05 (19)	08:23 17:42 (17)
22	05:35 21:24	19:39 (20) 20:32	06:20 20:03 (1)	07:08 19:24	07:57 18:05 (19)	08:23 17:44 (17)
23	05:36 21:23	19:38 (20) 20:30	06:22 20:02 (1)	07:10 19:22	07:58 18:04 (19)	08:24 17:48 (17)
24	05:38 21:22	19:38 (20) 20:28	06:24 20:00 (1)	07:11 19:19	08:00 18:04 (19)	08:24 17:49 (17)
25	05:39 21:20	19:37 (20) 20:26	06:25 19:41 (1)	07:13 19:17	08:02 18:35 (19)	08:24 17:13
26	05:40 21:19	19:38 (20) 20:23	06:27 19:56 (1)	07:14 19:15	07:03 18:04 (19)	08:25 17:11
27	05:42 21:18	19:37 (20) 20:21	06:28 19:55 (1)	07:16 19:13	07:05 18:04 (19)	08:25 17:09
28	05:43 21:16	19:37 (20) 20:19	06:30 19:52 (1)	07:18 19:10	07:07 18:05 (19)	08:25 17:07
29	05:44 21:15	19:36 (20) 20:17	06:31 20:00 (1)	07:19 19:08	07:08 18:06 (19)	08:25 17:06
30	05:46 21:13	19:37 (20) 20:15	06:33 20:14 (20)	07:21 19:06	07:10 18:27 (19)	08:26 17:04
31	05:47 21:12	19:37 (20) 20:13	06:34 20:13		07:12 17:02	08:26 16:27
Sonnenscheinstunden 496 450 380 333 271 250						
astr. max. mögl. Beschattung 761 676 787 160 160 160						
Red. Sonnenscheinwahrsch. 0,47 0,46 0,38 0,26 0,26 0,26						
Reduktion Betriebsdauer 0,83 0,83 0,83 0,83 0,83 0,83						
Reduktion Windrichtung 0,53 0,54 0,63 0,67 0,67 0,67						
Gesamte Reduktion 0,21 0,21 0,20 0,15 0,15 0,15						
Met. wahrsch. Beschattung 159 140 155 23 23 23						

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	Schattenanfang (WEA mit erstem Schatten)	Schattende (WEA mit letztem Schatten)
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Projekt:
SW19001 Zelle

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: S - IP08/1 - Pfefferhöhe 19 (MC Donalds), 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor
N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni							
1	08:26 16:28	08:01 17:18	07:10 18:03	07:02 19:55	06:00 19:30	05:17 20:43	19:43 (1)	05:17	21:27		38	20:23 (20)	19:45 (20)
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 18:30	05:58 20:45	19:43 (1)	05:16	21:28		38	20:23 (20)	19:45 (20)
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 18:30	05:56 20:46	19:44 (1)	05:15	21:29		38	20:24 (20)	19:46 (20)
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 19:59	05:54 18:31	05:54 20:46	19:44 (1)	05:14	21:30		39	20:24 (20)	19:45 (20)
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 18:33	05:52 20:49	19:45 (1)	05:14	21:31		38	20:24 (20)	19:46 (20)
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 18:35	05:51 20:51	19:47 (1)	05:13	21:31		38	20:24 (20)	19:46 (20)
7	08:25 16:35	07:51 17:25	06:57 18:14	06:49 20:04	05:49 19:04	05:49 20:52	19:48 (1)	05:13	21:32		39	20:25 (20)	19:46 (20)
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 20:06	05:47 19:06	05:47 20:54	19:58 (1)	05:12	21:33		38	20:24 (20)	19:46 (20)
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 19:17	05:46 20:56	19:52 (1)	05:12	21:34		38	20:24 (20)	19:47 (20)
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 20:09	05:44 19:21	05:44 20:57	19:51 (1)	05:11	21:35		38	20:25 (20)	19:47 (20)
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	05:42 20:59	05:42 20:07	19:58 (20)	05:11	21:35	9	37	20:24 (20)	19:47 (20)
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00	05:41 20:11	19:55 (20)	05:11	21:36	16	38	20:25 (20)	19:48 (20)
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 20:14	05:39 21:02	05:39 20:12	19:53 (20)	05:10	21:37	19	37	20:25 (20)	19:48 (20)
14	08:21 16:45	07:39 17:37	06:42 18:25	06:33 20:16	05:38 21:03	05:38 20:14	19:52 (20)	05:10	21:37	22	37	20:25 (20)	19:48 (20)
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 20:17	05:36 21:05	05:36 20:15	19:50 (20)	05:10	21:38	25	38	20:26 (20)	19:48 (20)
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06	05:35 20:16	19:49 (20)	05:10	21:38	27	37	20:26 (20)	19:49 (20)
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 20:21	05:33 21:07	05:33 20:18	19:48 (20)	05:10	21:39	30	37	20:26 (20)	19:49 (20)
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:32 20:19	19:48 (20)	05:10	21:40	31	37	20:26 (20)	19:49 (20)
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:31 20:20	19:46 (20)	05:10	21:40	32	37	20:26 (20)	19:49 (20)
20	08:16 16:54	07:28 17:48	06:28 18:35	06:21 20:25	05:29 21:12	05:29 20:21	19:46 (20)	05:10	21:40	33	37	20:26 (20)	19:49 (20)
21	08:15 16:55	07:26 17:49	06:26 18:37	06:19 20:27	05:28 21:13	05:28 20:20	19:50 (1)	05:10	21:40	34	37	20:26 (20)	19:49 (20)
22	08:14 16:57	07:24 17:51	06:24 18:38	06:17 20:29	05:27 21:14	05:27 20:21	19:48 (1)	05:10	21:40	35	37	20:27 (20)	19:50 (20)
23	08:12 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:26 20:22	19:46 (1)	05:11	21:41	36	37	20:27 (20)	19:50 (20)
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:24 20:23	19:45 (1)	05:11	21:41	37	37	20:28 (20)	19:51 (20)
25	08:10 17:02	07:18 17:56	06:17 18:43	06:11 20:33	05:23 21:18	05:23 20:24	19:44 (1)	05:11	21:41	37	37	20:27 (20)	19:51 (20)
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	05:22 20:25	19:43 (1)	05:12	21:41	37	37	20:28 (20)	19:51 (20)
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:21 20:26	19:45 (1)	05:12	21:41	37	37	20:28 (20)	19:51 (20)
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:20 20:27	19:42 (1)	05:12	21:41	37	37	20:28 (20)	19:51 (20)
29	08:05 17:09		07:08 19:50	06:03 20:40	05:19 21:23	05:19 20:28	19:43 (1)	05:13	21:41	38	37	20:28 (20)	19:51 (20)
30	08:04 17:11		07:06 19:51	06:01 20:41	05:18 21:24	05:18 20:29	19:43 (1)	05:14	21:40	38	38	20:28 (20)	19:51 (20)
31	08:02 17:12		07:04 19:53	06:00 20:41	05:17 21:25	05:17 20:29	19:45 (20)	05:14	21:40	38	38	20:29 (20)	19:51 (20)
	Sonnenscheinstunden	264	280	367	414	480		492					
	astr.max.mögl.Beschattung		91	534	582	769		1125					
	Red.Sonnenscheinwahrsch.		0,28	0,31	0,40	0,44		0,38					
	Reduktion Betriebsdauer		0,83	0,83	0,83	0,83		0,83					
	Reduktion Windrichtung		0,66	0,63	0,58	0,54		0,54					
	Gesamte Reduktion		0,15	0,16	0,20	0,20		0,17					
	Met.wahrsch.Beschattung		14	85	114	153		193					

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang (WEA mit erstem Schatten)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schatteneinde (WEA mit letztem Schatten)
	Sonnenuntergang (SS:MM)			

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
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+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: S - IP08/1 - Pfefferhöhe 19 (MC Donalds), 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober		November		Dezember	
1	05:14	19:52 (20)	05:49	20:07 (20)	06:36		07:22		07:14	08:02		
	21:40	38 20:30 (20)	21:10	20:20 (20)	20:11		19:04		17:00	16:22		
2	05:15	19:51 (20)	05:50	20:11 (20)	06:37		07:24	19:20 (16)	07:15	08:04		
	21:40	38 20:29 (20)	21:09	20:16 (20)	20:09	3	19:23 (16)	19:01	16:58	16:21		
3	05:15	19:52 (20)	05:52		06:39		07:26	19:15 (16)	07:17	08:05		
	21:39	38 20:30 (20)	21:07		20:06	10	18:59	19:25 (16)	16:57	16:21		
4	05:16	19:52 (20)	05:53		06:40		07:27	19:05 (18)	07:19	08:06		
	21:39	38 20:30 (20)	21:05		20:04	19	18:57	19:27 (16)	16:55	16:20		
5	05:17	19:52 (20)	05:55	20:01 (1)	06:42		07:29	19:01 (18)	07:20	08:08		
	21:39	38 20:30 (20)	21:04	20:06 (1)	20:02	26	18:55	19:27 (16)	16:53	16:20		
6	05:18	19:52 (20)	05:56	19:57 (1)	06:44		07:30	18:31 (19)	07:22	08:09		
	21:38	38 20:30 (20)	21:02	20:08 (1)	20:00	43	18:53	19:28 (16)	16:52	16:20		
7	05:19	19:52 (20)	05:58	19:56 (1)	06:45		07:32	18:28 (19)	07:24	08:10		
	21:38	39 20:31 (20)	21:00	20:11 (1)	19:58	48	18:50	19:27 (16)	16:50	16:19		
8	05:19	19:53 (20)	05:59	19:54 (1)	06:47		07:34	18:26 (19)	07:26	08:11		
	21:37	38 20:31 (20)	20:58	20:11 (1)	19:55	54	18:48	19:28 (16)	16:48	16:19		
9	05:20	19:53 (20)	06:01	19:54 (1)	06:48		07:35	18:24 (19)	07:27	08:12		
	21:36	38 20:31 (20)	20:57	20:13 (1)	19:53	57	18:46	19:27 (16)	16:47	16:19		
10	05:21	19:53 (20)	06:02	19:52 (1)	06:50		07:37	18:23 (19)	07:29	08:13		
	21:36	38 20:31 (20)	20:55	20:13 (1)	19:51	57	18:44	19:25 (16)	16:45	16:18		
11	05:22	19:53 (20)	06:04	19:52 (1)	06:51		07:38	18:21 (19)	07:31	08:14		
	21:35	39 20:32 (20)	20:53	20:14 (1)	19:49	57	18:42	19:22 (16)	16:44	16:18		
12	05:23	19:52 (20)	06:05	19:51 (1)	06:53		07:40	18:21 (19)	07:32	08:15		
	21:34	39 20:31 (20)	20:51	20:14 (1)	19:46	57	18:40	19:21 (16)	16:42	16:18		
13	05:24	19:53 (20)	06:07	19:50 (1)	06:54		07:42	18:19 (19)	07:34	08:16		
	21:33	38 20:31 (20)	20:49	20:13 (1)	19:44	55	18:38	19:18 (16)	16:41	16:18		
14	05:25	19:53 (20)	06:08	19:51 (1)	06:56		07:43	18:19 (19)	07:36	08:17		
	21:33	38 20:31 (20)	20:48	20:14 (1)	19:42	52	18:35	19:14 (18)	16:40	16:18		
15	05:27	19:54 (20)	06:10	19:50 (1)	06:57		07:45	18:18 (19)	07:37	08:18		
	21:32	38 20:32 (20)	20:46	20:13 (1)	19:40	50	18:33	19:12 (18)	16:38	16:18		
16	05:28	19:54 (20)	06:11	19:50 (1)	06:59		07:47	18:18 (19)	07:39	08:19		
	21:31	38 20:32 (20)	20:44	20:13 (1)	19:37	48	18:31	19:11 (18)	16:37	16:18		
17	05:29	19:54 (20)	06:13	19:50 (1)	07:01		07:48	18:17 (19)	07:41	08:20		
	21:30	38 20:32 (20)	20:42	20:12 (1)	19:35	43	18:29	19:08 (18)	16:36	16:19		
18	05:30	19:54 (20)	06:14	19:51 (1)	07:02		07:50	18:18 (19)	07:42	08:21		
	21:29	37 20:31 (20)	20:40	20:12 (1)	19:33	34	18:27	19:04 (18)	16:34	16:19		
19	05:31	19:55 (20)	06:16	19:51 (1)	07:04		07:52	18:17 (19)	07:44	08:21		
	21:28	36 20:31 (20)	20:38	20:10 (1)	19:31	30	18:25	18:47 (19)	16:33	16:19		
20	05:32	19:55 (20)	06:17	19:52 (1)	07:05		07:53	18:18 (19)	07:46	08:22		
	21:26	36 20:31 (20)	20:36	20:09 (1)	19:28	29	18:23	18:47 (19)	16:32	16:20		
21	05:34	19:55 (20)	06:19	19:53 (1)	07:07		07:55	18:18 (19)	07:47	08:23		
	21:25	35 20:30 (20)	20:34	20:07 (1)	19:26	27	18:21	18:45 (19)	16:31	16:20		
22	05:35	19:56 (20)	06:20	19:55 (1)	07:08		07:57	18:19 (19)	07:49	08:23		
	21:24	35 20:31 (20)	20:32	20:05 (1)	19:24	25	18:19	18:44 (19)	16:30	16:20		
23	05:36	19:56 (20)	06:22	19:58 (1)	07:10		07:58	18:20 (19)	07:50	08:24		
	21:23	34 20:30 (20)	20:30	20:02 (1)	19:22	22	18:17	18:42 (19)	16:29	16:21		
24	05:38	19:57 (20)	06:24		07:11		08:00	18:22 (19)	07:52	08:24		
	21:22	32 20:29 (20)	20:28		19:19	18	18:15	18:40 (19)	16:28	16:22		
25	05:39	19:57 (20)	06:25		07:13		07:02	18:24 (19)	07:53	08:24		
	21:20	32 20:29 (20)	20:26		19:17	12	17:13	18:36 (19)	16:27	16:22		
26	05:40	19:59 (20)	06:27		07:14		07:03		07:55	08:25		
	21:19	30 20:29 (20)	20:23		19:15		17:11		16:26	16:23		
27	05:42	19:59 (20)	06:28		07:16		07:05		07:56	08:25		
	21:18	29 20:28 (20)	20:21		19:13		17:09		16:25	16:24		
28	05:43	20:00 (20)	06:30		07:18		07:07		07:58	08:25		
	21:16	26 20:26 (20)	20:19		19:10		17:07		16:24	16:24		
29	05:44	20:01 (20)	06:31		07:19		07:08		07:59	08:25		
	21:15	24 20:25 (20)	20:17		19:08		17:06		16:23	16:25		
30	05:46	20:03 (20)	06:33		07:21		07:10		08:01	08:26		
	21:13	21 20:24 (20)	20:15		19:06		17:04		16:23	16:26		
31	05:47	20:04 (20)	06:34				07:12			08:26		
	21:12	18 20:22 (20)	20:13				17:02			16:27		
Sonnenscheinstunden	496		450		380		333		271	250		
astr. max. mögl. Beschattung	1074		350		876		142					
Red. Sonnenscheinwahrsch.	0,47		0,46		0,38		0,26					
Reduktion Betriebsdauer	0,83		0,83		0,83		0,83					
Reduktion Windrichtung	0,54		0,53		0,62		0,66					
Gesamte Reduktion	0,21		0,20		0,19		0,15					
Met. wahrsch. Beschattung	225		71		170		21					

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattende
			(WEA mit letztem Schatten)

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: T - IP09 - Am Holzberg 100, 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	20:04 (1)	05:17		20:19 (20)			
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	20:03 (1)	05:16	25	20:19 (20)			
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	20:17 (1)	05:15	25	20:44 (20)			
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 20:00	05:54 20:48	20:03 (1)	05:14	26	20:19 (20)			
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:49	20:01 (1)	05:14	26	20:45 (20)			
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 19:30 (19)	20:02 (1)	05:13	27	20:19 (20)			
7	08:24 16:35	07:51 17:25	06:57 18:14	06:49 20:04	05:49 19:39 (18)	20:01 (1)	05:13	27	20:46 (20)			
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 17:49 (17)	05:47 19:16 (19)	20:02 (1)	05:12	27	20:19 (20)			
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 17:50 (17)	05:46 19:40 (18)	20:02 (1)	05:12	27	20:46 (20)			
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 17:44 (17)	05:44 19:14 (19)	20:02 (1)	05:11	27	20:20 (20)			
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 17:56 (17)	05:42 19:43 (18)	20:03 (1)	05:11	28	20:47 (20)			
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 17:42 (17)	05:41 19:12 (19)	20:03 (1)	05:11	28	20:19 (20)			
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 17:42 (17)	05:39 19:47 (16)	20:05 (1)	05:10	28	20:47 (20)			
14	08:21 16:45	07:39 17:37	06:42 18:25	06:33 17:42 (17)	05:38 19:11 (19)	20:07 (1)	05:10	28	20:20 (20)			
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 17:43 (17)	05:36 19:50 (16)	20:15 (1)	05:10	28	20:48 (20)			
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 17:43 (17)	05:35 19:11 (19)		05:10	28	20:21 (20)			
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 17:45 (17)	05:33 19:48 (16)		05:10	28	20:49 (20)			
18	08:17 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 19:12 (19)		05:10	28	20:21 (20)			
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 19:45 (16)		05:10	28	20:49 (20)			
20	08:16 16:54	07:28 17:48	06:28 18:35	06:21 20:25	05:29 19:13 (19)		05:10	28	20:22 (20)			
21	08:15 16:55	07:26 17:49	06:26 18:37	06:19 20:27	05:28 19:39 (18)		05:10	28	20:49 (20)			
22	08:14 16:57	07:24 17:51	06:24 18:38	06:17 20:29	05:27 19:16 (19)	20:27 (20)	05:10	28	20:23 (20)			
23	08:12 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 19:29 (19)	8	05:11	28	20:50 (20)			
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 19:24 (19)	12	05:11	28	20:22 (20)			
25	08:10 17:02	07:18 17:56	06:17 18:43	06:11 20:33	05:23 21:17	14	05:11	28	20:50 (20)			
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	17	05:12	28	20:23 (20)			
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	19	05:12	28	20:51 (20)			
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 20:10 (1)	20	05:12	28	20:23 (20)			
29	08:05 17:09	07:08 19:50	06:08 20:40	06:03 20:07 (1)	05:19 20:13 (1)	22	05:13	28	20:51 (20)			
30	08:04 17:11	07:06 19:51	06:06 20:41	06:01 20:05 (1)	05:18 20:14 (1)	22	05:14	28	20:24 (20)			
31	08:02 17:12	07:04 19:53	06:04 20:42	06:00 20:06 (1)	05:17 21:25	24	05:15	28	20:52 (20)			
Sonnenscheinstunden	264	280	367	414	480	480	492					
astr. max. mögl. Beschattung			104	480	403		817					
Red. Sonnenscheinwahrsch.			0,31	0,40	0,44		0,38					
Reduktion Betriebsdauer			0,83	0,83	0,83		0,83					
Reduktion Windrichtung			0,64	0,58	0,54		0,54					
Gesamte Reduktion			0,16	0,19	0,20		0,17					
Met. wahrsch. Beschattung			17	92	80		139					

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang (WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM) Schattenende (WEA mit letztem Schatten)
	Minuten mit Schatten	

Projekt:

SW19001 Zell

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
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Lizenzierter Anwender:

windtest grevenbroich gmbh
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lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: T - IP09 - Am Holzberg 100, 36304 Alsfeld

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Table with 12 columns (Jan-Dec) and 1 row of values: 1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

Table with 13 columns (N, NNO, ONO, O, OSO, SSO, S, SSW, WSW, W, WNW, NNW, Summe) and 1 row of values: 472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Main shadow calculation table with columns for months (Juli-Dezember) and rows for each day (1-31), showing start/end times and various reduction metrics.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Summary table with columns: Tag im Monat, Sonnenaufgang (SS:MM), Sonnenuntergang (SS:MM), Minuten mit Schatten, Zeitpunkt (SS:MM) Schattenanfang, Zeitpunkt (SS:MM) Schattenende, (WEA mit erstem Schatten), (WEA mit letztem Schatten)

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
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- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziierter Anwender:

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lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: U - IP09/1 - Am Holzberg 31, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember
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1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:26	05:14 21:40	05:49 21:10	06:36 20:11	07:22 19:04	07:13 17:00	08:02 16:22
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	05:15 21:40	05:50 21:09	06:37 20:08	07:24 19:01	07:15 16:58	08:04 16:21
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	05:15 21:39	05:52 21:07	06:39 20:06	07:25 18:59	07:17 16:57	08:05 16:21
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 20:00	05:54 20:48	05:14 21:30	05:16 21:39	05:53 21:05	06:40 20:04	07:27 18:57	07:19 16:55	08:06 16:20
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:49	05:14 21:30	05:17 21:39	05:55 21:04	06:42 20:02	07:29 18:55	07:20 16:53	08:08 16:20
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:31	05:18 21:38	05:56 21:02	06:44 20:00	07:30 18:53	07:22 16:52	08:09 16:20
7	08:24 16:35	07:51 17:25	06:57 18:14	06:49 20:04	05:49 20:52	05:13 21:32	05:19 21:38	05:58 21:00	06:45 19:58	07:32 18:50	07:24 16:50	08:10 16:19
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 20:06	05:47 20:54	05:12 21:33	05:19 21:37	05:59 20:58	06:47 19:55	07:33 18:48	07:25 16:48	08:11 16:19
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	05:12 21:34	05:20 21:36	06:01 20:57	06:48 19:53	07:35 18:46	07:27 16:47	08:12 16:19
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 20:09	05:44 20:57	05:11 21:35	05:21 21:36	06:02 20:55	06:50 19:51	07:37 18:44	07:29 16:45	08:13 16:18
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	05:42 20:59	05:11 21:35	05:22 21:35	06:04 20:53	06:51 19:49	07:38 18:42	07:31 16:44	08:14 16:18
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:12	05:41 21:00	05:11 21:36	05:23 21:34	06:05 20:51	06:53 19:46	07:40 18:40	07:32 16:42	08:15 16:18
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 20:14	05:39 21:02	05:10 21:37	05:24 21:33	06:07 20:49	06:54 19:44	07:42 18:38	07:34 16:41	08:16 16:18
14	08:21 16:45	07:39 17:37	06:42 18:25	06:33 20:16	05:38 21:03	05:10 21:37	05:25 21:32	06:08 20:47	06:56 19:42	07:43 18:35	07:36 16:40	08:17 16:18
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 20:17	05:36 21:05	05:10 21:38	05:27 21:32	06:10 20:46	06:57 19:40	07:45 18:33	07:37 16:38	08:18 16:18
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06	05:10 21:38	05:28 21:31	06:11 20:44	06:59 19:37	07:47 18:31	07:39 16:37	08:19 16:18
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 20:21	05:33 21:07	05:10 21:39	05:29 21:30	06:13 20:42	07:00 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	08:17 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:10 21:39	05:30 21:29	06:14 20:40	07:02 19:33	07:50 18:27	07:42 16:34	08:21 16:19
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:10 21:40	05:31 21:27	06:16 20:38	07:04 19:31	07:51 18:25	07:44 16:33	08:19 16:19
20	08:16 16:54	07:28 17:48	06:28 18:35	06:21 20:25	05:29 21:12	05:10 21:40	05:32 21:26	06:17 20:36	07:05 19:28	07:53 18:23	07:46 16:32	08:22 16:20
21	08:15 16:55	07:26 17:49	06:26 18:37	06:19 20:27	05:28 21:13	05:10 21:40	05:34 21:25	06:19 20:34	07:07 19:26	07:55 18:21	07:47 16:31	08:23 16:20
22	08:14 16:57	07:24 17:51	06:24 18:38	06:17 20:29	05:27 21:14	05:10 21:40	05:35 21:24	06:20 20:32	07:08 19:24	07:56 18:19	07:49 16:30	08:23 16:20
23	08:12 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 21:40	05:36 21:23	06:22 20:30	07:10 19:22	07:58 18:17	07:50 16:29	08:24 16:21
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:11 21:41	05:38 21:22	06:24 20:28	07:11 19:19	08:00 18:15	07:52 16:28	08:24 16:22
25	08:10 17:02	07:18 17:56	06:17 18:43	06:11 20:33	05:23 21:18	05:11 21:41	05:39 21:20	06:25 20:26	07:13 19:17	07:02 17:13	07:53 16:27	08:24 16:22
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:19	05:12 21:41	05:40 21:19	06:27 20:23	07:14 19:15	07:03 17:11	07:55 16:26	08:25 16:23
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 21:41	05:42 21:17	06:28 20:21	07:16 19:13	07:05 17:09	07:56 16:25	08:25 16:24
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:12 21:41	05:43 21:16	06:30 20:19	07:18 19:10	07:07 17:07	07:58 16:24	08:25 16:24
29	08:05 17:09	07:08 19:50	07:08 20:40	06:03 21:23	05:19 21:40	05:13 21:40	05:44 21:15	06:31 20:17	07:19 19:08	07:08 17:06	07:59 16:23	08:25 16:25
30	08:04 17:11	07:06 19:51	07:06 20:41	06:01 21:24	05:18 21:40	05:14 21:40	05:46 21:13	06:33 20:15	07:21 19:06	07:10 17:04	08:01 16:23	08:26 16:26
31	08:02 17:12	07:04 19:53	07:04 21:25	05:17 21:25	05:17 21:25	05:47 21:12	06:34 20:13	07:12 20:13	17:02	17:02	17:02	08:26 16:27
Sonnenscheinstunden		264	280	367	414	480	492	450	380	333	271	250
astr. max. mögl. Beschattung												
Red. Sonnenscheinwahrsch.												
Reduktion Betriebsdauer												
Reduktion Windrichtung												
Gesamte Reduktion												
Met. wahrsch. Beschattung												

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenende (WEA mit letztem Schatten)

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: V - IP10 - Am Holzberg 45, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni						
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	19:16 (17) 19:27 (17)	06:00 20:43	7	20:08 (16)	05:17	20:07 (19)		
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	19:15 (17) 19:28 (17)	05:58 20:45	10	20:06 (16)	05:16	20:07 (19)		
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	19:14 (17) 19:28 (17)	05:56 20:46	12	20:06 (16)	05:15	20:08 (19)		
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 20:00	19:13 (17) 19:28 (17)	05:54 20:48	13	20:05 (16)	05:14	20:08 (19)		
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	19:13 (17) 19:28 (17)	05:52 20:49	14	20:04 (16)	05:14	20:09 (19)		
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	19:14 (17) 19:27 (17)	05:51 20:51	15	20:05 (16)	05:13	20:09 (19)		
7	08:24 16:35	07:51 17:25	06:57 18:14	06:49 20:04	19:14 (17) 19:26 (17)	05:49 20:52	16	20:04 (16)	05:13	20:10 (19)		
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 20:06	19:15 (17) 19:23 (17)	05:47 20:54	16	20:05 (16)	05:12	20:10 (19)		
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	19:23 (17) 20:54	05:46 20:56	16	20:05 (18)	05:12	20:11 (19)		
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 20:09	20:54 20:57	05:44 20:57	17	20:04 (18)	05:11	20:12 (19)		
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	20:52 20:59	05:42 20:59	17	20:04 (18)	05:11	20:12 (19)		
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:12	20:51 21:00	05:41 21:00	17	20:05 (18)	05:11	20:12 (19)		
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 20:14	21:02 21:02	05:39 21:02	16	20:05 (18)	05:10	20:13 (19)		
14	08:21 16:45	07:39 17:37	06:42 18:25	06:33 20:16	21:01 21:03	05:38 21:03	15	20:06 (18)	05:10	20:14 (19)		
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 20:17	21:03 21:05	05:36 21:05	17	20:05 (18)	05:10	20:14 (19)		
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	21:06 21:06	05:35 21:06	17	20:06 (18)	05:10	20:15 (19)		
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 20:21	21:07 21:07	05:33 21:07	17	20:08 (18)	05:10	20:15 (19)		
18	08:17 16:51	07:32 17:44	06:33 18:32	06:25 20:22	21:08 21:09	05:32 21:09	19	20:08 (19)	05:10	20:16 (19)		
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	21:09 21:10	05:31 21:10	19	20:06 (19)	05:10	20:16 (19)		
20	08:16 16:54	07:28 17:48	06:28 18:35	06:21 20:25	21:10 21:12	05:29 21:12	20	20:06 (19)	05:10	20:16 (19)		
21	08:15 16:55	07:26 17:49	06:26 18:37	06:19 20:27	21:13 21:13	05:28 21:13	21	20:06 (19)	05:10	20:16 (19)		
22	08:14 16:57	07:24 17:51	06:24 18:38	06:17 20:29	21:14 21:14	05:27 21:14	22	20:05 (19)	05:10	20:17 (19)		
23	08:12 16:59	07:22 17:53	06:22 18:40	06:15 20:30	21:16 21:16	05:26 21:16	23	20:05 (19)	05:11	20:17 (19)		
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	21:17 21:17	05:24 21:17	23	20:05 (19)	05:11	20:17 (19)		
25	08:10 17:02	07:18 17:56	06:17 18:43	06:11 20:33	21:18 21:18	05:23 21:18	23	20:05 (19)	05:11	20:17 (19)		
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	21:19 21:19	05:22 21:19	23	20:05 (19)	05:12	20:17 (19)		
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	21:20 21:21	05:21 21:21	23	20:05 (19)	05:12	20:17 (19)		
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	21:21 21:22	05:20 21:22	22	20:06 (19)	05:12	20:17 (19)		
29	08:05 17:09	07:08 19:50	06:03 19:50	06:03 20:40	21:22 21:23	05:19 21:23	22	20:06 (19)	05:13	20:16 (19)		
30	08:04 17:11	07:06 19:51	06:01 19:51	06:01 20:41	21:23 21:24	05:18 21:24	22	20:07 (19)	05:14	20:17 (19)		
31	08:02 17:12	07:04 19:53	06:00 19:53	06:00 19:26 (17)	21:24 21:25	20:07 (19) 21:25	21	20:07 (19)	20:07 (19)	20:30 (19)		
Sonnenscheinstunden	264	280	367	414	480	492						
astr. max. mögl. Beschattung			8	101	554	410						
Red. Sonnenscheinwahrsch.			0,31	0,40	0,44	0,38						
Reduktion Betriebsdauer			0,83	0,83	0,83	0,83						
Reduktion Windrichtung			0,60	0,60	0,54	0,54						
Gesamte Reduktion			0,15	0,20	0,20	0,17						
Met. wahrsch. Beschattung			1	20	110	70						

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	Schattenanfang (WEA mit erstem Schatten)	Schattenende (WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: V - IP10 - Am Holzberg 45, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober	November	Dezember
1	05:14	20:17 (19)	05:49	20:16 (18)	06:36		07:22	07:13	08:02
	21:40	14	20:31 (19)	21:10	16	20:32 (18)	20:11	19:04	17:00
2	05:15	20:16 (19)	05:50	20:15 (18)	06:37		07:24	07:15	08:04
	21:40	15	20:31 (19)	21:09	17	20:32 (18)	20:08	19:01	16:58
3	05:15	20:16 (19)	05:52	20:15 (18)	06:39		07:25	07:17	08:05
	21:39	16	20:32 (19)	21:07	16	20:31 (18)	20:06	18:59	16:57
4	05:16	20:16 (19)	05:53	20:15 (16)	06:40		19:13 (17)	07:27	07:19
	21:39	17	20:33 (19)	21:05	17	20:32 (18)	20:04	8	19:21 (17)
5	05:17	20:15 (19)	05:55	20:14 (16)	06:42		19:11 (17)	07:29	07:20
	21:39	17	20:32 (19)	21:04	17	20:31 (18)	20:02	11	19:22 (17)
6	05:18	20:15 (19)	05:56	20:14 (16)	06:44		19:10 (17)	07:30	07:22
	21:38	18	20:33 (19)	21:02	16	20:30 (18)	20:00	13	19:23 (17)
7	05:19	20:15 (19)	05:58	20:14 (16)	06:45		19:08 (17)	07:32	07:24
	21:38	19	20:34 (19)	21:00	15	20:29 (18)	19:58	15	19:23 (17)
8	05:19	20:15 (19)	05:59	20:14 (16)	06:47		19:08 (17)	07:33	07:25
	21:37	20	20:35 (19)	20:58	13	20:27 (18)	19:55	15	19:23 (17)
9	05:20	20:15 (19)	06:01	20:14 (16)	06:48		19:08 (17)	07:35	07:27
	21:36	20	20:35 (19)	20:57	13	20:27 (16)	19:53	14	19:22 (17)
10	05:21	20:15 (19)	06:02	20:14 (16)	06:50		19:08 (17)	07:37	07:29
	21:36	21	20:36 (19)	20:55	12	20:26 (16)	19:51	14	19:22 (17)
11	05:22	20:15 (19)	06:04	20:16 (16)	06:51		19:09 (17)	07:38	07:31
	21:35	21	20:36 (19)	20:53	10	20:26 (16)	19:49	11	19:20 (17)
12	05:23	20:14 (19)	06:05	20:17 (16)	06:53		19:10 (17)	07:40	07:32
	21:34	22	20:36 (19)	20:51	6	20:23 (16)	19:46	8	19:18 (17)
13	05:24	20:14 (19)	06:07		06:54		07:42	07:34	08:16
	21:33	22	20:36 (19)	20:49		19:44	18:38	16:41	16:18
14	05:25	20:15 (19)	06:08		06:56		07:43	07:36	08:17
	21:32	22	20:37 (19)	20:47		19:42	18:35	16:40	16:18
15	05:27	20:15 (19)	06:10		06:57		07:45	07:37	08:18
	21:32	22	20:37 (19)	20:46		19:40	18:33	16:38	16:18
16	05:28	20:15 (19)	06:11		06:59		07:47	07:39	08:19
	21:31	22	20:37 (19)	20:44		19:37	18:31	16:37	16:18
17	05:29	20:15 (19)	06:13		07:00		07:48	07:41	08:20
	21:30	23	20:38 (19)	20:42		19:35	18:29	16:36	16:19
18	05:30	20:15 (19)	06:14		07:02		07:50	07:42	08:21
	21:29	22	20:37 (19)	20:40		19:33	18:27	16:34	16:19
19	05:31	20:15 (19)	06:16		07:04		07:51	07:44	08:21
	21:27	22	20:37 (19)	20:38		19:31	18:25	16:33	16:19
20	05:32	20:15 (19)	06:17		07:05		07:53	07:46	08:22
	21:26	22	20:37 (19)	20:36		19:28	18:23	16:32	16:20
21	05:34	20:15 (19)	06:19		07:07		07:55	07:47	08:23
	21:25	22	20:37 (19)	20:34		19:26	18:21	16:31	16:20
22	05:35	20:16 (19)	06:20		07:08		07:56	07:49	08:23
	21:24	22	20:38 (19)	20:32		19:24	18:19	16:30	16:20
23	05:36	20:16 (19)	06:22		07:10		07:58	07:50	08:24
	21:23	21	20:37 (19)	20:30		19:22	18:17	16:29	16:21
24	05:38	20:16 (19)	06:24		07:11		08:00	07:52	08:24
	21:22	20	20:36 (19)	20:28		19:19	18:15	16:28	16:22
25	05:39	20:17 (19)	06:25		07:13		07:02	07:53	08:24
	21:20	19	20:36 (19)	20:26		19:17	17:13	16:27	16:22
26	05:40	20:18 (19)	06:27		07:14		07:03	07:55	08:25
	21:19	18	20:36 (19)	20:23		19:15	17:11	16:26	16:23
27	05:42	20:18 (18)	06:28		07:16		07:05	07:56	08:25
	21:17	17	20:35 (19)	20:21		19:13	17:09	16:25	16:24
28	05:43	20:17 (18)	06:30		07:18		07:07	07:58	08:25
	21:16	16	20:33 (19)	20:19		19:10	17:07	16:24	16:24
29	05:44	20:16 (18)	06:31		07:19		07:08	07:59	08:25
	21:15	15	20:31 (18)	20:17		19:08	17:06	16:23	16:25
30	05:46	20:16 (18)	06:33		07:21		07:10	08:01	08:26
	21:13	16	20:32 (18)	20:15		19:06	17:04	16:23	16:26
31	05:47	20:15 (18)	06:34				07:12		08:26
	21:12	17	20:32 (18)	20:13			17:02		16:27
Sonnenscheinstunden	496		450		380		333	271	250
astr. max. mögl. Beschattung	600		168		109				
Red. Sonnenscheinwahrsch.	0,47		0,46		0,38				
Reduktion Betriebsdauer	0,83		0,83		0,83				
Reduktion Windrichtung	0,54		0,54		0,60				
Gesamte Reduktion	0,21		0,21		0,19				
Met. wahrsch. Beschattung	125		34		20				

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: W - IP10/1 - Romröder Str. 4, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni		
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:26	21 20:36 (19)	
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	22 20:36 (19)	
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	22 20:37 (19)	
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 20:00	19:25 (17) 19:31 (17)	05:54 20:48	5 20:14 (16) 21:30	21 20:36 (19)
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	19:23 (17) 19:33 (17)	05:52 20:49	10 20:11 (16) 21:30	21 20:36 (19)
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	19:22 (17) 19:34 (17)	05:51 20:51	11 20:11 (16) 21:31	21 20:36 (19)
7	08:24 16:35	07:51 17:25	06:57 18:14	06:49 20:04	19:21 (17) 19:34 (17)	05:49 20:52	12 20:10 (16) 21:32	21 20:37 (19)
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 20:06	19:19 (17) 19:34 (17)	05:47 20:54	13 20:23 (16) 21:33	21 20:37 (19)
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	19:19 (17) 19:33 (17)	05:46 20:56	15 20:09 (16) 21:34	21 20:37 (19)
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 20:09	19:20 (17) 19:33 (17)	05:44 20:57	16 20:09 (16) 21:35	20 20:37 (19)
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	19:20 (17) 19:32 (17)	05:42 20:59	16 20:10 (16) 21:35	20 20:37 (19)
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:12	19:21 (17) 19:30 (17)	05:41 21:00	17 20:10 (16) 21:36	20 20:37 (19)
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 20:14	19:25 (17) 19:26 (17)	05:39 21:02	16 20:11 (18) 21:37	19 20:37 (19)
14	08:21 16:45	07:39 17:37	06:42 18:25	06:33 20:16	19:26 (17)	05:38 21:03	15 20:12 (18) 21:37	20 20:38 (19)
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 20:17	05:36 21:05	05:36 21:07	16 20:11 (18) 21:38	20 20:38 (19)
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06	05:35 21:07	16 20:11 (18) 21:38	19 20:38 (19)
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 20:21	05:33 21:07	05:33 21:07	15 20:12 (18) 21:39	19 20:38 (19)
18	08:17 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:32 21:09	15 20:12 (18) 21:39	19 20:38 (19)
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:31 21:10	14 20:12 (18) 21:40	19 20:38 (19)
20	08:16 16:54	07:28 17:48	06:28 18:35	06:21 20:25	05:29 21:12	05:29 21:12	16 20:12 (18) 21:40	19 20:38 (19)
21	08:15 16:55	07:26 17:49	06:26 18:37	06:19 20:27	05:28 21:13	05:28 21:13	17 20:13 (18) 21:40	19 20:38 (19)
22	08:13 16:57	07:24 17:51	06:24 18:38	06:17 20:29	05:27 21:14	05:27 21:14	17 20:14 (18) 21:40	19 20:39 (19)
23	08:12 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:26 21:16	17 20:15 (18) 21:40	19 20:39 (19)
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:24 21:17	17 20:16 (19) 21:41	19 20:39 (19)
25	08:10 17:02	07:18 17:56	06:17 18:43	06:11 20:33	05:23 21:18	05:23 21:18	18 20:16 (19) 21:41	19 20:40 (19)
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:19	05:22 21:19	19 20:15 (19) 21:41	19 20:40 (19)
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:21 21:21	19 20:15 (19) 21:41	19 20:40 (19)
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:20 21:22	20 20:15 (19) 21:41	20 20:41 (19)
29	08:05 17:09	07:08 19:50	06:03 20:40	06:03 20:40	05:19 21:23	05:19 21:23	21 20:14 (19) 21:40	19 20:40 (19)
30	08:04 17:11	07:06 19:51	06:01 20:41	06:01 20:41	05:18 21:24	05:18 21:24	21 20:15 (19) 21:40	20 20:41 (19)
31	08:02 17:12	07:04 19:53	06:04 20:42	06:04 20:42	05:17 21:25	05:17 21:25	21 20:15 (19) 21:40	20 20:41 (19)
Sonnenscheinstunden	264	280	367	414	480	492		
astr.max.mögl.Beschattung				105	445	597		
Red.Sonnenscheinwahrsch.				0,40	0,44	0,38		
Reduktion Betriebsdauer				0,83	0,83	0,83		
Reduktion Windrichtung				0,59	0,54	0,54		
Gesamte Reduktion				0,20	0,20	0,17		
Met.wahrsch.Beschattung				21	88	102		

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: W - IP10/1 - Romröder Str. 4, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober	November	Dezember
1	05:14	20:22 (19)	05:49	20:21 (16)	06:36	19:19 (17)	07:22	07:13	08:02
	21:40	20:42 (19)	21:10	16	20:37 (18)	20:11	19:31 (17)	19:04	17:00
2	05:15	20:21 (19)	05:50	20:20 (16)	06:37	19:19 (17)	07:24	07:15	08:04
	21:40	20:42 (19)	21:08	16	20:36 (18)	20:08	19:32 (17)	19:01	16:58
3	05:15	20:22 (19)	05:52	20:19 (16)	06:39	19:17 (17)	07:25	07:17	08:05
	21:39	20:42 (19)	21:07	16	20:35 (18)	20:06	19:31 (17)	18:59	16:57
4	05:16	20:22 (19)	05:53	20:20 (16)	06:40	19:17 (17)	07:27	07:19	08:06
	21:39	20:43 (19)	21:05	13	20:33 (18)	20:04	19:32 (17)	18:57	16:55
5	05:17	20:21 (19)	05:55	20:20 (16)	06:42	19:17 (17)	07:29	07:20	08:07
	21:39	20:42 (19)	21:04	12	20:32 (16)	20:02	19:30 (17)	18:55	16:53
6	05:18	20:22 (19)	05:56	20:20 (16)	06:44	19:18 (17)	07:30	07:22	08:09
	21:38	20:43 (19)	21:02	11	20:31 (16)	20:00	19:30 (17)	18:53	16:52
7	05:19	20:22 (19)	05:58	20:21 (16)	06:45	19:18 (17)	07:32	07:24	08:10
	21:38	20:43 (19)	21:00	10	20:31 (16)	19:58	19:28 (17)	18:50	16:50
8	05:19	20:22 (19)	05:59	20:21 (16)	06:47	19:20 (17)	07:33	07:25	08:11
	21:37	20:44 (19)	20:58	9	20:30 (16)	19:55	19:26 (17)	18:48	16:48
9	05:20	20:23 (19)	06:01	20:24 (16)	06:48	19:20 (17)	07:35	07:27	08:12
	21:36	20:44 (19)	20:57	4	20:28 (16)	19:53	18:46	16:47	16:19
10	05:21	20:23 (19)	06:02	06:50	07:37	07:29	08:13		
	21:36	20:44 (19)	20:55	19:51	18:44	16:45	16:18		
11	05:22	20:23 (19)	06:04	06:51	07:38	07:31	08:14		
	21:35	20:44 (19)	20:53	19:49	18:42	16:44	16:18		
12	05:23	20:22 (19)	06:05	06:53	07:40	07:32	08:15		
	21:34	20:43 (19)	20:51	19:46	18:40	16:42	16:18		
13	05:24	20:22 (19)	06:07	06:54	07:42	07:34	08:16		
	21:33	20:43 (19)	20:49	19:44	18:38	16:41	16:18		
14	05:25	20:24 (19)	06:08	06:56	07:43	07:36	08:17		
	21:32	20:44 (19)	20:47	19:42	18:35	16:40	16:18		
15	05:27	20:24 (19)	06:10	06:57	07:45	07:37	08:18		
	21:32	20:44 (19)	20:46	19:40	18:33	16:38	16:18		
16	05:28	20:24 (19)	06:11	06:59	07:47	07:39	08:19		
	21:31	20:44 (19)	20:44	19:37	18:31	16:37	16:18		
17	05:29	20:25 (19)	06:13	07:00	07:48	07:41	08:20		
	21:30	20:44 (19)	20:42	19:35	18:29	16:36	16:19		
18	05:30	20:25 (19)	06:14	07:02	07:50	07:42	08:21		
	21:29	20:43 (19)	20:40	19:33	18:27	16:34	16:19		
19	05:31	20:25 (19)	06:16	07:04	07:51	07:44	08:21		
	21:27	20:43 (19)	20:38	19:31	18:25	16:33	16:19		
20	05:32	20:26 (18)	06:17	07:05	07:53	07:46	08:22		
	21:26	20:42 (19)	20:36	19:28	18:23	16:32	16:20		
21	05:34	20:24 (18)	06:19	07:07	07:55	07:47	08:23		
	21:25	20:41 (19)	20:34	19:26	18:21	16:31	16:20		
22	05:35	20:24 (18)	06:20	07:08	07:56	07:49	08:23		
	21:24	20:41 (19)	20:32	19:24	18:19	16:30	16:20		
23	05:36	20:23 (18)	06:22	07:10	07:58	07:50	08:24		
	21:23	20:39 (19)	20:30	19:22	18:17	16:29	16:21		
24	05:38	20:23 (18)	06:24	07:11	08:00	07:52	08:24		
	21:22	20:37 (18)	20:28	19:19	18:15	16:28	16:22		
25	05:39	20:22 (18)	06:25	07:13	07:02	07:53	08:24		
	21:20	20:37 (18)	20:26	19:17	17:13	16:27	16:22		
26	05:40	20:22 (18)	06:27	07:14	07:03	07:55	08:25		
	21:19	20:38 (18)	20:23	19:15	17:11	16:26	16:23		
27	05:42	20:22 (18)	06:28	07:16	07:05	07:56	08:25		
	21:17	20:38 (18)	20:21	19:13	17:09	16:25	16:24		
28	05:43	20:22 (18)	06:30	07:18	07:07	07:58	08:25		
	21:16	20:38 (18)	20:19	19:10	17:07	16:24	16:24		
29	05:44	20:21 (18)	06:31	07:19	07:08	07:59	08:25		
	21:15	20:37 (18)	20:17	19:08	17:06	16:23	16:25		
30	05:46	20:22 (18)	06:33	19:24 (17)	07:21	07:10	08:01	08:26	
	21:13	20:38 (18)	20:15	3	19:27 (17)	17:04	16:23	16:26	
31	05:47	20:21 (16)	06:34	19:21 (17)	07:12	07:12	08:26		
	21:12	20:37 (18)	20:13	9	19:30 (17)	17:02	16:27		
Sonnenscheinstunden	496		450	380		333	271	250	
astr. max.mögl. Beschattung	578		119	95					
Red. Sonnenscheinwahrsch.	0,47		0,46	0,38					
Reduktion Betriebsdauer	0,83		0,83	0,83					
Reduktion Windrichtung	0,54		0,55	0,59					
Gesamte Reduktion	0,21		0,21	0,18					
Met. wahrsch. Beschattung	121		25	17					

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang (WEA mit erstem Schatten)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenende (WEA mit letztem Schatten)
--------------	-----------------------	--	-------------------------	----------------------	---

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: X - IP10/2 - An der Huth 3, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:26	18 20:23 (19)
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	18 20:23 (19)
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	19 20:23 (19)
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 20:00	05:54 20:48	05:14 21:30	19 20:23 (19)
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:49	05:14 21:30	20 20:23 (19)
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	7 19:28 (17) 19:35 (17)	05:51 20:51	21 20:22 (19)
7	08:24 16:35	07:51 17:25	06:57 18:14	06:49 20:04	11 19:25 (17) 19:36 (17)	05:49 20:52	8 20:16 (16) 21:32
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 20:06	13 19:23 (17) 19:36 (17)	05:47 20:54	10 20:16 (16) 21:33
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	14 19:23 (17) 19:37 (17)	05:46 20:56	12 20:14 (16) 21:34
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 20:09	15 19:22 (17) 19:37 (17)	05:44 20:57	13 20:13 (16) 21:35
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	14 19:22 (17) 19:36 (17)	05:42 20:59	14 20:13 (16) 21:35
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:12	14 19:22 (17) 19:36 (17)	05:41 21:00	14 20:14 (16) 21:36
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 20:14	12 19:23 (17) 19:35 (17)	05:39 21:02	16 20:13 (16) 21:37
14	08:21 16:45	07:39 17:37	06:42 18:25	06:33 20:16	9 19:24 (17) 19:33 (17)	05:38 21:03	17 20:14 (16) 21:37
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 20:17	3 19:27 (17) 19:30 (17)	05:36 21:05	17 20:14 (16) 21:38
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06	05:10 20:32 (18)	18 20:14 (16) 21:38
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 20:21	05:33 21:07	05:10 20:16 (16)	16 20:32 (18) 21:39
18	08:17 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:10 20:33 (18)	16 20:17 (18) 21:39
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:10 20:16 (18)	16 20:33 (18) 21:40
20	08:16 16:54	07:28 17:48	06:28 18:35	06:21 20:25	05:29 21:12	05:10 20:16 (18)	16 20:32 (18) 21:40
21	08:15 16:55	07:26 17:49	06:26 18:37	06:19 20:27	05:28 21:13	05:10 20:16 (18)	16 20:32 (18) 21:40
22	08:14 16:57	07:24 17:51	06:24 18:38	06:17 20:29	05:27 21:14	05:10 20:17 (18)	16 20:33 (18) 21:40
23	08:12 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 20:17 (18)	16 20:33 (18) 21:40
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:11 20:18 (18)	15 20:32 (18) 21:41
25	08:10 17:02	07:18 17:56	06:17 18:43	06:11 20:33	05:23 21:18	05:11 20:18 (18)	14 20:32 (18) 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:19	05:12 20:19 (18)	14 20:32 (18) 21:41
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 20:19 (18)	16 20:35 (19) 21:41
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:12 20:20 (18)	18 20:37 (19) 21:41
29	08:05 17:09	07:08 19:50	06:03 20:40	06:03 20:40	05:19 21:23	05:13 20:21 (18)	18 20:38 (19) 21:41
30	08:04 17:11	07:06 19:51	06:01 20:41	06:01 20:41	05:18 21:24	05:14 20:24 (18)	18 20:39 (19) 21:40
31	08:02 17:12	07:04 19:53	06:00 20:41	06:00 20:41	05:17 21:25	05:14 20:24 (19)	16 20:40 (19) 21:40
Sonnenscheinstunden	264	280	367	414	480	492	
astr. max. mögl. Beschattung				112	382	635	
Red. Sonnenscheinwahrsch.				0,40	0,44	0,38	
Reduktion Betriebsdauer				0,83	0,83	0,83	
Reduktion Windrichtung				0,58	0,54	0,54	
Gesamte Reduktion				0,19	0,20	0,17	
Met. wahrsch. Beschattung				22	76	108	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
--------------	-----------------------	-------------------------	----------------------	----------------------------------	--------------------------------	---------------------------	----------------------------

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: X - IP10/2 - An der Huth 3, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

July August September Oktober November Dezember

1	05:14	20:28 (19)	05:49	20:24 (16)	06:36	19:21 (17)	07:22	07:13	08:02
	21:40	20:49 (19)	21:10	20:38 (18)	20:11	19:35 (17)	19:04	17:00	16:22
2	05:15	20:27 (19)	05:50	20:24 (16)	06:37	19:21 (17)	07:24	07:15	08:04
	21:40	20:49 (19)	21:08	20:37 (16)	20:08	19:36 (17)	19:01	16:58	16:21
3	05:15	20:28 (19)	05:52	20:24 (16)	06:39	19:21 (17)	07:25	07:17	08:05
	21:39	20:49 (19)	21:07	20:36 (16)	20:06	19:35 (17)	18:59	16:57	16:21
4	05:16	20:29 (19)	05:53	20:25 (16)	06:40	19:21 (17)	07:27	07:19	08:06
	21:39	20:50 (19)	21:05	20:36 (16)	20:04	19:34 (17)	18:57	16:55	16:20
5	05:17	20:28 (19)	05:55	20:25 (16)	06:42	19:22 (17)	07:29	07:20	08:08
	21:39	20:49 (19)	21:04	20:35 (16)	20:02	19:32 (17)	18:55	16:53	16:20
6	05:18	20:29 (19)	05:56	20:27 (16)	06:44	19:24 (17)	07:30	07:22	08:09
	21:38	20:49 (19)	21:02	20:33 (16)	20:00	19:31 (17)	18:53	16:52	16:20
7	05:19	20:29 (19)	05:58		06:45		07:32	07:24	08:10
	21:38	20:50 (19)	21:00		19:58		18:50	16:50	16:19
8	05:19	20:30 (19)	05:59		06:47		07:33	07:25	08:11
	21:37	20:50 (19)	20:58		19:55		18:48	16:48	16:19
9	05:20	20:30 (19)	06:01		06:48		07:35	07:27	08:12
	21:36	20:50 (19)	20:57		19:53		18:46	16:47	16:19
10	05:21	20:31 (19)	06:02		06:50		07:37	07:29	08:13
	21:36	20:50 (19)	20:55		19:51		18:44	16:45	16:18
11	05:22	20:31 (19)	06:04		06:51		07:38	07:31	08:14
	21:35	20:49 (19)	20:53		19:49		18:42	16:44	16:18
12	05:23	20:31 (19)	06:05		06:53		07:40	07:32	08:15
	21:34	20:48 (19)	20:51		19:46		18:40	16:42	16:18
13	05:24	20:32 (19)	06:07		06:54		07:42	07:34	08:16
	21:33	20:48 (19)	20:49		19:44		18:38	16:41	16:18
14	05:25	20:32 (18)	06:08		06:56		07:43	07:36	08:17
	21:32	20:48 (19)	20:47		19:42		18:35	16:40	16:18
15	05:27	20:30 (18)	06:10		06:57		07:45	07:37	08:18
	21:32	20:48 (19)	20:46		19:40		18:33	16:38	16:18
16	05:28	20:29 (18)	06:11		06:59		07:47	07:39	08:19
	21:31	20:47 (19)	20:44		19:37		18:31	16:37	16:18
17	05:29	20:29 (18)	06:13		07:00		07:48	07:41	08:20
	21:30	20:45 (19)	20:42		19:35		18:29	16:36	16:19
18	05:30	20:28 (18)	06:14		07:02		07:50	07:42	08:21
	21:29	20:43 (19)	20:40		19:33		18:27	16:34	16:19
19	05:31	20:27 (18)	06:16		07:04		07:51	07:44	08:21
	21:27	20:42 (18)	20:38		19:31		18:25	16:33	16:19
20	05:32	20:27 (18)	06:17		07:05		07:53	07:46	08:22
	21:26	20:42 (18)	20:36		19:28		18:23	16:32	16:20
21	05:34	20:26 (18)	06:19		07:07		07:55	07:47	08:23
	21:25	20:42 (18)	20:34		19:26		18:21	16:31	16:20
22	05:35	20:27 (18)	06:20		07:08		07:56	07:49	08:23
	21:24	20:43 (18)	20:32		19:24		18:19	16:30	16:20
23	05:36	20:27 (18)	06:22		07:10		07:58	07:50	08:24
	21:23	20:43 (18)	20:30		19:22		18:17	16:29	16:21
24	05:38	20:26 (18)	06:24		07:11		08:00	07:52	08:24
	21:22	20:43 (18)	20:28		19:19		18:15	16:28	16:22
25	05:39	20:26 (18)	06:25		07:13		07:02	07:53	08:24
	21:20	20:43 (18)	20:26		19:17		17:13	16:27	16:22
26	05:40	20:27 (18)	06:27		07:14		07:03	07:55	08:25
	21:19	20:43 (18)	20:23		19:15		17:11	16:26	16:23
27	05:42	20:26 (16)	06:28		07:16		07:05	07:56	08:25
	21:17	20:43 (18)	20:21		19:13		17:09	16:25	16:24
28	05:43	20:25 (16)	06:30	19:27 (17)	07:18		07:07	07:58	08:25
	21:16	20:42 (18)	20:19	4 19:31 (17)	19:10		17:07	16:24	16:24
29	05:44	20:24 (16)	06:31	19:25 (17)	07:19		07:08	07:59	08:25
	21:15	20:41 (18)	20:17	9 19:34 (17)	19:08		17:06	16:23	16:25
30	05:46	20:24 (16)	06:33	19:23 (17)	07:21		07:10	08:01	08:26
	21:13	20:41 (18)	20:15	12 19:35 (17)	19:06		17:04	16:23	16:26
31	05:47	20:24 (16)	06:34	19:22 (17)			07:12		08:26
	21:12	20:39 (18)	20:13	14 19:36 (17)			17:02		16:27
Sonnenscheinstunden	496		450		380		333	271	250
astr. max.mögl. Beschattung		551	105		73				
Red. Sonnenscheinwahrsch.		0,47	0,46		0,38				
Reduktion Betriebsdauer		0,83	0,83		0,83				
Reduktion Windrichtung		0,54	0,56		0,58				
Gesamte Reduktion		0,21	0,21		0,18				
Met. wahrsch. Beschattung		115	22		13				

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenanfang	Zeitpunkt (SS:MM) Schattenende	(WEA mit erstem Schatten)	(WEA mit letztem Schatten)
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: Y - IP10/3 - An der Huth 6, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:26	16 20:24 (18)
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	17 20:25 (18)
3	08:25 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	18 20:42 (19)
4	08:25 16:31	07:56 17:19	07:03 18:08	06:55 20:00	05:54 20:48	05:14 21:30	18 20:26 (18)
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:49	05:14 21:30	18 20:44 (19)
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:31	15 20:29 (18)
7	08:24 16:35	07:51 17:25	06:57 18:14	06:49 20:04	05:49 20:52	05:13 21:32	15 20:31 (19)
8	08:24 16:36	07:50 17:26	06:55 18:15	06:46 20:06	8 19:29 (17) 19:37 (17)	05:12 20:54	16 20:47 (19)
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	12 19:27 (17) 19:39 (17)	05:46 20:56	7 20:31 (19)
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 20:09	13 19:26 (17) 19:39 (17)	05:44 20:57	10 20:18 (16)
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	15 19:25 (17) 19:40 (17)	05:42 20:59	11 20:18 (16)
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:12	15 19:25 (17) 19:40 (17)	05:41 21:00	12 20:18 (16)
13	08:21 16:43	07:41 17:35	06:44 18:24	06:36 20:14	14 19:25 (17) 19:39 (17)	05:39 21:02	13 20:30 (16)
14	08:21 16:45	07:39 17:37	06:42 18:25	06:33 20:16	14 19:25 (17) 19:39 (17)	05:38 21:03	14 20:17 (16)
15	08:20 16:46	07:37 17:39	06:40 18:27	06:31 20:17	12 19:26 (17) 19:38 (17)	05:36 21:05	16 20:16 (16)
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	9 19:27 (17) 19:36 (17)	05:35 21:06	17 20:17 (16)
17	08:18 16:49	07:34 17:42	06:35 18:30	06:27 20:21	1 19:31 (17) 19:32 (17)	05:33 21:07	18 20:34 (18)
18	08:17 16:51	07:32 17:44	06:33 18:32	06:25 20:22	18 19:32 (17) 21:09	05:32 21:36	18 20:18 (16)
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	18 20:36 (18) 21:10	21:39 21:40	20 20:18 (16)
20	08:16 16:54	07:28 17:48	06:28 18:35	06:21 20:25	18 20:36 (18) 21:12	21:40 21:40	20 20:19 (16)
21	08:15 16:55	07:26 17:49	06:26 18:37	06:19 20:27	16 20:37 (18) 21:13	05:10 21:40	20 20:32 (19)
22	08:14 16:57	07:24 17:51	06:24 18:38	06:17 20:29	16 20:37 (18) 21:14	05:10 21:40	20 20:32 (19)
23	08:12 16:59	07:22 17:53	06:22 18:40	06:15 20:30	16 20:37 (18) 21:16	05:11 21:40	20 20:33 (19)
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	17 20:38 (18) 21:17	05:11 21:41	20 20:33 (19)
25	08:10 17:02	07:18 17:56	06:17 18:43	06:11 20:33	17 20:38 (18) 21:18	05:11 21:41	19 20:34 (19)
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	17 20:38 (18) 21:19	05:12 21:41	20 20:33 (19)
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	15 20:22 (18) 21:21	05:12 21:41	20 20:33 (19)
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	15 20:37 (18) 21:22	05:12 21:41	19 20:34 (19)
29	08:05 17:09		07:08 19:50	06:03 20:40	15 20:22 (18) 21:23	05:13 21:40	19 20:34 (19)
30	08:04 17:11		07:06 19:51	06:01 20:41	15 20:37 (18) 21:24	05:14 21:40	18 20:35 (19)
31	08:02 17:12		07:04 19:53		13 20:24 (18) 21:25		13 20:37 (18)
Sonnenscheinstunden	264	280	367	414	480	492	
astr. max. mögl. Beschattung				113	343	556	
Red. Sonnenscheinwahrsch.				0,40	0,44	0,38	
Reduktion Betriebsdauer				0,83	0,83	0,83	
Reduktion Windrichtung				0,58	0,54	0,54	
Gesamte Reduktion				0,19	0,20	0,17	
Met. wahrsch. Beschattung				22	68	95	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenende
			(WEA mit letztem Schatten)

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender

Berechnung: Gesamtbelastung Schattenrezeptor: Y - IP10/3 - An der Huth 6, 36304 Alsfeld-Liederbach

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober	November	Dezember
1	05:14	20:36 (19)	05:49	20:28 (16)	06:36	19:24 (17)	07:22	07:13	08:02
	21:40	18 20:54 (19)	21:10	13 20:41 (16)	20:11	15 19:39 (17)	19:04	17:00	16:22
2	05:15	20:35 (19)	05:50	20:29 (16)	06:37	19:25 (17)	07:24	07:15	08:04
	21:40	18 20:53 (19)	21:08	10 20:39 (16)	20:08	13 19:38 (17)	19:01	16:58	16:21
3	05:15	20:36 (19)	05:52	20:29 (16)	06:39	19:25 (17)	07:25	07:17	08:05
	21:39	18 20:54 (19)	21:07	9 20:38 (16)	20:06	12 19:37 (17)	18:59	16:57	16:21
4	05:16	20:37 (19)	05:53	20:32 (16)	06:40	19:27 (17)	07:27	07:19	08:06
	21:39	17 20:54 (19)	21:05	4 20:36 (16)	20:04	8 19:35 (17)	18:57	16:55	16:20
5	05:17	20:37 (19)	05:55		06:42		07:29	07:20	08:08
	21:39	16 20:53 (19)	21:04		20:02		18:55	16:53	16:20
6	05:18	20:38 (19)	05:56		06:44		07:30	07:22	08:09
	21:38	15 20:53 (19)	21:02		20:00		18:53	16:52	16:20
7	05:19	20:37 (18)	05:58		06:45		07:32	07:24	08:10
	21:38	16 20:53 (19)	21:00		19:58		18:50	16:50	16:19
8	05:19	20:35 (18)	05:59		06:47		07:33	07:25	08:11
	21:37	17 20:52 (19)	20:58		19:55		18:48	16:48	16:19
9	05:20	20:34 (18)	06:01		06:48		07:35	07:27	08:12
	21:36	18 20:52 (19)	20:57		19:53		18:46	16:47	16:19
10	05:21	20:33 (18)	06:02		06:50		07:37	07:29	08:13
	21:36	18 20:51 (19)	20:55		19:51		18:44	16:45	16:18
11	05:22	20:33 (18)	06:04		06:51		07:38	07:31	08:14
	21:35	17 20:50 (19)	20:53		19:49		18:42	16:44	16:18
12	05:23	20:32 (18)	06:05		06:53		07:40	07:32	08:15
	21:34	12 20:44 (18)	20:51		19:46		18:40	16:42	16:18
13	05:24	20:31 (18)	06:07		06:54		07:42	07:34	08:16
	21:33	13 20:44 (18)	20:49		19:44		18:38	16:41	16:18
14	05:25	20:32 (18)	06:08		06:56		07:43	07:36	08:17
	21:32	14 20:46 (18)	20:47		19:42		18:35	16:40	16:18
15	05:27	20:32 (18)	06:10		06:57		07:45	07:37	08:18
	21:32	14 20:46 (18)	20:46		19:40		18:33	16:38	16:18
16	05:28	20:31 (18)	06:11		06:59		07:47	07:39	08:19
	21:31	16 20:47 (18)	20:44		19:37		18:31	16:37	16:18
17	05:29	20:31 (18)	06:13		07:00		07:48	07:41	08:20
	21:30	16 20:47 (18)	20:42		19:35		18:29	16:36	16:19
18	05:30	20:31 (18)	06:14		07:02		07:50	07:42	08:21
	21:29	16 20:47 (18)	20:40		19:33		18:27	16:34	16:19
19	05:31	20:31 (18)	06:16		07:04		07:51	07:44	08:21
	21:27	16 20:47 (18)	20:38		19:31		18:25	16:33	16:19
20	05:32	20:31 (18)	06:17		07:05		07:53	07:46	08:22
	21:26	16 20:47 (18)	20:36		19:28		18:23	16:32	16:20
21	05:34	20:30 (18)	06:19		07:07		07:55	07:47	08:23
	21:25	17 20:47 (18)	20:34		19:26		18:21	16:31	16:20
22	05:35	20:31 (18)	06:20		07:08		07:56	07:49	08:23
	21:24	17 20:48 (18)	20:32		19:24		18:19	16:30	16:20
23	05:36	20:30 (16)	06:22		07:10		07:58	07:50	08:24
	21:23	17 20:47 (18)	20:30		19:22		18:17	16:29	16:21
24	05:38	20:29 (16)	06:24		07:11		08:00	07:52	08:24
	21:22	18 20:47 (18)	20:28		19:19		18:15	16:28	16:22
25	05:39	20:28 (16)	06:25		07:13		07:02	07:53	08:24
	21:20	18 20:46 (18)	20:26		19:17		17:13	16:27	16:22
26	05:40	20:28 (16)	06:27		07:14		07:03	07:55	08:25
	21:19	18 20:46 (18)	20:23	3 19:35 (17)	19:15		17:11	16:26	16:23
27	05:42	20:28 (16)	06:28		07:16		07:05	07:56	08:25
	21:17	17 20:45 (18)	20:21	9 19:38 (17)	19:13		17:09	16:25	16:24
28	05:43	20:27 (16)	06:30		07:18		07:07	07:58	08:25
	21:16	16 20:43 (18)	20:19	12 19:39 (17)	19:10		17:07	16:24	16:24
29	05:44	20:28 (16)	06:31		07:19		07:08	07:59	08:25
	21:15	14 20:42 (18)	20:17	14 19:40 (17)	19:08		17:06	16:23	16:25
30	05:46	20:28 (16)	06:33		07:21		07:10	08:01	08:26
	21:13	13 20:41 (16)	20:15	14 19:39 (17)	19:06		17:04	16:23	16:26
31	05:47	20:27 (16)	06:34		07:22		07:12		08:26
	21:12	13 20:40 (16)	20:13	15 19:40 (17)			17:02		16:27
Sonnenscheinstunden	496		450		380		333	271	250
astr. max.mögl. Beschattung	499		103		48				
Red. Sonnenscheinwahrsch.	0,47		0,46		0,38				
Reduktion Betriebsdauer	0,83		0,83		0,83				
Reduktion Windrichtung	0,54		0,56		0,58				
Gesamte Reduktion	0,21		0,21		0,18				
Met. wahrsch. Beschattung	104		22		9				

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM) Schattenanfang	(WEA mit erstem Schatten)
	Sonnenuntergang (SS:MM)	Minuten mit Schatten	Zeitpunkt (SS:MM) Schattenende
			(WEA mit letztem Schatten)

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 1 - ENERCON E-138 EP3 TES 3500 138.3 !- NH: 160,0 m (Ges:229,1 m) (28)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 18:59-19:28/29 19:55 07:45-08:13/28	06:00 19:42-20:15/33 20:43	05:17 05:49-06:12/23 21:27
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:00-19:29/29 19:56 07:45-08:13/28	05:58 19:43-20:17/34 20:45	05:16 05:49-06:13/24 21:28
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:00-19:29/29 19:58 07:44-08:12/28	05:56 19:44-20:19/35 20:46	05:15 05:48-06:12/24 21:29
4	08:25 16:31	07:56 17:19	07:04 18:09	06:55 19:01-19:29/28 20:00 07:44-08:11/27	05:54 19:44-20:20/36 20:48	05:14 05:47-06:12/25 21:30
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 19:04-19:30/26 20:01 07:44-08:11/27	05:52 19:45-20:21/36 20:49	05:14 05:48-06:13/25 21:31
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 17:30-17:47/17 20:03 07:44-08:10/26	05:51 20:02-20:21/19 20:51 19:47-20:01/14	05:13 05:45-06:13/28 21:32
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 17:30-17:49/19 20:05 07:45-08:09/24	05:49 20:01-20:21/20 20:53 19:48-19:58/10	05:13 05:45-06:13/28 21:32
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 17:28-17:49/21 20:06 07:46-08:08/22	05:47 20:02-20:21/19 20:54	05:12 05:45-06:14/29 21:33
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 17:28-17:49/21 20:08 07:46-08:05/19	05:46 20:02-20:20/18 20:56	05:12 05:44-06:14/30 21:34
10	08:23 16:39	07:46 17:30	06:51 18:19	06:42 17:28-17:49/21 20:09 07:47-08:03/16	05:44 20:02-20:19/17 20:57	05:11 05:44-06:14/30 21:35
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 19:13-19:23/10 20:11 07:50-08:00/10	05:42 20:03-20:19/16 20:59	05:11 05:44-06:14/30 21:36
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 20:05-20:18/13 21:00	05:11 05:43-06:14/31 21:36
13	08:22 16:43	07:41 17:35	06:44 18:24	06:36 20:14	05:39 20:05-20:17/12 21:02	05:10 05:43-06:14/31 21:37
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	05:38 20:07-20:15/8 21:03	05:10 05:43-06:14/31 21:37
15	08:20 16:46	07:38 17:39	06:40 18:27	06:31 20:17	05:36 19:44-19:52/8 21:05	05:10 05:43-06:15/32 21:38
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 19:41-19:53/12 21:06	05:10 05:43-06:15/32 21:38
17	08:18 16:49	07:34 17:43	06:35 18:30	06:27 20:21	05:33 19:40-19:55/15 21:08	05:10 05:43-06:15/32 21:39
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 19:38-19:56/18 21:09	05:10 05:43-06:15/32 21:39
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 19:37-19:58/21 21:10	05:10 05:44-06:15/31 21:40
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	05:29 19:36-19:59/23 21:12	05:10 05:44-06:15/31 21:40
21	08:15 16:55	07:26 17:50	06:26 18:37	06:19 20:27	05:28 19:36-20:01/25 21:13	05:10 05:45-06:16/31 21:40
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 19:35-20:02/27 21:14	05:10 05:45-06:16/31 21:40
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 19:35-20:04/29 21:16	05:11 05:45-06:16/31 21:41
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 19:35-20:05/30 21:17	05:11 05:44-06:16/32 21:41
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 19:35-20:06/31 21:18	05:11 05:45-06:17/32 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 19:35-20:06/31 21:20	05:12 05:45-06:17/32 21:41
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 18:01-18:19/18 06:07 19:36-20:06/30 21:21	05:12 05:46-06:18/32 21:41
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 20:10-20:11/1 05:20 05:53-06:10/17 21:22	05:12 05:46-06:18/32 21:41
29	08:05 17:09		07:08 18:59-19:19/20 19:50 07:48-08:13/25	06:03 20:40	05:19 20:07-20:13/6 19:38-20:06/28 21:23	05:13 05:47-06:18/31 21:41
30	08:04 17:11		07:06 19:52 07:46-08:12/26	06:01 20:42	05:18 19:39-20:14/35 21:24	05:14 05:47-06:18/31 21:40
31	08:02 17:12		07:04 19:53 07:45-08:13/28		05:17 05:50-06:11/21 21:26	
Sonnenscheinstunden	264	280	367	414	480	492
Anzahl Minuten mit Schatten	0	0	520	892	475	894

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
			Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 1 - ENERCON E-138 EP3 TES 3500 138.3 !-! NH: 160,0 m (Ges:229,1 m) (28)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober		November/Dezember	
1	05:14	05:48-06:19/31	05:49	20:15-20:29/14	06:36	19:12-19:22/10	07:22	18:07-18:27/20	07:14	08:02
	21:40		21:10		20:11	07:49-07:59/10	19:04		17:00	16:22
2	05:15	05:48-06:18/30	05:50	20:13-20:30/17	06:37	19:10-19:24/14	07:24	18:06-18:27/21	07:15	08:04
	21:40		21:09		20:09	07:46-08:02/16	19:02		16:58	16:22
3	05:16	05:49-06:19/30	05:52	20:12-20:30/18	06:39	19:08-19:24/16	07:26	18:05-18:27/22	07:17	08:05
	21:40		21:07		20:06	07:44-08:03/19	18:59		16:57	16:21
4	05:16	05:50-06:19/29	05:53	20:12-20:31/19	06:41	19:07-19:25/18	07:27	18:05-18:27/22	07:19	08:06
	21:39		21:05		20:04	07:43-08:05/22	18:57		16:55	16:20
5	05:17	05:51-06:19/28	05:55	20:12-20:31/19	06:42	19:06-19:25/19	07:29	18:05-18:26/21	07:20	08:08
	21:39		21:04	20:01-20:06/5	20:02	07:41-08:05/24	18:55		16:53	16:20
6	05:18	05:51-06:19/28	05:56	20:11-20:30/19	06:44	19:06-19:25/19	07:30	18:05-18:26/21	07:22	08:09
	21:38		21:02	19:57-20:08/11	20:00	07:40-08:06/26	18:53		16:52	16:20
7	05:19	05:53-06:19/26	05:58	19:56-20:31/35	06:45	18:59-19:25/26	07:32	18:06-18:24/18	07:24	08:10
	21:38		21:00		19:58	07:39-08:06/27	18:51		16:50	16:19
8	05:20	05:55-06:20/25	05:59	19:54-20:30/36	06:47	18:57-19:25/28	07:34	18:06-18:21/15	07:26	08:11
	21:37		20:59		19:55	07:39-08:06/27	18:48		16:48	16:19
9	05:20	05:55-06:20/25	06:01	19:54-20:29/35	06:48	18:54-19:23/29	07:35	18:08-18:19/11	07:27	08:12
	21:36		20:57		19:53	07:38-08:06/28	18:46		16:47	16:19
10	05:21	05:56-06:20/24	06:02	19:52-20:27/35	06:50	18:53-19:23/30	07:37	18:09-18:16/7	07:29	08:13
	21:36		20:55		19:51	07:38-08:06/28	18:44		16:45	16:18
11	05:22	05:57-06:20/23	06:04	19:52-20:26/34	06:51	18:51-19:21/30	07:38		07:31	08:15
	21:35		20:53		19:49	07:37-08:05/28	18:42		16:44	16:18
12	05:23	05:58-06:20/22	06:05	19:50-20:23/33	06:53	18:51-19:19/28	07:40		07:32	08:16
	21:34		20:51		19:46	07:38-08:05/27	18:40		16:42	16:18
13	05:24	05:59-06:20/21	06:07	19:46-20:21/35	06:54	19:11-19:15/4 07:37-08:04/27	07:42		07:34	08:17
	21:33		20:49		19:44	18:50-19:10/20	18:38		16:41	16:18
14	05:26	06:00-06:20/20	06:08	20:16-20:20/4	06:56	18:50-19:10/20	07:43		07:36	08:17
	21:33		20:48	19:45-20:14/29	19:42	07:38-08:03/25	18:36		16:40	16:18
15	05:27	06:02-06:19/17	06:10	19:43-20:13/30	06:58	18:50-19:09/19	07:45		07:37	08:18
	21:32		20:46		19:40	07:38-08:01/23	18:33		16:38	16:18
16	05:28	06:02-06:19/17	06:11	19:43-20:13/30	06:59	18:50-19:09/19	07:47		07:39	08:19
	21:31		20:44		19:37	07:40-08:00/20	18:31		16:37	16:18
17	05:29	06:03-06:18/15	06:13	19:42-20:12/30	07:01	18:50-19:07/17	07:48		07:41	08:20
	21:30		20:42		19:35	07:40-07:57/17	18:29		16:36	16:19
18	05:30	06:04-06:17/13	06:14	19:42-20:12/30	07:02	18:52-19:06/14	07:50		07:42	08:21
	21:29		20:40		19:33	07:43-07:55/12	18:27		16:34	16:19
19	05:31	06:05-06:16/11	06:16	19:41-20:10/29	07:04	18:53-19:03/10	07:52		07:44	08:21
	21:28		20:38		19:31		18:25		16:33	16:19
20	05:33	06:06-06:15/9	06:17	19:41-20:09/28	07:05		07:53		07:46	08:22
	21:27		20:36		19:28		18:23		16:32	16:20
21	05:34	06:09-06:13/4	06:19	19:40-20:07/27	07:07		07:55		07:47	08:23
	21:25		20:34		19:26		18:21		16:31	16:20
22	05:35		06:21	19:41-20:05/24	07:08		07:57		07:49	08:23
	21:24		20:32		19:24		18:19		16:30	16:20
23	05:36		06:22	19:40-20:02/22	07:10		07:58		07:50	08:24
	21:23		20:30		19:22		18:17		16:29	16:21
24	05:38		06:24	19:40-20:00/20	07:11		08:00		07:52	08:24
	21:22		20:28		19:19		18:15		16:28	16:22
25	05:39		06:25	19:41-19:59/18	07:13		07:02		07:54	08:25
	21:20		20:26		19:17		17:13		16:27	16:22
26	05:40		06:27	19:42-19:56/14	07:15		07:03		07:55	08:25
	21:19		20:24		19:15		17:11		16:26	16:23
27	05:42		06:28	19:43-19:55/12	07:16	18:14-18:21/7	07:05		07:57	08:25
	21:18		20:21		19:13		17:09		16:25	16:24
28	05:43		06:30	19:45-19:52/7	07:18	18:12-18:24/12	07:07		07:58	08:25
	21:16		20:19		19:10		17:08		16:24	16:24
29	05:45	20:19-20:23/4	06:31		07:19	18:10-18:26/16	07:08		08:00	08:26
	21:15		20:17		19:08		17:06		16:23	16:25
30	05:46	20:17-20:26/9	06:33		07:21	18:08-18:26/18	07:10		08:01	08:26
	21:13		20:15		19:06		17:04		16:23	16:26
31	05:47	20:15-20:28/13	06:34	19:17-19:19/2			07:12			08:26
	21:12		20:13				17:02			16:27
Sonnenscheinstunden	496		450		380		333		271	250
Anzahl Minuten mit Schatten	474		721		849		178		0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
--------------	-----------------------	-------------------------	-------------------	----------------------------------	-----------------------------------

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 2 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (1)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Table with columns for months (Januar to Dezember) and rows for each day (1-31). Each cell contains start and end times for shadows and sun hours. Summary rows at the bottom show total sun hours and shadow minutes.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat Sonnenaufgang (SS:MM) Sonnenuntergang (SS:MM) Zeitpunkt (SS:MM) Schattenanfang-Zeitpunkt (SS:MM) Schattenende/Minuten mit Schatten



Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 3 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (2)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:27	05:14 21:40	05:49 21:10	06:36 20:11	07:22 19:04	07:54 17:00	08:11 16:22
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	05:15 21:40	05:50 21:09	06:38 20:09	07:24 19:02	08:03 16:59	08:10 16:22
3	08:26 16:30	07:58 17:18	07:06 18:07	07:06 19:58	05:56 20:46	05:15 21:29	05:16 21:40	05:52 21:07	06:39 20:06	07:26 18:59	08:09 16:57	08:30 16:21
4	08:25 16:32	07:56 17:19	07:04 18:09	07:04 19:59	05:54 20:48	05:14 21:30	05:16 21:39	05:53 21:05	06:41 20:04	07:27 18:57	08:11 16:55	08:29 16:20
5	08:25 16:33	07:55 17:21	07:01 18:10	07:01 19:59	05:53 20:50	05:14 21:31	05:17 21:39	05:55 21:04	06:42 20:02	07:29 18:55	08:11 16:53	08:05 16:20
6	08:25 16:34	07:53 17:23	08:29-08:36/7 18:12	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:32	05:56 21:38	06:44 21:02	07:30 18:53	08:14-08:24/10 16:52	08:09 16:20
7	08:25 16:35	07:52 17:25	08:27-08:38/11 18:14	06:57 18:14	07:39-07:46/7 20:05	06:49 20:53	05:13 21:33	05:58 21:00	06:45 19:58	07:32 18:51	07:24 16:50	08:10 16:19
8	08:24 16:36	07:50 17:27	08:25-08:40/15 18:15	06:55 18:15	07:35-07:49/14 20:06	06:46 20:54	05:12 21:33	05:59 21:37	06:47 19:55	07:34 18:48	07:26 16:49	08:11 16:19
9	08:24 16:38	07:48 17:28	08:25-08:41/16 18:17	06:53 18:17	07:33-07:50/17 20:08	06:44 20:56	05:12 21:34	06:01 21:37	06:48 19:53	07:35 18:46	07:27 16:47	08:12 16:19
10	08:23 16:39	07:47 17:30	08:24-08:42/18 18:19	06:51 18:19	07:32-07:52/20 20:09	06:42 20:57	05:11 21:35	06:02 20:55	06:50 19:51	07:37 18:44	07:29 16:45	08:14 16:18
11	08:23 16:40	07:45 17:32	08:24-08:42/18 18:20	06:48 18:20	07:31-07:52/21 20:11	06:40 20:59	05:11 21:36	06:04 20:53	06:51 19:49	07:38 18:42	07:31 16:44	08:15 16:18
12	08:22 16:42	07:43 17:34	08:24-08:42/18 18:22	06:46 18:22	07:22-07:53/31 20:13	06:38 21:00	05:11 21:36	06:05 20:51	06:53 19:47	07:40 18:40	07:32 16:42	08:16 16:18
13	08:22 16:43	07:41 17:35	08:23-08:42/19 18:24	06:44 18:24	07:18-07:52/34 20:14	06:36 21:02	05:10 21:37	06:07 20:50	06:54 19:44	07:42 18:38	07:34 16:41	08:17 16:18
14	08:21 16:45	07:39 17:37	08:24-08:42/18 18:25	06:42 18:25	07:17-07:52/35 20:16	06:34 21:03	05:10 21:38	06:08 21:33	06:56 19:42	07:43 18:36	07:36 16:40	08:18 16:18
15	08:20 16:46	07:38 17:39	08:24-08:41/17 18:27	06:40 18:27	07:16-07:52/36 20:18	06:31 21:05	05:36 21:38	06:27 21:32	06:58 19:40	07:45 18:33	07:38 16:38	08:18 16:18
16	08:19 16:48	07:36 17:41	08:24-08:41/17 18:29	06:37 18:29	07:15-07:52/37 20:19	06:29 21:06	05:35 21:39	06:11 21:31	06:59 19:38	07:47 18:31	07:39 16:37	08:19 16:19
17	08:19 16:49	07:34 17:43	08:26-08:40/14 18:30	06:35 18:30	07:14-07:50/36 20:21	06:27 21:08	05:33 21:39	06:13 21:30	07:01 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	08:18 16:51	07:32 17:44	08:28-08:39/11 18:32	06:33 18:32	07:13-07:49/36 20:22	06:25 21:09	05:32 21:39	06:14 21:29	07:02 19:33	07:50 18:27	07:42 16:34	08:21 16:19
19	08:17 16:52	07:30 17:46	08:31-08:35/4 18:34	06:31 18:34	07:14-07:48/34 20:24	06:23 21:10	05:31 21:40	06:16 21:28	07:04 19:31	08:05-08:13/8 18:25	07:52 16:33	08:21 16:19
20	08:16 16:54	07:28 17:48	06:29 18:35	06:29 18:35	07:14-07:46/32 20:26	06:21 21:12	05:29 21:40	05:33 21:27	06:17 19:29	08:02-08:16/14 18:23	07:53 16:32	08:22 16:20
21	08:15 16:55	07:26 17:50	06:26 18:37	06:26 18:37	07:13-07:33/20 20:27	06:19 21:13	05:28 21:40	06:19 21:25	07:07 19:26	08:00-08:17/17 18:21	07:55 16:31	08:23 16:20
22	08:14 16:57	07:24 17:51	06:24 18:39	06:24 18:39	07:14-07:31/17 20:29	06:17 21:15	05:27 21:41	06:35 21:24	06:21 19:24	07:08 08:21-08:27/6 18:19	07:57 16:30	08:23 16:21
23	08:13 16:59	07:22 17:53	06:22 18:40	06:22 18:40	07:16-07:30/14 20:30	06:15 21:16	05:26 21:41	06:22 21:23	07:10 19:22	07:58-08:29/31 18:17	08:59-09:06/7 16:29	08:24 16:21
24	08:11 17:00	07:20 17:55	06:20 18:42	06:20 18:42	07:18-07:28/10 20:32	06:13 21:17	05:24 21:41	06:24 21:22	07:11 19:20	07:57-08:31/34 18:15	08:00 16:28	08:24 16:22
25	08:10 17:02	07:18 17:57	06:17 18:43	06:17 18:43	05:23 20:34	05:11 21:18	05:38 21:41	06:24 20:26	07:11 19:17	07:56-08:32/36 17:13	08:00 16:27	08:24 16:25
26	08:09 17:04	07:16 17:58	06:15 18:45	06:15 18:45	05:22 20:35	05:12 21:20	05:40 21:41	06:27 20:24	07:15 19:15	07:56-08:33/37 17:11	08:00 16:26	08:25 16:23
27	08:08 17:05	07:14 18:00	06:13 18:47	06:13 18:47	05:21 20:37	05:12 21:21	05:42 21:41	06:28 20:22	07:16 19:13	07:57-08:33/36 17:09	08:00 16:25	08:25 16:24
28	08:06 17:07	07:12 18:02	06:11 18:48	06:11 18:48	05:20 20:38	05:13 21:22	05:43 21:46	06:30 20:19	07:18 19:11	07:56-08:33/37 17:08	08:00 16:24	08:25 16:24
29	08:05 17:09		07:09 18:50	07:09 18:50	06:03 20:40	05:19 21:23	05:13 21:41	06:31 20:17	07:19 19:08	07:57-08:33/36 17:06	08:00 16:24	08:26 16:25
30	08:04 17:11		07:06 19:52	07:06 19:52	06:01 20:42	05:18 21:24	05:14 21:40	06:33 20:15	07:21 19:06	07:57-08:32/35 17:04	08:01 16:23	08:26 16:26
31	08:02 17:12		07:04 19:53	07:04 19:53	06:01 20:42	05:17 21:26	05:17 21:42	06:34 20:13	07:12 19:02	07:54-08:12/18 17:02	08:01 16:23	08:26 16:27
Sonnenscheinstunden												
Anzahl Minuten mit Schatten												
	264	280	367	414	480	492	496	450	380	333	270	250
	0	203	459	0	0	0	0	0	346	265	63	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:

SW19001 Zell

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 4 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (3)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Table with columns for months (Januar to Dezember) and rows for each day of the month, showing start and end times of shadows and total minutes with shadows.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Table with 6 columns: Tag im Monat, Sonnenaufgang (SS:MM), Sonnenuntergang (SS:MM), Zeitpunkt (SS:MM) Schattenanfang, Zeitpunkt (SS:MM) Schattenanfang, Zeitpunkt (SS:MM) Schattenende, Minuten mit Schatten



Projekt: SW19001 Zelle
Beschreibung: Schattenwurfberechnung für den Standort Zell
 Zusatzbelastung:
 - 1x ENERCON E-138, 3.500 kW, NH: 160 m
 Vorbelastung:
 - 5x ENERCON E-115, 3.000 kW, NH: 149 m
 - 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
 - 1x AN BONUS, 1.000 kW, NH: 70,0 m
 - 1x AN BONUS, 600 kW, NH: 58,0 m
 - 1x AN BONUS, 150 kW, NH: 30,0 m
 - 1x AN BONUS, 300 kW, NH: 40,0 m
Lizenzierter Anwender: windtest grevenbroich gmbh
 Frimmersdorfer Straße 73a
 DE-41517 Grevenbroich
 +49 2181 2278 0
 lasma.pikuma@windtest-nrw.de
 Berechnet:
 22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 5 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (4)

Voraussetzungen für Berechnung des Schattenwurfs
 Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]
 Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor
 N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
 472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
 Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember
1	08:26 09:07-09:21/14 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:27	05:14 21:40	05:49 21:10	06:36 20:11	07:22 19:04	07:14 17:00	08:02 08:51-09/09/18 16:22
2	08:26 09:08-09:22/14 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	05:15 21:40	05:50 21:09	06:38 20:09	07:24 19:02	07:15 16:59	08:04 08:52-09/10/18 16:22
3	08:26 09:07-09:22/15 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	05:16 21:40	05:52 21:07	06:39 20:06	07:26 18:59	07:17 16:57	08:05 08:52-09/10/18 16:21
4	08:25 09:07-09:23/16 16:32	07:56 17:19	07:04 18:09	06:55 20:00	05:54 20:48	05:14 21:30	05:16 21:39	05:53 21:05	06:41 20:04	07:27 18:57	07:19 16:55	08:06 08:53-09/11/18 16:20
5	08:25 09:08-09:24/16 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:50	05:14 21:31	05:17 21:39	05:55 21:04	06:42 20:02	07:29 18:55	07:21 16:53	08:08 08:53-09/11/18 16:20
6	08:25 09:08-09:24/16 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:32	05:18 21:38	05:56 21:02	06:44 20:00	07:30 18:53	07:22 16:52	08:09 08:54-09/11/17 16:20
7	08:25 09:08-09:26/18 16:35	07:52 17:25	06:57 18:14	06:49 20:05	05:49 20:53	05:13 21:32	05:19 21:38	05:58 21:00	06:45 19:58	07:32 18:51	07:24 16:50	08:10 08:54-09/10/16 16:19
8	08:24 09:08-09:26/18 16:36	07:50 17:27	06:55 18:15	06:46 20:06	05:47 20:54	05:12 21:33	05:20 21:37	05:59 20:59	06:47 19:55	07:34 18:48	07:26 16:49	08:11 08:55-09/11/16 16:19
9	08:24 09:09-09:27/18 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	05:12 21:34	05:20 21:37	06:01 20:57	06:48 19:53	07:35 18:46	07:27 16:47	08:12 08:56-09/11/15 16:19
10	08:23 09:09-09:27/18 16:39	07:47 17:30	06:51 18:19	06:42 20:09	05:44 20:57	05:11 21:35	05:21 21:36	06:02 20:55	06:50 19:51	07:37 18:44	07:29 16:45	08:14 08:57-09/11/14 16:19
11	08:23 09:09-09:27/18 16:40	07:45 17:32	06:48 18:20	06:40 20:11	05:42 20:59	05:11 21:36	05:22 21:35	06:04 20:53	06:51 19:49	07:38 18:42	07:31 16:44	08:15 08:57-09/11/14 16:18
12	08:22 08:57-09/04/7 16:42	07:43 18:22	06:46 20:13	06:38 21:00	05:41 21:00	05:11 21:36	05:23 21:34	06:05 20:51	06:53 19:47	07:40 18:40	07:32 16:42	08:34-08:39/5 16:18
13	08:22 08:56-09/05/9 16:43	07:41 18:24	06:44 20:14	06:36 21:02	05:39 21:02	05:10 21:37	05:24 21:34	06:07 20:50	06:54 19:44	07:42 18:38	07:34 16:41	08:32-08:42/10 16:18
14	08:21 08:55-09/06/11 16:45	07:39 18:25	06:42 20:16	06:34 21:03	05:38 21:03	05:10 21:38	05:26 21:33	06:08 20:48	06:56 19:42	07:43 18:36	07:36 16:40	08:31-08:44/13 16:18
15	08:20 08:55-09/08/13 16:46	07:38 18:27	06:40 20:17	06:31 21:05	05:36 21:05	05:10 21:38	05:27 21:32	06:10 20:46	06:58 19:40	07:45 18:33	07:38 16:38	08:30-08:44/14 16:18
16	08:19 08:54-09/09/15 16:48	07:36 18:29	06:37 20:19	06:29 21:06	05:35 21:06	05:10 21:39	05:28 21:31	06:11 20:44	06:59 19:38	07:47 18:31	07:39 16:37	08:29-08:45/16 16:19
17	08:19 08:54-09/09/15 16:49	07:34 18:30	06:35 20:21	06:27 21:08	05:33 21:08	05:10 21:39	05:29 21:30	06:13 20:42	07:01 19:35	07:48 18:29	07:41 16:36	08:29-08:46/17 16:19
18	08:18 08:54-09/10/16 16:51	07:32 18:32	06:33 20:22	06:25 21:09	05:32 21:09	05:10 21:39	05:30 21:29	06:14 20:40	07:02 19:33	07:50 18:27	07:42 16:34	08:29-08:47/18 16:19
19	08:17 08:54-09/11/17 16:52	07:30 18:34	06:31 20:24	06:23 21:10	05:31 21:10	05:10 21:40	05:31 21:28	06:16 20:38	07:04 19:31	07:52 18:25	07:44 16:33	08:30-08:47/17 16:19
20	08:16 08:54-09/12/18 16:54	07:28 18:35	06:29 20:26	06:21 21:12	05:29 21:12	05:10 21:40	05:33 21:27	06:17 20:36	07:05 19:29	07:53 18:23	07:46 16:32	08:56-08:58/2 16:20
21	08:15 08:55-09/12/17 16:55	07:26 18:37	06:26 20:27	06:19 21:13	05:28 21:13	05:10 21:40	05:34 21:25	06:19 20:34	07:07 19:26	07:55 18:21	07:47 16:31	08:29-08:47/18 16:20
22	08:14 08:54-09/12/18 16:57	07:24 18:39	06:24 20:29	06:17 21:15	05:27 21:15	05:10 21:41	05:35 21:24	06:21 20:32	07:08 19:24	07:57 18:19	07:49 16:30	08:30-08:47/17 16:20
23	08:13 08:55-09/12/17 16:59	07:22 18:40	06:22 20:30	06:15 21:16	05:26 21:16	05:11 21:41	05:36 21:23	06:22 20:30	07:10 19:22	07:58 18:17	07:51 16:29	08:31-08:48/18 16:21
24	08:11 08:55-09/13/18 17:00	07:20 18:42	06:20 20:32	06:13 21:17	05:24 21:17	05:11 21:41	05:38 21:22	06:24 20:28	07:11 19:20	08:00 18:15	07:52 16:28	08:51-09/06/15 16:22
25	08:10 08:56-09/13/17 17:02	07:18 18:43	06:17 20:34	06:11 21:18	05:23 21:18	05:11 21:41	05:39 21:20	06:25 20:26	07:13 19:17	08:00 17:13	07:54 16:27	08:31-08:47/17 16:22
26	08:09 08:56-09/12/16 17:04	07:16 18:45	06:15 20:35	06:09 21:20	05:22 21:20	05:12 21:41	05:40 21:19	06:27 20:24	07:15 19:15	08:00 17:11	07:49 16:26	08:30-08:48/18 16:23
27	08:08 08:58-09/12/14 17:06	07:14 18:00	06:13 20:47	06:07 21:21	05:21 21:21	05:12 21:41	05:42 21:18	06:28 20:22	07:16 19:13	08:00 17:09	07:57 16:25	08:33-08:48/18 16:24
28	08:06 08:58-09/11/13 17:07	07:12 18:48	06:11 20:38	06:05 21:22	05:20 21:22	05:13 21:41	05:43 21:16	06:30 20:19	07:18 19:11	08:00 17:08	07:58 16:24	08:34-08:47/18 16:24
29	08:05 09:00-09/10/10 17:09	07:09 19:50	06:03 20:40	05:19 21:23	05:19 21:23	05:13 21:41	05:45 21:15	06:31 20:17	07:19 19:08	08:00 17:06	08:00 16:24	08:50-09/09/19 16:25
30	08:04 09:03-09/07/4 17:11	07:06 19:52	06:01 20:42	05:18 21:24	05:18 21:24	05:14 21:40	05:46 21:13	06:33 20:15	07:21 19:06	08:01 17:04	08:01 16:23	08:51-09/09/18 16:26
31	08:02 17:12	07:04 19:53	06:04 21:26	05:18 21:26	05:18 21:26	05:18 21:26	05:47 21:12	06:34 20:13	07:12 19:02	08:02 17:02	08:02 16:27	08:59-09/20/13 16:27
Sonnenscheinstunden	264	280	367	414	480	492	496	450	380	333	271	250
Anzahl Minuten mit Schatten	622	0	0	0	0	0	0	0	0	0	443	409

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:
SW19001 Zell
 TurboWind Energie GmbH
 Vahrenwalder Str. 245-247
 30179 Hannover

Beschreibung:
 Schattenwurfberechnung für den Standort Zell
 Zusatzbelastung:
 - 1x ENERCON E-138, 3.500 kW, NH: 160 m
 Vorbelastung:
 - 5x ENERCON E-115, 3.000 kW, NH: 149 m
 - 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
 - 1x AN BONUS, 1.000 kW, NH: 70,0 m
 - 1x AN BONUS, 600 kW, NH: 58,0 m
 - 1x AN BONUS, 150 kW, NH: 30,0 m
 - 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
 windtest grevenbroich gmbh
 Frimmersdorfer Straße 73a
 DE-41517 Grevenbroich
 +49 2181 2278 0
 lasma.pikuma@windtest-nrw.de
 Berechnet:
 22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 6 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (5)

Voraussetzungen für Berechnung des Schattenwurfs
 Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]
 Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor
 N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
 472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
 Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember			
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	06:47-06:55/8 20:58	05:17 21:27	05:50-06:05/15 21:40	05:14 21:10	05:56-06:12/16 21:10	05:49 21:10	06:36 20:11	07:22 19:04	07:14 17:00	08:02 16:22
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	07:00 20:45	07:00 20:56	05:16 21:28	05:51-06:06/15 21:40	05:15 21:40	05:55-06:12/17 21:09	05:50 21:09	06:38 20:09	07:24 19:02	07:15 16:58	08:04 16:21
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	06:57 20:46	06:57 20:54	05:15 21:29	05:51-06:06/15 21:40	05:15 21:40	05:56-06:12/16 21:07	05:52 21:07	06:39 20:06	07:26 18:59	07:17 16:57	08:05 16:21
4	08:26 16:31	07:56 17:19	07:04 18:09	06:55 20:00	06:55 20:48	06:55 20:54	05:14 21:30	05:50-06:06/16 21:39	05:16 21:39	05:56-06:13/17 21:05	05:53 21:05	06:41 20:04	07:27 18:57	07:19 16:55	08:06 16:20
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	06:53 20:50	06:53 20:51	05:14 21:31	05:51-06:07/16 21:39	05:17 21:39	05:56-06:12/16 21:04	05:55 21:04	06:42 20:02	07:29 18:55	07:21 16:53	08:08 16:20
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	06:51 20:51	06:51 20:52	05:13 21:32	05:50-06:06/16 21:38	05:18 21:38	05:56-06:12/16 21:02	05:56 21:02	06:44 20:00	07:30 18:53	07:22 16:52	08:09 16:20
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	06:49 20:53	06:49 20:54	05:13 21:33	05:51-06:07/16 21:38	05:19 21:38	05:57-06:13/16 21:00	05:58 21:00	06:45 19:58	07:32 18:51	07:24 16:50	08:10 16:19
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 20:06	06:46 20:54	06:46 20:55	05:12 21:33	05:50-06:06/16 21:37	05:20 21:37	05:58-06:13/15 21:01	05:59 21:01	06:47 19:55	07:34 18:48	07:26 16:48	08:11 16:19
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	06:44 20:56	06:44 20:57	05:12 21:34	05:51-06:07/16 21:37	05:20 21:37	05:58-06:13/15 21:01	06:01 21:01	06:48 19:53	07:35 18:46	07:27 16:47	08:12 16:19
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12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	06:38 21:00	06:38 21:01	05:11 21:36	05:51-06:08/17 21:34	05:23 21:34	05:59-06:14/15 21:04	06:05 21:04	06:55-07:04/9 19:47	07:40 18:40	07:32 16:42	08:16 16:18
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14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	06:34 21:03	06:34 21:04	05:10 21:38	05:52-06-08/16 21:33	05:25 21:33	06:00-06:14/14 21:06	06:08 21:06	06:53-07-07/14 19:42	07:43 18:36	07:36 16:40	08:18 16:18
15	08:20 16:46	07:38 17:39	06:40 18:27	06:31 20:18	06:31 21:05	06:31 21:06	05:10 21:38	05:52-06-09/17 21:32	05:27 21:32	06:00-06:13/13 21:06	06:10 21:06	06:52-07-07/15 19:40	07:45 18:33	07:38 16:38	08:18 16:18
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	06:29 21:06	06:29 21:07	05:09 21:39	05:52-06-09/17 21:31	05:28 21:31	06:01-06:13/12 21:04	06:11 21:04	06:52-07-07/15 19:38	07:47 18:31	07:39 16:37	08:19 16:18
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18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	06:25 21:09	06:25 21:10	05:10 21:39	05:52-06-09/17 21:29	05:30 21:29	06:02-06:11/9 21:00	06:14 21:00	06:51-07-07/16 19:33	07:50 18:27	07:42 16:34	08:21 16:19
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21	08:15 16:55	07:26 17:50	06:26 18:37	06:19 20:27	06:19 21:13	06:19 21:14	05:10 21:40	05:53-06-09/16 21:25	05:34 21:25	06:03-06-10/7 21:00	06:19 21:00	06:52-07-04/12 19:26	07:55 18:21	07:47 16:31	08:23 16:20
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	06:17 21:15	06:17 21:16	05:10 21:41	05:54-06-10/16 21:24	05:35 21:24	06:04-07-03/9 21:00	06:21 21:00	06:54-07-03/9 19:24	07:57 18:19	07:49 16:30	08:23 16:20
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	06:15 21:16	06:15 21:17	05:11 21:41	05:54-06-10/16 21:23	05:36 21:23	06:05-06-10/7 21:00	06:22 21:00	06:56-07-00/4 19:22	07:58 18:17	07:51 16:29	08:24 16:21
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	06:13 21:17	06:13 21:18	05:11 21:41	05:53-06-10/17 21:22	05:38 21:22	06:06-06-10/7 21:00	06:24 21:00	06:57-07-00/4 19:28	07:11 18:15	07:52 16:28	08:24 16:22
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	06:11 21:18	06:11 21:19	05:11 21:41	05:54-06-11/17 21:20	05:39 21:20	06:07-06-11/9 21:00	06:25 21:00	06:57-07-00/4 19:27	07:13 18:13	07:54 16:27	08:25 16:22
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27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	06:07 21:21	06:07 21:22	05:12 21:41	05:54-06-11/17 21:18	05:42 21:18	06:09-06-11/9 21:00	06:28 21:00	06:57-07-00/4 19:22	07:16 18:13	07:57 16:25	08:25 16:24
28	08:07 17:07	07:12 18:02	06:11 18:48	06:05 20:38	06:05 21:22	06:05 21:23	05:12 21:41	05:55-06-11/16 21:16	05:43 21:16	06:10-06-11/9 21:00	06:30 21:00	06:57-07-00/4 19:21	07:18 18:11	07:58 16:24	08:25 16:24
29	08:05 17:09	07:09 19:50	06:03 20:40	06:45-06:59/14 21:23	06:45-06:59/14 21:23	06:45-06:59/14 21:23	05:19 21:41	05:54-06-11/17 21:15	05:35 21:15	06:09-06-11/9 21:00	06:31 21:00	06:57-07-00/4 19:20	07:19 18:08	08:00 16:23	08:26 16:25
30	08:04 17:11	07:06 19:52	06:01 20:42	06:46-06:57/11 21:24	06:46-06:57/11 21:24	06:46-06:57/11 21:24	05:18 21:40	05:55-06-12/17 21:13	05:45 21:13	06:10-06-11/9 21:00	06:33 21:00	06:57-07-00/4 19:16	07:21 18:04	08:01 16:23	08:26 16:26
31	08:02 17:12	07:04 19:53	06:01 20:42	06:46-06:57/11 21:24	06:46-06:57/11 21:24	06:46-06:57/11 21:24	05:17 21:40	05:55-06-12/17 21:12	05:47 21:12	06:10-06-11/9 21:00	06:34 21:00	06:57-07-00/4 19:12	07:12 18:04	08:01 16:23	08:26 16:27
Sonnenscheinstunden	264	280	367	414	480	492	496	450	380	333	270	250			
Anzahl Minuten mit Schatten	0	0	0	148	98	491	271	154	0	0	0	0			

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenziertes Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: 7 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (6)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	07:30-07:43/13 06:00 06:26-06:41/15	05:17 20:43
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	07:29-07:43/14 05:58 06:26-06:43/17	05:16 21:28
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	07:27-07:43/16 05:56 06:25-06:43/18	05:15 21:29
4	08:26 16:31	07:56 17:19	07:04 18:09	06:55 20:00	07:27-07:43/16 05:54 06:24-06:43/19	05:14 21:30
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	07:27-07:43/16 05:52 06:24-06:43/19	05:14 21:31
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	07:27-07:42/15 05:51 06:24-06:44/20	05:13 21:32
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	07:28-07:41/13 05:49 06:24-06:43/19	05:13 21:33
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 20:06	07:29-07:40/11 05:47 06:25-06:44/19	05:12 21:33
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	07:30-07:36/6 05:46 06:25-06:43/18	05:12 21:34
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	06:26-06:43/17 05:44 06:26-06:43/17	05:11 21:35
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	06:27-06:42/15 05:42 06:27-06:42/15	05:11 21:36
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	06:28-06:41/13 05:41 06:28-06:41/13	05:11 21:36
13	08:22 16:43	07:41 17:35	06:44 18:24	06:36 20:14	06:29-06:40/11 05:39 06:29-06:40/11	05:10 21:37
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	06:31-06:38/7 05:38 06:31-06:38/7	05:10 21:38
15	08:20 16:46	07:38 17:39	06:40 18:27	06:31 20:17	05:36 21:05	05:10 21:38
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06	05:10 21:39
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	05:33 21:08	05:10 21:39
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:10 21:39
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:10 21:40
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	05:29 21:12	05:10 21:40
21	08:15 16:55	07:26 17:50	06:26 18:37	06:19 20:27	05:28 21:13	05:10 21:40
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15	05:10 21:41
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 21:41
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:11 21:41
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18	05:11 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	05:12 21:41
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 21:41
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:12 21:41
29	08:05 17:09		07:09 19:50	06:03 20:40	06:31-06:35/4 05:19 21:23	05:13 21:41
30	08:04 17:11		07:06 19:52	06:01 20:42	06:28-06:39/11 05:18 21:24	05:14 21:40
31	08:02 17:12		07:04 19:53	07:32-07:41/9 05:17 21:26		
Sonnenscheinstunden	264	280	367	414	480	492
Anzahl Minuten mit Schatten	0	0	9	135	227	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
			Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 7 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (6)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli	August	September	Oktober	November	Dezember
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1	05:14 21:40	05:49 06:39-06:52/13 21:10	06:36 20:11	07:22 19:04	07:14 17:00	08:02 16:22
2	05:15 21:40	05:50 06:37-06:53/16 21:09	06:38 20:09	07:24 19:02	07:15 16:58	08:04 16:21
3	05:15 21:40	05:52 06:35-06:53/18 21:07	06:39 07:28-07:34/6 20:06	07:26 18:59	07:17 16:57	08:05 16:21
4	05:16 21:39	05:53 06:35-06:54/19 21:05	06:41 07:26-07:37/11 20:04	07:27 18:57	07:19 16:55	08:06 16:20
5	05:17 21:39	05:55 06:34-06:53/19 21:04	06:42 07:24-07:37/13 20:02	07:29 18:55	07:21 16:53	08:08 16:20
6	05:18 21:38	05:56 06:34-06:54/20 21:02	06:44 07:23-07:38/15 20:00	07:30 18:53	07:22 16:52	08:09 16:20
7	05:19 21:38	05:58 06:34-06:53/19 21:00	06:45 07:22-07:38/16 19:58	07:32 18:51	07:24 16:50	08:10 16:19
8	05:20 21:37	05:59 06:33-06:53/20 20:59	06:47 07:22-07:38/16 19:55	07:34 18:48	07:26 16:48	08:11 16:19
9	05:20 21:37	06:01 06:34-06:53/19 20:57	06:48 07:21-07:37/16 19:53	07:35 18:46	07:27 16:47	08:12 16:19
10	05:21 21:36	06:02 06:34-06:51/17 20:55	06:50 07:22-07:37/15 19:51	07:37 18:44	07:29 16:45	08:14 16:18
11	05:22 21:35	06:04 06:35-06:51/16 20:53	06:51 07:22-07:35/13 19:49	07:38 18:42	07:31 16:44	08:15 16:18
12	05:23 21:34	06:05 06:35-06:49/14 20:51	06:53 07:24-07:34/10 19:47	07:40 18:40	07:32 16:42	08:16 16:18
13	05:24 21:34	06:07 06:37-06:46/9 20:50	06:54 07:26-07:30/4 19:44	07:42 18:38	07:34 16:41	08:17 16:18
14	05:25 21:33	06:08 20:48	06:56 19:42	07:43 18:36	07:36 16:40	08:18 16:18
15	05:27 21:32	06:10 20:46	06:58 19:40	07:45 18:33	07:38 16:38	08:18 16:18
16	05:28 21:31	06:11 20:44	06:59 19:38	07:47 18:31	07:39 16:37	08:19 16:18
17	05:29 21:30	06:13 20:42	07:01 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	05:30 21:29	06:14 20:40	07:02 19:33	07:50 18:27	07:42 16:34	08:21 16:19
19	05:31 21:28	06:16 20:38	07:04 19:31	07:52 18:25	07:44 16:33	08:21 16:19
20	05:33 21:27	06:17 20:36	07:05 19:29	07:53 18:23	07:46 16:32	08:22 16:20
21	05:34 21:25	06:19 20:34	07:07 19:26	07:55 18:21	07:47 16:31	08:23 16:20
22	05:35 21:24	06:21 20:32	07:08 19:24	07:57 18:19	07:49 16:30	08:23 16:20
23	05:36 21:23	06:22 20:30	07:10 19:22	07:58 18:17	07:51 16:29	08:24 16:21
24	05:38 21:22	06:24 20:28	07:11 19:19	08:00 18:15	07:52 16:28	08:24 16:22
25	05:39 21:20	06:25 20:26	07:13 19:17	07:02 17:13	07:54 16:27	08:25 16:22
26	05:40 21:19	06:27 20:24	07:15 19:15	07:03 17:11	07:55 16:26	08:25 16:23
27	05:42 21:18	06:28 20:22	07:16 19:13	07:05 17:09	07:57 16:25	08:25 16:24
28	05:43 21:16	06:30 20:19	07:18 19:11	07:07 17:08	07:58 16:24	08:25 16:24
29	05:45 06:43-06:47/4 21:15	06:31 20:17	07:19 19:08	07:09 17:06	08:00 16:23	08:26 16:25
30	05:46 06:41-06:50/9 21:13	06:33 20:15	07:21 19:06	07:10 17:04	08:01 16:23	08:26 16:26
31	05:47 06:39-06:51/12 21:12	06:34 20:13		07:12 17:02		08:26 16:27
Sonnenscheinstunden	496	450	380	333	270	250
Anzahl Minuten mit Schatten	25	219	135	0	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
			Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 8 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (7)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Table with 12 columns (Jan to Dez) and 1 row of values: 1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

Table with 13 columns (N to Summe) and 1 row of values: 472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Main shadow calculation table with columns for months (Januar to Dezember) and rows for each day (1 to 31). Includes columns for sunrise, sunset, and shadow start/end times.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Table with 6 columns: Tag im Monat, Sonnenaufgang (SS:MM), Sonnenuntergang (SS:MM), Zeitpunkt (SS:MM), Schattenanfang-Zeitpunkt (SS:MM), Schattenende/Minuten mit Schatten



Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 9 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (8)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:27	05:14 21:40	05:49 21:10	06:36 21:10	07:22 19:04	07:14 17:00	08:02 16:22
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	05:15 21:40	05:50 21:09	06:37 20:09	07:24 19:02	07:15 16:58	08:04 16:21
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	05:15 21:40	05:52 21:07	06:39 20:06	07:26 18:59	07:17 16:57	08:05 16:21
4	08:25 16:31	07:56 17:19	07:04 18:09	06:55 20:00	05:54 20:48	05:14 21:30	05:16 21:39	05:53 21:05	06:41 20:04	07:27 18:57	07:19 16:55	08:06 16:20
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:49	05:14 21:31	05:17 21:39	05:55 21:04	06:42 20:02	07:29 18:55	07:21 16:53	08:08 16:20
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:32	05:18 21:38	05:56 21:02	06:44 20:00	07:30 18:53	07:22 16:52	08:09 16:20
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	05:49 20:53	05:13 21:32	05:19 21:38	05:58 21:00	06:45 19:58	07:32 18:51	07:24 16:50	08:10 16:19
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 20:06	05:47 20:54	05:12 21:33	05:20 21:37	05:59 20:59	06:47 19:55	07:34 18:48	07:26 16:48	08:11 16:19
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	05:12 21:34	05:20 21:37	06:01 20:57	06:48 19:53	07:35 18:46	07:27 16:47	08:12 16:19
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	05:44 20:57	05:11 21:35	05:21 21:36	06:02 20:55	06:50 19:51	07:37 18:44	07:29 16:45	08:14 16:18
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	05:42 20:59	05:11 21:36	05:22 21:35	06:04 20:53	06:51 19:49	07:38 18:42	07:31 16:44	08:15 16:18
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00	05:11 21:36	05:23 21:34	06:05 20:51	06:53 19:47	07:40 18:40	07:32 16:42	08:16 16:18
13	08:22 16:43	07:41 17:35	06:44 18:24	06:36 20:14	05:39 21:02	05:10 21:37	05:24 21:34	06:07 20:50	06:54 19:44	07:42 18:38	07:34 16:41	08:17 16:18
14	08:21 16:45	07:39 17:37	06:42 18:25	07:07-07:14/7	06:34 20:16	05:38 21:03	05:10 21:38	06:08 21:33	06:56 20:48	07:43 18:36	07:36 16:40	08:18 16:18
15	08:20 16:46	07:38 17:39	06:40 18:27	07:05-07:15/10	06:31 20:17	05:36 21:05	05:10 21:38	06:10 20:46	06:58 19:40	07:45 18:33	07:37 16:38	08:18 16:18
16	08:19 16:48	07:36 17:41	06:37 18:29	07:04-07:16/12	06:29 20:19	05:35 21:06	05:10 21:39	06:11 20:44	06:59 19:38	07:47 18:31	07:39 16:37	08:19 16:18
17	08:19 16:49	07:34 17:43	06:35 18:30	07:02-07:16/14	06:27 20:21	05:33 21:08	05:10 21:39	06:13 20:42	07:01 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	08:18 16:51	07:32 17:44	06:33 18:32	07:02-07:16/14	06:25 20:22	05:32 21:09	05:10 21:39	06:14 20:40	07:02 19:33	07:50 18:27	07:42 16:34	08:21 16:19
19	08:17 16:52	07:30 17:46	06:31 18:34	07:02-07:16/14	06:23 20:24	05:31 21:10	05:10 21:40	06:16 20:38	07:04 19:31	07:52 18:25	07:44 16:33	08:21 16:19
20	08:16 16:54	07:28 17:48	06:29 18:35	07:03-07:15/12	06:21 20:26	05:29 21:12	05:10 21:40	06:17 20:36	07:05 19:28	07:53 18:23	07:46 16:32	08:22 16:20
21	08:15 16:55	07:26 17:50	06:26 18:37	07:03-07:13/10	06:19 20:27	05:28 21:13	05:10 21:40	06:19 20:34	07:07 19:26	07:52-07:55/3	07:55 18:21	08:23 16:20
22	08:14 16:57	07:24 17:51	06:24 18:39	07:05-07:10/5	06:17 20:29	05:27 21:15	05:10 21:41	06:21 20:32	07:08 19:24	07:49-07:58/9	07:57 18:19	08:23 16:20
23	08:13 16:59	07:22 17:53	06:22 18:40		06:15 20:30	05:26 21:16	05:11 21:41	06:22 20:30	07:10 19:22	07:47-07:58/11	07:58 18:17	08:24 16:21
24	08:11 17:00	07:20 17:55	06:20 18:42		06:13 20:32	05:24 21:17	05:11 21:41	06:24 20:28	07:11 19:19	07:46-07:59/13	08:00 18:15	08:24 16:22
25	08:10 17:02	07:18 17:57	06:17 18:43		06:11 20:34	05:23 21:18	05:11 21:41	06:25 20:26	07:13 19:17	07:45-07:59/14	07:02 17:13	08:25 16:22
26	08:09 17:04	07:16 17:58	06:15 18:45		06:09 20:35	05:22 21:20	05:12 21:41	06:27 20:24	07:15 19:15	07:45-07:59/14	07:03 17:11	08:25 16:23
27	08:08 17:05	07:14 18:00	06:13 18:47		06:07 20:37	05:21 21:21	05:12 21:41	06:28 20:21	07:16 19:13	07:45-07:58/13	07:05 17:09	08:25 16:24
28	08:06 17:07	07:12 18:02	06:11 18:48		06:05 20:38	05:20 21:22	05:12 21:41	06:30 20:19	07:18 19:10	07:45-07:57/12	07:07 17:08	08:25 16:24
29	08:05 17:09		07:09 19:50		06:03 20:40	05:19 21:23	05:13 21:41	06:31 20:17	07:19 19:08	07:47-07:55/8	07:09 17:06	08:26 16:25
30	08:04 17:11		07:06 19:52		06:01 20:42	05:18 21:24	05:14 21:40	06:33 20:15	07:21 19:06		07:10 17:04	08:26 16:26
31	08:02 17:12		07:04 19:53			05:17 21:26		06:34 20:13			07:12 17:02	08:26 16:27
Sonnenscheinstunden	264	280	367	414	480	492	496	450	380	333	270	250
Anzahl Minuten mit Schatten	0	0	98	0	0	0	0	0	97	0	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: 10 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (9)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:27	05:14 21:40	05:49 21:10	06:36 20:11	07:22 19:04	07:14 17:00	08:02 16:22
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	05:15 21:40	05:50 21:09	06:38 20:09	07:24 19:02	07:15 16:58	08:04 16:22
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	05:16 21:40	05:52 21:07	06:39 20:06	07:26 18:59	07:17 16:57	08:05 16:21
4	08:25 16:31	07:56 17:19	07:04 18:09	06:55 20:00	05:54 20:48	05:14 21:30	05:16 21:39	05:53 21:05	06:41 20:04	07:27 18:57	07:19 16:55	08:06 16:20
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:49	05:14 21:31	05:17 21:39	05:55 21:04	06:42 20:02	07:29 18:55	07:21 16:53	08:08 16:20
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:32	05:18 21:38	05:56 21:02	06:44 20:00	07:30 18:53	07:22 16:52	08:09 16:20
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	05:49 20:53	05:13 21:32	05:19 21:38	05:58 21:00	06:45 19:58	07:32 18:51	07:24 16:50	08:10 16:19
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 20:06	05:47 20:54	05:12 21:33	05:20 21:37	05:59 20:59	06:47 19:55	07:34 18:48	07:26 16:48	08:11 16:19
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	05:12 21:34	05:20 21:37	06:01 20:57	06:48 19:53	07:35 18:46	07:27 16:47	08:12 16:19
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	05:44 20:57	05:11 21:35	05:21 21:36	06:02 20:55	06:50 19:51	07:37 18:44	07:29 16:45	08:14 16:18
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	05:42 20:59	05:11 21:36	05:22 21:35	06:04 20:53	06:51 19:49	07:38 18:42	07:31 16:44	08:15 16:18
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00	05:11 21:36	05:23 21:34	06:05 20:51	06:53 19:47	07:40 18:40	07:32 16:42	08:16 16:18
13	08:22 16:43	07:41 17:35	06:44 18:24	06:36 20:14	05:39 21:02	05:10 21:37	05:24 21:34	06:07 20:50	06:54 19:44	07:42 18:38	07:34 16:41	08:17 16:18
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	05:38 21:03	05:10 21:37	05:26 21:33	06:08 20:48	06:56 19:42	07:43 18:36	07:36 16:40	08:18 16:18
15	08:20 16:46	07:38 17:39	06:40 18:27	06:31 20:17	05:36 21:05	05:10 21:38	05:27 21:32	06:10 20:46	06:58 19:40	07:45 18:33	07:37 16:38	08:18 16:18
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06	05:10 21:39	05:28 21:31	06:11 20:44	06:59 19:38	07:47 18:31	07:39 16:37	08:19 16:18
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	05:33 21:08	05:10 21:39	05:29 21:30	06:13 20:42	07:01 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:10 21:39	05:30 21:29	06:14 20:40	07:02 19:33	07:50 18:27	07:42 16:34	08:21 16:19
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:10 21:40	05:31 21:28	06:16 20:38	07:04 19:31	07:52 18:25	07:44 16:33	08:21 16:19
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	05:29 21:12	05:10 21:40	05:33 21:27	06:17 20:36	07:05 19:29	07:53 18:23	07:46 16:32	08:22 16:20
21	08:15 16:55	07:26 17:50	06:26 18:37	06:19 20:27	05:28 21:13	05:10 21:40	05:34 21:25	06:19 20:34	07:07 19:26	07:55 18:21	07:47 16:31	08:23 16:20
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15	05:10 21:41	05:35 21:24	06:21 20:32	07:08 19:24	07:57 18:19	07:49 16:30	08:23 16:20
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 21:41	05:36 21:23	06:22 20:30	07:10 19:22	07:58 18:17	07:50 16:29	08:24 16:21
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:11 21:41	05:38 21:22	06:24 20:28	07:11 19:19	08:00 18:15	07:52 16:28	08:24 16:22
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18	05:11 21:41	05:39 21:20	06:25 20:26	07:13 19:17	07:02 17:13	07:54 16:27	08:25 16:22
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	05:12 21:41	05:40 21:19	06:27 20:24	07:15 19:15	07:03 17:11	07:55 16:26	08:25 16:23
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 21:41	05:42 21:18	06:28 20:21	07:16 19:13	07:05 17:09	07:57 16:25	08:25 16:24
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:12 21:41	05:43 21:16	06:30 20:19	07:18 19:11	07:07 17:08	07:58 16:24	08:25 16:24
29	08:05 17:09		07:09 19:50	06:03 20:40	05:19 21:23	05:13 21:41	05:45 21:15	06:31 20:17	07:19 19:08	07:09 17:06	08:00 16:23	08:26 16:25
30	08:04 17:11		07:06 19:52	06:01 20:42	05:18 21:24	05:14 21:40	05:46 21:13	06:33 20:15	07:21 19:06	07:10 17:04	08:01 16:23	08:26 16:26
31	08:02 17:12		07:04 19:53		05:17 21:26		05:47 21:12	06:34 20:13		07:12 17:02		08:26 16:27
Sonnenscheinstunden	264	280	367	414	480	492	496	450	380	333	271	250
Anzahl Minuten mit Schatten	0	0	0	0	0	0	0	0	0	0	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 11 - DEWIND D6/62-1MW 1000 62.0 !O! NH: 68,5 m (Ges:99,5 m) (10)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember	
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:27	05:14 21:40	05:49 21:10	06:30-06:48/18	06:36 20:11	07:22 19:04	07:14 17:00	
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28	05:15 21:40	05:50 21:09	06:30-06:47/17	06:38 20:09	07:24 19:02	07:15 16:58	
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29	05:16 21:40	05:52 21:07	06:31-06:46/15	06:39 20:06	07:26 18:59	07:17 16:57	
4	08:25 16:32	07:56 17:19	07:04 18:09	06:55 20:00	05:54 20:48	05:14 21:30	05:16 21:39	05:53 21:05	06:32-06:45/13	06:41 20:04	07:27 18:57	07:19 16:55	
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	05:52 20:49	05:14 21:31	05:17 21:39	05:55 21:04	06:34-06:43/9	06:42 20:02	07:29 18:55	07:20 16:53	
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	05:51 20:51	05:13 21:32	05:18 21:38	05:56 21:02		06:44 20:00	07:30 18:53	07:22 16:52	
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	05:49 20:53	05:13 21:32	05:19 21:38	05:58 21:00		06:45 19:58	07:32 18:51	07:24 16:50	
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 20:06	05:47 20:54	05:12 21:33	05:20 21:37	05:59 20:59		06:47 19:55	07:34 18:48	07:26 16:48	
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	05:46 20:56	05:12 21:34	05:20 21:36	06:01 20:57		06:48 19:53	07:35 18:46	07:27 16:47	
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	05:44 20:57	05:11 21:35	05:21 21:36	06:02 20:55		06:50 19:51	07:37 18:44	07:29 16:45	
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	05:42 20:59	05:11 21:36	05:22 21:35	06:04 20:53		06:51 19:49	07:38 18:42	07:31 16:44	
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	05:41 21:00	05:11 21:36	05:23 21:34	06:05 20:51		06:53 19:47	07:40 18:40	07:32 16:42	
13	08:22 16:43	07:41 17:35	06:44 18:24	06:36 20:14	05:39 21:02	05:10 21:37	05:24 21:34	06:07 20:50		06:54 19:44	07:42 18:38	07:34 16:41	
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	05:38 21:03	05:10 21:37	06:36-06:40/4	06:08 20:48		06:56 19:42	07:43 18:36	07:36 16:40	
15	08:20 16:46	07:38 17:39	06:40 18:27	06:31 20:17	05:36 21:05	05:10 21:38	06:34-06:42/8	06:10 20:46		06:58 19:40	07:45 18:33	07:37 16:38	
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	05:35 21:06	05:10 21:39	06:33-06:44/11	06:11 20:44		06:59 19:38	07:47 18:31	07:39 16:37	
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	05:33 21:08	05:10 21:39	06:32-06:45/13	06:13 20:42		07:01 19:35	07:48 18:29	07:41 16:36	
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	05:32 21:09	05:10 21:39	06:31-06:46/15	06:14 20:40		07:02 19:33	07:50 18:27	07:42 16:34	
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:10 21:40	06:30-06:46/16	06:16 20:38		07:04 19:31	07:52 18:25	07:44 16:33	
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	05:29 21:12	05:10 21:40	06:29-06:47/18	06:17 20:36		07:05 19:29	07:53 18:23	07:46 16:32	
21	08:15 16:55	07:26 17:50	06:26 18:37	06:19 20:27	05:28 21:13	05:10 21:40	06:29-06:47/18	06:19 20:34		07:07 19:26	07:55 18:21	07:47 16:31	
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15	05:10 21:41	06:29-06:48/19	06:21 20:32		07:08 19:24	07:57 18:19	07:49 16:30	
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 21:41	06:29-06:49/20	06:22 20:30		07:10 19:22	07:58 18:17	07:50 16:29	
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:11 21:41	06:28-06:49/21	06:24 20:28		07:11 19:19	08:00 18:15	07:52 16:28	
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18	05:11 21:41	06:28-06:49/21	06:25 20:26		07:13 19:17	07:02 17:13	07:54 16:27	
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	05:12 21:41	06:28-06:50/22	06:27 20:24		07:15 19:15	07:03 17:11	07:55 16:26	
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 21:41	06:28-06:49/21	06:28 20:21		07:16 19:13	07:05 17:09	07:57 16:25	
28	08:06 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	05:13 21:41	06:28-06:49/21	06:30 20:19		07:18 19:11	07:07 17:08	07:58 16:24	
29	08:05 17:09		07:09 19:50	06:03 20:40	05:19 21:23	05:13 21:41	06:29-06:49/20	06:31 20:17		07:19 19:08	07:09 17:06	08:00 16:24	
30	08:04 17:11		07:06 19:52	06:01 20:42	05:18 21:24	05:14 21:40	06:29-06:49/20	06:33 20:15		07:21 19:06	07:10 17:04	08:01 16:23	
31	08:02 17:12		07:04 19:53		05:17 21:26		06:29-06:48/19	06:34 20:13		07:12 17:02		08:26 16:27	
Sonnenscheinstunden	264	280	367	414	480	492	496	450		380	333	271	250
Anzahl Minuten mit Schatten	0	0	0	0	382	0	307	72		0	0	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
--------------	-----------------------	-------------------------	-------------------	----------------------------------	-----------------------------------

Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 12 - ANBONUS AN 1MW / 54 1000-200 54.0 !O! NH: 70,0 m (Ges:97,0 m) (11)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
1,28	2,77	3,62	5,55	6,87	6,24	7,46	6,68	4,78	2,83	1,59	1,12

Betriebsdauer je Sektor

N	NNO	ONO	O	OSO	SSO	S	SSW	WSW	W	WNW	NNW	Summe
472	434	438	443	336	762	458	1.263	1.455	697	282	197	7.238

Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Jun
1	08:26 16:28	08:01 17:14	07:10 18:03	07:02 19:55	06:00 20:43	05:17 21:27
2	08:26 16:29	07:59 17:16	07:08 18:05	07:00 19:56	05:58 20:45	05:16 21:28
3	08:26 16:30	07:58 17:18	07:06 18:07	06:57 19:58	05:56 20:46	05:15 21:29
4	08:26 16:31	07:56 17:19	07:04 18:09	06:55 20:00	05:54 20:48	05:14 21:30
5	08:25 16:33	07:55 17:21	07:01 18:10	06:53 20:01	07:42-07:52/10 20:50	05:14 21:31
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 20:03	07:39-07:54/15 20:51	05:13 21:32
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 20:05	07:38-07:55/17 20:53	05:13 21:33
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 20:06	07:37-07:56/19 20:54	05:12 21:33
9	08:24 16:38	07:48 17:28	06:53 18:17	06:44 20:08	07:35-07:55/20 20:56	05:12 21:34
10	08:23 16:39	07:47 17:30	06:51 18:19	06:42 20:09	07:34-07:55/21 20:57	05:11 21:35
11	08:23 16:40	07:45 17:32	06:48 18:20	06:40 20:11	07:34-07:55/21 20:59	05:11 21:36
12	08:22 16:42	07:43 17:34	06:46 18:22	06:38 20:13	07:34-07:55/21 21:00	05:11 21:36
13	08:22 16:43	07:41 17:35	06:44 18:24	06:36 20:14	07:34-07:55/21 21:02	05:10 21:37
14	08:21 16:45	07:39 17:37	06:42 18:25	06:34 20:16	07:34-07:54/20 21:03	05:10 21:38
15	08:20 16:46	07:38 17:39	06:40 18:27	06:31 20:18	07:34-07:53/19 21:05	05:10 21:38
16	08:19 16:48	07:36 17:41	06:37 18:29	06:29 20:19	07:35-07:52/17 21:06	05:10 21:39
17	08:19 16:49	07:34 17:43	06:35 18:30	06:27 20:21	07:36-07:50/14 21:08	05:10 21:39
18	08:18 16:51	07:32 17:44	06:33 18:32	06:25 20:22	07:38-07:48/10 21:09	05:10 21:39
19	08:17 16:52	07:30 17:46	06:31 18:34	06:23 20:24	05:31 21:10	05:10 21:40
20	08:16 16:54	07:28 17:48	06:29 18:35	06:21 20:26	05:29 21:12	05:10 21:40
21	08:15 16:55	07:26 17:50	06:26 18:37	06:19 20:27	05:28 21:13	05:10 21:40
22	08:14 16:57	07:24 17:51	06:24 18:39	06:17 20:29	05:27 21:15	05:10 21:41
23	08:13 16:59	07:22 17:53	06:22 18:40	06:15 20:30	05:26 21:16	05:11 21:41
24	08:11 17:00	07:20 17:55	06:20 18:42	06:13 20:32	05:24 21:17	05:11 21:41
25	08:10 17:02	07:18 17:57	06:17 18:43	06:11 20:34	05:23 21:18	05:11 21:41
26	08:09 17:04	07:16 17:58	06:15 18:45	06:09 20:35	05:22 21:20	05:12 21:41
27	08:08 17:05	07:14 18:00	06:13 18:47	06:07 20:37	05:21 21:21	05:12 21:41
28	08:07 17:07	07:12 18:02	06:11 18:48	06:05 20:38	05:20 21:22	06:12-06:16/4 21:41
29	08:05 17:09		07:09 19:50	06:03 20:40	05:19 21:23	06:09-06:18/9 21:41
30	08:04 17:11		07:06 19:52	06:01 20:42	05:18 21:25	06:09-06:20/11 21:40
31	08:02 17:12		07:04 19:53		05:17 21:26	06:08-06:21/13 21:40
Sonnenscheinstunden	264	280	367	414	480	492
Anzahl Minuten mit Schatten	0	0	0	245	37	593

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
			Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
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DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 12 - ANBONUS AN 1MW / 54 1000-200 54.0 !O! NH: 70,0 m (Ges:97,0 m) (11)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

| Juli | August | September | Oktober | November | Dezember

1	05:14 21:40	06:11-06:31/20 21:10	05:49 21:09	06:36 20:11	07:33-07:54/21 20:11	07:22 19:04	07:14 17:00	08:02 16:22
2	05:15 21:40	06:10-06:30/20 21:09	05:50 21:09	06:38 20:09	07:33-07:54/21 20:09	07:24 19:02	07:15 16:58	08:04 16:22
3	05:16 21:40	06:11-06:31/20 21:07	05:52 21:07	06:39 20:06	07:33-07:53/20 20:06	07:26 18:59	07:17 16:57	08:05 16:21
4	05:16 21:39	06:12-06:31/19 21:05	05:53 21:05	06:41 20:04	07:34-07:53/19 20:04	07:27 18:57	07:19 16:55	08:06 16:20
5	05:17 21:39	06:11-06:30/19 21:04	05:55 21:04	06:42 20:02	07:34-07:51/17 20:02	07:29 18:55	07:21 16:53	08:08 16:20
6	05:18 21:38	06:12-06:31/19 21:02	05:56 21:02	06:44 20:00	07:35-07:50/15 20:00	07:30 18:53	07:22 16:52	08:09 16:20
7	05:19 21:38	06:12-06:31/19 21:00	05:58 21:00	06:45 19:58	07:37-07:47/10 19:58	07:32 18:51	07:24 16:50	08:10 16:19
8	05:20 21:37	06:13-06:31/18 20:59	05:59 20:59	06:47 19:55	07:37-07:47/10 19:55	07:34 18:48	07:26 16:48	08:11 16:19
9	05:20 21:37	06:14-06:31/17 20:57	06:01 20:57	06:48 19:53	07:37-07:47/10 19:53	07:35 18:46	07:27 16:47	08:13 16:19
10	05:21 21:36	06:14-06:30/16 20:55	06:02 20:55	06:50 19:51	07:37-07:47/10 19:51	07:37 18:44	07:29 16:45	08:14 16:18
11	05:22 21:35	06:15-06:30/15 20:53	06:04 20:53	06:51 19:49	07:37-07:47/10 19:49	07:39 18:42	07:31 16:44	08:15 16:18
12	05:23 21:34	06:16-06:30/14 20:51	06:05 20:51	06:53 19:47	07:37-07:47/10 19:47	07:40 18:40	07:32 16:42	08:16 16:18
13	05:24 21:34	06:17-06:29/12 20:50	06:07 20:50	06:54 19:44	07:37-07:47/10 19:44	07:42 18:38	07:34 16:41	08:17 16:18
14	05:26 21:33	06:18-06:28/10 20:48	06:08 20:48	06:56 19:42	07:37-07:47/10 19:42	07:43 18:36	07:36 16:40	08:18 16:18
15	05:27 21:32	06:20-06:26/6 20:46	06:10 20:46	06:58 19:40	07:37-07:47/10 19:40	07:45 18:33	07:38 16:38	08:18 16:18
16	05:28 21:31	06:11 20:44	06:11 20:44	06:59 19:38	07:37-07:47/10 19:38	07:47 18:31	07:39 16:37	08:19 16:18
17	05:29 21:30	06:13 20:42	06:13 20:42	07:01 19:35	07:37-07:47/10 19:35	07:48 18:29	07:41 16:36	08:20 16:19
18	05:30 21:29	06:14 20:40	06:14 20:40	07:02 19:33	07:37-07:47/10 19:33	07:50 18:27	07:43 16:34	08:21 16:19
19	05:31 21:28	06:16 20:38	06:16 20:38	07:04 19:31	07:37-07:47/10 19:31	07:52 18:25	07:44 16:33	08:22 16:19
20	05:33 21:27	06:17 20:36	06:17 20:36	07:05 19:29	07:37-07:47/10 19:29	07:53 18:23	07:46 16:32	08:22 16:20
21	05:34 21:25	06:19 20:34	06:19 20:34	07:07 19:26	07:37-07:47/10 19:26	07:55 18:21	07:47 16:31	08:23 16:20
22	05:35 21:24	06:21 20:32	06:21 20:32	07:08 19:24	07:37-07:47/10 19:24	07:57 18:19	07:49 16:30	08:23 16:20
23	05:36 21:23	06:22 20:30	06:22 20:30	07:10 19:22	07:37-07:47/10 19:22	07:58 18:17	07:51 16:29	08:24 16:21
24	05:38 21:22	06:24 20:28	06:24 20:28	07:11 19:20	07:37-07:47/10 19:20	08:00 18:15	07:52 16:28	08:24 16:22
25	05:39 21:20	06:25 07:41-07:51/10 20:26	06:25 07:41-07:51/10 20:26	07:13 19:17	07:37-07:47/10 19:17	07:02 17:13	07:54 16:27	08:25 16:22
26	05:40 21:19	06:27 07:39-07:53/14 20:24	06:27 07:39-07:53/14 20:24	07:15 19:15	07:37-07:47/10 19:15	07:03 17:11	07:55 16:26	08:25 16:23
27	05:42 21:18	06:28 07:37-07:54/17 20:22	06:28 07:37-07:54/17 20:22	07:16 19:13	07:37-07:47/10 19:13	07:05 17:09	07:57 16:25	08:25 16:24
28	05:43 21:16	06:30 07:35-07:54/19 20:19	06:30 07:35-07:54/19 20:19	07:18 19:11	07:37-07:47/10 19:11	07:07 17:08	07:58 16:24	08:25 16:24
29	05:45 21:15	06:31 07:35-07:55/20 20:17	06:31 07:35-07:55/20 20:17	07:19 19:08	07:37-07:47/10 19:08	07:09 17:06	08:00 16:23	08:26 16:25
30	05:46 21:13	06:33 07:34-07:55/21 20:15	06:33 07:34-07:55/21 20:15	07:21 19:06	07:37-07:47/10 19:06	07:10 17:04	08:01 16:23	08:26 16:26
31	05:47 21:12	06:34 07:34-07:55/21 20:13	06:34 07:34-07:55/21 20:13	07:21 19:02	07:37-07:47/10 19:02	07:12 17:02	08:01 16:23	08:26 16:27
Sonnenscheinstunden	496	450	380	333	270	250	0	0
Anzahl Minuten mit Schatten	244	122	123	0	0	0	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
			Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:

SW19001 Zell

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
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- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 13 - ANBONUS AN 600kW / 44-3 600-120 44.0 !O! NH: 58,0 m (Ges:80,0 m) (12)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

Table with columns for months (Januar to Dezember) and rows for each day of the year (1-31), showing sunrise/sunset times and shadow cast durations.

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Table with 6 columns: Tag im Monat, Sonnenaufgang (SS:MM), Sonnenuntergang (SS:MM), Zeitpunkt (SS:MM), Schattenanfang-Zeitpunkt (SS:MM), Schattenende/Minuten mit Schatten.



Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 14 - ANBONUS AN 150 150-30 23.0 !O! NH: 30,0 m (Ges:41,5 m) (22)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember
1	08:26	08:01	07:10	07:02	06:00	05:17	05:14	05:49	06:36	07:22	07:14	08:02
	16:28	17:14	18:04	19:55	20:43	21:27	21:40	21:10	20:11	19:04	17:00	16:22
2	08:26	07:59	07:08	07:00	05:58	05:16	05:15	05:50	06:38	07:24	07:15	08:04
	16:29	17:16	18:05	19:56	20:45	21:28	21:40	21:09	20:09	19:02	16:59	16:22
3	08:26	07:58	07:06	06:58	05:56	05:15	05:16	05:52	06:39	07:26	07:17	08:05
	16:31	17:18	18:07	19:58	20:46	21:29	21:40	21:07	20:06	18:59	16:57	16:21
4	08:25	07:56	07:04	06:55	05:54	05:15	05:16	05:53	06:41	07:27	07:19	08:06
	16:32	17:20	18:09	20:00	20:48	21:30	21:39	21:05	20:04	18:57	16:55	16:21
5	08:25	07:55	07:01	06:53	05:53	05:14	05:17	05:55	06:42	07:29	07:21	08:08
	16:33	17:21	18:10	20:01	20:49	21:31	21:39	21:04	20:02	18:55	16:53	16:20
6	08:25	07:53	06:59	06:51	05:51	05:13	05:18	05:56	06:44	07:30	07:22	08:09
	16:34	17:23	18:12	20:03	20:51	21:32	21:38	21:02	20:00	18:53	16:52	16:20
7	08:25	07:52	06:57	06:49	05:49	05:13	05:19	05:58	06:45	07:32	07:24	08:10
	16:35	17:25	18:14	20:05	20:53	21:32	21:38	21:00	19:58	18:51	16:50	16:19
8	08:24	07:50	06:55	06:47	05:47	05:12	05:20	05:59	06:47	07:34	07:26	08:11
	16:36	17:27	18:15	20:06	20:54	21:33	21:37	20:59	19:55	18:48	16:49	16:19
9	08:24	07:48	06:53	06:44	05:46	05:12	05:21	06:01	06:48	07:35	07:27	08:12
	16:38	17:28	18:17	20:08	20:56	21:34	21:36	20:57	19:53	18:46	16:47	16:19
10	08:23	07:47	06:51	06:42	05:44	05:11	05:22	06:02	06:50	07:37	07:29	08:14
	16:39	17:30	18:19	20:09	20:57	21:35	21:36	20:55	19:51	18:44	16:46	16:19
11	08:23	07:45	06:49	06:40	05:42	05:11	05:23	06:04	06:51	07:39	07:31	08:15
	16:40	17:32	18:20	20:11	20:59	21:36	21:35	20:53	19:49	18:42	16:44	16:18
12	08:22	07:43	06:46	06:38	05:41	05:11	05:24	06:05	06:53	07:40	07:32	08:16
	16:42	17:34	18:22	20:13	21:00	21:36	21:34	20:51	19:47	18:40	16:43	16:18
13	08:22	07:41	06:44	06:36	05:39	05:11	05:25	06:07	06:55	07:42	07:34	08:17
	16:43	17:36	18:24	20:14	21:02	21:37	21:33	20:50	19:44	18:38	16:41	16:18
14	08:21	07:39	06:42	06:34	05:38	05:10	05:26	06:08	06:56	07:43	07:36	08:17
	16:45	17:37	18:25	20:16	21:03	21:37	21:33	20:48	19:42	18:36	16:40	16:18
15	08:20	07:38	06:40	06:32	05:36	05:10	05:27	06:10	06:58	07:45	07:37	08:18
	16:46	17:39	18:27	20:17	21:05	21:38	21:32	20:46	19:40	18:34	16:38	16:19
16	08:19	07:36	06:38	06:29	05:35	05:10	05:28	06:11	06:59	07:47	07:39	08:19
	16:48	17:41	18:29	20:19	21:06	21:38	21:31	20:44	19:38	18:31	16:37	16:19
17	08:19	07:34	06:35	06:27	05:34	05:10	05:29	06:13	07:01	07:48	07:41	08:20
	16:49	17:43	18:30	20:21	21:08	21:39	21:30	20:42	19:35	18:29	16:36	16:19
18	08:18	07:32	06:33	06:25	05:32	05:10	05:30	06:14	07:02	07:50	07:42	08:21
	16:51	17:44	18:32	20:22	21:09	21:39	21:29	20:40	19:33	18:27	16:35	16:19
19	08:17	07:30	06:31	06:23	05:31	05:10	05:31	06:16	07:04	07:52	07:44	08:21
	16:52	17:46	18:34	20:24	21:10	21:40	21:28	20:38	19:31	18:25	16:33	16:19
20	08:16	07:28	06:29	06:21	05:29	05:10	05:33	06:18	07:05	07:53	07:46	08:22
	16:54	17:48	18:35	20:26	21:12	21:40	21:27	20:36	19:29	18:23	16:32	16:20
21	08:15	07:26	06:26	06:19	05:28	05:10	05:34	06:19	07:07	07:55	07:47	08:23
	16:56	17:50	18:37	20:27	21:13	21:40	21:25	20:34	19:26	18:21	16:31	16:20
22	08:14	07:24	06:24	06:17	05:27	05:11	05:35	06:21	07:08	07:57	07:49	08:23
	16:57	17:51	18:39	20:29	21:14	21:40	21:24	20:32	19:24	18:19	16:30	16:21
23	08:13	07:22	06:22	06:15	05:26	05:11	05:37	06:22	07:10	07:58	07:50	08:24
	16:59	17:53	18:40	20:30	21:16	21:41	21:23	20:30	19:22	18:17	16:29	16:21
24	08:11	07:20	06:20	06:13	05:25	05:11	05:38	06:24	07:12	08:00	07:52	08:24
	17:01	17:55	18:42	20:32	21:17	21:41	21:22	20:28	19:20	18:15	16:28	16:22
25	08:10	07:18	06:17	06:11	05:23	05:11	05:39	06:25	07:13	07:02	07:54	08:25
	17:02	17:57	18:43	20:34	21:18	21:41	21:20	20:26	19:17	17:13	16:27	16:22
26	08:09	07:16	06:15	06:09	05:22	05:12	05:41	06:27	07:15	07:03	07:55	08:25
	17:04	17:58	18:45	20:35	21:20	21:41	21:19	20:24	19:15	17:11	16:26	16:23
27	08:08	07:14	06:13	06:07	05:21	05:12	05:42	06:28	07:16	07:05	07:57	08:25
	17:06	18:00	18:47	20:37	21:21	21:41	21:18	20:22	19:13	17:10	16:25	16:24
28	08:06	07:12	06:11	06:05	05:20	05:13	05:43	06:30	07:18	07:07	07:58	08:25
	17:07	18:02	18:48	20:38	21:22	21:41	21:16	20:19	19:11	17:08	16:24	16:25
29	08:05		07:09	06:03	05:19	05:13	05:45	06:31	07:19	07:09	08:00	08:26
	17:09		19:50	20:40	21:23	21:41	21:15	20:17	19:08	17:06	16:24	16:25
30	08:04		07:06	06:02	05:18	05:14	05:46	06:33	07:21	07:10	08:01	08:26
	17:11		19:52	20:42	21:24	21:40	21:13	20:15	19:06	17:04	16:23	16:26
31	08:02		07:04		05:18		05:48	06:35		07:12		08:26
	17:13		19:53		21:26		21:12	20:13		17:02		16:27
Sonnenscheinstunden	264	280	367	414	480	492	496	450	380	333	271	250
Anzahl Minuten mit Schatten	0	0	0	0	0	0	0	0	0	0	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
--------------	-----------------------	-------------------------	-------------------	----------------------------------	-----------------------------------

Projekt:
SW19001 Zell

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: 15 - ANBONUS AN 300kW 300 33.0 !O! NH: 40,0 m (Ges:56,5 m) (23)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	Juli	August	September	Oktober	November	Dezember
1	08:26	08:01	07:10	07:02	06:00	05:17	05:14	05:49	06:36	07:22	07:14	08:02
	16:28	17:14	18:04	19:55	20:43	21:27	21:40	21:10	20:11	19:04	17:00	16:22
2	08:26	07:59	07:08	07:00	05:58	05:16	05:15	05:50	06:38	07:24	07:15	08:04
	16:29	17:16	18:05	19:56	20:45	21:28	21:40	21:09	20:09	19:02	16:59	16:22
3	08:26	07:58	07:06	06:57	05:56	05:15	05:16	05:52	06:39	07:26	07:17	08:05
	16:31	17:18	18:07	19:58	20:46	21:29	21:40	21:07	20:06	18:59	16:57	16:21
4	08:25	07:56	07:04	06:55	05:54	05:15	05:16	05:53	06:41	07:27	07:19	08:06
	16:32	17:20	18:09	20:00	20:48	21:30	21:39	21:05	20:04	18:57	16:55	16:21
5	08:25	07:55	07:01	06:53	05:53	05:14	05:17	05:55	06:42	07:29	07:21	08:08
	16:33	17:21	18:10	20:01	20:49	21:31	21:39	21:04	20:02	18:55	16:53	16:20
6	08:25	07:53	06:59	06:51	05:51	05:13	05:18	05:56	06:44	07:30	07:22	08:09
	16:34	17:23	18:12	20:03	20:51	21:32	21:38	21:02	20:00	18:53	16:52	16:20
7	08:25	07:52	06:57	06:49	05:49	05:13	05:19	05:58	06:45	07:32	07:24	08:10
	16:35	17:25	18:14	20:05	20:53	21:32	21:38	21:00	19:58	18:51	16:50	16:19
8	08:24	07:50	06:55	06:47	05:47	05:12	05:20	05:59	06:47	07:34	07:26	08:11
	16:36	17:27	18:15	20:06	20:54	21:33	21:37	20:59	19:55	18:48	16:49	16:19
9	08:24	07:48	06:53	06:44	05:46	05:12	05:21	06:01	06:48	07:35	07:27	08:12
	16:38	17:28	18:17	20:08	20:56	21:34	21:36	20:57	19:53	18:46	16:47	16:19
10	08:23	07:47	06:51	06:42	05:44	05:11	05:22	06:02	06:50	07:37	07:29	08:14
	16:39	17:30	18:19	20:09	20:57	21:35	21:36	20:55	19:51	18:44	16:46	16:19
11	08:23	07:45	06:49	06:40	05:42	05:11	05:23	06:04	06:51	07:39	07:31	08:15
	16:40	17:32	18:20	20:11	20:59	21:36	21:35	20:53	19:49	18:42	16:44	16:18
12	08:22	07:43	06:46	06:38	05:41	05:11	05:24	06:05	06:53	07:40	07:32	08:16
	16:42	17:34	18:22	20:13	21:00	21:36	21:34	20:51	19:47	18:40	16:43	16:18
13	08:22	07:41	06:44	06:36	05:39	05:11	05:25	06:07	06:55	07:42	07:34	08:17
	16:43	17:36	18:24	20:14	21:02	21:37	21:33	20:50	19:44	18:38	16:41	16:18
14	08:21	07:39	06:42	06:34	05:38	05:10	05:26	06:08	06:56	07:43	07:36	08:17
	16:45	17:37	18:25	20:16	21:03	21:37	21:33	20:48	19:42	18:36	16:40	16:18
15	08:20	07:38	06:40	06:32	05:36	05:10	05:27	06:10	06:58	07:45	07:37	08:18
	16:46	17:39	18:27	20:17	21:05	21:38	21:32	20:46	19:40	18:34	16:38	16:19
16	08:19	07:36	06:38	06:29	05:35	05:10	05:28	06:11	06:59	07:47	07:39	08:19
	16:48	17:41	18:29	20:19	21:06	21:38	21:31	20:44	19:38	18:31	16:37	16:19
17	08:19	07:34	06:35	06:27	05:34	05:10	05:29	06:13	07:01	07:48	07:41	08:20
	16:49	17:43	18:30	20:21	21:08	21:39	21:30	20:42	19:35	18:29	16:36	16:19
18	08:18	07:32	06:33	06:25	05:32	05:10	05:30	06:14	07:02	07:50	07:42	08:21
	16:51	17:44	18:32	20:22	21:09	21:39	21:29	20:40	19:33	18:27	16:35	16:19
19	08:17	07:30	06:31	06:23	05:31	05:10	05:31	06:16	07:04	07:52	07:44	08:21
	16:52	17:46	18:34	20:24	21:10	21:40	21:28	20:38	19:31	18:25	16:33	16:19
20	08:16	07:28	06:29	06:21	05:29	05:10	05:33	06:18	07:05	07:53	07:46	08:22
	16:54	17:48	18:35	20:26	21:12	21:40	21:27	20:36	19:29	18:23	16:32	16:20
21	08:15	07:26	06:26	06:19	05:28	05:10	05:34	06:19	07:07	07:55	07:47	08:23
	16:56	17:50	18:37	20:27	21:13	21:40	21:25	20:34	19:26	18:21	16:31	16:20
22	08:14	07:24	06:24	06:17	05:27	05:11	05:35	06:21	07:08	07:57	07:49	08:23
	16:57	17:51	18:39	20:29	21:14	21:40	21:24	20:32	19:24	18:19	16:30	16:21
23	08:13	07:22	06:22	06:15	05:26	05:11	05:37	06:22	07:10	07:58	07:50	08:24
	16:59	17:53	18:40	20:30	21:16	21:41	21:23	20:30	19:22	18:17	16:29	16:21
24	08:11	07:20	06:20	06:13	05:25	05:11	05:38	06:24	07:12	08:00	07:52	08:24
	17:01	17:55	18:42	20:32	21:17	21:41	21:22	20:28	19:20	18:15	16:28	16:22
25	08:10	07:18	06:17	06:11	05:23	05:11	05:39	06:25	07:13	07:02	07:54	08:25
	17:02	17:57	18:43	20:34	21:18	21:41	21:20	20:26	19:17	17:13	16:27	16:22
26	08:09	07:16	06:15	06:09	05:22	05:12	05:41	06:27	07:15	07:03	07:55	08:25
	17:04	17:58	18:45	20:35	21:20	21:41	21:19	20:24	19:15	17:11	16:26	16:23
27	08:08	07:14	06:13	06:07	05:21	05:12	05:42	06:28	07:16	07:05	07:57	08:25
	17:06	18:00	18:47	20:37	21:21	21:41	21:18	20:22	19:13	17:10	16:25	16:24
28	08:06	07:12	06:11	06:05	05:20	05:13	05:43	06:30	07:18	07:07	07:58	08:25
	17:07	18:02	18:48	20:38	21:22	21:41	21:16	20:19	19:11	17:08	16:24	16:25
29	08:05		07:09	06:03	05:19	05:13	05:45	06:31	07:19	07:09	08:00	08:26
	17:09		19:50	20:40	21:23	21:41	21:15	20:17	19:08	17:06	16:24	16:25
30	08:04		07:06	06:02	05:18	05:14	05:46	06:33	07:21	07:10	08:01	08:26
	17:11		19:52	20:42	21:24	21:40	21:13	20:15	19:06	17:04	16:23	16:26
31	08:02		07:04		05:18		05:48	06:35		07:12		08:26
	17:13		19:53		21:26		21:12	20:13		17:02		16:27
Sonnenscheinstunden	264	280	367	414	480	492	496	450	380	333	271	250
Anzahl Minuten mit Schatten	0	0	0	0	0	0	0	0	0	0	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
--------------	-----------------------	-------------------------	-------------------	----------------------------------	-----------------------------------

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 16 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (40)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni	
1	08:26 09:04-09:28/24 16:28	08:01 17:14	07:10 07:58-08:15/17 18:03	07:02 19:10-19:30/20 19:55	06:00 20:08-20:15/7 20:43 06:32-06:45/13	05:17 05:57-06:32/35 21:27	
2	08:26 09:05-09:29/24 16:29	07:59 17:16	07:08 07:56-08:17/21 18:05	07:00 19:10-19:32/22 19:56	05:58 20:06-20:16/10 20:45 06:31-06:47/16	05:16 05:57-06:32/35 21:28	
3	08:26 09:04-09:28/24 16:30	07:58 17:18	07:06 07:54-08:17/23 18:07	06:57 19:10-19:32/22 19:58	05:56 20:06-20:18/12 20:46 06:30-06:47/17	05:15 05:56-06:31/35 21:29	
4	08:25 09:05-09:29/24 16:32	07:56 17:19	07:04 07:53-08:18/25 18:09	06:55 19:11-19:32/21 20:00	05:54 20:05-20:19/14 20:48 06:29-06:47/18	05:14 05:55-06:30/35 21:30	
5	08:25 09:05-09:29/24 16:33	07:55 17:21	07:01 07:52-08:18/26 18:10	06:53 19:13-19:32/19 20:01	05:52 20:04-20:21/17 20:49 06:26-06:48/22	05:14 05:55-06:29/34 21:31	
6	08:25 09:00-09:28/28 16:34	07:53 17:23	06:59 07:52-08:19/27 18:12	06:51 19:16-19:32/16 20:03	05:51 20:05-20:22/17 20:51 06:24-06:48/24	05:13 05:54-06:28/34 21:32	
7	08:25 09:00-09:28/28 16:35	07:52 17:25	06:57 07:52-08:19/27 18:14	06:49 19:16-19:31/15 20:05 07:19-07:24/5	05:49 20:04-20:24/20 20:53 06:22-06:47/25	05:13 05:54-06:29/35 21:32	
8	08:24 09:22-09:27/5 16:36	07:50 17:27	06:55 07:50-08:18/28 18:15	06:46 19:16-19:29/13 20:06 07:16-07:27/11	05:47 20:05-20:26/21 20:54 06:22-06:47/25	05:12 05:54-06:29/35 21:33	
9	08:24 08:59-09:22/23 16:38	07:48 17:28	06:53 07:51-08:18/27 18:17	06:44 19:40-19:42/2 07:14-07:28/14 20:08 19:17-19:27/10	05:46 20:05-20:27/22 20:56 06:21-06:47/26	05:12 05:54-06:28/34 21:34	
10	08:23 08:59-09:23/24 16:39	07:46 17:30	06:51 17:46-17:54/8 18:19 07:51-08:17/26	06:42 19:38-19:43/5 07:12-07:28/16 20:09 19:21-19:23/2 07:06-07:11/5	05:44 20:06-20:28/22 20:57 06:21-06:47/26	05:11 05:54-06:29/35 21:35	
11	08:23 08:58-09:23/25 16:40	07:45 17:32	06:48 17:44-17:56/12 18:20 07:51-08:17/26	06:40 19:37-19:45/8 20:11 07:03-07:29/26	05:42 20:08-20:29/21 20:59 06:20-06:46/26	05:11 05:54-06:29/35 21:36	
12	08:22 08:59-09:24/25 16:42	07:43 17:34	06:46 17:42-17:56/14 18:22 07:52-08:16/24	06:38 19:36-19:47/11 20:13 07:02-07:29/27	05:41 20:10-20:30/20 21:00 06:18-06:45/27	05:11 05:53-06:28/35 21:36	
13	08:22 08:59-09:24/25 16:43	07:41 17:35	06:44 17:42-17:56/14 18:24 07:52-08:14/22	06:36 19:35-19:48/13 20:14 07:01-07:29/28	05:39 20:11-20:30/19 21:02 06:17-06:44/27	05:10 05:53-06:28/35 21:37	
14	08:21 08:59-09:24/25 16:45	07:39 17:37	06:42 17:42-17:56/14 18:25 07:53-08:12/19	06:34 19:35-19:50/15 20:16 07:00-07:28/28	05:38 20:12-20:31/19 21:03 06:16-06:43/27	05:10 05:54-06:28/34 21:37	
15	08:20 08:59-09:24/25 16:46	07:38 17:39	06:40 17:42-17:56/14 18:27 07:55-08:10/15	06:31 19:35-19:49/14 20:17 06:59-07:28/29	05:36 20:13-20:30/17 21:05 06:16-06:41/25	05:10 05:54-06:28/34 21:38	
16	08:19 08:59-09:24/25 16:48	07:36 17:41	06:37 17:56-18:04/8 07:59-08:06/7 18:29 17:43-17:55/12	06:29 19:36-19:48/12 20:19 06:59-07:27/28	05:35 20:14-20:30/16 21:06 06:14-06:38/24	05:10 05:54-06:28/34 21:38	
17	08:18 08:59-09:24/25 16:49	07:34 17:43	06:35 17:43-18:05/22 18:30	06:27 19:36-19:47/11 20:21 07:00-07:26/26	05:33 20:16-20:30/14 21:08 06:12-06:38/26	05:10 05:54-06:28/34 21:39	
18	08:18 09:00-09:24/24 16:51	07:32 17:44	06:33 17:53-18:06/13 18:32 17:45-17:51/6	06:25 19:38-19:45/7 20:22 07:00-07:24/24	05:32 20:17-20:30/13 21:09 06:11-06:37/26	05:10 05:54-06:29/35 21:39	
19	08:17 09:00-09:24/24 16:52	07:30 17:18-17:19/1 17:46	06:31 17:52-18:06/14 18:34	06:23 07:15-07:21/6 20:24 07:01-07:12/11	05:31 20:18-20:29/11 21:10 06:10-06:37/27	05:10 05:54-06:29/35 21:40	
20	08:16 09:01-09:23/22 16:54	07:28 17:15-17:21/6 17:48	06:29 17:52-18:06/14 18:35	06:21 07:02-07:10/8 20:26	05:29 20:19-20:28/9 21:12 06:08-06:35/27	05:10 05:54-06:29/35 21:40	
21	08:15 09:02-09:22/20 16:55	07:26 17:14-17:23/9 17:50	06:26 17:51-18:05/14 18:37	06:19 20:27	05:28 20:21-20:27/6 21:13 06:08-06:35/27	05:10 05:55-06:30/35 21:40	
22	08:14 09:02-09:16/14 16:57	07:24 17:13-17:25/12 17:51	06:24 17:52-18:04/12 18:39	06:17 20:29	05:27 06:07-06:35/28 21:14	05:10 05:55-06:30/35 21:40	
23	08:13 09:03-09:15/12 16:59	07:22 17:13-17:27/14 17:53	06:22 17:53-18:03/10 18:40	06:15 20:30	05:26 06:04-06:35/31 21:16	05:11 05:55-06:30/35 21:41	
24	08:11 09:05-09:15/10 17:00	07:20 17:13-17:28/15 17:55	06:20 17:55-18:00/5 18:42	06:13 20:32	05:24 06:03-06:35/32 21:17	05:11 05:55-06:30/35 21:41	
25	08:10 09:07-09:14/7 17:02	07:18 17:13-17:28/15 17:57	06:17 18:43	06:11 20:34	05:23 06:02-06:35/33 21:18	05:11 05:56-06:31/35 21:41	
26	08:09 17:04	07:16 17:13-17:27/14 17:58	06:15 18:45	06:09 20:35	05:22 06:01-06:35/34 21:20	05:12 05:56-06:30/34 21:41	
27	08:08 17:05	07:14 17:14-17:26/12 18:00 08:04-08:09/5	06:13 18:15-18:22/7 18:47	06:07 20:37	05:21 06:00-06:34/34 21:21	05:12 05:57-06:31/34 21:41	
28	08:06 17:07	07:12 17:16-17:25/9 18:02 08:00-08:13/13	06:11 18:13-18:24/11 18:48	06:05 20:38	05:20 06:00-06:34/34 21:22	05:13 05:57-06:31/34 21:41	
29	08:05 17:09		07:09 19:11-19:24/13 19:50	06:03 06:38-06:40/2 20:40	05:19 05:59-06:33/34 21:23	05:13 05:58-06:32/34 21:41	
30	08:04 17:11		07:06 19:10-19:26/16 19:52	06:01 06:34-06:44/10 20:42	05:18 06:00-06:34/34 21:24	05:14 05:57-06:32/35 21:40	
31	08:02 17:12		07:04 19:10-19:28/18 19:53		05:18 05:59-06:33/34 21:26		
	Sonnenscheinstunden Anzahl Minuten mit Schatten	264 560	280 125	367 631	414 562	480 1156	492 1039

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
--------------	-----------------------	-------------------------	-------------------	----------------------------------	-----------------------------------

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 16 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (40)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember	
1	05:14 05:58-06:33/35 21:40	05:49 20:20-20:41/21 21:10 06:29-06:56/27	06:36 19:36-19:44/8 20:11 07:02-07:28/26	07:22 18:22-18:36/14 19:04 08:31-08:54/23	07:14 17:00	08:02 08:40-09:05/25 16:22	
2	05:15 05:58-06:33/35 21:40	05:50 20:17-20:39/22 21:09 06:30-06:56/26	06:38 19:37-19:42/5 20:09 19:20-19:23/3	07:11-07:27/16 07:24 18:22-18:34/12	07:15 16:58	08:04 08:42-09:06/24 16:22	
3	05:16 05:59-06:33/34 21:40	05:52 20:16-20:38/22 21:07 06:30-06:56/26	06:39 19:38-19:40/2 20:06 19:15-19:25/10	07:11-07:25/14 07:26 18:23-18:32/9	07:17 16:57	08:05 08:42-09:05/23 16:21	
4	05:16 05:59-06:34/35 21:39	05:53 20:15-20:36/21 21:05 06:31-06:57/26	06:41 19:14-19:27/13 20:04 07:13-07:24/11	07:27 18:25-18:31/6 18:57 08:29-08:55/26	07:19 16:55	08:06 09:07-09:12/5 16:20 08:44-09:06/22	
5	05:17 05:59-06:34/35 21:39	05:55 20:14-20:35/21 21:04 06:32-06:57/25	06:42 19:12-19:27/15 20:02 07:15-07:20/5	07:29 08:27-08:55/28 18:55	07:20 16:53	08:08 08:45-09:13/28 16:20	
6	05:18 06:00-06:34/34 21:38	05:56 20:14-20:33/19 21:02 06:33-06:58/25	06:44 19:12-19:28/16 20:00	07:30 08:27-08:55/28 18:53	07:22 16:52	08:09 08:46-09:14/28 16:20	
7	05:19 06:01-06:35/34 21:38	05:58 20:14-20:31/17 21:00 06:34-06:57/23	06:45 19:08-19:27/19 19:58	07:32 08:28-08:55/27 18:51	07:24 16:50	08:10 08:48-09:15/27 16:19	
8	05:20 06:02-06:37/35 21:37	05:59 20:14-20:30/16 20:59 06:35-06:56/21	06:47 19:06-19:28/22 19:55	07:34 08:27-08:54/27 18:48	07:26 16:48	08:11 08:53-09:17/24 16:19	
9	05:20 06:03-06:38/35 21:36	06:01 20:14-20:28/14 20:57 06:39-06:56/17	06:48 19:04-19:27/23 19:53	07:35 08:28-08:53/25 18:46	07:27 16:47	08:12 08:53-09:17/24 16:19	
10	05:21 06:04-06:39/35 21:36	06:02 20:14-20:26/12 20:55 06:39-06:55/16	06:50 19:04-19:25/21 19:51	07:37 08:28-08:53/25 18:44	07:29 16:45	08:13 08:54-09:18/24 16:19	
11	05:22 06:05-06:40/35 21:35	06:04 20:16-20:26/10 20:53 06:40-06:55/15	06:51 19:02-19:22/20 19:49	07:38 08:28-08:51/23 18:42	07:31 16:44	08:15 08:55-09:18/23 16:18	
12	05:23 06:07-06:41/34 21:34	06:05 20:17-20:23/6 20:51 06:41-06:53/12	06:53 19:02-19:21/19 19:46	07:40 08:30-08:49/19 18:40	07:32 16:42	08:16 08:55-09:19/24 16:18	
13	05:24 06:08-06:42/34 21:33	06:07 06:43-06:52/9 20:49	06:54 19:02-19:18/16 19:44	07:42 17:50-17:56/6 18:38 08:32-08:48/16	07:34 16:41	08:17 08:56-09:20/24 16:18	
14	05:26 06:08-06:43/35 21:33	06:08 20:48	06:56 19:02-19:16/14 19:42	07:43 17:47-17:58/11 18:36 08:33-08:44/11	07:36 16:40	08:17 08:57-09:20/23 16:18	
15	05:27 06:09-06:43/34 21:32	06:10 20:46	06:58 19:02-19:13/11 19:40	07:45 17:46-17:59/13 18:33	07:37 16:38	08:18 08:58-09:21/23 16:18	
16	05:28 06:09-06:44/35 21:31	06:11 20:44	06:59 19:04-19:12/8 19:38	07:47 17:45-18:00/15 18:31	07:39 16:37	08:19 08:59-09:22/23 16:19	
17	05:29 06:10-06:44/34 21:30	06:13 20:42	07:01 19:06-19:09/3 19:35	07:48 17:44-17:59/15 18:29	07:41 08:40-08:47/7 16:36	08:20 08:59-09:21/22 16:19	
18	05:30 06:11-06:44/33 21:29	06:14 20:40	07:02 19:33	07:50 17:44-17:59/15 18:27	07:42 08:39-08:49/10 16:34	08:21 09:00-09:22/22 16:19	
19	05:31 06:12-06:45/33 21:28	06:16 20:38	07:04 18:44-18:45/1 19:31	07:52 17:44-17:57/13 18:25	07:44 08:38-08:50/12 16:33	08:21 09:09-09:23/14 16:19	
20	05:33 06:13-06:45/32 21:27	06:17 20:36	07:05 18:40-18:49/9 19:28	07:53 17:45-17:56/11 18:23	07:46 08:37-08:51/14 16:32	08:22 09:01-09:23/22 16:20	
21	05:34 06:16-06:46/30 21:25	06:19 20:34	07:07 18:38-18:49/11 19:26	07:55 17:45-17:53/8 18:21	07:47 08:37-08:57/20 16:31	08:23 09:02-09:24/22 16:20	
22	05:35 20:32-20:37/5 21:24	06:21 06:18-06:46/28	07:08 18:37-18:50/13 19:24	07:57 17:46-17:51/5 18:19	07:49 08:37-08:59/22 16:30	08:23 09:02-09:24/22 16:21	
23	05:36 20:30-20:38/8 21:23	06:22 07:06-07:14/8 06:18-06:45/27	07:10 18:36-18:50/14 19:22	07:58 18:17	07:50 08:37-09:01/24 16:29	08:24 09:03-09:25/22 16:21	
24	05:38 20:29-20:39/10 21:22	06:24 07:18-07:25/7 06:19-06:46/27	07:11 18:36-18:50/14 19:19	08:00 18:15	07:52 08:37-09:01/24 16:28	08:24 09:11-09:25/14 16:22	
25	05:39 20:28-20:39/11 21:20	06:25 19:40-19:48/8 06:20-06:47/27	07:13 18:35-18:49/14 19:17	07:02 17:13	07:54 08:37-09:02/25 16:27	08:25 09:11-09:25/14 16:22	
26	05:40 20:27-20:41/14 21:19	06:27 19:38-19:49/11 06:22-06:48/26	07:15 18:36-18:48/12 19:15	07:03 17:11	07:55 08:38-09:03/25 16:26	08:25 09:04-09:26/22 16:23	
27	05:42 20:26-20:41/15 21:18	06:28 19:37-19:50/13 06:23-06:48/25	07:16 18:24-18:46/22 19:13	07:05 17:09	07:57 08:38-09:03/25 16:25	08:25 09:04-09:27/23 16:24	
28	05:43 20:25-20:41/16 21:16	06:30 19:36-19:50/14 06:25-06:48/23	07:18 18:39-18:43/4 19:10	07:07 17:08	07:58 08:39-09:04/25 16:24	08:25 09:04-09:27/23 16:24	
29	05:45 20:23-20:41/18 21:15	06:31 19:36-19:51/15 06:26-06:52/26	07:19 18:23-18:37/14 19:08	07:08 17:06	08:00 08:39-09:04/25 16:24	08:26 09:04-09:27/23 16:25	
30	05:46 20:22-20:41/19 21:13	06:33 19:35-19:48/13 06:27-06:54/27	07:21 18:22-18:36/14 19:06	07:10 17:04	08:01 08:40-09:05/25 16:23	08:26 09:04-09:28/24 16:26	
31	05:47 20:21-20:40/19 21:12	06:34 19:36-19:47/11 06:27-06:54/27	07:23 18:22-18:36/14 19:06	07:12 17:02	08:02 08:40-09:05/25 16:23	08:26 09:04-09:28/24 16:27	
	Sonnenscheinstunden Anzahl Minuten mit Schatten	496 1114	450 772	380 546	333 482	271 283	250 728

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 17 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (41)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 17:14-17:31/17 18:03 07:38-07:48/10	07:02 19:16-19:27/11 19:55 07:37-08:09/32	06:00 20:43	05:17 21:27
2	08:26 16:29	07:59 17:16	07:08 17:15-17:30/15 18:05 07:37-07:49/12	07:00 19:15-19:28/13 19:56 07:36-08:07/31	05:58 20:45	05:16 21:28
3	08:26 16:30	07:58 17:18	07:06 17:16-17:29/13 18:07 07:34-07:49/15	06:57 19:14-19:28/14 19:58 07:33-08:04/31	05:56 20:46	05:15 21:29
4	08:25 16:32	07:56 17:19	07:04 17:18-17:27/9 18:09 07:34-07:50/16	06:55 19:13-19:31/18 20:00 07:32-08:02/30	05:54 20:48	05:15 21:30
5	08:25 16:33	09:11-09:16/5 07:55 17:21	07:01 07:33-07:50/17 18:10	06:53 19:13-19:33/20 20:01 07:31-08:01/30	05:52 20:49	05:14 21:31
6	08:25 16:34	09:10-09:18/8 07:53 16:53-16:55/2 17:23	06:59 07:33-07:50/17 18:12	06:51 19:14-19:35/21 20:03 07:28-07:59/31	05:51 20:51	05:13 21:32
7	08:25 16:35	09:10-09:20/10 07:52 16:50-16:56/6 17:25	06:57 07:34-07:50/16 18:14	06:49 19:14-19:36/22 20:04 07:25-07:56/31	05:49 20:53	05:13 21:32
8	08:24 16:36	09:09-09:21/12 07:50 16:48-16:58/10 17:27	06:55 17:49-17:50/1 07:19-07:25/6 18:15 07:33-07:48/15	06:46 19:15-19:37/22 20:06 07:22-07:53/31	05:47 20:54	05:12 21:33
9	08:24 16:38	09:09-09:22/13 07:48 16:48-17:00/12 17:28	06:53 17:46-17:52/6 07:16-07:26/10 18:17 07:34-07:47/13	06:44 19:19-19:39/20 20:08 07:20-07:51/31	05:46 20:56	05:12 21:34
10	08:23 16:39	09:08-09:23/15 07:46 16:48-17:02/14 17:30	06:51 17:44-17:54/10 07:15-07:28/13 18:19 07:36-07:45/9	06:42 19:20-19:39/19 20:09 07:19-07:51/32	05:44 20:57	05:11 21:35
11	08:23 16:40	09:08-09:24/16 07:45 16:48-17:02/14 17:32	06:48 17:44-17:56/12 18:20 07:14-07:28/14	06:40 19:20-19:40/20 20:11 07:18-07:50/32	05:42 20:59	05:11 21:36
12	08:22 16:42	09:07-09:24/17 07:43 16:48-17:01/13 17:34	06:46 17:42-17:57/15 18:22 07:13-07:28/15	06:38 19:21-19:40/19 20:13 07:18-07:49/31	05:41 21:00	05:11 21:36
13	08:22 16:43	09:08-09:26/18 07:41 17:03-17:08/5 17:35 16:48-17:01/13	06:44 17:42-17:57/15 18:24 07:13-07:27/14	06:36 19:23-19:39/16 20:14 07:17-07:47/30	05:39 21:02	05:10 21:37
14	08:21 16:45	09:08-09:27/19 07:39 17:01-17:10/9 17:37 16:48-17:00/12	06:42 17:42-17:57/15 18:25 07:13-07:27/14	06:34 19:24-19:39/15 20:16 07:17-07:45/28	05:38 21:03	05:10 21:37
15	08:20 16:46	16:13-16:14/1 09:08-09:27/19 17:39 16:50-16:59/9	06:40 17:43-17:56/13 18:27 07:14-07:26/12	06:31 19:26-19:38/12 20:17 07:17-07:41/24	05:36 21:05	05:10 21:38
16	08:19 16:48	16:13-16:16/3 09:08-09:28/20 17:41 16:52-16:56/4	06:37 17:43-17:54/11 18:29 07:15-07:24/9	06:29 19:27-19:36/9 20:19 07:17-07:39/22	05:35 21:06	05:10 21:38
17	08:18 16:49	16:12-16:18/6 09:08-09:28/20 17:43	06:35 17:45-17:51/6 18:30 07:18-07:20/2	06:27 19:31-19:32/1 20:21 07:17-07:38/21	05:33 21:08	05:10 21:39
18	08:18 16:51	16:12-16:19/7 09:08-09:29/21 17:44	06:33 07:06-07:09/3 18:32	06:25 07:18-07:37/19 20:22	05:32 21:09	05:10 21:39
19	08:17 16:52	16:12-16:21/9 09:09-09:29/20 17:46 16:59-17:12/13	06:31 07:02-07:12/10 18:34	06:23 07:19-07:36/17 20:24	05:31 21:10	05:10 21:40
20	08:16 16:54	16:12-16:23/11 09:09-09:30/21 17:48 16:59-17:11/12	06:29 07:00-07:14/14 18:35	06:21 07:20-07:34/14 20:26	05:29 21:12	05:10 21:40
21	08:15 16:55	16:12-16:24/12 09:10-09:30/20 17:50 17:00-17:10/10	06:26 06:58-07:14/16 18:37	06:19 07:22-07:31/9 20:27	05:28 21:13	05:10 21:40
22	08:14 16:57	16:12-16:26/14 09:09-09:29/20 17:51 17:03-17:08/5	06:24 06:57-07:15/18 18:39	06:17 07:22-07:31/9 20:29	05:27 21:14	05:10 21:40
23	08:13 16:59	16:13-16:27/14 09:10-09:30/20 17:53	06:22 06:53-07:15/22 18:40	06:15 20:30	05:26 21:16	05:11 21:41
24	08:11 17:00	16:14-16:27/13 09:11-09:30/19 17:55	06:20 06:51-07:15/24 18:42	06:13 20:32	05:25 21:17	05:11 21:41
25	08:10 17:02	16:14-16:26/12 09:11-09:29/18 17:57	06:17 06:49-07:13/24 18:43	06:11 20:34	05:23 21:18	05:11 21:41
26	08:09 17:04	16:15-16:26/11 09:13-09:29/16 17:58	06:15 06:48-07:13/25 18:45	06:09 20:35	05:22 21:20	05:12 21:41
27	08:08 17:06	16:17-16:25/8 09:14-09:28/14 18:00	06:13 06:48-07:12/24 18:47	06:07 20:37	05:21 21:21	05:12 21:41
28	08:06 17:07	16:19-16:23/4 09:15-09:26/11 18:02	06:11 06:47-07:12/25 18:48	06:05 20:38	05:20 21:22	05:13 21:41
29	08:05 17:09	09:19-09:24/5 08:04	07:09 07:46-08:12/26 19:50	06:03 20:40	05:19 21:23	05:13 21:41
30	08:04 17:11		07:06 07:41-08:11/30 19:52	06:01 20:42	05:18 21:24	05:14 21:40
31	08:02 17:12		07:04 19:18-19:26/8 19:53 07:39-08:10/31		05:18 21:25	
Sonnenscheinstunden	264	280	367	414	480	492
Anzahl Minuten mit Schatten	522	370	707	829	0	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 17 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (41)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14 21:40	05:49 21:10	06:36 19:19-19:39/20	07:22 18:22-18:37/15	07:14 16:17-16:30/13	08:02 08:50-09:06/16
2	05:15 21:40	05:50 21:09	06:38 19:19-19:38/19	07:24 18:21-18:34/13	07:15 16:17-16:29/12	08:04 08:51-09:06/15
3	05:16 21:39	05:52 21:07	06:39 19:17-19:37/20	07:26 18:22-18:32/10	07:17 16:18-16:28/10	08:05 08:52-09:06/14
4	05:16 21:39	05:53 21:05	06:41 19:13-19:35/22	07:27 18:23-18:31/8	07:19 16:20-16:26/6	08:06 08:53-09:05/12
5	05:17 21:39	05:55 21:04	06:42 19:11-19:32/21	07:29 18:24-18:28/4	07:20 16:20-16:26/6	08:08 08:55-09:05/10
6	05:18 21:38	05:56 21:02	06:44 19:10-19:31/21	07:30 18:24-18:26/16	07:22 16:20-16:26/6	08:09 08:56-09:04/8
7	05:19 21:38	05:58 21:00	06:45 19:08-19:28/20	07:32 18:10-18:26/16	07:24 16:20-16:26/6	08:10 08:57-09:03/6
8	05:20 21:37	05:59 20:59	06:47 19:08-19:26/18	07:34 18:08-18:25/17	07:26 16:20-16:26/6	08:11 16:19
9	05:20 21:36	06:01 20:57	06:48 19:08-19:22/14	07:35 17:55-18:00/5	07:27 16:20-16:26/6	08:12 16:19
10	05:21 21:36	06:02 20:55	06:50 19:08-19:22/14	07:37 17:51-18:02/11	07:29 16:20-16:26/6	08:13 16:19
11	05:22 21:35	06:04 20:53	06:51 19:09-19:20/11	07:38 17:50-18:03/13	07:31 16:20-16:26/6	08:15 16:18
12	05:23 21:34	06:05 20:51	06:53 19:10-19:18/8	07:40 17:49-18:04/15	07:32 16:20-16:26/6	08:16 16:18
13	05:24 21:33	06:07 20:49	06:54 19:32-18:02/30	07:42 17:47-18:05/18	07:34 16:20-16:26/6	08:17 16:18
14	05:26 21:33	06:08 20:48	06:56 19:42	07:43 17:44-18:04/20	07:36 15:50-15:55/5	08:17 16:18
15	05:27 21:32	06:10 20:46	06:58 19:40	07:45 17:43-18:04/21	07:37 15:49-15:57/8	08:18 16:18
16	05:28 21:31	06:11 20:44	06:59 19:37	07:47 17:43-18:04/21	07:39 15:48-15:59/11	08:19 16:19
17	05:29 21:30	06:13 20:42	07:01 19:35	07:48 17:41-18:01/20	07:41 15:48-16:00/12	08:20 16:19
18	05:30 21:29	06:14 20:40	07:02 19:33	07:50 17:41-17:59/18	07:42 15:48-16:01/13	08:21 16:19
19	05:31 21:28	06:16 20:38	07:04 19:31	07:52 17:42-17:57/15	07:44 15:47-16:01/14	08:21 16:19
20	05:33 21:26	06:17 20:36	07:05 19:28	07:53 17:42-17:56/14	07:46 15:47-16:01/14	08:22 16:20
21	05:34 21:25	06:19 20:34	07:07 19:26	07:55 17:42-17:53/11	07:47 15:48-16:00/12	08:23 16:20
22	05:35 21:24	06:21 20:32	07:08 19:24	07:57 17:44-17:51/7	07:49 15:48-15:59/11	08:23 16:21
23	05:36 21:23	06:22 20:30	07:10 19:22	07:58 17:48-17:49/1	07:50 15:48-15:57/9	08:24 16:21
24	05:38 21:22	06:24 20:28	07:11 19:19	07:59 17:29-17:43/14	07:52 15:49-15:56/7	08:24 16:22
25	05:39 21:20	06:25 20:26	07:13 19:17	08:00 17:29-17:43/14	07:54 15:50-15:56/6	08:24 16:22
26	05:40 21:19	06:27 20:24	07:15 19:15	08:01 17:29-17:43/14	07:55 15:51-15:54/3	08:25 16:23
27	05:42 21:18	06:28 20:21	07:16 19:13	08:02 17:29-17:43/14	07:57 15:52-15:53/1	08:25 16:24
28	05:43 21:16	06:30 20:19	07:18 19:10	08:03 17:29-17:43/14	07:58 15:50-15:56/6	08:25 16:24
29	05:45 21:15	06:31 20:17	07:19 19:08	08:04 17:29-17:43/14	07:59 15:49-15:56/7	08:25 16:25
30	05:46 21:13	06:33 20:15	07:21 19:06	08:05 17:29-17:43/14	08:01 15:50-15:56/6	08:26 16:26
31	05:47 21:12	06:34 20:13	07:22 19:05	08:06 17:29-17:43/14	08:02 15:50-15:56/6	08:26 16:27
Sonnenscheinstunden	496	450	380	333	271	250
Anzahl Minuten mit Schatten	0	290	952	647	487	81

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 18 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (42)

Voraussetzungen für Berechnung des Schattenwurfs: Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26	08:01	07:10 17:28-17:36/8	07:02 18:56-19:23/27	06:00 06:27-06:54/27	05:17 20:24-20:36/12
	16:28	17:14	18:03 07:44-08:02/18	19:55 07:26-07:39/13	20:43	21:27
2	08:26	07:59	07:08 17:25-17:37/12	07:00 18:59-19:23/24	05:58 06:27-06:53/26	05:16 20:25-20:35/10
	16:29	17:16	18:05 07:44-08:03/19	19:56 07:22-07:40/18	20:45	21:28
3	08:26	07:58	07:06 17:23-17:39/16	06:57 19:01-19:22/21	05:56 06:24-06:51/27	05:15 20:26-20:35/9
	16:30	17:18	18:07 07:42-08:02/20	19:58 07:20-07:40/20	20:46	21:29
4	08:25	07:56	07:04 17:23-17:39/16	06:55 19:01-19:21/20	05:54 20:11-20:16/5	05:14 20:27-20:34/7
	16:31	17:19	18:09 07:42-08:02/20	20:00 07:17-07:38/21	20:48 06:22-06:48/26	21:30
5	08:25	07:55 16:47-16:52/5	07:01 17:22-17:40/18	06:53 19:02-19:20/18	05:52 20:08-20:18/10	05:14 20:29-20:33/4
	16:33	17:21	18:10 07:42-08:02/20	20:01 07:15-07:38/23	20:49 06:22-06:48/26	21:31
6	08:25	07:53 16:46-16:55/9	06:59 17:22-17:40/18	06:51 19:03-19:19/16	05:51 20:07-20:10/13	05:13
	16:34	17:23	18:12 07:42-08:02/20	20:03 07:14-07:36/22	20:51 06:21-06:47/26	21:32
7	08:25	07:52 16:45-16:56/11	06:57 17:22-17:40/18	06:49 19:38-19:39/1 07:27-07:34/7	05:49 20:06-20:10/14	05:13
	16:35	17:25	18:14 07:43-08:01/18	20:04 19:04-19:17/13 07:14-07:26/12	20:53 06:20-06:45/25	21:32
8	08:24	07:50 16:44-16:58/14	06:55 17:42-17:46/4 07:43-07:59/16	06:46 19:32-19:40/8 07:14-07:25/11	05:47 20:06-20:21/15	05:12
	16:36	17:27	18:15 17:21-17:38/17	20:06 19:06-19:13/7	20:54 06:15-06:43/28	21:33
9	08:24	07:48 16:43-17:00/17	06:53 17:39-17:49/10 07:44-07:57/13	06:44 19:31-19:42/11	05:46 20:05-20:24/19	05:12
	16:38	17:28	18:17 17:22-17:37/15	20:08 07:15-07:24/9	20:56 06:13-06:40/27	21:34
10	08:23	07:46 16:43-17:02/19	06:51 17:37-17:51/14 07:47-07:55/8	06:42 19:29-19:43/14	05:44 20:04-20:25/21	05:11
	16:39	17:30	18:19 17:23-17:36/13	20:09 07:17-07:20/3	20:57 06:12-06:40/28	21:35
11	08:23	07:45 16:43-17:02/19	06:48 17:36-17:52/16	06:40 19:29-19:45/16	05:42 20:05-20:26/21	05:11
	16:40	17:32	18:20 17:25-17:34/9	20:11	20:59 06:11-06:38/27	21:36
12	08:22	07:43 16:43-17:02/19	06:46 17:34-17:51/17	06:38 19:28-19:46/18	05:41 20:05-20:28/23	05:11
	16:42	17:34	18:22	20:13	21:00 06:11-06:37/26	21:36
13	08:22 08:51-08:56/5	07:41 16:43-17:01/18	06:44 17:34-17:52/18	06:36 19:28-19:46/18	05:39 20:05-20:29/24	05:10
	16:43	17:35	18:24	20:14	21:02 06:10-06:36/26	21:37
14	08:21 08:49-08:57/8	07:39 16:44-17:01/17	06:42 17:34-17:52/18	06:34 19:28-19:46/18	05:38 20:06-20:31/25	05:10
	16:45	17:37	18:25	20:16	21:03 06:10-06:35/25	21:37
15	08:20 08:49-08:59/10	07:38 16:44-17:00/16	06:40 17:34-17:51/17	06:31 19:28-19:45/17	05:36 20:05-20:32/27	05:10
	16:46	17:39	18:27	20:17 06:57-07:01/4	21:05 06:10-06:35/25	21:38
16	08:19 08:48-09:00/12	07:36 16:45-16:59/14	06:37 17:35-17:51/16	06:29 19:28-19:44/16	05:35 20:06-20:34/28	05:10
	16:48	17:41	18:29	20:19 06:54-07:03/9	21:06 06:09-06:33/24	21:38
17	08:18 08:48-09:00/12	07:34 16:47-16:57/10	06:35 17:35-17:48/13	06:27 19:29-19:43/14	05:33 20:08-20:35/27	05:10
	16:49	17:43	18:30	20:21 06:52-07:05/13	21:08 06:10-06:32/22	21:39
18	08:18 08:45-09:01/16	07:32 16:51-16:53/2	06:33 17:37-17:47/10	06:25 19:30-19:42/12	05:32 20:09-20:36/27	05:10
	16:51	17:44	18:32	20:22 06:51-07:05/14	21:09 06:10-06:27/17	21:39
19	08:17 08:44-09:02/18	07:30	06:31 17:41-17:42/1	06:23 19:32-19:39/7	05:31 20:10-20:36/26	05:10
	16:52	17:46	18:34	20:24 06:48-07:05/17	21:10 06:11-06:27/16	21:40
20	08:16 08:43-09:02/19	07:28	06:29	06:21 06:46-07:05/19	05:29 20:12-20:37/25	05:10
	16:54	17:48	18:35	20:25	21:12 06:10-06:26/16	21:40
21	08:15 08:43-09:03/20	07:26	06:26 18:02-18:11/9	06:19 06:44-07:05/21	05:28 20:13-20:37/24	05:10
	16:55	17:50	18:37	20:27	21:13 06:11-06:26/15	21:40
22	08:14 08:42-09:02/20	07:24	06:24 17:59-18:14/15	06:17 06:44-07:04/20	05:27 20:14-20:37/23	05:10
	16:57	17:51	18:39	20:29	21:14 06:12-06:25/13	21:40
23	08:13 08:42-09:03/21	07:22	06:22 17:58-18:15/17	06:15 06:42-07:03/21	05:26 20:15-20:38/23	05:11
	16:59	17:53	18:40	20:30	21:16 06:13-06:25/12	21:41
24	08:11 08:43-09:03/20	07:20	06:20 17:57-18:16/19	06:13 06:41-07:02/21	05:24 20:17-20:38/21	05:11
	17:00	17:55	18:42	20:32	21:17 06:14-06:24/10	21:41
25	08:10 08:43-09:03/20	07:18	06:17 17:55-18:15/20	06:11 06:39-07:00/21	05:23 20:18-20:38/20	05:11
	17:02	17:57	18:43	20:34	21:18 06:15-06:22/7	21:41
26	08:09 08:43-09:01/18	07:16 07:50-07:57/7	06:15 17:55-18:19/24	06:09 06:36-06:57/21	05:22 20:19-20:38/19	05:12
	17:04	17:58	18:45	20:35	21:20	21:41
27	08:08 08:44-09:00/16	07:14 07:47-07:59/12	06:13 17:54-18:21/27	06:07 06:35-06:56/21	05:21 20:19-20:37/18	05:12
	17:05	18:00	18:47	20:37	21:21	21:41
28	08:06 08:44-08:55/11	07:12 07:45-08:01/16	06:11 17:54-18:23/29	06:05 06:34-06:56/22	05:20 20:20-20:37/17	05:13
	17:07	18:02	18:48	20:38	21:22	21:41
29	08:05 08:46-08:55/9		07:08 18:54-19:22/28	06:03 06:31-06:55/24	05:19 20:21-20:37/16	05:13
	17:09		19:50	20:40	21:23	21:41
30	08:04 08:47-08:53/6		07:06 18:54-19:23/29	06:01 06:29-06:55/26	05:18 20:24-20:37/13	05:14
	17:11		19:52 07:28-07:37/9	20:42	21:24	21:40
31	08:02		07:04 18:55-19:23/28		05:17 20:24-20:37/13	
	17:12		19:53 07:27-07:38/11		21:25	
Sonnenscheinstunden	264	280	367	414	480	492
Anzahl Minuten mit Schatten	261	225	751	769	1104	42

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten

Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 18 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (42)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember	
1	05:14 21:40	05:49 20:16-20:38/22 21:10 06:21-06:48/27	06:36 19:27-19:44/17 20:11	07:22 18:14-18:31/17 19:04	07:14 16:12-16:30/18 17:00	08:02 16:22	
2	05:15 21:40	05:50 20:15-20:36/21 21:09 06:22-06:49/27	06:37 19:28-19:42/14 20:09 07:16-07:19/3	07:24 18:14-18:30/16 19:02 18:05-18:10/5	07:15 16:13-16:29/16 16:58	08:04 16:22	
3	05:16 21:39	05:52 20:15-20:35/20 21:07 06:22-06:50/28	06:39 19:29-19:40/11 20:06 07:12-07:21/9	07:26 18:14-18:29/15 08:26-08:31/5 18:59 18:02-18:13/11	07:17 16:14-16:28/14 16:57	08:05 16:21	
4	05:16 21:39	05:53 20:16-20:33/17 21:05 06:24-06:51/27	06:41 19:30-19:38/8 07:11-07:23/12 20:04 19:05-19:11/6	07:27 18:16-18:28/12 08:23-08:34/11 18:57 18:01-18:15/14	07:19 16:15-16:26/11 16:55	08:06 16:20	
5	05:17 21:39	05:55 20:16-20:31/15 21:04 06:26-06:53/27	06:42 19:33-19:35/2 07:23-07:30/7 20:02 19:01-19:13/12 07:10-07:22/12	07:29 18:17-18:25/8 08:20-08:35/15 18:55 17:59-18:15/16	07:20 16:16-16:24/8 16:53	08:08 16:20	
6	05:18 21:38	05:56 20:16-20:30/14 21:02 06:30-06:56/26	06:44 18:59-19:15/16 20:00 07:10-07:32/22	07:30 17:58-18:15/17 18:53 08:19-08:36/17	07:22 16:19-16:23/4 16:52	08:09 16:20	
7	05:19 20:37-20:38/1 21:38	05:58 20:17-20:29/12 21:00 06:30-06:57/27	06:45 18:57-19:15/18 19:58 07:10-07:33/23	07:32 17:57-18:15/18 18:51 08:19-08:37/18	07:24 16:50	08:10 16:19	
8	05:20 20:35-20:41/6 21:37	05:59 20:18-20:27/9 20:59 06:30-06:57/27	06:47 18:56-19:16/20 19:55 07:12-07:33/21	07:34 17:57-18:15/18 18:48 08:17-08:37/20	07:26 16:48	08:11 16:19	
9	05:20 20:34-20:42/8 21:36	06:01 20:22-20:24/2 20:57 06:32-06:58/26	06:48 18:55-19:16/21 19:53 07:13-07:33/20	07:35 17:57-18:15/18 18:46 08:17-08:37/20	07:27 16:47	08:12 16:19	
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11	05:22 20:33-20:44/11 21:35	06:04 06:35-07:02/27 20:53	06:51 18:49-19:16/27 19:49 07:18-07:32/14	07:38 17:58-18:12/14 18:42 08:16-08:36/20	07:31 16:44	08:15 16:18	
12	05:23 20:32-20:44/12 21:34	06:05 06:36-07:02/26 20:51	06:53 18:48-19:16/28 19:46 07:19-07:31/12	07:40 17:59-18:11/12 18:40 08:17-08:35/18	07:32 08:19-08:25/6 16:42	08:16 16:18	
13	05:24 20:31-20:44/13 21:33	06:07 06:38-07:03/25 20:49	06:54 18:46-19:14/28 19:44 07:19-07:29/10	07:42 18:02-18:08/6 18:38 08:18-08:35/17	07:34 08:18-08:27/9 16:41	08:17 16:18	
14	05:26 20:32-20:46/14 21:33	06:08 06:40-07:03/23 20:48	06:56 18:45-19:14/29 19:42 07:23-07:25/2	07:43 08:18-08:33/15 18:36	07:36 08:17-08:28/11 16:40	08:17 16:18	
15	05:27 20:30-20:46/16 21:32	06:10 06:41-07:03/22 20:46	06:57 18:44-19:12/28 19:40	07:45 08:20-08:31/11 18:33	07:37 08:16-08:32/16 16:38	08:18 16:18	
16	05:28 20:29-20:47/18 21:31	06:11 06:43-07:03/20 20:44	06:59 18:44-19:11/27 19:37	07:47 18:31	07:39 08:16-08:34/18 16:37	08:19 16:19	
17	05:29 20:29-20:47/18 21:30	06:13 06:43-07:03/20 20:42	07:01 18:43-19:08/25 19:35	07:48 18:29	07:41 08:16-08:36/20 16:36	08:20 16:19	
18	05:30 20:28-20:47/19 21:29 06:26-06:31/5	06:14 06:46-07:07/21 20:40	07:02 18:43-19:04/21 19:33	07:50 18:27	07:42 08:16-08:37/21 16:34	08:21 16:19	
19	05:31 20:27-20:47/20 21:28 06:24-06:33/9	06:16 06:47-07:08/21 20:38	07:04 18:43-19:02/19 19:31	07:52 18:25	07:44 08:17-08:38/21 16:33	08:21 16:19	
20	05:33 20:26-20:47/21 21:26 06:23-06:34/11	06:17 06:48-07:09/21 20:36	07:05 18:44-19:02/18 19:28	07:53 18:23	07:46 08:17-08:37/20 16:32	08:22 16:20	
21	05:34 20:24-20:47/23 21:25 06:23-06:36/13	06:19 06:48-07:09/21 20:34	07:07 18:44-18:59/15 19:26	07:55 18:21	07:47 08:18-08:38/20 16:31	08:23 16:20	
22	05:35 20:24-20:48/24 21:24 06:22-06:36/14	06:21 06:49-07:10/21 20:32	07:08 18:46-18:58/12 19:24	07:57 18:19	07:49 08:19-08:38/19 16:30	08:23 16:20	
23	05:36 20:23-20:47/24 21:23 06:21-06:37/16	06:22 06:50-07:09/19 20:30	07:10 18:50-18:52/2 19:22	07:58 18:17	07:50 08:21-08:39/18 16:29	08:24 16:21	
24	05:38 20:23-20:47/24 21:22 06:20-06:37/17	06:24 19:34-19:42/8 20:28 06:52-07:09/17	07:11 19:19	08:00 17:20-17:25/5 18:15	07:52 08:22-08:38/16 16:28	08:24 16:22	
25	05:39 20:20-20:46/26 21:20 06:20-06:37/17	06:25 19:33-19:45/12 20:26 06:54-07:08/14	07:13 18:20-18:29/9 19:17	07:02 16:17-16:28/11 17:13	07:54 08:25-08:38/13 16:27	08:24 16:22	
26	05:40 20:19-20:46/27 21:19 06:20-06:41/21	06:27 19:31-19:45/14 20:24 06:55-07:07/12	07:15 18:18-18:31/13 19:15	07:03 16:14-16:29/15 17:11	07:55 08:27-08:39/12 16:26	08:25 16:23	
27	05:42 20:18-20:45/27 21:18 06:20-06:43/23	06:28 19:30-19:46/16 20:21 06:56-07:05/9	07:16 18:16-18:31/15 19:13	07:05 16:14-16:30/16 17:09	07:57 08:28-08:38/10 16:25	08:25 16:24	
28	05:43 20:17-20:43/26 21:16 06:20-06:44/24	06:30 19:29-19:46/17 20:19 06:59-07:01/2	07:18 18:15-18:32/17 19:10	07:07 16:13-16:30/17 17:08	07:58 08:29-08:37/8 16:24	08:25 16:24	
29	05:45 20:16-20:42/26 21:15 06:20-06:46/26	06:31 19:28-19:47/19 20:17	07:19 18:15-18:32/17 19:08	07:08 16:13-16:31/18 17:06	07:59 08:31-08:36/5 16:23	08:26 16:25	
30	05:46 20:16-20:41/25 21:13 06:20-06:46/26	06:33 19:28-19:46/18 20:15	07:21 18:14-18:31/17 19:06	07:10 16:13-16:31/18 17:04	08:01 16:23	08:26 16:26	
31	05:47 20:15-20:39/24 21:12 06:20-06:46/26	06:34 19:28-19:46/18 20:13		07:12 16:13-16:31/18 17:02		08:26 16:27	
Sonnenscheinstunden		496	450	380	333	271	0
Anzahl Minuten mit Schatten		711	864	721	558	334	0

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 19 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (43)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 16:16-16:35/19 17:14 15:59-16:04/5	07:10 17:03-17:24/21 07:39-07:53/14 18:03 16:49-17:00/11	07:02 18:29-18:58/29 19:55	06:00 06:36-06:46/10 20:43	05:17 20:07-20:41/34 21:27
2	08:26 16:29	07:59 16:16-16:35/19 17:16	07:08 17:01-17:24/23 18:05 07:38-07:53/15	07:00 18:30-18:57/27 19:56	05:58 06:39-06:45/6 20:45	05:16 20:07-20:42/35 21:28
3	08:26 16:30	07:58 16:17-16:36/19 17:18	07:06 17:01-17:24/23 18:07 07:37-07:52/15	06:57 18:30-18:55/25 19:58	05:56 20:46	05:15 20:08-20:44/36 21:29
4	08:25 16:31	07:56 16:17-16:36/19 17:19	07:03 17:01-17:24/23 18:09 07:37-07:52/15	06:55 18:31-18:53/22 20:00	05:54 20:48	05:14 20:08-20:45/37 21:30
5	08:25 16:33	07:55 16:17-16:35/18 17:21	07:01 17:01-17:24/23 18:10 07:37-07:52/15	06:53 18:33-18:51/18 20:01	05:52 20:49	05:14 20:09-20:46/37 21:31
6	08:25 15:53-15:54/1 16:34	07:53 16:18-16:35/17 17:23	06:59 17:01-17:24/23 18:12 07:38-07:51/13	06:51 19:23-19:30/7 20:03	05:51 20:51	05:13 20:09-20:46/37 21:32
7	08:25 15:51-15:58/7 16:35	07:52 16:19-16:34/15 17:25	06:57 17:02-17:23/21 18:14 07:40-07:50/10	06:49 19:20-19:33/13 20:04	05:49 20:53	05:13 20:10-20:47/37 21:32
8	08:24 15:49-15:59/10 16:36	07:50 16:20-16:33/13 17:27	06:55 17:02-17:21/19 18:15 07:41-07:46/5	06:46 19:16-19:34/18 20:06	05:47 20:54	05:12 20:10-20:47/37 21:33
9	08:24 15:48-16:00/12 16:38	07:48 16:21-16:31/10 17:28	06:53 17:03-17:20/17 18:17	06:44 19:15-19:35/20 20:08	05:46 20:56	05:12 20:11-20:48/37 21:34
10	08:23 15:48-16:02/14 16:39	07:46 16:26-16:29/3 17:30	06:51 17:04-17:18/14 18:19	06:42 19:14-19:36/22 20:09	05:44 20:57	05:11 20:12-20:49/37 21:35
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14	08:21 15:47-16:06/19 16:45	07:39 17:37	06:42 17:26-17:48/22 18:25	06:34 19:11-19:37/26 20:16 06:57-07:13/16	05:38 21:03	05:10 20:14-20:50/36 21:37
15	08:20 15:47-16:07/20 16:46	07:38 16:50-17:00/10 17:39	06:40 17:25-17:49/24 18:27	06:31 19:11-19:37/26 20:17 06:56-07:13/17	05:36 21:05	05:10 20:14-20:51/37 21:38
16	08:19 15:47-16:08/21 16:48	07:36 16:48-17:02/14 17:41	06:37 17:24-17:50/26 18:29	06:29 19:11-19:36/25 20:19 06:54-07:12/18	05:35 21:06	05:10 20:15-20:51/36 21:38
17	08:18 15:47-16:09/22 16:49	07:34 16:46-17:04/18 17:42	06:35 17:22-17:50/28 18:30	06:27 19:12-19:36/24 20:21 06:51-07:12/21	05:33 21:07	05:10 20:15-20:51/36 21:39
18	08:18 15:47-16:09/22 16:51	07:32 16:45-17:05/20 17:44	06:33 17:21-17:52/31 18:32	06:25 19:12-19:35/23 20:22 06:49-07:10/21	05:32 21:09	05:10 20:16-20:52/36 21:39
19	08:17 15:47-16:10/23 16:52	07:30 16:44-17:05/21 17:46	06:31 17:21-17:55/34 18:34	06:23 19:13-19:34/21 20:24 06:47-07:08/21	05:31 21:10	05:10 20:16-20:52/36 21:40
20	08:16 15:47-16:10/23 16:54	07:28 16:44-17:06/22 17:48	06:29 17:21-17:57/36 18:35	06:21 19:13-19:32/19 20:25 06:45-07:06/21	05:29 21:12	05:10 20:16-20:52/36 21:40
21	08:15 15:47-16:10/23 16:55	07:26 16:43-17:06/23 17:50	06:26 17:20-17:58/38 18:37	06:19 19:15-19:31/16 20:27 06:44-07:05/21	05:28 21:13	05:10 20:16-20:52/36 21:40
22	08:14 15:47-16:11/24 16:57	07:24 16:43-17:06/23 17:51	06:24 17:20-17:59/39 18:38	06:17 19:16-19:29/13 20:29 06:41-07:03/22	05:27 21:14	05:10 20:17-20:53/36 21:40
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25	08:10 15:49-16:11/22 17:02	07:18 17:10-17:17/7 17:56 16:44-17:06/22	06:17 17:20-18:00/40 18:43	06:11 06:36-06:56/20 20:34	05:23 21:18	05:11 20:17-20:53/36 21:41
26	08:09 16:21-16:28/7 17:04 15:50-16:11/21	07:16 17:07-17:20/13 17:58 16:45-17:05/20	06:15 17:21-18:00/39 18:45	06:09 06:35-06:55/20 20:35	05:22 21:20	05:12 20:17-20:53/36 21:41
27	08:08 16:20-16:31/11 17:05 15:51-16:11/20	07:14 17:05-17:22/17 07:42-07:50/8 18:00 16:46-17:04/18	06:13 17:23-18:01/38 18:47	06:07 06:35-06:54/19 20:37	05:21 21:21	05:12 20:17-20:53/36 21:41
28	08:06 16:18-16:32/14 17:07 15:51-16:10/19	07:12 17:04-17:23/19 07:40-07:52/12 18:02 16:47-17:02/15	06:11 17:24-18:01/37 18:48	06:05 06:35-06:52/17 20:38	05:20 21:22	05:12 20:17-20:53/36 21:41
29	08:05 16:18-16:33/15 17:09 15:53-16:10/17		07:08 18:26-18:59/33 19:50	06:03 06:35-06:49/14 20:40	05:19 21:23	05:13 20:16-20:53/37 21:41
30	08:04 16:17-16:34/17 17:11 15:54-16:08/14		07:06 18:28-18:59/31 19:51	06:01 06:36-06:48/12 20:42	05:18 21:24	05:14 20:17-20:53/36 21:40
31	08:02 16:17-16:35/18 17:12 15:56-16:07/11		07:04 18:28-18:58/30 19:53		05:17 21:25	
Sonnenscheinstunden	264	280	367	414	480	492
Anzahl Minuten mit Schatten	544	505	972	840	457	1089

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 19 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (43)

Voraussetzungen für Berechnung des Schattenwurfs Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	July	August	September	Oktober	November	Dezember
1	05:14 20:17-20:54/37 21:40	05:49 21:10	06:36 19:12-19:35/23 20:11 07:02-07:09/7	07:22 18:09-18:25/16 19:04	07:14 15:53-15:59/6 17:00	08:02 15:29-15:45/16 16:22
2	05:15 20:16-20:53/37 21:40	05:50 21:09	06:37 19:13-19:35/22 20:09	07:24 18:11-18:21/10 19:02 17:47-17:51/4	07:15 15:51-16:01/10 16:58	08:04 15:31-15:45/14 16:21
3	05:15 20:16-20:54/38 21:39	05:52 21:07	06:39 19:13-19:33/20 20:06	07:26 17:43-17:55/12 18:59	07:17 15:49-16:03/14 16:57	08:05 15:32-15:44/12 16:21
4	05:16 20:16-20:54/38 21:39	05:53 21:05	06:41 19:14-19:32/18 20:04	07:27 17:41-17:57/16 18:57	07:19 15:48-16:04/16 16:55	08:06 15:33-15:43/10 16:20
5	05:17 20:15-20:53/38 21:39	05:55 21:04	06:42 19:16-19:29/13 20:02	07:29 17:39-17:58/19 18:55	07:20 15:48-16:05/17 16:53	08:08 15:36-15:43/7 16:20
6	05:18 20:15-20:53/38 21:38	05:56 21:02	06:44 19:19-19:26/7 20:00 18:31-18:45/14	07:30 17:38-17:59/21 18:53 08:17-08:25/8	07:22 15:47-16:06/19 16:52	08:09 15:38-15:40/2 16:20
7	05:19 20:15-20:53/38 21:38	05:58 21:00	06:45 18:28-18:46/18 19:58	07:32 17:37-17:58/21 18:51 08:15-08:26/11	07:24 15:47-16:06/19 16:50	08:10 16:19
8	05:20 20:15-20:52/37 21:37	05:59 20:59	06:47 18:26-18:48/22 19:55	07:34 17:36-17:59/23 18:48 08:13-08:27/14	07:26 15:47-16:06/19 16:48	08:11 16:19
9	05:20 20:15-20:52/37 21:36	06:01 20:57	06:48 18:24-18:49/25 19:53	07:35 17:36-17:59/23 18:46 08:12-08:27/15	07:27 15:47-16:06/19 16:47	08:12 16:19
10	05:21 20:15-20:51/36 21:36	06:02 20:55	06:50 18:23-18:50/27 19:51	07:37 17:35-17:58/23 18:44 08:12-08:28/16	07:29 15:47-16:06/19 16:45 15:29-15:35/6	08:13 16:18
11	05:22 20:15-20:50/35 21:35	06:04 06:47-06:54/7 20:53	06:51 18:21-18:50/29 19:49	07:38 17:35-17:58/23 18:42 08:11-08:27/16	07:31 15:48-16:06/18 16:44 15:27-15:38/11	08:14 16:18
12	05:23 20:14-20:48/34 21:34	06:05 06:45-06:55/10 20:51	06:53 18:21-18:51/30 19:46	07:40 17:36-17:57/21 08:12-08:26/14 18:40 17:24-17:32/8	07:32 15:49-16:06/17 16:42 15:25-15:40/15	08:16 16:18
13	05:24 20:14-20:48/34 21:33	06:07 06:44-06:57/13 20:49	06:54 18:19-18:50/31 19:44	07:42 17:37-17:57/20 08:12-08:26/14 18:38 17:21-17:35/14	07:34 15:50-16:05/15 16:41 15:25-15:42/17	08:16 16:18
14	05:26 20:15-20:48/33 21:33	06:08 06:43-06:56/13 20:48	06:56 18:17-18:51/34 19:42	07:43 17:37-17:55/18 08:13-08:23/10 18:35 17:18-17:35/17	07:36 15:50-16:04/14 16:40 15:23-15:42/19	08:17 16:18
15	05:27 20:15-20:48/33 21:32	06:10 06:42-06:59/17 20:46	06:57 18:14-18:50/36 19:40	07:45 17:38-17:54/16 08:15-08:21/6 18:33 17:17-17:37/20	07:37 15:52-16:03/11 16:38 15:23-15:43/20	08:18 16:18
16	05:28 20:15-20:47/32 21:31	06:11 06:42-07:02/20 20:44	06:59 18:12-18:50/38 19:37	07:47 17:40-17:52/12 18:31 17:16-17:37/21	07:39 15:54-16:01/7 16:37 15:22-15:44/22	08:19 16:18
17	05:29 20:15-20:45/30 21:30	06:13 06:42-07:02/20 20:42	07:01 18:10-18:49/39 19:35	07:48 17:15-17:37/22 18:29	07:41 15:22-15:45/23 16:36	08:20 16:19
18	05:30 20:15-20:43/28 21:29	06:14 06:43-07:04/21 20:40	07:02 18:09-18:49/40 19:33	07:50 17:15-17:37/22 18:27	07:42 15:23-15:45/22 16:34	08:21 16:19
19	05:31 20:15-20:43/28 21:28	06:16 06:43-07:04/21 20:38	07:04 18:07-18:47/40 19:31	07:52 17:14-17:38/24 18:25	07:44 15:22-15:45/23 16:33	08:21 16:19
20	05:33 20:15-20:42/27 21:26	06:17 19:25-19:31/6 20:36 06:44-07:06/22	07:05 18:07-18:47/40 19:28	07:53 17:15-17:38/23 18:23	07:46 15:22-15:46/24 16:32	08:22 16:20
21	05:34 20:15-20:41/26 21:25	06:19 19:21-19:34/13 20:34 06:46-07:08/22	07:07 18:05-18:45/40 19:26	07:55 17:14-17:37/23 18:21	07:47 15:23-15:46/23 16:31	08:23 16:20
22	05:35 20:16-20:41/25 21:24	06:20 19:19-19:36/17 20:32 06:49-07:10/21	07:08 18:05-18:44/39 19:24	07:57 17:14-17:36/22 18:19	07:49 15:23-15:47/24 16:30	08:23 16:20
23	05:36 20:16-20:39/23 21:23	06:22 19:17-19:36/19 20:30 06:49-07:10/21	07:10 18:04-18:42/38 19:22	07:58 17:15-17:36/21 18:17	07:50 15:23-15:46/23 16:29	08:24 16:21
24	05:38 20:16-20:37/21 21:22	06:24 19:15-19:37/22 20:28 06:51-07:13/22	07:11 18:04-18:40/36 19:19	08:00 17:16-17:35/19 18:15	07:52 15:24-15:46/22 16:28	08:24 16:22
25	05:39 20:17-20:36/19 21:20	06:25 19:15-19:38/23 20:26 06:52-07:13/21	07:13 18:04-18:36/32 19:17	07:02 16:17-16:34/17 17:13	07:54 15:25-15:47/22 16:27	08:24 16:22
26	05:40 20:18-20:36/18 21:19	06:27 19:13-19:37/24 20:24 06:54-07:15/21	07:15 18:04-18:33/29 19:15	07:03 16:18-16:31/13 17:11	07:55 15:25-15:46/21 16:26	08:25 16:23
27	05:42 20:19-20:35/16 21:18	06:28 19:13-19:38/25 20:21 06:56-07:14/18	07:16 18:04-18:31/27 19:13	07:05 16:21-16:29/8 17:09	07:57 15:26-15:46/20 16:25	08:25 16:24
28	05:43 20:19-20:33/14 21:16	06:30 19:12-19:37/25 20:19 06:57-07:14/17	07:18 18:05-18:31/26 19:10	07:07 17:08	07:58 15:27-15:47/20 16:24	08:25 16:24
29	05:45 20:21-20:31/10 21:15	06:31 19:12-19:38/26 20:17 06:58-07:14/16	07:19 18:06-18:30/24 19:08	07:08 17:06	07:59 15:27-15:46/19 16:23	08:25 16:25
30	05:46 20:24-20:30/6 21:13	06:33 19:12-19:37/25 20:15 07:00-07:13/13	07:21 18:07-18:27/20 19:06	07:10 17:04	08:01 15:29-15:46/17 16:23	08:26 16:26
31	05:47 21:12	06:34 19:12-19:37/25 20:13 07:01-07:12/11	 380	07:12 333	 271	08:26 16:27
Sonnenscheinstunden	496	450	380	333	271	250
Anzahl Minuten mit Schatten	866	617	884	716	653	61

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:
SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:
Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:
windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: 20 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (44)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Januar	Februar	März	April	Mai	Juni
1	08:26 16:28	08:01 17:14	07:10 16:50-17:11/21 18:03 16:35-16:43/8	07:02 18:26-19:10/44 19:55	06:00 19:34-19:57/23 20:43	05:17 19:36-20:44/68 21:27
2	08:26 16:29	07:59 17:16	07:08 16:50-17:10/20 18:05	07:00 18:27-19:11/44 19:56	05:58 19:32-19:58/26 20:45	05:16 19:36-20:44/68 21:28
3	08:26 16:30	07:58 17:18	07:06 16:51-17:08/17 18:07	06:57 18:45-19:11/26 19:58 18:28-18:44/16	05:56 19:32-20:00/28 20:46	05:15 19:38-20:45/67 21:29
4	08:25 16:31	07:56 17:19	07:03 16:53-17:07/14 18:09	06:55 18:45-19:12/27 20:00 18:32-18:41/9	05:54 19:30-20:00/30 20:48	05:14 19:38-20:45/67 21:30
5	08:25 16:33	07:55 17:21	07:01 16:56-17:03/7 18:10	06:53 18:44-19:12/28 20:01	05:52 19:29-20:01/32 20:49	05:14 19:40-20:46/66 21:31
6	08:25 16:34	07:53 17:23	06:59 18:12	06:51 18:44-19:12/28 20:03	05:51 19:29-20:02/33 20:51	05:13 19:41-20:46/65 21:32
7	08:25 16:35	07:52 17:25	06:57 18:14	06:49 18:44-19:12/28 20:04	05:49 19:28-20:02/34 20:53	05:13 19:43-20:47/64 21:32
8	08:24 16:36	07:50 17:27	06:55 18:15	06:46 18:43-19:11/28 20:06	05:47 19:28-20:03/35 20:54	05:12 19:44-20:46/62 21:33
9	08:24 16:38	07:48 16:33-16:45/12 17:28	06:53 18:17	06:44 18:43-19:10/27 20:08	05:46 19:27-20:03/36 20:56	05:12 19:47-20:47/60 21:34
10	08:23 16:39	07:46 16:31-16:49/18 17:30	06:51 18:19	06:42 18:43-19:09/26 20:09	05:44 19:26-20:03/37 20:57	05:11 19:47-20:47/60 21:35
11	08:23 16:40	07:45 16:30-16:50/20 17:32	06:48 18:20	06:40 18:44-19:09/25 20:11	05:42 19:27-20:07/40 20:59	05:11 19:47-20:47/60 21:36
12	08:22 16:42	07:43 16:28-16:52/24 17:34	06:46 18:22	06:38 18:45-19:08/23 20:13	05:41 19:27-20:11/44 21:00	05:11 19:47-20:47/60 21:36
13	08:21 16:43	07:41 16:27-16:52/25 17:35	06:44 18:24	06:36 18:46-19:06/20 20:14	05:39 19:26-20:12/46 21:02	05:10 19:48-20:48/60 21:37
14	08:21 16:45	07:39 16:26-16:53/27 17:37	06:42 18:25	06:34 18:47-19:05/18 20:16	05:38 19:27-20:14/47 21:03	05:10 19:48-20:48/60 21:37
15	08:20 16:46	07:38 16:25-16:54/29 17:39	06:40 18:27	06:31 18:49-19:02/13 20:17	05:36 19:26-20:15/49 21:05	05:10 19:48-20:48/60 21:38
16	08:19 16:48	07:36 16:25-16:54/29 17:41	06:37 18:29	06:29 18:53-18:58/5 20:19	05:35 19:26-20:16/50 21:06	05:10 19:49-20:49/60 21:38
17	08:18 16:49	07:34 16:24-16:55/31 17:42	06:35 18:30	06:27 20:21	05:33 19:27-20:18/51 21:07	05:10 19:49-20:49/60 21:39
18	08:18 16:51	07:32 16:58-17:04/6 17:44 16:24-16:55/31	06:33 17:35-17:48/13 18:32	06:25 20:22	05:32 19:27-20:19/52 21:09	05:10 19:49-20:49/60 21:39
19	08:17 16:52	07:30 16:24-17:07/43 17:46	06:31 17:32-17:50/18 18:34 06:57-07:03/6	06:23 20:24	05:31 19:27-20:18/51 21:10	05:10 19:49-20:49/60 21:40
20	08:16 16:54	07:28 16:24-17:09/45 17:48	06:29 17:30-17:52/22 18:35 06:55-07:05/10	06:21 20:25	05:29 19:27-20:19/52 21:12	05:10 19:49-20:49/60 21:40
21	08:15 16:55	07:26 16:24-17:10/46 17:50	06:26 17:28-17:52/24 18:37 06:53-07:05/12	06:19 20:27	05:28 19:28-20:20/52 21:13	05:10 19:49-20:49/60 21:40
22	08:14 16:57	07:24 16:24-17:11/47 17:51	06:24 17:27-17:53/26 18:38 06:52-07:06/14	06:17 20:29	05:27 20:27-20:35/8 21:14 19:29-20:21/52	05:10 19:50-20:50/60 21:40
23	08:12 16:59	07:22 16:25-17:12/47 17:53	06:22 17:26-17:53/27 18:40 06:52-07:06/14	06:15 20:30	05:26 20:25-20:37/12 21:16 19:29-20:21/52	05:11 19:50-20:50/60 21:41
24	08:11 17:00	07:20 16:26-17:12/46 17:55	06:20 17:26-17:54/28 18:42 06:52-07:06/14	06:13 20:32	05:24 20:24-20:38/14 21:17 19:30-20:21/51	05:11 19:50-20:50/60 21:41
25	08:10 17:02	07:18 16:27-17:13/46 17:56	06:17 17:24-17:53/29 18:43 06:51-07:05/14	06:11 20:34	05:23 20:23-20:40/17 21:18 19:30-20:22/52	05:11 19:51-20:51/60 21:41
26	08:09 17:04	07:16 16:28-17:13/45 17:58	06:15 17:24-17:53/29 18:45 06:52-07:04/12	06:09 20:35	05:22 19:31-20:41/70 21:20	05:12 19:51-20:51/60 21:41
27	08:08 17:05	07:14 16:29-17:12/43 18:00	06:13 17:24-17:53/29 18:47 06:53-07:02/9	06:07 20:37	05:21 19:31-20:41/70 21:21	05:12 19:51-20:51/60 21:41
28	08:06 17:07	07:12 16:50-17:12/22 18:02 16:32-16:47/15	06:11 17:24-17:53/29 18:48 06:56-06:58/2	06:05 20:38	05:20 19:32-20:42/70 21:22	05:12 19:51-20:51/60 21:41
29	08:05 17:09		07:08 18:56-19:04/8 19:50 18:24-18:51/27	06:03 19:40-19:53/13 20:40	05:19 19:33-20:42/69 21:23	05:13 19:51-20:51/60 21:41
30	08:04 17:11		07:06 18:52-19:07/15 19:51 18:24-18:51/27	06:01 19:37-19:55/18 20:42	05:18 19:34-20:44/70 21:24	05:14 19:51-20:52/61 21:40
31	08:02 17:12		07:04 18:25-19:09/44 19:53		05:17 19:35-20:44/69 21:25	
Sonnenscheinstunden	264	280	367	414	480	492
Anzahl Minuten mit Schatten	0	697	589	466	1524	1848

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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Projekt:

SW19001 Zell

TurboWind Energie GmbH
Vahrenwalder Str. 245-247
30179 Hannover

Beschreibung:

Schattenwurfberechnung für den Standort Zell
Zusatzbelastung:
- 1x ENERCON E-138, 3.500 kW, NH: 160 m
Vorbelastung:
- 5x ENERCON E-115, 3.000 kW, NH: 149 m
- 10x DEWIND D6/62, 1.000 kW, NH: 68,5 m
- 1x AN BONUS, 1.000 kW, NH: 70,0 m
- 1x AN BONUS, 600 kW, NH: 58,0 m
- 1x AN BONUS, 150 kW, NH: 30,0 m
- 1x AN BONUS, 300 kW, NH: 40,0 m

Lizenzierter Anwender:

windtest grevenbroich gmbh
Frimmersdorfer Straße 73a
DE-41517 Grevenbroich
+49 2181 2278 0
lasma.pikuma@windtest-nrw.de
Berechnet:
22.04.2020 13:02/3.3.274



SHADOW - Kalender pro WEA

Berechnung: GesamtbelastungWEA: 20 - ENERCON E-115 TES 3000 115.7 !O! NH: 149,0 m (Ges:206,9 m) (44)

Voraussetzungen für Berechnung des Schattenwurfs

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [GIESSEN]

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,28 2,77 3,62 5,55 6,87 6,24 7,46 6,68 4,78 2,83 1,59 1,12

Betriebsdauer je Sektor

N NNO ONO O OSO SSO S SSW WSW W WNW NNW Summe
472 434 438 443 336 762 458 1.263 1.455 697 282 197 7.238
Startwindgeschwindigkeit: Startwindgeschw. aus Leistungskennlinie

	Juli		August		September		Oktober		November		Dezember	
1	05:14	19:52-20:52/60	05:49	19:37-20:20/43	06:36	18:43-19:08/25	07:22		07:14	16:00-16:17/17	08:02	
	21:40		21:10		20:11		19:04		17:00		16:22	
2	05:15	19:51-20:52/61	05:50	19:37-20:16/39	06:37	18:42-19:08/26	07:24		07:15	16:03-16:14/11	08:04	
	21:40		21:09		20:09		19:02		16:58		16:21	
3	05:15	19:52-20:52/60	05:52	19:37-20:13/36	06:39	18:41-19:08/27	07:26		07:17		08:05	
	21:39		21:07		20:06		18:59		16:57		16:21	
4	05:16	19:52-20:53/61	05:53	19:38-20:13/35	06:41	18:41-19:09/28	07:27		07:19		08:06	
	21:39		21:05		20:04		18:57		16:55		16:20	
5	05:17	19:49-20:52/63	05:55	19:38-20:12/34	06:42	18:40-19:08/28	07:29		07:20		08:08	
	21:39		21:04		20:02		18:55		16:53		16:20	
6	05:18	19:48-20:52/64	05:56	19:38-20:11/33	06:44	18:40-19:08/28	07:30		07:22		08:09	
	21:38		21:02		20:00		18:53		16:52		16:20	
7	05:19	19:47-20:52/65	05:58	19:39-20:11/32	06:45	18:39-19:07/28	07:32		07:24		08:10	
	21:38		21:00		19:58		18:51		16:50		16:19	
8	05:19	19:46-20:53/67	05:59	19:39-20:10/31	06:47	18:40-19:07/27	07:34		07:26		08:11	
	21:37		20:59		19:55	18:27-18:35/8	18:48		16:48		16:19	
9	05:20	19:46-20:53/67	06:01	19:40-20:09/29	06:48	18:39-19:05/26	07:35	17:29-17:40/11	07:27		08:12	
	21:36		20:57		19:53	18:23-18:38/15	18:46		16:47		16:19	
10	05:21	19:45-20:53/68	06:02	19:41-20:08/27	06:50	18:21-19:05/44	07:37	17:26-17:42/16	07:29		08:13	
	21:36		20:55		19:51		18:44		16:45		16:18	
11	05:22	19:44-20:52/68	06:04	19:42-20:07/25	06:51	18:18-19:03/45	07:38	17:25-17:43/18	07:31		08:15	
	21:35		20:53		19:49		18:42		16:44		16:18	
12	05:23	19:43-20:52/69	06:05	19:43-20:05/22	06:53	18:17-19:02/45	07:40	17:24-17:44/20	07:32		08:16	
	21:34		20:51		19:46		18:40		16:42		16:18	
13	05:24	19:42-20:51/69	06:07	19:45-20:02/17	06:54	18:43-18:59/16	07:42	17:23-17:45/22	07:34		08:16	
	21:33		20:49		19:44	18:16-18:42/26	18:38	17:07-17:18/11	16:41		16:18	
14	05:25	19:41-20:51/70	06:08	19:48-20:00/12	06:56	18:46-18:56/10	07:43	17:22-17:44/22	07:36		08:17	
	21:33		20:48		19:42	18:15-18:43/28	18:35	17:03-17:20/17	16:40		16:18	
15	05:27	19:42-20:52/70	06:10		06:57	18:14-18:42/28	07:45	17:01-17:45/44	07:37		08:18	
	21:32		20:46		19:40		18:33		16:38		16:18	
16	05:28	19:41-20:51/70	06:11		06:59	18:14-18:42/28	07:47	17:00-17:45/45	07:39		08:19	
	21:31		20:44		19:37	07:43-07:51/8	18:31		16:37		16:18	
17	05:29	19:41-20:51/70	06:13		07:01	18:13-18:42/29	07:48	16:58-17:44/46	07:41		08:20	
	21:30		20:42		19:35	07:40-07:52/12	18:29		16:36		16:19	
18	05:30	20:32-20:50/18	06:14		07:02	18:13-18:42/29	07:50	16:57-17:44/47	07:42		08:21	
	21:29	19:40-20:31/51	20:40		19:33	07:39-07:53/14	18:27		16:34		16:19	
19	05:31	20:33-20:49/16	06:16		07:04	18:12-18:40/28	07:52	16:56-17:43/47	07:44		08:21	
	21:28	19:40-20:31/51	20:38		19:31	07:38-07:53/15	18:25		16:33		16:19	
20	05:33	20:34-20:47/13	06:17		07:05	18:13-18:40/27	07:53	16:56-17:42/46	07:46		08:22	
	21:26	19:39-20:31/52	20:36		19:28	07:38-07:53/15	18:23		16:32		16:20	
21	05:34	20:35-20:45/10	06:19		07:07	18:12-18:39/27	07:55	16:54-17:40/46	07:47		08:23	
	21:25	19:38-20:30/52	20:34		19:26	07:37-07:52/15	18:21		16:31		16:20	
22	05:35	20:40-20:43/3	06:20		07:08	18:13-18:38/25	07:57	16:54-17:39/45	07:49		08:23	
	21:24	19:39-20:31/52	20:32		19:24	07:38-07:51/13	18:19		16:30		16:20	
23	05:36	19:38-20:30/52	06:22		07:10	18:13-18:36/23	07:58	17:26-17:37/11	07:50		08:24	
	21:23		20:30		19:22	07:38-07:49/11	18:17	16:54-17:25/31	16:29		16:21	
24	05:38	19:38-20:29/51	06:24		07:11	18:15-18:34/19	08:00	16:55-17:25/30	07:52		08:24	
	21:22		20:28		19:19	07:40-07:48/8	18:15		16:28		16:22	
25	05:39	19:37-20:29/52	06:25		07:13	18:16-18:31/15	07:02	15:55-16:25/30	07:54		08:24	
	21:20		20:26		19:17		17:13		16:27		16:22	
26	05:40	19:38-20:29/51	06:27		07:15	18:20-18:28/8	07:03	15:54-16:24/30	07:55		08:25	
	21:19		20:24		19:15		17:11		16:26		16:23	
27	05:42	19:37-20:28/51	06:28	18:54-19:00/6	07:16		07:05	15:55-16:23/28	07:57		08:25	
	21:18		20:21		19:13		17:09		16:25		16:24	
28	05:43	19:37-20:26/49	06:30	18:50-19:03/13	07:18		07:07	15:56-16:23/27	07:58		08:25	
	21:16		20:19		19:10		17:07		16:24		16:24	
29	05:44	19:36-20:25/49	06:31	18:48-19:06/18	07:19		07:08	15:57-16:22/25	07:59		08:25	
	21:15		20:17		19:08		17:06		16:23		16:25	
30	05:46	19:37-20:24/47	06:33	18:46-19:06/20	07:21		07:10	15:58-16:21/23	08:01		08:26	
	21:13		20:15		19:06		17:04		16:23		16:26	
31	05:47	19:37-20:22/45	06:34	18:45-19:08/23			07:12	16:00-16:20/20			08:26	
	21:12		20:13				17:02				16:27	
Sonnenscheinstunden	496		450		380		333		271		250	
Anzahl Minuten mit Schatten	1887		495		877		758		28		0	

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

Tag im Monat	Sonnenaufgang (SS:MM)	Sonnenuntergang (SS:MM)	Zeitpunkt (SS:MM)	Schattenanfang-Zeitpunkt (SS:MM)	Schattenende/Minuten mit Schatten
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