

Project:
Friestad

Licensed user:
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Calculated:
07.11.2018 13:58/3.2.712

SHADOW - Main Result

Calculation: 201811_1xE82 E4_2.35MW_68.9mHH

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/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50

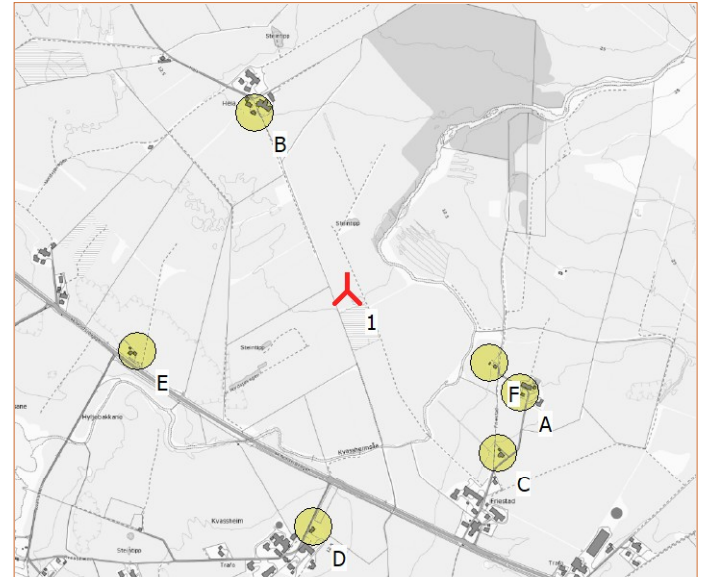
Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
519 114 182 361 1,420 1,052 448 252 330 247 555 1,519 6,999

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: Elevation Grid Data Object: Friestad_EMDGrid_0.wpg (1)
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
UTM (north)-ETRS89 Zone: 32

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 [RPM]
1	307,702	6,494,825	11.0 ENERCON E-82 E4-Friestad 2350 82.0 !O! hub: ...	Yes	ENERCON	E-82 E4-Friestad-2,350	2,350	82.0	68.9	1,603	18.0



Scale 1:20,000
New WTG Shadow receptor

Shadow receptor-Input

No.	Easting	Northing	Z	Width [m]	Height [m]	Elevation a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
A	308,159	6,494,555	14.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
B	307,457	6,495,296	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
C	308,101	6,494,395	17.2	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
D	307,611	6,494,201	14.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
E	307,146	6,494,665	7.5	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
F	308,076	6,494,635	10.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0

Calculation Results

No.	Shadow, worst case			Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	Shadow days per year [days/year]
A	50:54	100	0:39	16:32	34
B	48:52	91	0:39	15:09	30
C	2:39	25	0:09	0:51	11
D	0:00	0	0:00	0:00	0
E	25:42	58	0:35	5:54	12
F	74:25	107	0:49	23:56	48

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

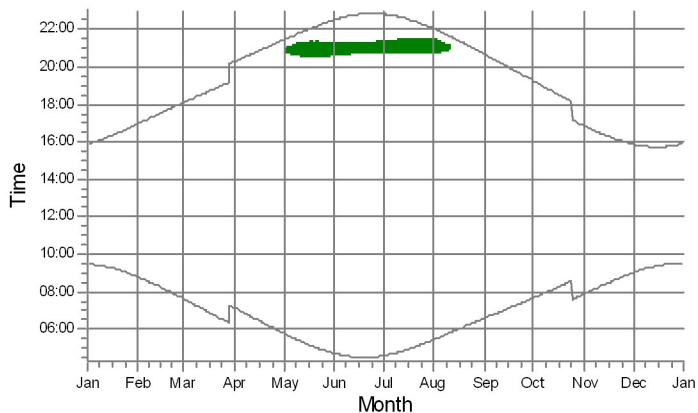
No.	Name	Worst case [h/year]	Expected [h/year]
1	ENERCON E-82 E4-Friestad 2350 82.0 !O! hub: 68.9 m (TOT: 109.9 m) (34)	170:30	52:01

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.

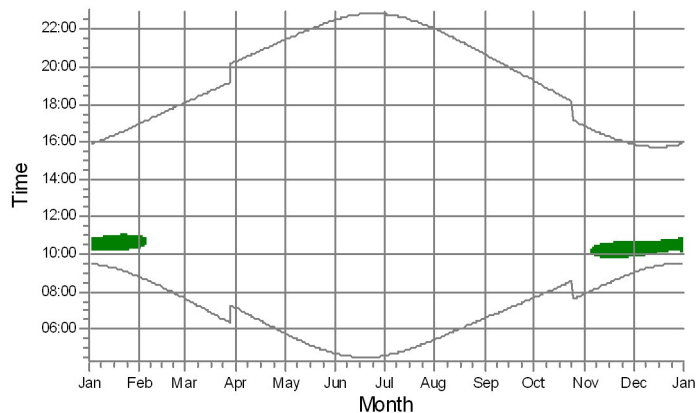
SHADOW - Calendar, graphical

Calculation: 201811_1xE82 E4_2.35MW_68.9mHH

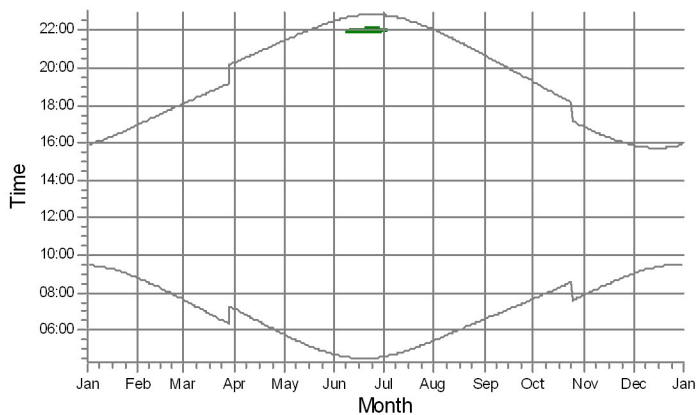
A: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 0.0° (1)



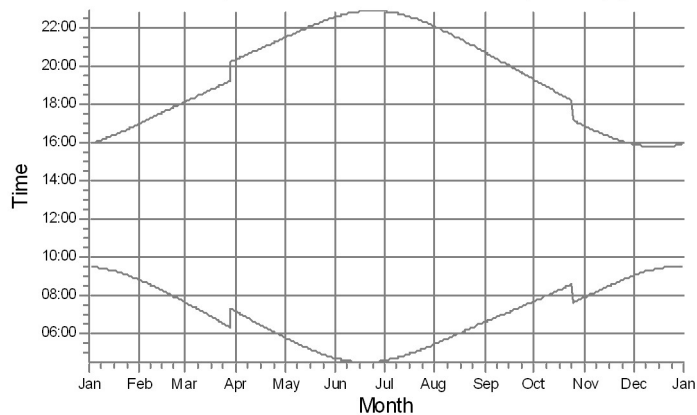
B: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 0.0° (2)



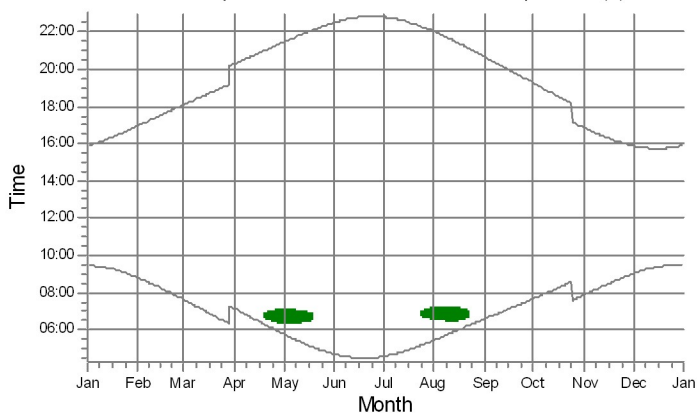
C: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 0.0° (3)



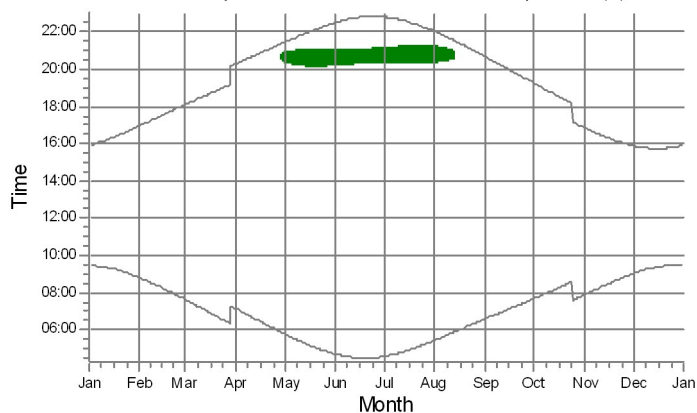
D: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 0.0° (4)



E: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 0.0° (5)



F: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 0.0° (6)



WTGs



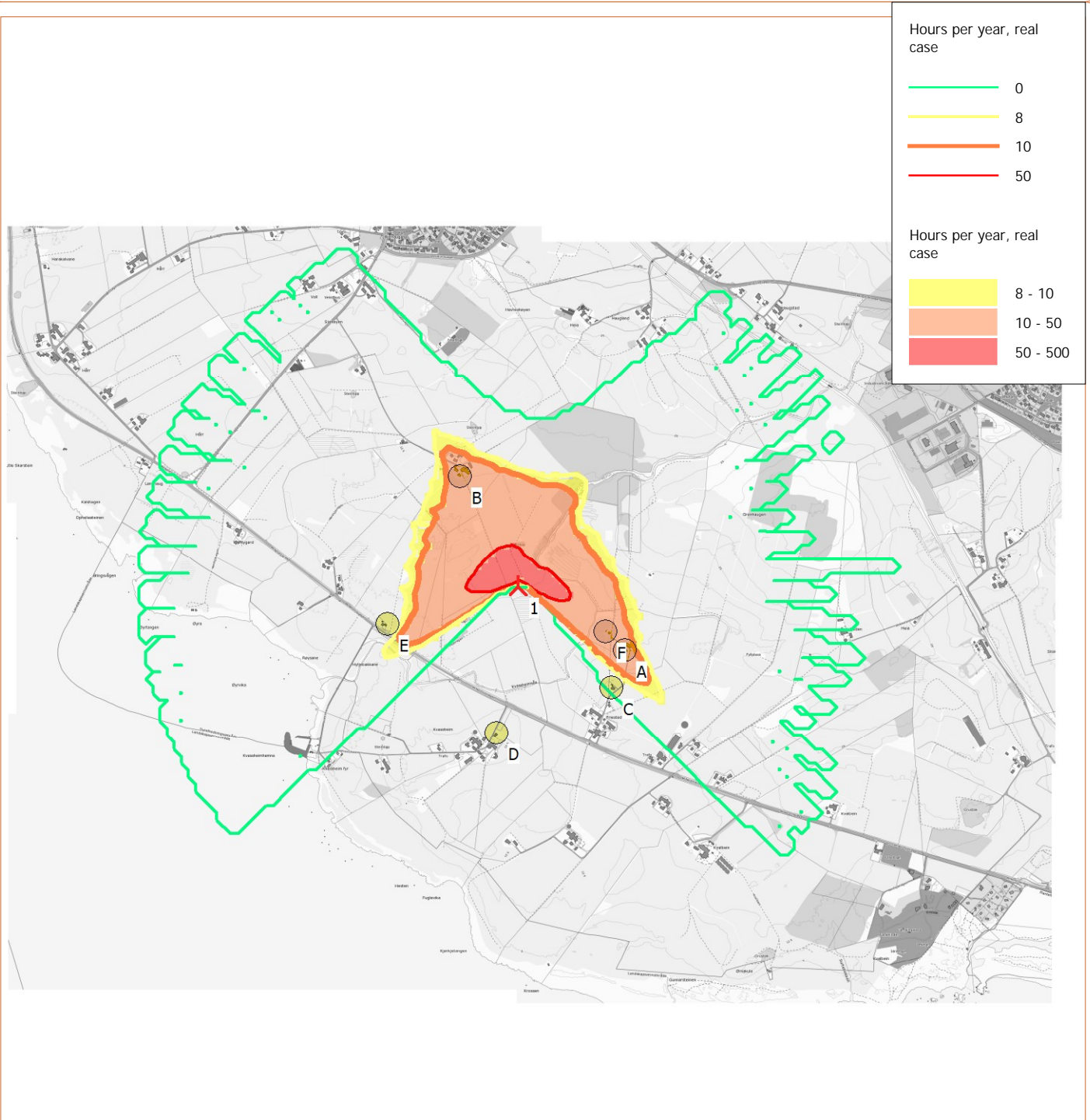
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SHADOW - Map

Calculation: 201811_1xE82 E4_2.35MW_68.9mHH



0 250 500 750 1000m

Map: Bitmap map: Export (2).png , Print scale 1:25,000, Map center UTM (north)-ETRS89 Zone: 32 East: 307,590 North: 6,494,700

New WTG

Shadow receptor

Flicker map level: Elevation Grid Data Object: Friestad_EMDGrid_0.wpg (1)