

Parco Eolico "San Leone"

Comune di Crotone, Cutro, Scandale (KR)

Proponente



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STUDIO SUGLI EFFETTI DI SHADOW-FLICKERING

Progettista



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1 Premessa

La società Renantis Italia Srl, d'ora in avanti il Proponente, intende realizzare un impianto di produzione di energia elettrica da fonte eolica nella provincia Crotona (KR), in agro dei comuni di Crotona, Cutro e Scandale.

L'impianto, denominato parco eolico "San Leone", sarà costituito da 12 aerogeneratori di potenza unitaria nominale fino a 6,2 MW, per una potenza installata complessiva fino a 74,4 MW, abbinato a un sistema di accumulo elettrochimico di potenza nominale pari a 10 MW e capacità 40 MWh.

Data la potenza dell'impianto, superiore ai 10.000 kW, il servizio di connessione sarà erogato in alta tensione (AT), ai sensi della Delibera dell'Autorità per l'energia elettrica e il gas 23 luglio 2008 n.99 e s.m.i.

Gli aerogeneratori forniscono energia elettrica in bassa tensione (690V) e sono pertanto dotati di un trasformatore MT/BT ciascuno, alloggiato all'interno dell'aerogeneratore stesso e in grado di elevare la tensione a quella della rete del parco. La rete del parco è costituita da un elettrodotto interrato a 36 kV, tramite il quale l'energia elettrica viene convogliata dagli aerogeneratori alla sottostazione elettrica (SSE) di raccolta di proprietà del Proponente che sarà collegata a una nuova Stazione Elettrica a 380/150/36 kV di proprietà di Terna Spa da inserire in entra – esce alla linea RTN a 380 kV "Belcastro - Scandale" (nel seguito "nuova SE").

Le opere progettuali sono quindi sintetizzate nel seguente elenco:

- parco eolico composto da 12 aerogeneratori, da 6,2 MW ciascuno, con torre di altezza fino a 125 m e diametro del rotore fino a 170 m, e dalle relative opere civili connesse quali strade di accesso, piazzole e fondazioni;
- impianto di utenza per la connessione alla RTN, consistente nella rete di terra, nella rete di comunicazione in fibra ottica, nell'elettrodotto a 36 kV di collegamento tra aerogeneratori interamente interrato e sviluppato principalmente sotto strade esistenti, nella SSE di raccolta di proprietà del Proponente e nell'elettrodotto interrato a 36 kV di collegamento tra la SSE e la nuova SE.
- Impianto di rete per la connessione alla RTN, consistente in una nuova SE a 380/150/36 kV della RTN da inserire in entra – esce alla linea RTN a 380 kV "Belcastro - Scandale" e nello stallo di arrivo produttore a 36 kV della nuova SE.

I progetti del tipo in esame rispondono a finalità di interesse pubblico (riduzione dei gas ad effetto serra, risparmio di fonti fossili scarse ed importate) e in quanto tali sono indifferibili e urgenti, come stabilito dalla legge 1° giugno 2002, n. 120, concernente "Ratifica ed esecuzione del Protocollo di Kyoto alla Convenzione quadro delle Nazioni Unite sui cambiamenti climatici, stipulato a Kyoto l'11 dicembre 1997" e dal D.Lgs. 29 dicembre 2003, n.387 "Attuazione della direttiva 2001/77/CE relativa alla promozione dell'energia elettrica prodotta da fonti energetiche rinnovabili nel mercato interno dell'elettricità" e s.m.i..

2 Scopo

Scopo della presente relazione è analizzare gli effetti di ombreggiamento e sfarfallio (shadow-flickering) causati dal parco eolico "San Leone", che la società Renantis Italia Srl propone di realizzare in agro del comune di Scandale, Crotona e Cutro (KR).

L'analisi condotta permette di determinare l'entità del fenomeno, in termini di aree interessate e tempo di occorrenza, e di studiarne l'impatto sui potenziali recettori sensibili presenti in prossimità dell'impianto.

3 Effetto di shadow-flickering

L'effetto "Shadow-flickering" è dovuto all'ombra delle pale in movimento e comporta un effetto di sfarfallio che può avere un impatto negativo sulle persone che vivono in prossimità del parco eolico. In particolare la variazione di intensità luminosa genera un senso di fastidio a frequenze comprese tra i 2,5 ed i 20 Hz [Verkuijlen and Westra, 1984].

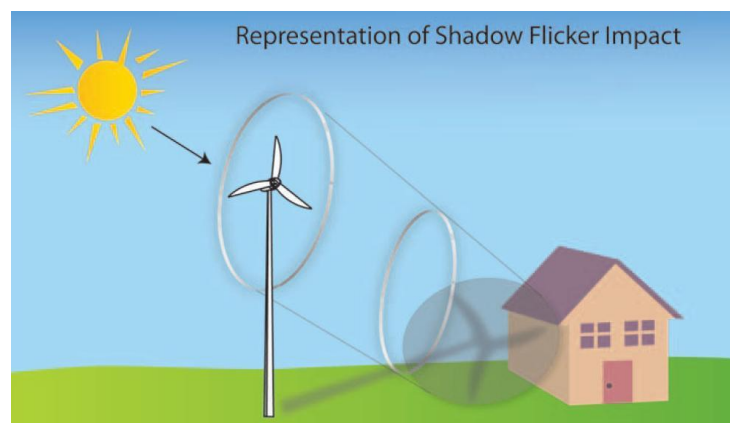


Figura 3-1 – Rappresentazione dell'impatto dovuto all'effetto "shadow-flickering"

Gli aerogeneratori di grande taglia, come quelli a progetto, sono caratterizzati da basse velocità di rotazione (8-10 rpm) che si traducono in frequenze di passaggio dell'ombra dell'ordine dei 0,5-1,5 Hz. Tali valori, inferiori al range considerato fastidioso per l'individuo, possono essere considerati innocui e non correlabili ad eventuali malesseri o attacchi di natura epilettica.

In ogni caso, gli effetti negativi di tale fenomeno stroboscopico dipendono da una serie di condizioni ambientali, tra cui la posizione del sole, variabile a seconda dell'ora del giorno e del giorno dell'anno, le condizioni meteorologiche e la posizione di recettori sensibili rispetto agli aerogeneratori.

4 Potenziali recettori

In Figura 4-1 sono illustrati i recettori sensibili presenti nell'area, presi in considerazione nella presente analisi. I fabbricati sono identificabili mediante riferimento numerico e i relativi dati catastali sono riportati in Tabella 4.1. Per maggiori dettagli il censimento dei ricettori sensibili è riportato nell'Allegato II. Lo studio è stato condotto per un aerogeneratore di riferimento corrispondente al modello SG170 della Siemens Gamesa, con rotore di diametro 170 m.

Tabella 4.1 – Dati catastali e coordinate dei ricettori sensibili presenti nell’area

ID	Comune	Foglio	Particella	Categoria	Coordinate WGS84 UTM 32N		Elevazione e [m.s.l.m.]
A01	Crotone	23	583	A03	676197 m E	4328446 m N	37
A02	Crotone	23	584	A03	676187 m E	4328412 m N	37
A03	Crotone	23	814	A03 / C06	676142 m E	4328411 m N	37
A04	Crotone	23	806	A03	676033 m E	4328469 m N	40
A05	Crotone	28	323	A02 / C03	675596 m E	4328830 m N	69
A06	Scandale	14	283	A03	672468 m E	4330413 m N	102
A07	Scandale	17	61	A03 / D10	672619 m E	4328646 m N	164

Tabella 4.2 – Legenda categorie catastali

Categoria	Descrizione
A/2	Abitazioni di tipo civile
A/3	Abitazioni di tipo economico
A/4	Abitazioni di tipo popolare
C/2	Magazzini e locali di deposito
C/6	Stalle, scuderie, rimesse, autorimesse (senza fine di lucro)
D/10	Fabbricati per funzioni produttive connesse alle attività agricole
E/3	Costruzioni e fabbricati per speciali esigenze pubbliche
F/3	Unità in corso di costruzione

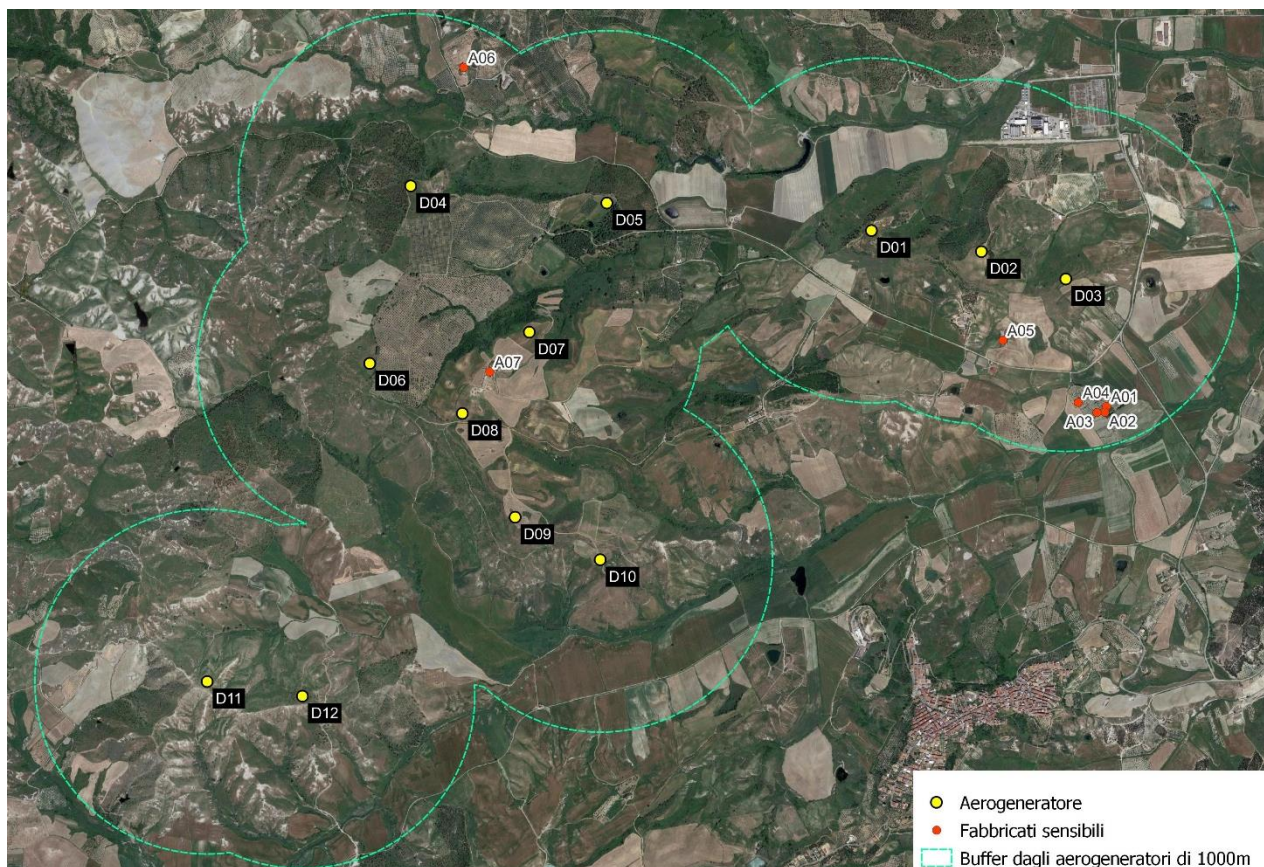


Figura 4-1 – Localizzazione recettori sensibili presenti nell'area di impianto

5 Metodologia

L'analisi è stata condotta mediante l'utilizzo del software WindPro.

Gli scenari considerati sono:

- **caso peggiore**, basato sulle ipotesi di:
 - impianto in funzione per 8760 ore l'anno, ovvero presenza costante di vento;
 - sole splendente per tutto l'anno dall'alba al tramonto;
 - rotore orientato sempre ortogonalmente all'asse di congiunzione tra il sole e il ricettore;
- **caso reale**, basato sulle ipotesi di:
 - impianto funzionante per 7807 ore l'anno.
 - probabilità di presenza del sole espressa come media mensile di ore al giorno di sole come riportato nella seguente tabella.

Tabella 5.1 – Media mensile di ore al giorno di presenza sole

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.16	4.62	5.58	6.71	8.10	9.27	10.00	9.47	7.89	5.95	5.05	4.11

Tali valori sono contenuti nel database di dati meteo-climatici interno al Software e in particolare si riferiscono a registrazioni effettuate nel periodo temporale 1969-1989 presso la stazione di Crotona, ad un'elevazione di 155 m.s.l.m. e ad una distanza di circa 11 km dal sito di progetto;

- rotore orientato in funzione della direzione del vento, determinata sulla base dei dati usati per la stima di producibilità dell'impianto. Per entrambi gli scenari (caso peggiore e caso reale) sono valide le seguenti assunzioni:
 - altezza minima del sole sull'orizzonte pari a 3°;
 - assenza di ostacoli nell'area, che blocchino l'ombra;
 - ombra proiettata fino a una distanza di 2040 m da ciascun aerogeneratore;
 - ricettori dotati di finestre con dimensione standard pari a 1,5x1,5 m e altezza da terra pari a 1 m;
 - altezza occhio umano pari a 1,7 m.
 - "green-house mode", ovvero che le finestre degli edifici sono modellate come ortogonali a tutti gli aerogeneratori.

Il censimento dei potenziali recettori è stato effettuato mediante l'utilizzo di mappa catastale e opportuni sopralluoghi in campo. Nella presente analisi sono stati considerati "recettori sensibili" i fabbricati regolarmente censiti a catasto con destinazione d'uso abitativa (categoria A) e i fabbricati caratterizzati dalla presenza continuativa di persone.

6 Risultati

In Tabella 6.1 sono riportati i risultati di calcolo in termini di numero massimo di ore d'ombra all'anno stimate, ad altezza uomo, in corrispondenza di ciascun recettore e dovute alla presenza dell'intero parco eolico. I risultati illustrati fanno riferimento ai due scenari (caso peggiore e caso reale) descritti nel precedente paragrafo. I risultati completi ottenuti dal software WindPro sono riportati alla fine della presente relazione nell'Allegato I. Il caso reale viene, inoltre, illustrato graficamente nell'immagine seguente, nella quale il numero di ore/anno di ombreggiamento viene indicato sull'area di interesse tramite differenti colorazioni.

Tabella 6.1 – Numero di ore d'ombra all'anno e numero massimo di minuti d'ombra al giorno al ricettore calcolato mediante software WindPro

ricettore	caso peggiore		caso reale	
	[h:mm/year]	[h:mm/day]	[h/year]	[mm/day]
A01	00:00	00:00	00:00	00:00
A02	00:00	00:00	00:00	00:00
A03	00:00	00:00	00:00	00:00
A04	00:00	00:00	00:00	00:00
A05	00:00	00:00	00:00	00:00
A06	02:56	00:13	00:39	00:04
A07	336:51	2:14	103:49	00:42

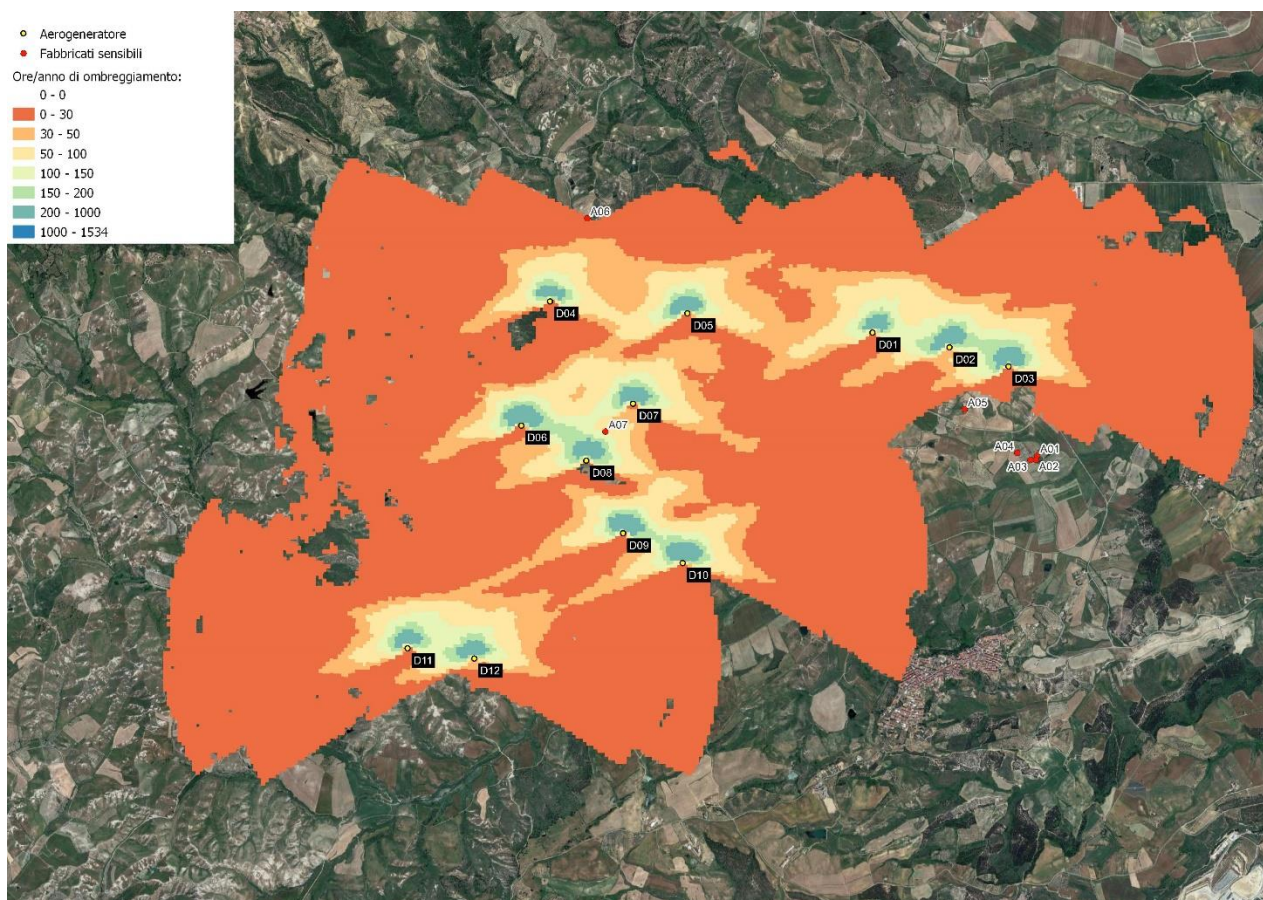


Figura 6-1 – Rappresentazione grafica del numero di ore d'ombra all'anno calcolato mediante software WindPro per lo scenario "caso reale"

7 Conclusioni

In conclusione, si sottolinea che l'effetto di ombreggiamento generato dagli aerogeneratori in movimento non ha alcun impatto sui ricettori sensibili presenti nell'area di progetto. In particolare, si riscontra un periodo di ombreggiamento nullo presso i ricettori A01, A02, A03, A04, A05.

L'unica eccezione la si ha presso i ricettori A06 e A07, i quali nello scenario di "caso peggiore" saranno rispettivamente impattati per 2:56 ore/anno e 336:51 ore/anno e nello scenario "caso reale" per 00:39 ore/anno e 103:49 ore/anno. Si evidenzia che la massima durata giornaliera dell'ombreggiamento nell'anno è pari a 42 minuti e che lo scenario reale si basa comunque su assunzioni conservative, quali ad esempio la totale assenza di ostacoli tra ricettori e parco eolico. Il ricettore A07, considerato sensibile in quanto censito a catasto come abitazione di tipo economico (categoria A/3), da indagini condotte in campo risulta non permanentemente abitato.

Ne emerge dunque che gli effetti di shadow flickering hanno un impatto nullo sui ricettori circostanti, fatta eccezione del fabbricato A07, il quale però non risulta abitato e dunque nel complesso si può affermare che non vi saranno ripercussioni negative sul territorio in cui si inseriscono le opere di progetto.

ALLEGATO I

Risultati della simulazione di shadow-flickering del parco eolico "San Leone"
eseguita mediante software WindPro

SHADOW - Main Result

Calculation: Worst case

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

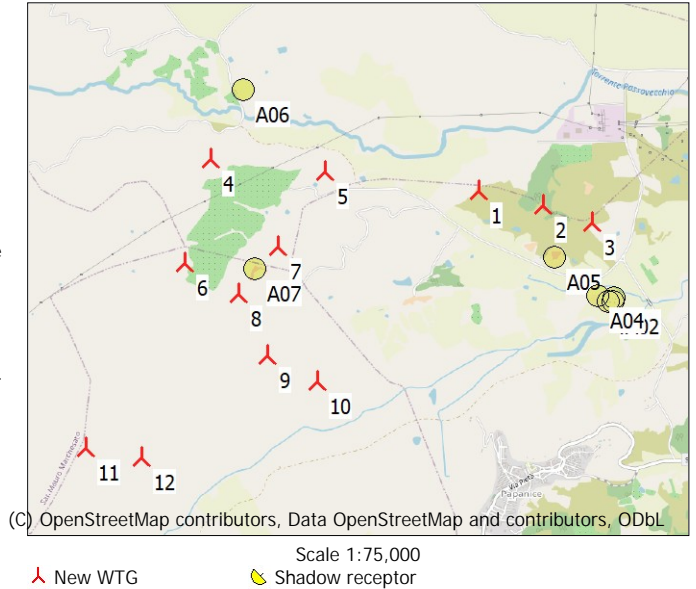
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes
The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values.
A WTG will be visible if it is visible from any part of the receiver window.

The ZVI calculation is based on the following assumptions:
Height contours used: Curve di livello
Receptor grid resolution: 1.0 m
Topographic shadow included in calculation

All coordinates are in
UTM (north)-WGS84 Zone: 33

WTGs



	Easting	Northing	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM
			[m]									
1	674,833	4,329,466	120.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
2	675,471	4,329,344	130.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
3	675,961	4,329,185	110.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
4	672,160	4,329,725	160.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
5	673,298	4,329,626	115.6	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
6	671,922	4,328,695	166.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
7	672,848	4,328,877	150.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
8	672,460	4,328,405	160.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
9	672,766	4,327,804	150.5	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
10	673,259	4,327,557	113.8	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
11	670,979	4,326,850	146.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
12	671,532	4,326,765	137.9	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l. [m]	of window [°]		(ZVI) a.g.l. [m]
A01	676,197	4,328,446	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A02	676,187	4,328,412	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A03	676,142	4,328,411	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A04	676,033	4,328,469	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A05	675,594	4,328,832	62.2	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A06	672,468	4,330,413	90.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A07	672,619	4,328,646	160.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5

Calculation Results

Shadow receptor

Shadow, worst case

No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A01	0:00	0	0:00
A02	0:00	0	0:00
A03	0:00	0	0:00
A04	0:00	0	0:00
A05	0:00	0	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Worst case

...continued from previous page

Shadow, worst case

No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A06	2:56	17	0:13
A07	346:51	232	2:14

Total amount of flickering on the shadow receptors caused by each WTG

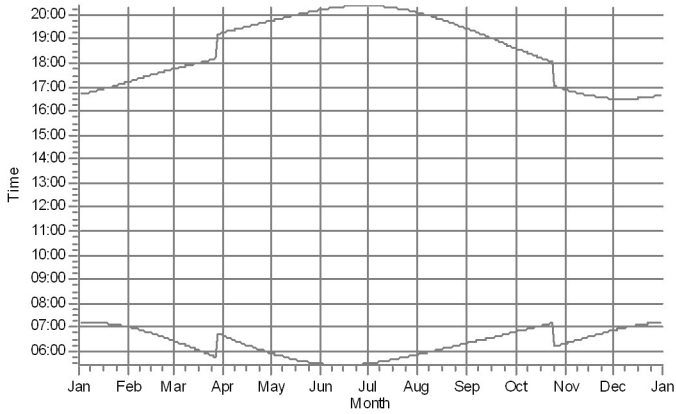
No.	Name	Worst case [h/year]
1	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (13)	0:00
2	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (14)	0:00
3	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (15)	0:00
4	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (16)	0:00
5	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (17)	2:56
6	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (18)	59:27
7	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (19)	0:00
8	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (20)	287:24
9	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (21)	0:00
10	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (22)	0:00
11	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (23)	0:00
12	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (24)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

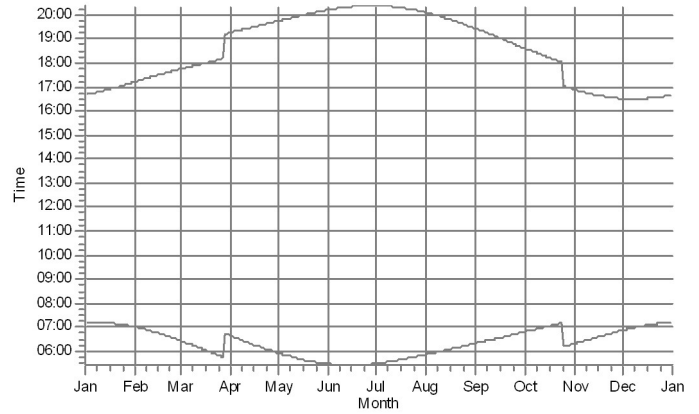
SHADOW - Calendar, graphical

Calculation: Worst case

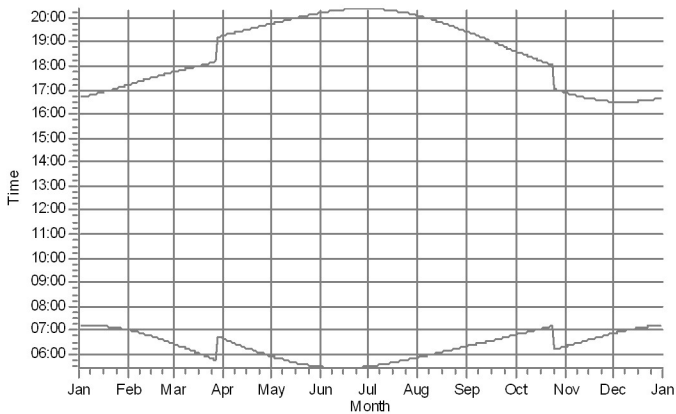
A01: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 90.0° (1)



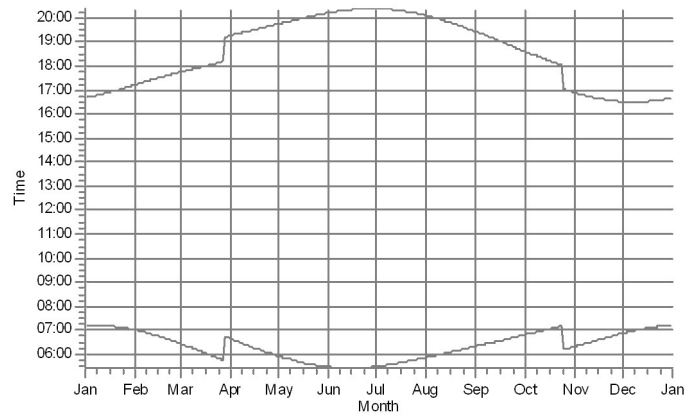
A02: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (2)



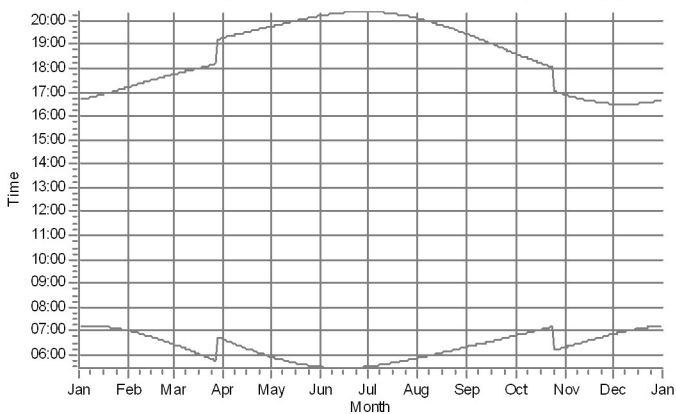
A03: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (3)



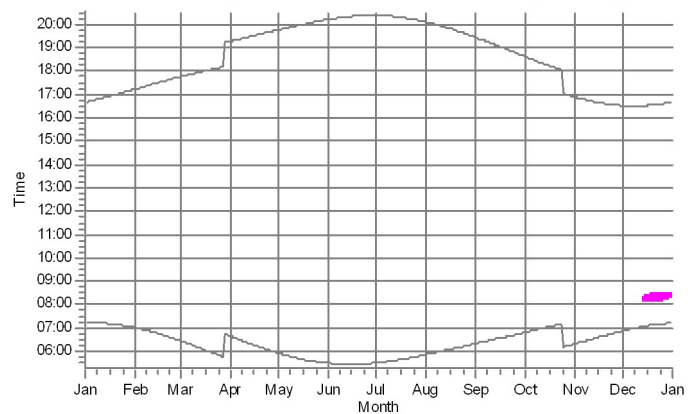
A04: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (4)



A05: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (5)



A06: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (6)

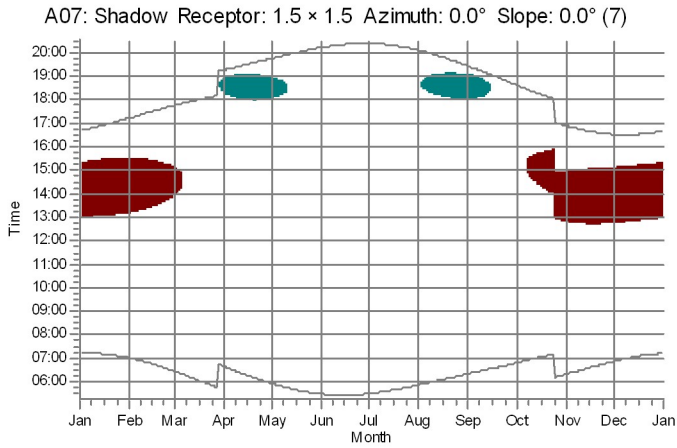


WTGs

5: Siemens Gamesa SG 170 6000 170.0 !OI! hub: 125.0 m (TOT: 210.0 m) (17)

SHADOW - Calendar, graphical

Calculation: Worst case



WTGs



6: Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (18)



8: Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (20)

SHADOW - Calendar

Calculation: Worst case Shadow receptor: A01 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 90.0° (1)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:26 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
2	07:12 16:41	06:59 17:14	06:25 17:45	06:37 19:16	05:54 19:45	05:28 20:12	05:30 20:22	05:53 20:04	06:21 19:23	06:48 18:35	06:20 16:52	06:53 16:30
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Potential sun hours Total, worst case	303	300	370	396	443	446	453	424	374	347	302	294

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker (WTG causing flicker first time)	Last time (hh:mm) with flicker (WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Worst case Shadow receptor: A02 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (2)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:26 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
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Potential sun hours Total, worst case	303	300	370	396	443	446	453	424	374	347	302	294

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker (WTG causing flicker first time)	Last time (hh:mm) with flicker (WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Worst case Shadow receptor: A03 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (3)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:26 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
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27	07:04 17:07	06:29 17:42	05:46 18:10	06:01 19:40	05:31 20:08	05:28 20:22	05:48 20:10	06:16 19:32	06:44 18:43	06:13 16:59	06:47 16:32	07:10 16:36
28	07:03 17:08	06:28 17:43	05:45 18:11	05:59 19:41	05:31 20:09	05:28 20:22	05:48 20:09	06:16 19:30	06:45 18:41	06:14 16:58	06:48 16:31	07:10 16:37
29	07:02 17:09		06:43 19:12	05:58 19:42	05:30 20:10	05:29 20:22	05:49 20:08	06:17 19:29	06:46 18:40	06:16 16:56	06:50 16:31	07:11 16:37
30	07:02 17:10		06:42 19:13	05:57 19:43	05:30 20:10	05:29 20:22	05:50 20:07	06:18 19:28	06:46 18:38	06:17 16:55	06:51 16:31	07:11 16:38
31	07:01 17:11		06:40 19:14		05:29 20:11		05:51 20:06	06:19 19:26		06:18 16:54		07:11 16:39
Potential sun hours Total, worst case	303	300	370	396	443	446	453	424	374	347	302	294

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker (WTG causing flicker first time)	Last time (hh:mm) with flicker (WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Worst case Shadow receptor: A04 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (4)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:26 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
2	07:12 16:41	06:59 17:14	06:25 17:45	06:37 19:16	05:54 19:45	05:28 20:12	05:30 20:22	05:53 20:04	06:21 19:23	06:48 18:35	06:20 16:52	06:53 16:30
3	07:12 16:42	06:58 17:15	06:24 17:46	06:35 19:17	05:53 19:46	05:28 20:13	05:31 20:22	05:54 20:03	06:22 19:21	06:49 18:33	06:21 16:50	06:54 16:30
4	07:12 16:42	06:57 17:16	06:22 17:47	06:34 19:18	05:52 19:47	05:28 20:14	05:31 20:22	05:55 20:02	06:23 19:20	06:50 18:32	06:22 16:49	06:54 16:30
5	07:12 16:43	06:56 17:17	06:21 17:48	06:32 19:19	05:51 19:48	05:27 20:14	05:32 20:22	05:56 20:01	06:24 19:18	06:51 18:30	06:23 16:48	06:55 16:30
6	07:12 16:44	06:55 17:18	06:19 17:49	06:31 19:20	05:50 19:49	05:27 20:15	05:32 20:22	05:56 20:00	06:25 19:17	06:52 18:29	06:24 16:47	06:56 16:30
7	07:12 16:45	06:54 17:19	06:18 17:50	06:29 19:21	05:48 19:50	05:27 20:16	05:33 20:21	05:57 19:59	06:26 19:15	06:53 18:27	06:25 16:46	06:57 16:30
8	07:12 16:46	06:53 17:21	06:16 17:51	06:28 19:22	05:47 19:51	05:27 20:16	05:33 20:21	05:58 19:57	06:26 19:14	06:54 18:26	06:27 16:45	06:58 16:30
9	07:12 16:47	06:52 17:22	06:15 17:52	06:26 19:23	05:46 19:52	05:26 20:17	05:34 20:21	05:59 19:56	06:27 19:12	06:55 18:24	06:28 16:44	06:59 16:30
10	07:12 16:48	06:51 17:23	06:13 17:53	06:25 19:24	05:45 19:53	05:26 20:17	05:35 20:20	06:00 19:55	06:28 19:10	06:56 18:23	06:29 16:43	07:00 16:30
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31	07:01 17:11		06:40 19:14		05:29 20:11		05:51 20:06	06:19 19:26		06:18 16:54		07:11 16:39
Potential sun hours Total, worst case	303	300	370	396	443	446	453	424	374	347	302	294

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker (WTG causing flicker first time)	Last time (hh:mm) with flicker (WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Worst case Shadow receptor: A05 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (5)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:27 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
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19	07:09 16:57	06:40 17:33	05:59 18:02	06:11 19:33	05:37 20:01	05:26 20:21	05:41 20:16	06:08 19:43	06:36 18:56	07:05 18:09	06:39 16:36	07:06 16:32
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31	07:01 17:11		06:40 19:14		05:29 20:11		05:51 20:06	06:19 19:26		06:18 16:54		07:11 16:39
Potential sun hours Total, worst case	303	300	370	396	443	446	453	424	374	347	302	294

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker (WTG causing flicker first time)	Last time (hh:mm) with flicker (WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Worst case Shadow receptor: A06 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (6)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:12 16:40	07:00 17:12	06:27 17:44	06:39 19:15	05:56 19:45	05:29 20:12	05:30 20:23	05:52 20:05	06:20 19:25	06:48 18:37	06:19 16:53	06:52 16:31	
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15	07:11 16:53	06:45 17:29	06:06 17:59	06:17 19:29	05:40 19:58	05:26 20:20	05:38 20:18	06:05 19:49	06:33 19:03	07:01 18:15	06:35 16:39	07:04 16:31	5 08:18 (5)
16	07:10 16:54	06:44 17:30	06:04 18:00	06:16 19:30	05:40 19:59	05:26 20:20	05:39 20:18	06:06 19:48	06:34 19:01	07:02 18:14	06:36 16:38	07:05 16:31	9 08:21 (5)
17	07:10 16:55	06:43 17:31	06:02 18:01	06:14 19:31	05:39 20:00	05:26 20:21	05:40 20:17	06:07 19:46	06:35 18:59	07:03 18:12	06:37 16:38	07:05 16:31	10 08:12 (5)
18	07:09 16:56	06:42 17:32	06:01 18:02	06:13 19:32	05:38 20:01	05:26 20:21	05:40 20:17	06:08 19:45	06:36 18:58	07:04 18:11	06:38 16:37	07:06 16:32	11 08:23 (5)
19	07:09 16:58	06:40 17:33	06:00 18:03	06:12 19:33	05:37 20:01	05:26 20:21	05:41 20:16	06:08 19:44	06:37 18:56	07:05 18:10	06:39 16:36	07:07 16:32	12 08:24 (5)
20	07:09 16:59	06:39 17:34	05:58 18:04	06:10 19:34	05:36 20:02	05:26 20:22	05:42 20:15	06:09 19:42	06:37 18:54	07:06 18:08	06:40 16:35	07:07 16:32	13 08:25 (5)
21	07:08 17:00	06:38 17:35	05:56 18:05	06:09 19:35	05:35 20:03	05:26 20:22	05:43 20:15	06:10 19:41	06:38 18:53	07:07 18:07	06:41 16:35	07:08 16:33	13 08:25 (5)
22	07:07 17:01	06:36 17:37	05:55 18:06	06:07 19:36	05:35 20:04	05:27 20:22	05:44 20:14	06:11 19:39	06:39 18:51	07:08 18:05	06:42 16:34	07:08 16:33	13 08:26 (5)
23	07:07 17:02	06:35 17:38	05:53 18:07	06:06 19:37	05:34 20:05	05:27 20:22	05:44 20:13	06:12 19:38	06:40 18:50	07:09 18:04	06:43 16:34	07:09 16:34	13 08:26 (5)
24	07:06 17:03	06:34 17:39	05:51 18:08	06:05 19:38	05:33 20:06	05:27 20:22	05:45 20:12	06:13 19:37	06:41 18:03	07:10 18:03	06:44 16:33	07:09 16:34	13 08:26 (5)
25	07:06 17:04	06:32 17:40	05:50 18:09	06:03 19:39	05:33 20:07	05:27 20:22	05:46 20:12	06:14 19:35	06:42 18:46	06:11 17:01	06:46 16:33	07:10 16:35	12 08:27 (5)
26	07:05 17:05	06:31 17:41	05:48 18:10	06:02 19:40	05:32 20:07	05:28 20:23	05:47 20:11	06:15 19:34	06:43 18:45	06:13 17:00	06:47 16:32	07:10 16:36	12 08:27 (5)
27	07:04 17:07	06:30 17:42	05:47 18:10	06:01 19:41	05:31 20:08	05:28 20:23	05:48 20:10	06:16 19:32	06:44 18:43	06:14 16:59	06:48 16:32	07:10 16:36	10 08:26 (5)
28	07:03 17:08	06:28 17:43	05:45 18:11	05:59 19:42	05:31 20:09	05:28 20:23	05:49 20:09	06:17 19:31	06:45 18:42	06:15 16:58	06:49 16:32	07:11 16:37	9 08:27 (5)
29	07:03 17:09		06:43 19:12	05:58 19:43	05:30 20:10	05:29 20:23	05:49 20:08	06:18 19:29	06:46 18:40	06:16 16:56	06:50 16:31	07:11 16:38	7 08:26 (5)
30	07:02 17:10		06:42 19:13	05:57 19:44	05:30 20:10	05:29 20:23	05:50 20:07	06:18 19:28	06:47 18:38	06:17 16:55	06:51 16:31	07:11 16:38	8 08:22 (5)
31	07:01 17:11		06:40 19:14		05:29 20:11		05:51 20:06	06:19 19:26		06:18 16:54		07:11 16:39	2 08:24 (5)
Potential sun hours	303	300	370	396	443	446	453	424	374	347	302	294	
Total, worst case													176

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Worst case Shadow receptor: A07 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (7)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January		February		March		April		May		June	
1	07:12		13:03 (8)	07:00	13:17 (8)	06:27	14:03 (8)	06:39	18:24 (6)	05:56	18:08 (6)	05:29
	16:40	133	15:16 (8)	17:13	15:25 (8)	17:44	15:01 (8)	19:15	18:50 (6)	19:45	18:51 (6)	20:12
2	07:12		13:03 (8)	06:59	13:18 (8)	06:25	14:07 (8)	06:37	18:20 (6)	05:54	18:09 (6)	05:28
	16:41	133	15:16 (8)	17:14	15:26 (8)	17:45	14:58 (8)	19:16	18:52 (6)	19:45	18:50 (6)	20:13
3	07:12		13:04 (8)	06:58	13:19 (8)	06:24	14:11 (8)	06:36	18:18 (6)	05:53	18:11 (6)	05:28
	16:42	133	15:17 (8)	17:15	15:26 (8)	17:46	14:55 (8)	19:17	18:54 (6)	19:46	18:49 (6)	20:13
4	07:12		13:04 (8)	06:57	13:20 (8)	06:22	14:16 (8)	06:34	18:16 (6)	05:52	18:12 (6)	05:28
	16:43	133	15:17 (8)	17:16	15:26 (8)	17:47	14:51 (8)	19:18	18:55 (6)	19:47	18:47 (6)	20:14
5	07:12		13:05 (8)	06:56	13:21 (8)	06:21	14:22 (8)	06:32	18:14 (6)	05:51	18:14 (6)	05:27
	16:43	133	15:18 (8)	17:17	15:25 (8)	17:48	14:46 (8)	19:19	18:56 (6)	19:48	18:46 (6)	20:15
6	07:12		13:05 (8)	06:55	13:22 (8)	06:19		06:31	18:13 (6)	05:50	18:15 (6)	05:27
	16:44	133	15:18 (8)	17:18	15:25 (8)	17:49		19:20	18:57 (6)	19:49	18:44 (6)	20:15
7	07:12		13:05 (8)	06:54	13:22 (8)	06:18		06:29	18:11 (6)	05:49	18:17 (6)	05:27
	16:45	134	15:19 (8)	17:20	15:24 (8)	17:50		19:21	18:57 (6)	19:50	18:42 (6)	20:16
8	07:12		13:06 (8)	06:53	13:23 (8)	06:16		06:28	18:10 (6)	05:47	18:20 (6)	05:27
	16:46	133	15:19 (8)	17:21	15:24 (8)	17:51		19:22	18:59 (6)	19:51	18:40 (6)	20:16
9	07:12		13:07 (8)	06:52	13:24 (8)	06:15		06:26	18:09 (6)	05:46	18:23 (6)	05:26
	16:47	133	15:20 (8)	17:22	15:23 (8)	17:53		19:23	18:59 (6)	19:52	18:36 (6)	20:17
10	07:12		13:07 (8)	06:51	13:25 (8)	06:13		06:25	18:08 (6)	05:45		05:26
	16:48	134	15:21 (8)	17:23	15:23 (8)	17:54		19:24	19:00 (6)	19:53		20:18
11	07:12		13:07 (8)	06:50	13:26 (8)	06:12		06:23	18:07 (6)	05:44		05:26
	16:49	134	15:21 (8)	17:24	15:23 (8)	17:55		19:25	18:59 (6)	19:54		20:18
12	07:11		13:07 (8)	06:49	13:28 (8)	06:10		06:22	18:06 (6)	05:43		05:26
	16:50	134	15:21 (8)	17:25	15:22 (8)	17:56		19:26	19:00 (6)	19:55		20:19
13	07:11		13:08 (8)	06:48	13:29 (8)	06:09		06:20	18:05 (6)	05:42		05:26
	16:51	134	15:22 (8)	17:26	15:22 (8)	17:57		19:27	19:00 (6)	19:56		20:19
14	07:11		13:08 (8)	06:47	13:30 (8)	06:07		06:19	18:05 (6)	05:41		05:26
	16:52	134	15:22 (8)	17:28	15:21 (8)	17:58		19:28	19:00 (6)	19:57		20:19
15	07:11		13:09 (8)	06:45	13:31 (8)	06:06		06:17	18:04 (6)	05:40		05:26
	16:53	134	15:23 (8)	17:29	15:20 (8)	17:59		19:29	19:00 (6)	19:58		20:20
16	07:10		13:09 (8)	06:44	13:33 (8)	06:04		06:16	18:04 (6)	05:40		05:26
	16:54	134	15:23 (8)	17:30	15:19 (8)	18:00		19:30	19:00 (6)	19:59		20:20
17	07:10		13:09 (8)	06:43	13:35 (8)	06:02		06:14	18:04 (6)	05:39		05:26
	16:55	134	15:23 (8)	17:31	15:19 (8)	18:01		19:31	19:00 (6)	20:00		20:21
18	07:09		13:10 (8)	06:42	13:36 (8)	06:01		06:13	18:04 (6)	05:38		05:26
	16:57	134	15:24 (8)	17:32	15:17 (8)	18:02		19:32	19:00 (6)	20:01		20:21
19	07:09		13:10 (8)	06:40	13:38 (8)	05:59		06:12	18:04 (6)	05:37		05:26
	16:58	134	15:24 (8)	17:33	15:17 (8)	18:03		19:33	19:00 (6)	20:01		20:21
20	07:08		13:11 (8)	06:39	13:40 (8)	05:58		06:10	18:03 (6)	05:36		05:26
	16:59	134	15:25 (8)	17:34	15:16 (8)	18:04		19:34	18:59 (6)	20:02		20:21
21	07:08		13:11 (8)	06:38	13:42 (8)	05:56		06:09	18:04 (6)	05:35		05:27
	17:00	134	15:25 (8)	17:35	15:14 (8)	18:05		19:35	18:59 (6)	20:03		20:22
22	07:07		13:11 (8)	06:36	13:44 (8)	05:55		06:07	18:04 (6)	05:35		05:27
	17:01	133	15:24 (8)	17:37	15:13 (8)	18:06		19:36	18:58 (6)	20:04		20:22
23	07:07		13:12 (8)	06:35	13:47 (8)	05:53		06:06	18:04 (6)	05:34		05:27
	17:02	133	15:25 (8)	17:38	15:12 (8)	18:07		19:37	18:57 (6)	20:05		20:22
24	07:06		13:12 (8)	06:34	13:49 (8)	05:51		06:05	18:04 (6)	05:33		05:27
	17:03	133	15:25 (8)	17:39	15:10 (8)	18:08		19:38	18:57 (6)	20:06		20:22
25	07:06		13:13 (8)	06:32	13:52 (8)	05:50		06:03	18:05 (6)	05:33		05:28
	17:04	132	15:25 (8)	17:40	15:09 (8)	18:09		19:39	18:57 (6)	20:07		20:22
26	07:05		13:14 (8)	06:31	13:54 (8)	05:48		06:02	18:05 (6)	05:32		05:28
	17:06	132	15:26 (8)	17:41	15:07 (8)	18:09		19:40	18:55 (6)	20:07		20:22
27	07:04		13:14 (8)	06:29	13:57 (8)	05:47		06:01	18:05 (6)	05:31		05:28
	17:07	132	15:26 (8)	17:42	15:05 (8)	18:10		19:41	18:55 (6)	20:08		20:23
28	07:03		13:15 (8)	06:28	14:01 (8)	05:45		05:59	18:06 (6)	05:31		05:29
	17:08	131	15:26 (8)	17:43	15:04 (8)	18:11		19:42	18:54 (6)	20:09		20:23
29	07:03		13:15 (8)			06:43		05:58	18:07 (6)	05:30		05:29
	17:09	131	15:26 (8)			19:12		19:43	18:53 (6)	20:10		20:23
30	07:02		13:15 (8)			06:42		05:57	18:07 (6)	05:30		05:29
	17:10	130	15:25 (8)			19:13	4	18:39 (6)	19:44	45	18:52 (6)	20:10
31	07:01		13:16 (8)			06:40		18:27 (6)				05:29
	17:11	129	15:25 (8)			19:14	19	18:46 (6)				20:11
Potential sun hours	303			300		370		396		443		446
Total, worst case		4122			2934		235		1474		276	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Worst case Shadow receptor: A07 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (7)
Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	July	August	September	October	November	December
1	05:30 20:22	05:52 20:05	06:20 19:25	18:06 (6) 18:37	06:48 16:53	12:55 (8) 14:53 (8)
2	05:30 20:22	05:53 20:04	06:21 19:23	18:06 (6) 18:35	06:48 16:52	12:53 (8) 14:53 (8)
3	05:31 20:22	05:54 20:03	18:37 (6) 19:22	06:22 18:07 (6)	06:49 18:34	12:52 (8) 14:54 (8)
4	05:31 20:22	05:55 20:02	18:31 (6) 18:47 (6)	06:23 19:20	18:07 (6) 18:56 (6)	12:51 (8) 14:54 (8)
5	05:32 20:22	05:56 20:01	18:29 (6) 18:50 (6)	06:24 19:18	18:08 (6) 18:54 (6)	12:51 (8) 14:55 (8)
6	05:32 20:22	05:57 20:00	18:26 (6) 18:52 (6)	06:25 19:17	18:09 (6) 18:53 (6)	12:50 (8) 14:55 (8)
7	05:33 20:21	05:57 19:59	18:24 (6) 18:54 (6)	06:26 19:15	18:10 (6) 18:52 (6)	12:50 (8) 14:56 (8)
8	05:33 20:21	05:58 19:58	18:22 (6) 18:55 (6)	06:27 19:14	18:10 (6) 18:49 (6)	12:49 (8) 14:56 (8)
9	05:34 20:21	05:59 19:56	18:20 (6) 18:56 (6)	06:28 19:12	18:11 (6) 18:47 (6)	12:48 (8) 14:56 (8)
10	05:35 20:20	06:00 19:55	18:19 (6) 18:58 (6)	06:28 19:11	18:13 (6) 18:45 (6)	12:47 (8) 14:56 (8)
11	05:35 20:20	06:01 19:54	18:18 (6) 18:59 (6)	06:29 19:09	18:15 (6) 18:42 (6)	12:48 (8) 14:57 (8)
12	05:36 20:20	06:02 19:53	18:17 (6) 19:00 (6)	06:30 19:07	18:19 (6) 18:20	12:47 (8) 14:57 (8)
13	05:37 20:19	06:03 19:51	18:16 (6) 19:01 (6)	06:31 19:06	18:24 (6) 18:33 (6)	12:47 (8) 14:58 (8)
14	05:37 20:19	06:04 19:50	18:15 (6) 19:01 (6)	06:32 19:04	18:32 (6) 18:17	12:47 (8) 14:58 (8)
15	05:38 20:18	06:05 19:49	18:14 (6) 19:02 (6)	06:33 19:03	07:01 18:15	12:46 (8) 14:58 (8)
16	05:39 20:18	06:06 19:48	18:12 (6) 19:02 (6)	06:34 19:01	07:02 18:14	12:47 (8) 14:59 (8)
17	05:40 20:17	06:07 19:46	18:11 (6) 19:02 (6)	06:35 18:59	07:03 18:12	12:47 (8) 14:59 (8)
18	05:40 20:17	06:08 19:45	18:11 (6) 19:03 (6)	06:36 18:58	07:04 18:11	12:46 (8) 14:59 (8)
19	05:41 20:16	06:08 19:44	18:10 (6) 19:03 (6)	06:37 18:56	07:05 18:10	12:46 (8) 14:59 (8)
20	05:42 20:15	06:09 19:42	18:09 (6) 19:03 (6)	06:37 18:54	07:06 18:08	12:46 (8) 14:59 (8)
21	05:43 20:15	06:10 19:41	18:09 (6) 19:03 (6)	06:38 18:53	07:07 18:07	12:46 (8) 15:00 (8)
22	05:44 20:14	06:11 19:39	18:08 (6) 19:03 (6)	06:39 18:51	07:08 18:05	12:47 (8) 15:01 (8)
23	05:44 20:13	06:12 19:38	18:08 (6) 19:04 (6)	06:40 18:50	07:09 18:04	12:47 (8) 15:01 (8)
24	05:45 20:12	06:13 19:37	18:07 (6) 19:02 (6)	06:41 18:48	07:10 18:03	12:47 (8) 15:01 (8)
25	05:46 20:12	06:14 19:35	18:07 (6) 19:02 (6)	06:42 18:46	06:11 17:01	12:47 (8) 15:01 (8)
26	05:47 20:11	06:15 19:34	18:06 (6) 19:02 (6)	06:43 18:45	06:13 17:00	12:47 (8) 15:01 (8)
27	05:48 20:10	06:16 19:32	18:06 (6) 19:02 (6)	06:44 18:43	06:14 16:59	12:48 (8) 15:02 (8)
28	05:49 20:09	06:17 19:31	18:06 (6) 19:02 (6)	06:45 18:42	06:15 16:58	12:48 (8) 15:02 (8)
29	05:49 20:08	06:18 19:29	18:06 (6) 19:01 (6)	06:46 18:40	06:16 16:56	12:48 (8) 15:02 (8)
30	05:50 20:07	06:18 19:28	18:06 (6) 19:01 (6)	06:47 18:38	06:17 16:55	12:48 (8) 15:02 (8)
31	05:51 20:06	06:19 19:26	18:06 (6) 19:00 (6)		06:18 16:54	12:56 (8) 14:53 (8)
Potential sun hours	453	424	374	347	302	294
Total, worst case		1296	498	1961	3898	4117

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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SHADOW - Main Result

Calculation: Real case

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CROTONE]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.16 4.62 5.58 6.71 8.10 9.27 10.00 9.47 7.89 5.95 5.05 4.11

Operational hours are calculated from WTGs in calculation and wind distribution:
Site data: WASP (7)

Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
1,460 849 653 555 268 180 349 1,485 738 262 304 726 7,828
Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values.
A WTG will be visible if it is visible from any part of the receiver window.
The ZVI calculation is based on the following assumptions:
Height contours used: Curve di livello
Receptor grid resolution: 1.0 m
Topographic shadow included in calculation

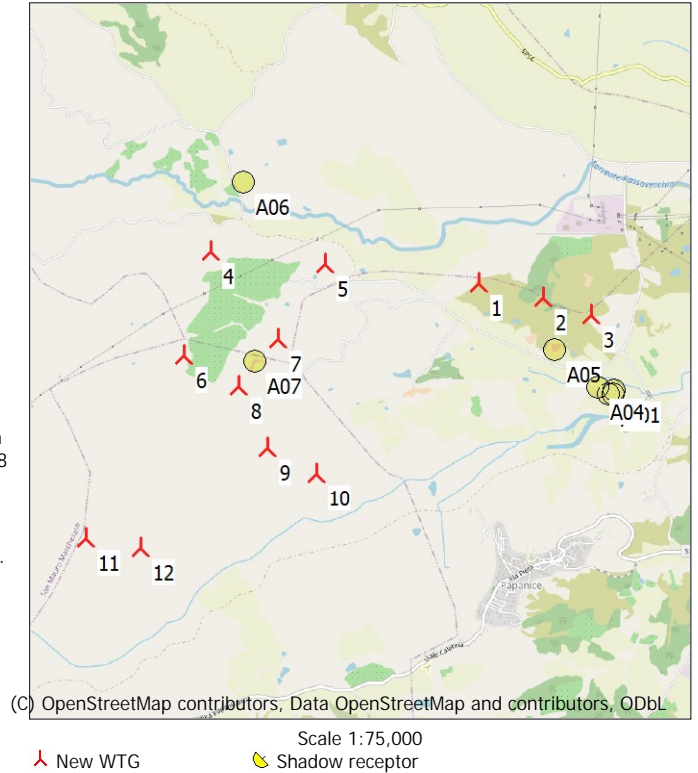
All coordinates are in
UTM (north)-WGS84 Zone: 33

WTGs

	Easting	Northing	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance [m]	RPM
			[m]									
1	674,833	4,329,466	120.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
2	675,471	4,329,344	130.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
3	675,961	4,329,185	110.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
4	672,160	4,329,725	160.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
5	673,298	4,329,626	115.6	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
6	671,922	4,328,695	166.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
7	672,848	4,328,877	150.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
8	672,460	4,328,405	160.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
9	672,766	4,327,804	150.5	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
10	673,259	4,327,557	113.8	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
11	670,979	4,326,850	146.0	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8
12	671,532	4,326,765	137.9	Siemens Gamesa SG 170 60...	Yes	Siemens Gamesa	SG 170-6,000	6,000	170.0	125.0	2,040	8.8

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l. [m]	window [°]		(ZVI) a.g.l. [m]
A01	676,197	4,328,446	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A02	676,187	4,328,412	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A03	676,142	4,328,411	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A04	676,033	4,328,469	40.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A05	675,594	4,328,832	62.2	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A06	672,468	4,330,413	90.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5
A07	672,619	4,328,646	160.0	1.5	1.5	1.0	90.0	"Green house mode"	2.5



SHADOW - Main Result

Calculation: Real case

Calculation Results

Shadow receptor

Shadow, expected values

No.	Shadow hours per year [h/year]
A01	0:00
A02	0:00
A03	0:00
A04	0:00
A05	0:00
A06	0:39
A07	103:49

Total amount of flickering on the shadow receptors caused by each WTG

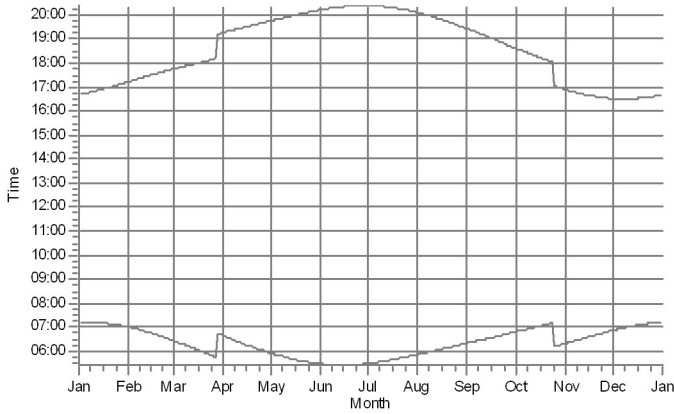
No.	Name	Expected [h/year]
1	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (13)	0:00
2	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (14)	0:00
3	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (15)	0:00
4	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (16)	0:00
5	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (17)	0:39
6	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (18)	16:02
7	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (19)	0:00
8	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (20)	86:23
9	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (21)	0:00
10	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (22)	0:00
11	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (23)	0:00
12	Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (24)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

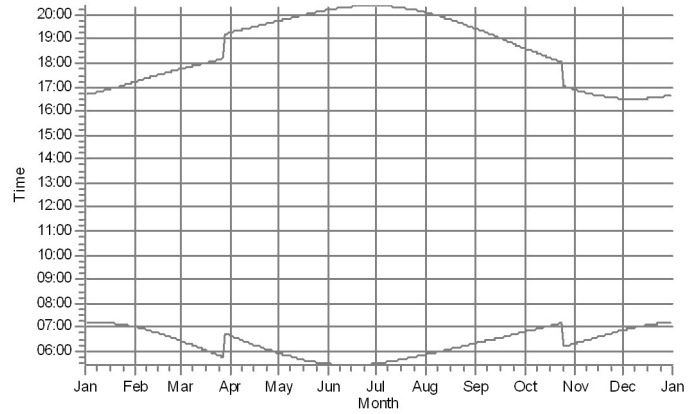
SHADOW - Calendar, graphical

Calculation: Real case

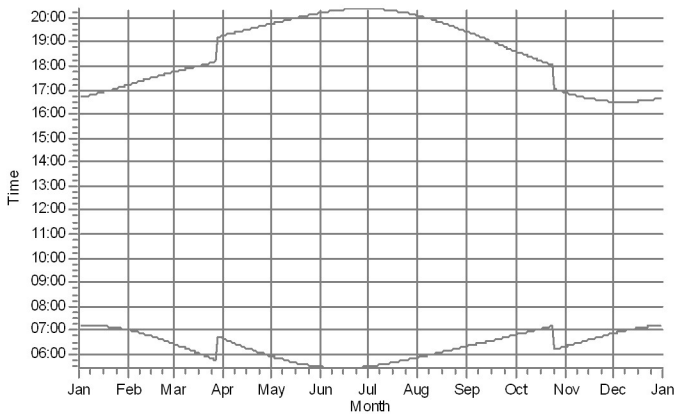
A01: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 90.0° (1)



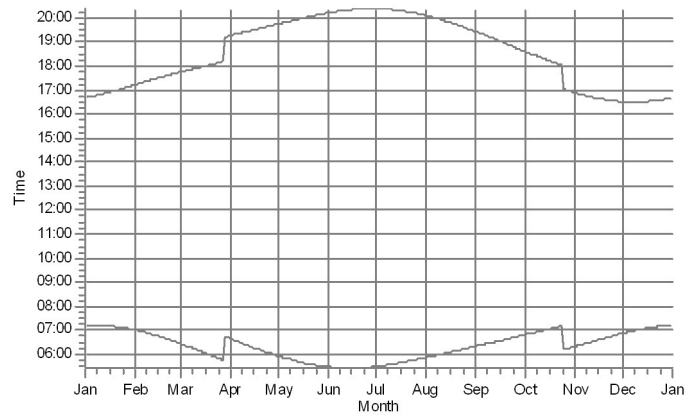
A02: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (2)



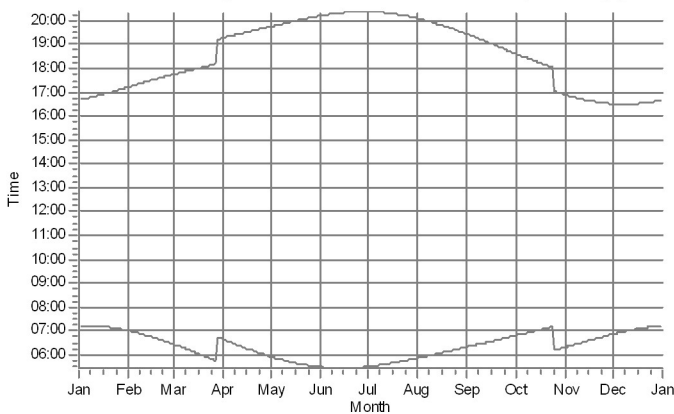
A03: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (3)



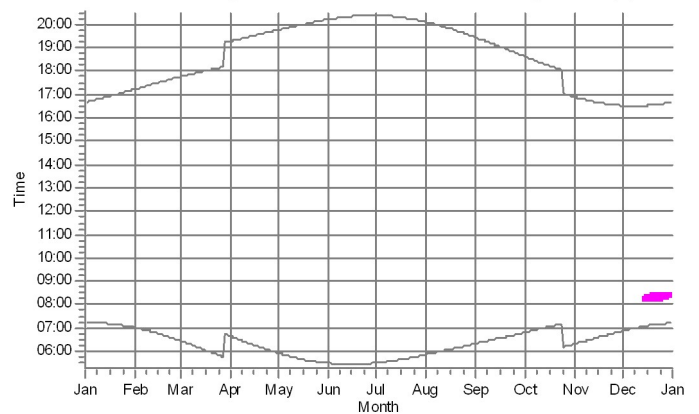
A04: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (4)



A05: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (5)



A06: Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (6)

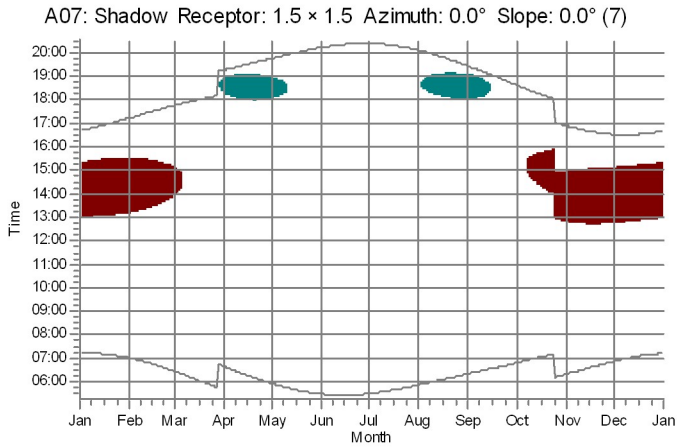


WTGs

5: Siemens Gamesa SG 170 6000 170.0 !OI! hub: 125.0 m (TOT: 210.0 m) (17)

SHADOW - Calendar, graphical

Calculation: Real case



WTGs



6: Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (18)



8: Siemens Gamesa SG 170 6000 170.0 !O! hub: 125.0 m (TOT: 210.0 m) (20)

SHADOW - Calendar

Calculation: Real case Shadow receptor: A01 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 90.0° (1)
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [CROTONE]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.16 4.62 5.58 6.71 8.10 9.27 10.00 9.47 7.89 5.95 5.05 4.11

Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
1,460 849 653 555 268 180 349 1,485 738 262 304 726 7,828
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:26 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
2	07:12 16:41	06:59 17:14	06:25 17:45	06:37 19:16	05:54 19:45	05:28 20:12	05:30 20:22	05:53 20:04	06:21 19:23	06:48 18:35	06:20 16:52	06:53 16:30
3	07:12 16:42	06:58 17:15	06:24 17:46	06:35 19:17	05:53 19:46	05:28 20:13	05:31 20:22	05:54 20:03	06:22 19:21	06:49 18:33	06:21 16:50	06:54 16:30
4	07:12 16:42	06:57 17:16	06:22 17:47	06:34 19:18	05:52 19:47	05:28 20:14	05:31 20:22	05:55 20:02	06:23 19:20	06:50 18:32	06:22 16:49	06:54 16:30
5	07:12 16:43	06:56 17:17	06:21 17:48	06:32 19:19	05:51 19:48	05:27 20:14	05:32 20:22	05:56 20:01	06:24 19:18	06:51 18:30	06:23 16:48	06:55 16:30
6	07:12 16:44	06:55 17:18	06:19 17:49	06:31 19:20	05:50 19:49	05:27 20:15	05:32 20:22	05:56 20:00	06:25 19:17	06:52 18:29	06:24 16:47	06:56 16:30
7	07:12 16:45	06:54 17:19	06:18 17:50	06:29 19:21	05:48 19:50	05:27 20:16	05:33 20:21	05:57 19:59	06:26 19:15	06:53 18:27	06:25 16:46	06:57 16:30
8	07:12 16:46	06:53 17:21	06:16 17:51	06:28 19:22	05:47 19:51	05:26 20:16	05:33 20:21	05:58 19:57	06:26 19:14	06:54 18:26	06:27 16:45	06:58 16:30
9	07:12 16:47	06:52 17:22	06:15 17:52	06:26 19:23	05:46 19:52	05:26 20:17	05:34 20:21	05:59 19:56	06:27 19:12	06:55 18:24	06:28 16:44	06:59 16:30
10	07:12 16:48	06:51 17:23	06:13 17:53	06:25 19:24	05:45 19:53	05:26 20:17	05:35 20:20	06:00 19:55	06:28 19:10	06:56 18:23	06:29 16:43	07:00 16:30
11	07:11 16:49	06:50 17:24	06:12 17:54	06:23 19:25	05:44 19:54	05:26 20:18	05:35 20:20	06:01 19:54	06:29 19:09	06:57 18:21	06:30 16:42	07:01 16:30
12	07:11 16:50	06:49 17:25	06:10 17:55	06:22 19:26	05:43 19:55	05:26 20:18	05:36 20:20	06:02 19:53	06:30 19:07	06:58 18:20	06:31 16:41	07:01 16:30
13	07:11 16:51	06:48 17:26	06:08 17:56	06:20 19:27	05:42 19:56	05:26 20:19	05:37 20:19	06:03 19:51	06:31 19:06	06:59 18:18	06:32 16:41	07:02 16:30
14	07:11 16:52	06:46 17:27	06:07 17:57	06:19 19:28	05:41 19:57	05:26 20:19	05:37 20:19	06:04 19:50	06:32 19:04	07:00 18:17	06:33 16:40	07:03 16:30
15	07:10 16:53	06:45 17:29	06:05 17:58	06:17 19:29	05:40 19:58	05:26 20:20	05:38 20:18	06:05 19:49	06:33 19:02	07:01 18:15	06:34 16:39	07:04 16:31
16	07:10 16:54	06:44 17:30	06:04 17:59	06:16 19:30	05:39 19:59	05:26 20:20	05:39 20:18	06:06 19:47	06:34 19:01	07:02 18:14	06:35 16:38	07:04 16:31
17	07:10 16:55	06:43 17:31	06:02 18:00	06:14 19:31	05:39 19:59	05:26 20:20	05:39 20:17	06:06 19:46	06:35 18:59	07:03 18:12	06:37 16:37	07:05 16:31
18	07:09 16:56	06:41 17:32	06:01 18:01	06:13 19:32	05:38 20:00	05:26 20:21	05:40 20:16	06:07 19:45	06:35 18:58	07:04 18:11	06:38 16:37	07:06 16:31
19	07:09 16:57	06:40 17:33	05:59 18:02	06:11 19:33	05:37 20:01	05:26 20:21	05:41 20:16	06:08 19:43	06:36 18:56	07:05 18:09	06:39 16:36	07:06 16:32
20	07:08 16:59	06:39 17:34	05:58 18:03	06:10 19:34	05:36 20:02	05:26 20:21	05:42 20:15	06:09 19:42	06:37 18:54	07:06 18:08	06:40 16:35	07:07 16:32
21	07:08 17:00	06:38 17:35	05:56 18:04	06:09 19:35	05:35 20:03	05:26 20:22	05:43 20:14	06:10 19:41	06:38 18:53	07:07 18:07	06:41 16:35	07:07 16:33
22	07:07 17:01	06:36 17:36	05:54 18:05	06:07 19:36	05:35 20:04	05:27 20:22	05:43 20:14	06:11 19:39	06:39 18:51	07:08 18:05	06:42 16:34	07:08 16:33
23	07:07 17:02	06:35 17:37	05:53 18:06	06:06 19:37	05:34 20:05	05:27 20:22	05:44 20:13	06:12 19:38	06:40 18:49	07:09 18:04	06:43 16:34	07:08 16:34
24	07:06 17:03	06:34 17:39	05:51 18:07	06:04 19:38	05:33 20:06	05:27 20:22	05:45 20:12	06:13 19:36	06:41 18:48	07:10 18:03	06:44 16:33	07:09 16:34
25	07:05 17:04	06:32 17:40	05:50 18:08	06:03 19:39	05:32 20:06	05:27 20:22	05:46 20:11	06:14 19:35	06:42 18:46	06:11 17:01	06:45 16:33	07:09 16:35
26	07:05 17:05	06:31 17:41	05:48 18:09	06:02 19:39	05:32 20:07	05:28 20:22	05:47 20:11	06:15 19:33	06:43 18:45	06:12 17:00	06:46 16:32	07:10 16:35
27	07:04 17:07	06:29 17:42	05:46 18:10	06:01 19:40	05:31 20:08	05:28 20:22	05:48 20:10	06:16 19:32	06:44 18:43	06:13 16:59	06:47 16:32	07:10 16:36
28	07:03 17:08	06:28 17:43	05:45 18:11	05:59 19:41	05:31 20:09	05:28 20:22	05:48 20:09	06:16 19:30	06:45 18:41	06:14 16:58	06:48 16:31	07:10 16:37
29	07:02 17:09		06:43 19:12	05:58 19:42	05:30 20:10	05:29 20:22	05:49 20:08	06:17 19:29	06:46 18:40	06:16 16:56	06:50 16:31	07:11 16:37
30	07:02 17:10		06:42 19:13	05:57 19:43	05:30 20:10	05:29 20:22	05:50 20:07	06:18 19:27	06:46 18:38	06:17 16:55	06:51 16:31	07:11 16:38
31	07:01 17:11		06:40 19:14		05:29 20:11		05:51 20:06	06:19 19:26		06:18 16:54		07:11 16:39
Potential sun hours	303	300	370	396	443	446	453	424	374	347	302	294
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Real case Shadow receptor: A03 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (3)
Assumptions for shadow calculations

Shine probability S (Average daily sunshine hours) [CROTONE]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.16 4.62 5.58 6.71 8.10 9.27 10.00 9.47 7.89 5.95 5.05 4.11

Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
1,460 849 653 555 268 180 349 1,485 738 262 304 726 7,828
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:26 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
2	07:12 16:41	06:59 17:14	06:25 17:45	06:37 19:16	05:54 19:45	05:28 20:12	05:30 20:22	05:53 20:04	06:21 19:23	06:48 18:35	06:20 16:52	06:53 16:30
3	07:12 16:42	06:58 17:15	06:24 17:46	06:35 19:17	05:53 19:46	05:28 20:13	05:31 20:22	05:54 20:03	06:22 19:21	06:49 18:33	06:21 16:50	06:54 16:30
4	07:12 16:42	06:57 17:16	06:22 17:47	06:34 19:18	05:52 19:47	05:28 20:14	05:31 20:22	05:55 20:02	06:23 19:20	06:50 18:32	06:22 16:49	06:54 16:30
5	07:12 16:43	06:56 17:17	06:21 17:48	06:32 19:19	05:51 19:48	05:27 20:14	05:32 20:22	05:56 20:01	06:24 19:18	06:51 18:30	06:23 16:48	06:55 16:30
6	07:12 16:44	06:55 17:18	06:19 17:49	06:31 19:20	05:50 19:49	05:27 20:15	05:32 20:22	05:56 20:00	06:25 19:17	06:52 18:29	06:24 16:47	06:56 16:30
7	07:12 16:45	06:54 17:19	06:18 17:50	06:29 19:21	05:48 19:50	05:27 20:16	05:33 20:21	05:57 19:59	06:26 19:15	06:53 18:27	06:25 16:46	06:57 16:30
8	07:12 16:46	06:53 17:21	06:16 17:51	06:28 19:22	05:47 19:51	05:27 20:16	05:33 20:21	05:58 19:57	06:26 19:14	06:54 18:26	06:27 16:45	06:58 16:30
9	07:12 16:47	06:52 17:22	06:15 17:52	06:26 19:23	05:46 19:52	05:26 20:17	05:34 20:21	05:59 19:56	06:27 19:12	06:55 18:24	06:28 16:44	06:59 16:30
10	07:12 16:48	06:51 17:23	06:13 17:53	06:25 19:24	05:45 19:53	05:26 20:17	05:35 20:20	06:00 19:55	06:28 19:10	06:56 18:23	06:29 16:43	07:00 16:30
11	07:11 16:49	06:50 17:24	06:12 17:54	06:23 19:25	05:44 19:54	05:26 20:18	05:35 20:20	06:01 19:54	06:29 19:09	06:57 18:21	06:30 16:42	07:01 16:30
12	07:11 16:50	06:49 17:25	06:10 17:55	06:22 19:26	05:43 19:55	05:26 20:18	05:36 20:20	06:02 19:53	06:30 19:07	06:58 18:20	06:31 16:41	07:01 16:30
13	07:11 16:51	06:48 17:26	06:08 17:56	06:20 19:27	05:42 19:56	05:26 20:19	05:37 20:19	06:03 19:51	06:31 19:06	06:59 18:18	06:32 16:41	07:02 16:30
14	07:11 16:52	06:46 17:27	06:07 17:57	06:19 19:28	05:41 19:57	05:26 20:19	05:37 20:19	06:04 19:50	06:32 19:04	07:00 18:17	06:33 16:40	07:03 16:30
15	07:10 16:53	06:45 17:29	06:05 17:58	06:17 19:29	05:40 19:58	05:26 20:20	05:38 20:18	06:05 19:49	06:33 19:02	07:01 18:15	06:34 16:39	07:04 16:31
16	07:10 16:54	06:44 17:30	06:04 17:59	06:16 19:30	05:39 19:59	05:26 20:20	05:39 20:18	06:06 19:47	06:34 19:01	07:02 18:14	06:35 16:38	07:04 16:31
17	07:10 16:55	06:43 17:31	06:02 18:00	06:14 19:31	05:39 19:59	05:26 20:20	05:39 20:17	06:06 19:46	06:35 18:59	07:03 18:12	06:37 16:37	07:05 16:31
18	07:09 16:56	06:41 17:32	06:01 18:01	06:13 19:32	05:38 20:00	05:26 20:21	05:40 20:16	06:07 19:45	06:35 18:58	07:04 18:11	06:38 16:37	07:06 16:31
19	07:09 16:57	06:40 17:33	05:59 18:02	06:11 19:33	05:37 20:01	05:26 20:21	05:41 20:16	06:08 19:43	06:36 18:56	07:05 18:09	06:39 16:36	07:06 16:32
20	07:08 16:59	06:39 17:34	05:58 18:03	06:10 19:34	05:36 20:02	05:26 20:21	05:42 20:15	06:09 19:42	06:37 18:54	07:06 18:08	06:40 16:35	07:07 16:32
21	07:08 17:00	06:38 17:35	05:56 18:04	06:09 19:35	05:35 20:03	05:26 20:22	05:43 20:14	06:10 19:41	06:38 18:53	07:07 18:07	06:41 16:35	07:07 16:33
22	07:07 17:01	06:36 17:36	05:54 18:05	06:07 19:36	05:35 20:04	05:27 20:22	05:43 20:14	06:11 19:39	06:39 18:51	07:08 18:05	06:42 16:34	07:08 16:33
23	07:07 17:02	06:35 17:37	05:53 18:06	06:06 19:37	05:34 20:05	05:27 20:22	05:44 20:13	06:12 19:38	06:40 18:49	07:09 18:04	06:43 16:34	07:08 16:34
24	07:06 17:03	06:34 17:39	05:51 18:07	06:04 19:38	05:33 20:06	05:27 20:22	05:45 20:12	06:13 19:36	06:41 18:48	07:10 18:03	06:44 16:33	07:09 16:34
25	07:05 17:04	06:32 17:40	05:50 18:08	06:03 19:39	05:32 20:06	05:27 20:22	05:46 20:11	06:14 19:35	06:42 18:46	06:11 17:01	06:45 16:33	07:09 16:35
26	07:05 17:05	06:31 17:41	05:48 18:09	06:02 19:39	05:32 20:07	05:28 20:22	05:47 20:11	06:15 19:33	06:43 18:45	06:12 17:00	06:46 16:32	07:10 16:35
27	07:04 17:07	06:29 17:42	05:46 18:10	06:01 19:40	05:31 20:08	05:28 20:22	05:48 20:10	06:16 19:32	06:44 18:43	06:13 16:59	06:47 16:32	07:10 16:36
28	07:03 17:08	06:28 17:43	05:45 18:11	05:59 19:41	05:31 20:09	05:28 20:22	05:48 20:09	06:16 19:30	06:45 18:41	06:14 16:58	06:48 16:31	07:10 16:37
29	07:02 17:09		06:43 19:12	05:58 19:42	05:30 20:10	05:29 20:22	05:49 20:08	06:17 19:29	06:46 18:40	06:16 16:56	06:50 16:31	07:11 16:37
30	07:02 17:10		06:42 19:13	05:57 19:43	05:30 20:10	05:29 20:22	05:50 20:07	06:18 19:28	06:46 18:38	06:17 16:55	06:51 16:31	07:11 16:38
31	07:01 17:11		06:40 19:14		05:29 20:11		05:51 20:06	06:19 19:26		06:18 16:54		07:11 16:39
Potential sun hours	303	300	370	396	443	446	453	424	374	347	302	294
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Real case Shadow receptor: A05 - Shadow Receptor: 1.5 x 1.5 Azimuth: 0.0° Slope: 0.0° (5)
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [CROTONE]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.16 4.62 5.58 6.71 8.10 9.27 10.00 9.47 7.89 5.95 5.05 4.11

Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
1,460 849 653 555 268 180 349 1,485 738 262 304 726 7,828
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:40	07:00 17:12	06:27 17:44	06:39 19:15	05:55 19:44	05:29 20:12	05:30 20:22	05:52 20:05	06:20 19:24	06:47 18:37	06:19 16:53	06:52 16:30
2	07:12 16:41	06:59 17:14	06:25 17:45	06:37 19:16	05:54 19:45	05:28 20:12	05:30 20:22	05:53 20:04	06:21 19:23	06:48 18:35	06:20 16:52	06:53 16:30
3	07:12 16:42	06:58 17:15	06:24 17:46	06:35 19:17	05:53 19:46	05:28 20:13	05:31 20:22	05:54 20:03	06:22 19:21	06:49 18:33	06:21 16:50	06:54 16:30
4	07:12 16:42	06:57 17:16	06:22 17:47	06:34 19:18	05:52 19:47	05:28 20:14	05:31 20:22	05:55 20:02	06:23 19:20	06:50 18:32	06:22 16:49	06:55 16:30
5	07:12 16:43	06:56 17:17	06:21 17:48	06:32 19:19	05:51 19:48	05:27 20:14	05:32 20:22	05:56 20:01	06:24 19:18	06:51 18:30	06:23 16:48	06:55 16:30
6	07:12 16:44	06:55 17:18	06:19 17:49	06:31 19:20	05:50 19:49	05:27 20:15	05:32 20:22	05:56 20:00	06:25 19:17	06:52 18:29	06:24 16:47	06:56 16:30
7	07:12 16:45	06:54 17:19	06:18 17:50	06:29 19:21	05:48 19:50	05:27 20:16	05:33 20:21	05:57 19:59	06:26 19:15	06:53 18:27	06:25 16:46	06:57 16:30
8	07:12 16:46	06:53 17:21	06:16 17:51	06:28 19:22	05:47 19:51	05:27 20:16	05:33 20:21	05:58 19:57	06:26 19:14	06:54 18:26	06:27 16:45	06:58 16:30
9	07:12 16:47	06:52 17:22	06:15 17:52	06:26 19:23	05:46 19:52	05:26 20:17	05:34 20:21	05:59 19:56	06:27 19:12	06:55 18:24	06:28 16:44	06:59 16:30
10	07:12 16:48	06:51 17:23	06:13 17:53	06:25 19:24	05:45 19:53	05:26 20:17	05:35 20:20	06:00 19:55	06:28 19:10	06:56 18:23	06:29 16:43	07:00 16:30
11	07:12 16:49	06:50 17:24	06:12 17:54	06:23 19:25	05:44 19:54	05:26 20:18	05:35 20:20	06:01 19:54	06:29 19:09	06:57 18:21	06:30 16:42	07:01 16:30
12	07:11 16:50	06:49 17:25	06:10 17:55	06:22 19:26	05:43 19:55	05:26 20:18	05:36 20:20	06:02 19:53	06:30 19:07	06:58 18:20	06:31 16:41	07:01 16:30
13	07:11 16:51	06:48 17:26	06:09 17:56	06:20 19:27	05:42 19:56	05:26 20:19	05:37 20:19	06:03 19:51	06:31 19:06	06:59 18:18	06:32 16:41	07:02 16:30
14	07:11 16:52	06:46 17:27	06:07 17:57	06:19 19:28	05:41 19:57	05:26 20:19	05:37 20:19	06:04 19:50	06:32 19:04	07:00 18:17	06:33 16:40	07:03 16:30
15	07:10 16:53	06:45 17:29	06:05 17:58	06:17 19:29	05:40 19:58	05:26 20:20	05:38 20:18	06:05 19:49	06:33 19:02	07:01 18:15	06:34 16:39	07:04 16:31
16	07:10 16:54	06:44 17:30	06:04 17:59	06:16 19:30	05:39 19:59	05:26 20:20	05:39 20:18	06:06 19:47	06:34 19:01	07:02 18:14	06:36 16:38	07:04 16:31
17	07:10 16:55	06:43 17:31	06:02 18:00	06:14 19:31	05:39 20:00	05:26 20:20	05:39 20:17	06:06 19:46	06:35 18:59	07:03 18:12	06:37 16:37	07:05 16:31
18	07:09 16:56	06:41 17:32	06:01 18:01	06:13 19:32	05:38 20:00	05:26 20:21	05:40 20:16	06:07 19:45	06:35 18:58	07:04 18:11	06:38 16:37	07:06 16:31
19	07:09 16:57	06:40 17:33	05:59 18:02	06:11 19:33	05:37 20:01	05:26 20:21	05:41 20:16	06:08 19:43	06:36 18:56	07:05 18:09	06:39 16:36	07:06 16:32
20	07:08 16:59	06:39 17:34	05:58 18:03	06:10 19:34	05:36 20:02	05:26 20:21	05:42 20:15	06:09 19:42	06:37 18:54	07:06 18:08	06:40 16:35	07:07 16:32
21	07:08 17:00	06:38 17:35	05:56 18:04	06:09 19:35	05:35 20:03	05:26 20:22	05:43 20:14	06:10 19:41	06:38 18:53	07:07 18:07	06:41 16:35	07:07 16:33
22	07:07 17:01	06:36 17:36	05:54 18:05	06:07 19:36	05:35 20:04	05:27 20:22	05:43 20:14	06:11 19:39	06:39 18:51	07:08 18:05	06:42 16:34	07:08 16:33
23	07:07 17:02	06:35 17:38	05:53 18:06	06:06 19:37	05:34 20:05	05:27 20:22	05:44 20:13	06:12 19:38	06:40 18:49	07:09 18:04	06:43 16:34	07:09 16:34
24	07:06 17:03	06:34 17:39	05:51 18:07	06:05 19:38	05:33 20:06	05:27 20:22	05:45 20:12	06:13 19:36	06:41 18:48	07:10 18:03	06:44 16:33	07:09 16:34
25	07:05 17:04	06:32 17:40	05:50 18:08	06:03 19:39	05:32 20:06	05:27 20:22	05:46 20:11	06:14 19:35	06:42 18:46	06:11 17:01	06:45 16:33	07:09 16:35
26	07:05 17:05	06:31 17:41	05:48 18:09	06:02 19:40	05:32 20:07	05:28 20:22	05:47 20:11	06:15 19:33	06:43 18:45	06:12 17:00	06:46 16:32	07:10 16:35
27	07:04 17:07	06:29 17:42	05:46 18:10	06:01 19:40	05:31 20:08	05:28 20:22	05:48 20:10	06:16 19:32	06:44 18:43	06:13 16:59	06:47 16:32	07:10 16:36
28	07:03 17:08	06:28 17:43	05:45 18:11	05:59 19:41	05:31 20:09	05:28 20:22	05:48 20:09	06:17 19:31	06:45 18:41	06:15 16:58	06:49 16:31	07:11 16:37
29	07:02 17:09		06:43 19:12	05:58 19:42	05:30 20:10	05:29 20:22	05:49 20:08	06:17 19:29	06:46 18:40	06:16 16:56	06:50 16:31	07:11 16:37
30	07:02 17:10		06:42 19:13	05:57 19:43	05:30 20:10	05:29 20:22	05:50 20:07	06:18 19:28	06:46 18:38	06:17 16:55	06:51 16:31	07:11 16:38
31	07:01 17:11		06:40 19:14		05:29 20:11		05:51 20:06	06:19 19:26		06:18 16:54		07:11 16:39
Potential sun hours	303	300	370	396	443	446	453	424	374	347	302	294
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Real case Shadow receptor: A07 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (7)
Assumptions for shadow calculations Sunshine probability S (Average daily sunshine hours) [CROTONE]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.16	4.62	5.58	6.71	8.10	9.27	10.00	9.47	7.89	5.95	5.05	4.11

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
1,460	849	653	555	268	180	349	1,485	738	262	304	726	7,828

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June
1	07:12 16:40 133	13:03 (8) 07:00 128	13:17 (8) 06:27 128	14:03 (8) 06:39 58	18:24 (6) 05:56 26	18:08 (6) 05:29 43
2	07:12 16:41 133	13:03 (8) 06:59 128	13:18 (8) 06:25 128	14:07 (8) 06:37 51	18:20 (6) 05:54 32	18:09 (6) 05:28 41
3	07:12 16:42 133	13:04 (8) 06:58 127	13:19 (8) 06:24 127	14:11 (8) 06:36 44	18:18 (6) 05:53 36	18:11 (6) 05:28 38
4	07:12 16:43 133	13:05 (8) 06:55 126	13:20 (8) 06:22 126	14:15 (8) 06:34 35	18:16 (6) 05:52 39	18:12 (6) 05:28 35
5	07:12 16:43 133	13:05 (8) 06:56 124	13:21 (8) 06:21 124	14:22 (8) 06:32 24	18:14 (6) 05:51 42	18:14 (6) 05:27 32
6	07:12 16:44 133	13:05 (8) 06:55 123	13:22 (8) 06:19 123	14:22 (8) 06:31 44	18:13 (6) 05:50 44	18:15 (6) 05:27 29
7	07:12 16:45 134	13:05 (8) 06:54 122	13:22 (8) 06:18 122	14:22 (8) 06:29 46	18:11 (6) 05:49 46	18:17 (6) 05:27 25
8	07:12 16:46 133	13:06 (8) 06:53 121	13:23 (8) 06:16 121	14:22 (8) 06:28 49	18:10 (6) 05:47 49	18:20 (6) 05:27 20
9	07:12 16:47 133	13:07 (8) 06:52 119	13:24 (8) 06:15 119	14:22 (8) 06:26 50	18:09 (6) 05:46 50	18:23 (6) 05:26 13
10	07:12 16:48 134	13:07 (8) 06:51 118	13:25 (8) 06:13 118	14:22 (8) 06:25 52	18:08 (6) 05:45 52	18:36 (6) 05:26 13
11	07:12 16:49 134	13:07 (8) 06:50 117	13:26 (8) 06:12 117	14:22 (8) 06:23 52	18:07 (6) 05:44 52	18:36 (6) 05:26 13
12	07:11 16:50 134	13:07 (8) 06:49 114	13:28 (8) 06:10 114	14:22 (8) 06:22 54	18:06 (6) 05:43 54	18:36 (6) 05:26 13
13	07:11 16:51 134	13:08 (8) 06:48 113	13:29 (8) 06:09 113	14:22 (8) 06:20 55	18:05 (6) 05:42 55	18:36 (6) 05:26 13
14	07:11 16:52 134	13:08 (8) 06:47 111	13:30 (8) 06:07 111	14:22 (8) 06:19 55	18:05 (6) 05:41 55	18:36 (6) 05:26 13
15	07:11 16:53 134	13:09 (8) 06:45 109	13:31 (8) 06:06 109	14:22 (8) 06:17 56	18:04 (6) 05:40 56	18:36 (6) 05:26 13
16	07:10 16:54 134	13:09 (8) 06:44 106	13:33 (8) 06:04 106	14:22 (8) 06:16 56	18:04 (6) 05:40 56	18:36 (6) 05:26 13
17	07:10 16:55 134	13:09 (8) 06:43 104	13:35 (8) 06:02 104	14:22 (8) 06:14 56	18:04 (6) 05:39 56	18:36 (6) 05:26 13
18	07:09 16:57 134	13:10 (8) 06:42 101	13:36 (8) 06:01 101	14:22 (8) 06:13 56	18:04 (6) 05:38 56	18:36 (6) 05:26 13
19	07:09 16:58 134	13:10 (8) 06:40 99	13:38 (8) 05:59 99	14:22 (8) 06:12 56	18:04 (6) 05:37 56	18:36 (6) 05:26 13
20	07:08 16:59 134	13:11 (8) 06:39 96	13:40 (8) 05:58 96	14:22 (8) 06:10 56	18:03 (6) 05:36 56	18:36 (6) 05:26 13
21	07:08 17:00 134	13:11 (8) 06:38 92	13:42 (8) 05:56 92	14:22 (8) 06:09 55	18:03 (6) 05:35 55	18:36 (6) 05:26 13
22	07:07 17:01 133	13:11 (8) 06:36 89	13:44 (8) 05:55 89	14:22 (8) 06:07 54	18:03 (6) 05:35 54	18:36 (6) 05:26 13
23	07:07 17:02 133	13:12 (8) 06:35 85	13:47 (8) 05:53 85	14:22 (8) 06:06 53	18:03 (6) 05:34 53	18:36 (6) 05:26 13
24	07:06 17:03 133	13:12 (8) 06:34 81	13:49 (8) 05:51 81	14:22 (8) 06:05 53	18:03 (6) 05:33 53	18:36 (6) 05:26 13
25	07:06 17:04 132	13:13 (8) 06:32 77	13:52 (8) 05:50 77	14:22 (8) 06:03 52	18:03 (6) 05:33 52	18:36 (6) 05:26 13
26	07:05 17:06 132	13:14 (8) 06:31 73	13:54 (8) 05:48 73	14:22 (8) 06:02 50	18:03 (6) 05:32 50	18:36 (6) 05:26 13
27	07:04 17:07 132	13:14 (8) 06:29 68	13:57 (8) 05:47 68	14:22 (8) 06:01 50	18:03 (6) 05:31 50	18:36 (6) 05:26 13
28	07:03 17:08 131	13:15 (8) 06:28 63	14:01 (8) 05:45 63	14:22 (8) 05:59 48	18:03 (6) 05:31 48	18:36 (6) 05:26 13
29	07:03 17:09 131	13:15 (8) 06:27 63	14:01 (8) 05:45 63	14:22 (8) 05:58 46	18:03 (6) 05:30 46	18:36 (6) 05:26 13
30	07:02 17:10 130	13:15 (8) 06:26 63	14:01 (8) 05:45 63	14:22 (8) 05:57 45	18:03 (6) 05:30 45	18:36 (6) 05:26 13
31	07:01 17:11 129	13:16 (8) 06:25 63	14:01 (8) 05:45 63	14:22 (8) 05:56 45	18:03 (6) 05:30 45	18:36 (6) 05:26 13
Potential sun hours	303	300	370	396	443	446
Total, worst case	4122	2934	235	1474	276	
Sun reduction	0.43	0.43	0.47	0.51	0.57	
Oper. time red.	0.89	0.89	0.89	0.89	0.89	
Wind dir. red.	0.73	0.73	0.71	0.51	0.51	
Total reduction	0.28	0.29	0.30	0.23	0.26	
Total, real	1168	842	71	343	72	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Real case Shadow receptor: A07 - Shadow Receptor: 1.5 × 1.5 Azimuth: 0.0° Slope: 0.0° (7)
Sunshine probability S (Average daily sunshine hours) [CROTONE]
Assumptions for shadow calculations

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.16	4.62	5.58	6.71	8.10	9.27	10.00	9.47	7.89	5.95	5.05	4.11

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
1,460	849	653	555	268	180	349	1,485	738	262	304	726	7,828

Idle start wind speed: Cut in wind speed from power curve

	July	August	September	October	November	December
1 05:30 05:52 06:20 18:06 (6) 06:48 06:19 12:55 (8) 06:52 12:49 (8)						
2 05:30 05:53 06:21 18:06 (6) 06:48 06:20 12:53 (8) 06:53 12:49 (8)						
3 05:31 05:54 18:37 (6) 06:22 18:07 (6) 06:49 06:21 12:52 (8) 06:54 12:50 (8)						
4 05:31 05:55 18:31 (6) 06:23 18:07 (6) 06:50 06:22 12:51 (8) 06:55 12:50 (8)						
5 05:32 05:56 18:29 (6) 06:24 18:08 (6) 06:51 06:23 12:51 (8) 06:56 12:50 (8)						
6 05:32 05:57 18:26 (6) 06:25 18:09 (6) 06:52 06:25 12:50 (8) 06:56 12:51 (8)						
7 05:33 05:57 18:24 (6) 06:26 18:10 (6) 06:53 06:26 12:50 (8) 06:57 12:52 (8)						
8 05:33 05:58 18:22 (6) 06:27 18:10 (6) 06:54 15:03 (8) 06:27 12:49 (8) 06:58 12:52 (8)						
9 05:34 05:59 18:20 (6) 06:28 18:11 (6) 06:55 14:54 (8) 06:28 12:48 (8) 06:59 12:53 (8)						
10 05:35 06:00 18:19 (6) 06:28 18:13 (6) 06:56 14:48 (8) 06:29 12:47 (8) 07:00 12:53 (8)						
11 05:35 06:01 18:18 (6) 06:29 18:15 (6) 06:57 14:43 (8) 06:30 12:48 (8) 07:01 12:54 (8)						
12 05:36 06:02 18:17 (6) 06:30 18:16 (6) 06:58 14:39 (8) 06:31 12:47 (8) 07:02 12:54 (8)						
13 05:37 06:03 18:16 (6) 06:31 18:16 (6) 06:59 14:35 (8) 06:32 12:47 (8) 07:02 12:54 (8)						
14 05:37 06:04 18:15 (6) 06:32 18:17 (6) 07:00 14:32 (8) 06:33 12:47 (8) 07:03 12:55 (8)						
15 05:38 06:05 18:14 (6) 06:33 18:17 (6) 07:01 14:28 (8) 06:35 12:46 (8) 07:04 12:55 (8)						
16 05:39 06:06 18:12 (6) 06:34 18:18 (6) 07:02 14:25 (8) 06:36 12:47 (8) 07:05 12:56 (8)						
17 05:40 06:07 18:11 (6) 06:35 18:19 (6) 07:03 14:22 (8) 06:37 12:47 (8) 07:05 12:57 (8)						
18 05:40 06:08 18:11 (6) 06:36 18:20 (6) 07:04 14:19 (8) 06:38 12:46 (8) 07:06 12:57 (8)						
19 05:41 06:08 18:10 (6) 06:37 18:21 (6) 07:05 14:17 (8) 06:39 12:46 (8) 07:06 12:57 (8)						
20 05:42 06:09 18:09 (6) 06:37 18:22 (6) 07:06 14:14 (8) 06:40 12:46 (8) 07:07 12:58 (8)						
21 05:43 06:10 18:09 (6) 06:38 18:23 (6) 07:07 14:12 (8) 06:41 12:46 (8) 07:08 12:58 (8)						
22 05:44 06:11 18:08 (6) 06:39 18:24 (6) 07:08 14:09 (8) 06:42 12:47 (8) 07:08 12:58 (8)						
23 05:44 06:12 18:08 (6) 06:40 18:25 (6) 07:09 14:08 (8) 06:43 12:47 (8) 07:09 12:59 (8)						
24 05:45 06:13 18:07 (6) 06:41 18:26 (6) 07:10 14:06 (8) 06:44 12:47 (8) 07:09 12:59 (8)						
25 05:46 06:14 18:07 (6) 06:42 18:27 (6) 07:11 14:05 (8) 06:45 12:47 (8) 07:10 13:01 (8)						
26 05:47 06:15 18:06 (6) 06:43 18:28 (6) 07:12 14:04 (8) 06:46 12:47 (8) 07:11 13:02 (8)						
27 05:48 06:16 18:06 (6) 06:44 18:29 (6) 07:13 14:03 (8) 06:47 12:48 (8) 07:11 13:02 (8)						
28 05:49 06:17 18:06 (6) 06:45 18:30 (6) 07:14 14:02 (8) 06:48 12:48 (8) 07:12 13:03 (8)						
29 05:49 06:18 18:06 (6) 06:46 18:31 (6) 07:15 14:01 (8) 06:49 12:48 (8) 07:13 13:03 (8)						
30 05:50 06:18 18:06 (6) 06:47 18:32 (6) 07:16 14:00 (8) 06:50 12:48 (8) 07:14 13:04 (8)						
31 05:51 06:19 18:06 (6) 06:48 18:33 (6) 07:17 13:59 (8) 06:51 12:48 (8) 07:15 13:04 (8)						
Potential sun hours 453 424 374 347 302 294						
Total, worst case 498 1961 3898 4117						
Sun reduction 0.69 0.53 0.50 0.43						
Oper. time red. 0.89 0.89 0.89 0.89						
Wind dir. red. 0.51 0.73 0.73 0.73						
Total reduction 0.32 0.29 0.33 0.29						
Total, real 411 144 693 1187						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)