TYSVÆR VINDPARK

15.04.2019

RAPPORT STØY OG SKYGGEKAST

TYSVÆR VINDPARK

SKYGGEKASTANALYSE

Denne rapporten beskriver metode og resultater for skyggekastanalysene for Tysvær Vindpark.

Beregningene er utført av Meventus AS, med bistand fra Stormvind AS.

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1 SKYGGEKAST

Skyggekast oppstår når en vindturbin i drift blir stående mellom solen og et mottakerpunkt, og det dannes roterende skygger fra rotorbladenes bevegelser. Hvor og når skyggekast inntreffer avhenger blant annet av lokal topografi, tidspunkt på dagen, sesong og mottakerpunktets lokalisering i forhold til vindturbinen. Skyggekast kan defineres inn i tre hovedgrupper (1) teoretisk skyggekast, (2) sannsynlig skyggekast og (3) faktisk skyggekast. Forskjellen på disse er:

1) Teoretisk skyggekast beregnes under følgende forutsetninger:
   - Solen skinner konstant i alle timer med dagslys
   - Turbinene står aldri stille; de er i konstant bevegelse
   - Vindretningen er slik at turbinene alltid står vendt mot skyggekastmottaker

2) Sannsynlig skyggekast (real case):

Som grunnlag for beregningen av sannsynlig skyggekastomfang er følgende meteorologiske/driftstekniske data tatt inn som del av forutsetningene:

- Solskinnssannsynlighet fordelt over årets måneder
- Årlig samlet driftstid for turbinene
- Fordeling av driftstimer på ulike vindretninger

3) Faktisk skyggekast:

Dette defineres som reelt omfang av skyggekast fra et vindkraftverk i drift. Faktisk skyggekast skiller seg fra sannsynlig skyggekast ved at sistnevnte bare er en prognose for omfang og mønster for reelt skyggekast.

NVE anbefaler at bygninger med skyggekastfølsomt bruk ikke skal utsettes for faktisk skyggekast i mer enn 8 timer per år eller for teoretisk skyggekast i mer enn 30 timer per år eller 30 minutter per dag.

1.1 Retningslinjer og metode

Skyggekastberegningen for Tysvær vindkraftverk er gjennomført i henhold til NVE sin veileder; «Veileder for beregning av skyggekast og presentasjon av NVEs forvaltningspraksis, nr. 2 2014». Beregningene er utført av Meventus AS med beregningsmodulen SHADOW i programpakken WindPRO versjon 3.2.743. Resultatet av disse beregningene viser hvor mange timers skyggekast per år som forventes for hvert punkt i et område rundt vindkraftverket.

Skyggekastmottakerne er lokalisert basert på N50 kartdata fra Statens Kartverk. Samtlige bygninger med skyggekastfølsomt bruk som ligger inntil 1500 m fra nærmeste vindturbin er inkludert i beregningene, dette omfatter 96 bygninger.

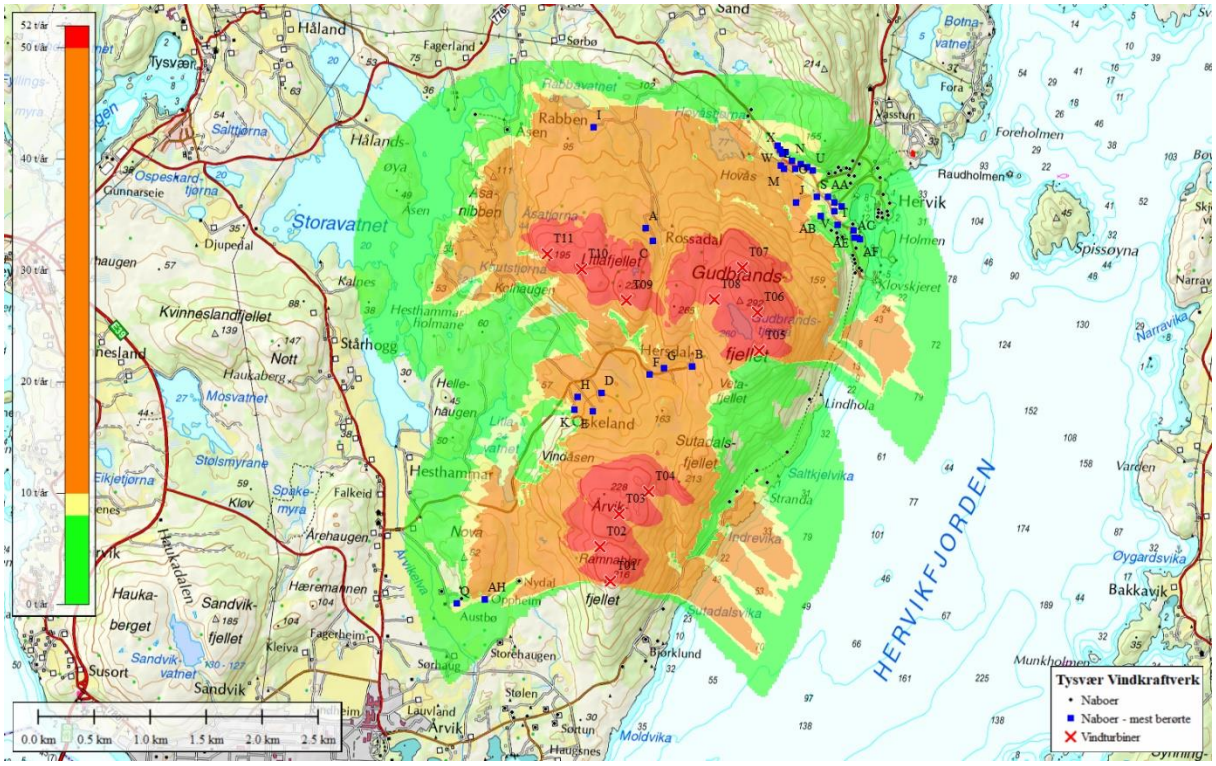
I henhold til NVEs veileder for skyggekastberegninger har mottakerne en størrelse på 2×2 meter, hevet 2 meter over bakken, og beregningene er basert på en drivhustilstand, som vil si at bygningene ikke har én bestemt retning mot turbinene og at mottakeren har vinduer i alle retninger. I tråd med veilederen er det gjort beregninger av både teoretisk og sannsynlig skyggekast. For beregningene av sannsynlig skyggekast er det brukt en konstant solskinnssannsynlighet på 50 %, og den årlige driftstiden for turbinene satt til 7000 timer. Det er videre brukt en retningsfordeling for vind over 12 sektorer basert på 19 år (2000-2019) med mesoskala referansedata fra datasettet EMDConwx. Det er i henhold til veilederen antatt at skyggekast ikke inntreffer når solen står lavere enn 3 grader over horisonten, og det er ikke gjort beregninger av skyggekast for mottakere som er mer enn 1500 meter unna nærmeste vindturbin.

Det er tatt hensyn til terrengets høydeprofil, høyde for skyggekastmottaker og skjermingseffekt av mellomliggende terreng. Det er benyttet en terrengmodell (DTM data fra Statens Kartverk) med 10 meters oppløsning.

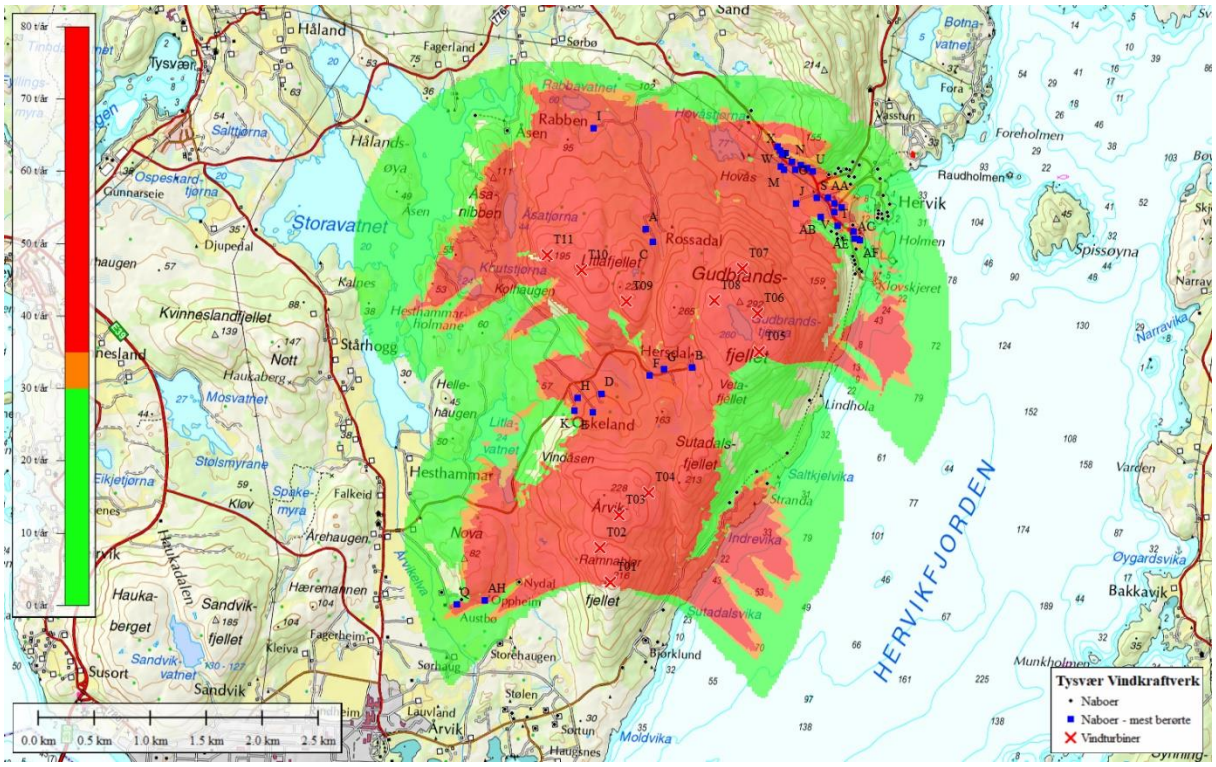
Beregningene er utført for et utbyggingsalternativ med 11 vindturbiner av typen Siemens S130 4.3MW med 85 m tårnhøyde.

1.2 Resultater

Nedenfor vises resultatet av skyggekastberegningene som skyggekastkart for sannsynlig skyggekast (Figur 1) og teoretisk maksimalt skyggekast (Figur 2).



FIGUR 1 – SKYGGEKASTKART FOR SANNSYNLIG SKYGGEKAST FRA TYSVÆR VINDKRAFTVERK



FIGUR 2 – SKYGGEKASTKART FOR TEORETISK MAKSIMALT SKYGGEKAST FRA TYSVÆR VINDKRAFTVERK

Beregningene viser at 79 av de 96 skyggekastmottakerne vil være eksponert for skyggekast fra de prosjekterte turbinene. Av disse forventes 34 nabobygg å bli eksponert for faktisk skyggekast over anbefalt grenseverdi på 8 timer per år. For teoretisk maksimalt skyggekast er det beregnet verdier over grenseverdien på 30 timer per år for 43 naboer, og verdier over grenseverdien på 30 minutter per dag for 51 nabobygg.

Beregnede verdier for samtlige skyggekastfølsomme bygg som vil være eksponert for skyggekast fra de planlagte vindturbinene er presentert i Tabell 1 under. Fullstendig beregningsrapport for skyggekast med beregninger for samtlige skyggekastmottakere innenfor 1500 m fra nærmeste turbin er lagt ved denne rapporten som vedlegg 1.1.

TABELL 1 – FORVENTET OMFANG AV SKYGGEKAST FOR SKYGGEKASTUTSATT BEBYGGELSE

Bygg (som navngitt i skyggekast-kartene)	Avstand til nærmeste turbin [m]	Beregnet sannsynlig skyggekast [timer: minutter/år]	Beregnet teoretisk maksimalt skyggekast [timer: minutter/år]	Beregnet teoretisk maksimalt skyggekast [timer:minutter/dag]
A	662.4	33:28	133:49	01:42
B	612.3	33:13	140:14	01:15
C	580.0	30:51	119:05	01:09
D	859.9	27:10	103:39	00:56
E	875.4	26:29	98:32	00:58
F	698.9	22:51	94:43	01:11
G	696.2	21:38	90:45	01:01
H	966.2	18:21	65:03	00:48
I	1203.1	16:45	65:00	01:10

J	748.6	13:40	61:33	00:47
K	989.4	12:22	43:16	00:47
L	973.1	12:10	50:21	00:48
M	957.4	12:07	50:31	00:45
N	1045.3	11:14	47:15	00:43
O	994.8	10:52	46:25	00:41
P	1056.8	10:40	45:47	00:38
Q	1368.8	09:52	46:41	00:37
R	1062.7	09:50	43:04	00:37
S	915.0	09:47	46:12	00:40
T	929.9	09:44	46:33	00:43
U	1065.6	09:09	40:53	00:36
V	961.3	09:08	43:53	00:39
W	1128.6	08:56	36:49	00:55
X	1101.6	08:55	37:05	00:54
Y	1101.0	08:49	37:19	00:52
Z	1077.9	08:48	36:59	00:51
AA	989.7	08:43	42:05	00:38
AB	833.6	08:38	42:22	00:44
AC	1034.3	08:36	41:46	00:42
AD	1004.1	08:34	41:23	00:37
AE	1045.2	08:12	39:55	00:41
AF	1075.0	08:10	39:34	00:41
AG	1038.6	08:08	39:14	00:37
AH	1129.5	08:01	37:35	00:28
AI	1081.4	07:57	38:38	00:42
AJ	1059.8	07:53	38:13	00:40
AK	1320.4	07:46	36:05	00:25
AL	1141.3	07:42	35:40	00:34
AM	1163.8	07:36	25:33	00:49
AN	782.6	07:27	30:45	00:37
AO	1057.6	07:16	33:14	00:28
AP	1027.0	07:09	34:15	00:46
AQ	1349.5	06:30	24:56	00:38
AR	896.3	06:18	30:31	00:32
AS	985.4	06:18	29:23	00:30
AT	1225.2	06:15	30:27	00:30
AU	1286.3	05:50	28:40	00:33
AV	1304.8	05:39	27:53	00:32
AW	1316.2	05:35	27:30	00:31
AX	1326.9	05:32	27:07	00:32
AY	1330.8	05:30	27:04	00:32
AZ	1402.3	05:25	17:53	00:40
BA	1184.9	05:12	24:51	00:31
BB	1233.2	04:57	23:32	00:30
BC	1229.4	04:51	23:21	00:30
BD	1252.4	04:32	22:29	00:30
BE	1282.1	04:30	21:49	00:30
BF	982.8	04:26	21:18	00:30
BG	1298.5	04:23	21:28	00:29
BH	1291.8	04:18	21:33	00:29
BI	1470.0	04:15	19:10	00:22
BJ	1381.7	04:11	20:36	00:22
BK	1381.4	04:10	20:37	00:21
BL	983.6	03:52	15:53	00:29
BM	972.1	03:49	16:08	00:30
BN	858.1	03:46	17:58	00:33

BO	888.5	03:43	17:26	00:32
BP	982.3	03:39	15:48	00:30
BQ	1407.8	03:24	12:50	00:23
BR	934.0	03:22	15:49	00:31
BS	1368.9	03:20	16:00	00:22
BT	1391.0	03:07	15:18	00:22
BU	935.6	03:02	14:13	00:30
BV	1415.8	02:46	13:47	00:21
BW	1428.9	02:42	13:32	00:21
BX	1469.2	02:38	13:05	00:20
BY	1495.6	02:38	13:06	00:20
BZ	728.7	01:50	09:15	00:24
CA	781.9	01:36	08:12	00:22

1.3 Forslag til avbøtende tiltak

For bebyggelse hvor skyggekastbelastningen er beregnet å ligge over anbefalte grenseverdier må det gjøres tiltak for å redusere omfang av skyggekast til et akseptabelt nivå.

Et eksempel på avbøtende tiltak kan være å benytte styring av spesifikke turbiner der turbinene blir stengt ned i perioder der det finnes risiko for at det vil oppstå skyggekast på bygningene der det er forventet overskridelse. Gjennom å analysere beregningene som er utført er det funnet at det er turbinene T05, T08 og T09 som vil forårsake størst skyggekastbelastning for nabobebyggelsen. For å oppnå akseptable verdier av faktisk skyggekast er det imidlertid behov for at samtlige turbiner stenges ned i perioder.

Forventet omfang av skyggekast som følge av foreslått avbøtende tiltak er presentert i Tabell 2. Behov for tidsperiode med nedstengning av turbiner vil være avhengig av eksakt plassering og vil bli avklart endelig før anlegget settes i drift. En mer nøyaktig beskrivelse av antall timer vindturbinene er nedstengt vises i vedlegg 1.2.

TABELL 2 – FORVENTET SKYGGEKAST ETTER FORSLAG TIL AVBØTENDE TILTAK

Bygg (som navngitt i skyggekast-kartene)	Avstand til nærmeste turbin [m]	Beregnet sannsynlig skyggekast [timer: minutter/år]	Beregnet teoretisk maksimalt skyggekast [timer: minutter/år]	Beregne teoretisk maksimalt skyggekast [timer:minutter/dag]	Merknad
A	662.4	06:25	22:10	00:29	
B	612.3	07:20	28:47	00:23	
C	580.0	06:57	23:04	00:50	*
D	859.9	06:47	25:01	00:36	*
E	875.4	06:14	25:10	00:21	
F	698.9	07:28	30:30	00:40	*
G	696.2	07:25	30:31	00:40	*
H	966.2	06:26	23:26	00:23	
I	1203.1	06:46	25:40	00:26	
J	748.6	06:36	27:48	00:29	
K	989.4	07:55	26:13	00:41	*
L	973.1	06:02	23:23	00:25	
M	957.4	06:47	26:57	00:26	
N	1045.3	07:00	28:27	00:34	*
O	994.8	05:49	23:43	00:28	

P	1056.8	06:46	28:08	00:29	
Q	1368.8	07:34	36:14	00:37	*
R	1062.7	07:31	32:25	00:30	*
S	915.0	07:46	36:03	00:26	*
T	929.9	07:18	35:26	00:40	*
U	1065.6	07:32	33:15	00:28	*
V	961.3	07:01	33:22	00:30	*
W	1128.6	07:58	32:44	00:53	*
X	1101.6	06:46	27:49	00:43	*
Y	1101.0	05:39	23:23	00:39	*
Z	1077.9	05:16	21:34	00:39	*
AA	989.7	07:16	34:37	00:29	*
AB	833.6	07:21	35:43	00:34	*
AC	1034.3	07:08	34:48	00:32	*
AD	1004.1	07:27	35:37	00:32	*
AE	1045.2	06:40	32:33	00:28	*
AF	1075.0	06:39	32:22	00:27	*
AG	1038.6	05:55	28:25	00:32	*
AH	1129.5	06:14	29:27	00:28	
AI	1081.4	06:32	31:53	00:31	*
AJ	1059.8	06:58	33:44	00:39	*
AK	1320.4	06:06	28:36	00:25	
AL	1141.3	07:28	34:33	00:34	*
AM	1163.8	07:36	25:33	00:49	*
AN	782.6	07:27	30:45	00:37	*
AO	1057.6	07:16	33:14	00:28	*
AP	1027.0	06:28	31:00	00:34	*
AQ	1349.5	06:30	24:56	00:38	*
AR	896.3	06:18	30:31	00:32	*
AS	985.4	06:18	29:23	00:30	
AT	1225.2	05:32	26:46	00:28	
AU	1286.3	05:08	25:17	00:33	*
AV	1304.8	05:09	25:27	00:32	*
AW	1316.2	05:14	25:45	00:31	*
AX	1326.9	04:52	23:57	00:32	*
AY	1330.8	04:58	24:29	00:32	*
AZ	1402.3	05:25	17:53	00:40	*
BA	1184.9	05:01	23:58	00:31	*
BB	1233.2	04:56	23:29	00:30	
BC	1229.4	04:41	22:34	00:30	
BD	1252.4	04:01	19:51	00:30	
BE	1282.1	04:22	21:11	00:30	
BF	982.8	04:26	21:18	00:30	
BG	1298.5	04:13	20:37	00:29	
BH	1291.8	03:52	19:17	00:29	
BI	1470.0	04:09	18:44	00:22	
BJ	1381.7	04:11	20:36	00:22	
BK	1381.4	04:10	20:37	00:21	
BL	983.6	03:52	15:53	00:29	
BM	972.1	03:49	16:08	00:30	
BN	858.1	03:46	17:58	00:33	*
BO	888.5	03:43	17:26	00:32	*
BP	982.3	03:39	15:48	00:30	
BQ	1407.8	03:24	12:50	00:23	
BR	934.0	03:22	15:49	00:31	*
BS	1368.9	03:20	16:00	00:22	
BT	1391.0	03:07	15:18	00:22	

BU	935.6	03:02	14:13	00:30	
BV	1415.8	02:46	13:47	00:21	
BW	1428.9	02:42	13:32	00:21	
BX	1469.2	02:38	13:05	00:20	
BY	1495.6	02:38	13:06	00:20	
BZ	728.7	01:50	09:15	00:24	
CA	781.9	01:36	08:12	00:22	

** Beregningen for sannsynlig skyggekast viser under 8 timer det er derfor antatt at avbøtende tiltak ikke vil være nødvendig for dette bygg selv om beregningen for teoretisk maksimalt skyggekast ligger over anbefalt grenseverdi.*

Som det fremgår i Tabell 2 er det etter foreslåtte avbøtende tiltak beregnet sannsynlig skyggekast under 8 timer per år for alle skyggekastfølsomme bygg som det ikke er inngått avtale med. For 42 av byggene er det fortsatt forventet et teoretisk maksimalt skyggekast som ligger noe over anbefalte grenseverdier. Tiltakshaver mener at siden forventet omfang av faktisk skyggekast ligger under grenseverdien på 8 timer med de foreslåtte avbøtende tiltak, burde dette være tilstrekkelig uten at det må gjøres ytterligere avbøtende tiltak for disse byggene.

Alternativt til nedstenging av turbiner kan det være aktuelt å inngå minnelige avtaler med eiere av enkelte av nabobyggene.

Project:
Tysvaer

Licensed user:
Meventus AS
Konsgård Allé 59
NO-4632 Kristiansand
+47 3860 7115
Data / data@meventus.com
Calculated:
14.04.2019 20:40/3.2.743

SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

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) []

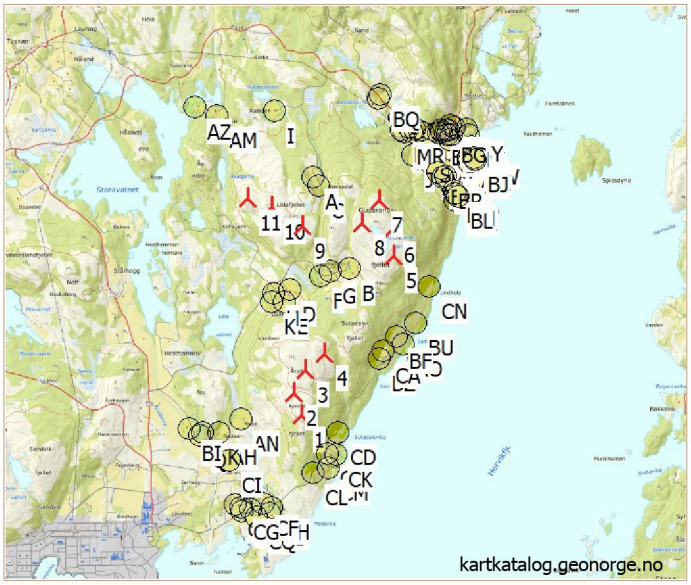
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
572	117	109	383	764	1,101	1,063	562	430	466	490	943	7,000

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: Height_DTM
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:100,000
New WTG
Shadow receptor

WTGs

	Easting	Northing	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	304,046	6,577,449	211.0	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
2	303,951	6,577,756	194.3	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
3	304,127	6,578,046	217.5	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
4	304,391	6,578,248	191.4	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
5	305,374	6,579,503	244.7	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
6	305,364	6,579,845	262.0	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
7	305,226	6,580,247	260.4	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
8	304,974	6,579,960	261.8	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
9	304,188	6,579,956	215.8	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
10	303,792	6,580,231	199.1	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
11	303,482	6,580,369	190.3	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5

Shadow receptor-Input

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
A	304,363	6,580,595	148.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
B	304,778	6,579,362	175.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
C	304,426	6,580,485	161.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
D	303,970	6,579,124	95.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
E	303,887	6,578,964	103.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
F	304,394	6,579,288	133.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
G	304,522	6,579,345	156.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
H	303,753	6,579,093	84.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
I	303,893	6,581,500	70.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
J	305,702	6,580,825	39.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
K	303,725	6,578,980	82.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
L	305,566	6,581,159	39.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
M	305,599	6,581,129	38.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
N	305,667	6,581,195	38.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
O	305,696	6,581,124	29.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
P	305,743	6,581,169	43.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Q	302,678	6,577,252	23.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
R	305,801	6,581,141	37.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0

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Project:
Tysvaer

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Calculated:
14.04.2019 20:40/3.2.743

SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
S	305,887	6,580,880	21.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
T	306,074	6,580,629	19.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
U	305,850	6,581,111	32.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
V	306,046	6,580,749	20.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
W	305,541	6,581,331	48.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
X	305,560	6,581,297	48.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Y	305,613	6,581,278	55.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Z	305,581	6,581,265	45.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AA	305,987	6,580,880	28.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AB	305,922	6,580,706	31.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AC	306,226	6,580,512	17.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AD	306,048	6,580,824	22.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AE	306,217	6,580,580	10.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AF	306,272	6,580,496	14.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AG	306,111	6,580,791	17.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AH	302,926	6,577,281	37.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AI	306,271	6,580,526	8.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AJ	306,212	6,580,636	2.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AK	302,716	6,577,288	27.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AL	305,999	6,581,087	31.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AM	303,122	6,581,476	27.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AN	303,231	6,577,449	32.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AO	305,446	6,578,325	9.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AP	306,239	6,580,417	25.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AQ	305,273	6,581,596	54.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AR	306,069	6,580,552	25.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AS	306,208	6,580,354	23.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AT	306,192	6,581,001	11.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AU	306,432	6,580,695	5.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AV	306,436	6,580,736	6.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AW	306,438	6,580,761	5.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AX	306,477	6,580,690	2.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AY	306,466	6,580,731	5.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AZ	302,838	6,581,615	28.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BA	306,056	6,581,093	28.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BB	306,079	6,581,138	34.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BC	306,102	6,581,110	28.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BD	306,173	6,581,067	20.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BE	306,155	6,581,131	29.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BF	305,356	6,578,435	23.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BG	306,184	6,581,124	29.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BH	306,227	6,581,064	18.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BI	302,537	6,577,353	21.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BJ	306,527	6,580,713	1.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BK	306,514	6,580,747	3.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BL	306,265	6,580,240	15.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BM	306,231	6,580,285	22.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BN	306,017	6,580,580	28.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BO	306,073	6,580,516	29.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BP	306,224	6,580,320	23.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BQ	305,303	6,581,653	49.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BR	306,120	6,580,518	21.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BS	306,210	6,581,199	28.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BT	306,267	6,581,170	23.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BU	305,623	6,578,601	19.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BV	306,483	6,580,899	4.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BW	306,537	6,580,816	2.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BX	306,456	6,581,051	6.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BY	306,432	6,581,132	14.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BZ	305,114	6,578,156	28.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CA	305,173	6,578,252	36.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CB	303,549	6,576,179	13.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CC	304,358	6,576,926	33.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CD	304,518	6,577,201	32.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CE	303,184	6,576,228	5.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0

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SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
CF	303,469	6,576,305	10.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CG	303,169	6,576,276	8.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CH	303,577	6,576,257	16.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CI	303,059	6,576,901	15.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CJ	306,234	6,580,201	20.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CK	304,468	6,576,910	16.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CL	304,155	6,576,682	37.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CM	304,362	6,576,737	16.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CN	305,824	6,579,068	21.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CO	303,305	6,576,243	11.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CP	303,105	6,576,312	4.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CQ	303,373	6,576,142	6.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CR	306,292	6,580,217	10.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0

Calculation Results

Shadow receptor

	Shadow, worst case			Shadow, expected values
No.	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]
A	133:49	179	1:42	33:28
B	140:14	162	1:15	33:13
C	119:05	171	1:09	30:51
D	103:39	207	0:56	27:10
E	98:32	220	0:58	26:29
F	94:43	161	1:11	22:51
G	90:45	159	1:01	21:38
H	65:03	156	0:48	18:21
I	65:00	86	1:10	16:45
J	61:33	132	0:47	13:40
K	43:16	106	0:47	12:22
L	50:21	114	0:48	12:10
M	50:31	114	0:45	12:07
N	47:15	113	0:43	11:14
O	46:25	110	0:41	10:52
P	45:47	113	0:38	10:40
Q	46:41	112	0:37	9:52
R	43:04	110	0:37	9:50
S	46:12	118	0:40	9:47
T	46:33	122	0:43	9:44
U	40:53	107	0:36	9:09
V	43:53	120	0:39	9:08
W	36:49	74	0:55	8:56
X	37:05	76	0:54	8:55
Y	37:19	76	0:52	8:49
Z	36:59	76	0:51	8:48
AA	42:05	114	0:38	8:43
AB	42:22	95	0:44	8:38
AC	41:46	112	0:42	8:36
AD	41:23	115	0:37	8:34
AE	39:55	111	0:41	8:12
AF	39:34	109	0:41	8:10
AG	39:14	114	0:37	8:08
AH	37:35	101	0:28	8:01
AI	38:38	107	0:42	7:57
AJ	38:13	110	0:40	7:53
AK	36:05	115	0:25	7:46
AL	35:40	103	0:34	7:42
AM	25:33	46	0:49	7:36
AN	30:45	65	0:37	7:27
AO	33:14	110	0:28	7:16
AP	34:15	82	0:46	7:09
AQ	24:56	64	0:38	6:30
AR	30:31	78	0:32	6:18

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SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	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]
AS	29:23	76	0:30	6:18
AT	30:27	99	0:30	6:15
AU	28:40	97	0:33	5:50
AV	27:53	95	0:32	5:39
AW	27:30	94	0:31	5:35
AX	27:07	91	0:32	5:32
AY	27:04	93	0:32	5:30
AZ	17:53	40	0:40	5:25
BA	24:51	72	0:31	5:12
BB	23:32	70	0:30	4:57
BC	23:21	71	0:30	4:51
BD	22:29	69	0:30	4:32
BE	21:49	67	0:30	4:30
BF	21:18	64	0:30	4:26
BG	21:28	68	0:29	4:23
BH	21:33	67	0:29	4:18
BI	19:10	71	0:22	4:15
BJ	20:36	79	0:22	4:11
BK	20:37	80	0:21	4:10
BL	15:53	43	0:29	3:52
BM	16:08	42	0:30	3:49
BN	17:58	42	0:33	3:46
BO	17:26	42	0:32	3:43
BP	15:48	42	0:30	3:39
BQ	12:50	44	0:23	3:24
BR	15:49	40	0:31	3:22
BS	16:00	60	0:22	3:20
BT	15:18	57	0:22	3:07
BU	14:13	43	0:30	3:02
BV	13:47	53	0:21	2:46
BW	13:32	52	0:21	2:42
BX	13:05	51	0:20	2:38
BY	13:06	52	0:20	2:38
BZ	9:15	30	0:24	1:50
CA	8:12	28	0:22	1:36
CB	0:00	0	0:00	0:00
CC	0:00	0	0:00	0:00
CD	0:00	0	0:00	0:00
CE	0:00	0	0:00	0:00
CF	0:00	0	0:00	0:00
CG	0:00	0	0:00	0:00
CH	0:00	0	0:00	0:00
CI	0:00	0	0:00	0:00
CJ	0:00	0	0:00	0:00
CK	0:00	0	0:00	0:00
CL	0:00	0	0:00	0:00
CM	0:00	0	0:00	0:00
CN	0:00	0	0:00	0:00
CO	0:00	0	0:00	0:00
CP	0:00	0	0:00	0:00
CQ	0:00	0	0:00	0:00
CR	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)	87:50	20:20
2	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)	128:06	31:18
3	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (3)	156:25	40:18
4	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (4)	164:44	43:55
5	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)	219:56	49:23
6	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)	238:00	53:21
7	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)	321:10	71:34

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SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
8	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)	166:24	38:20
9	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (9)	126:17	30:28
10	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (10)	97:31	25:08
11	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (11)	66:17	18:25

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.

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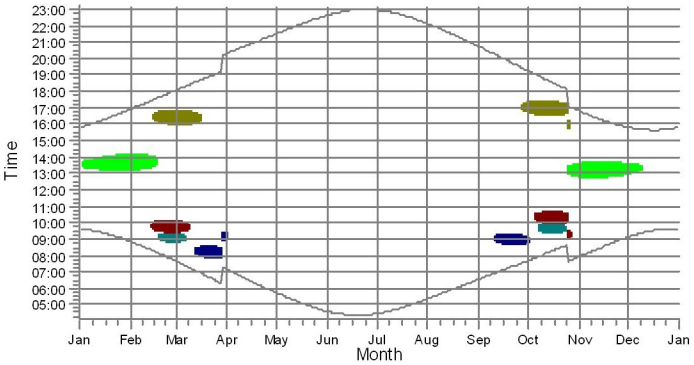
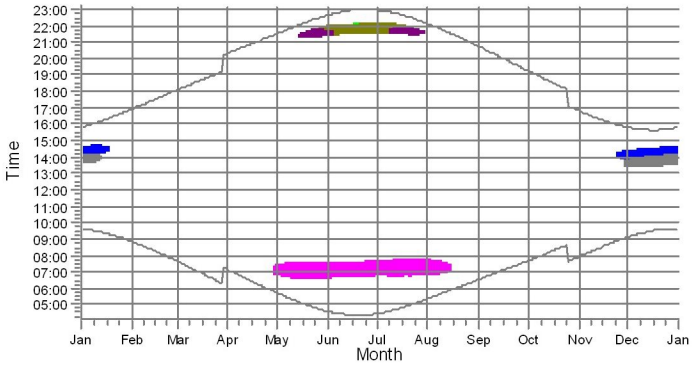
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

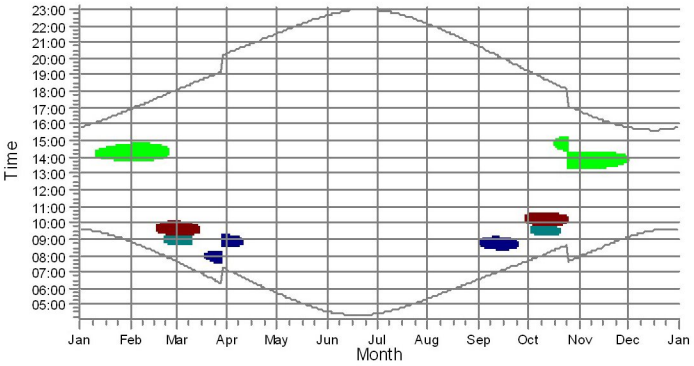
A: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (97)



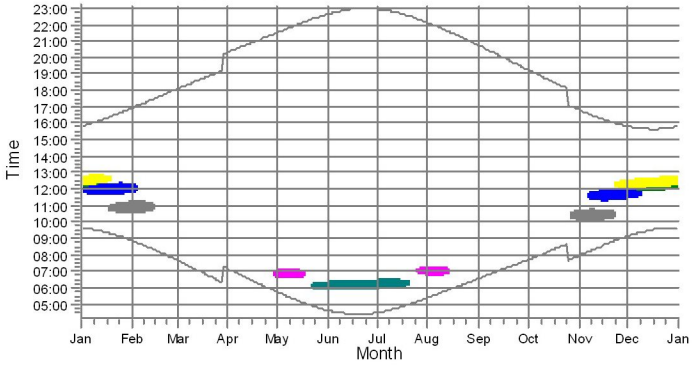
B: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (98)



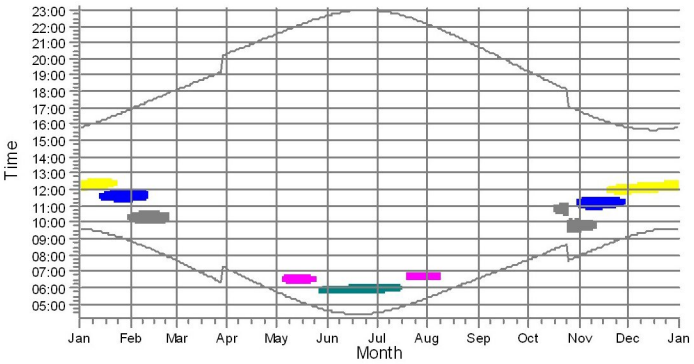
C: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (99)



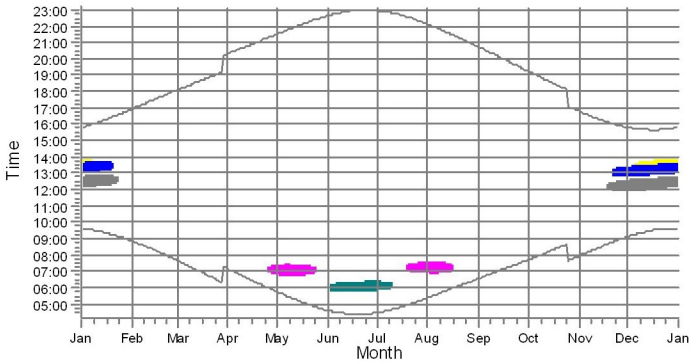
D: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (100)



E: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (101)



F: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (102)



WTGs

- 1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)
- 2: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)
- 3: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (3)
- 4: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (4)
- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)
- 9: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (9)
- 10: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (10)
- 11: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (11)

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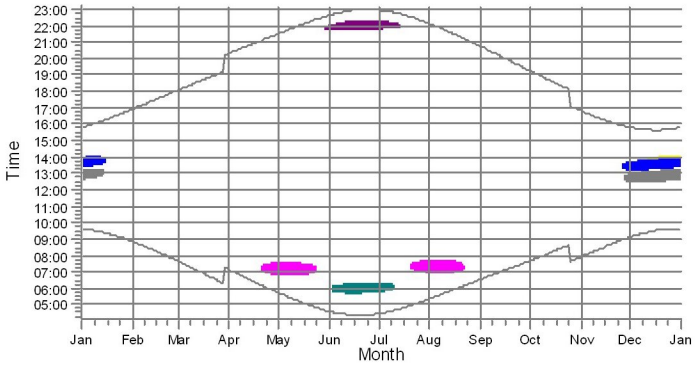
Calculated:
14.04.2019 20:40/3.2.743

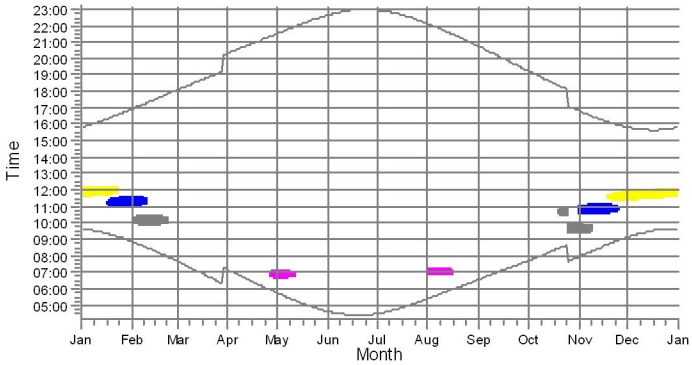
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

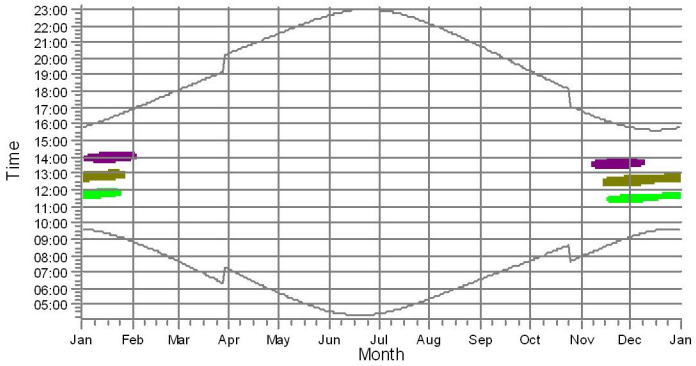
G: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (103)



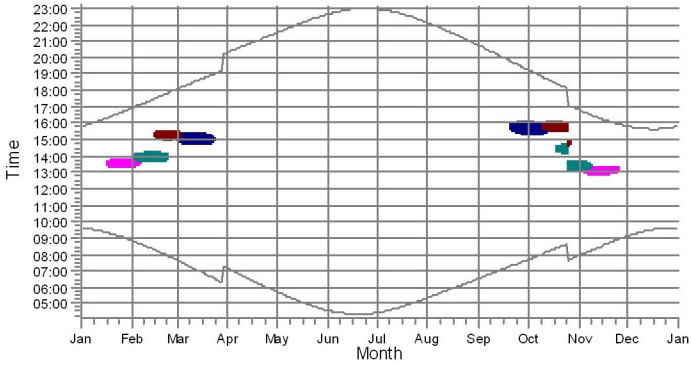
H: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (104)



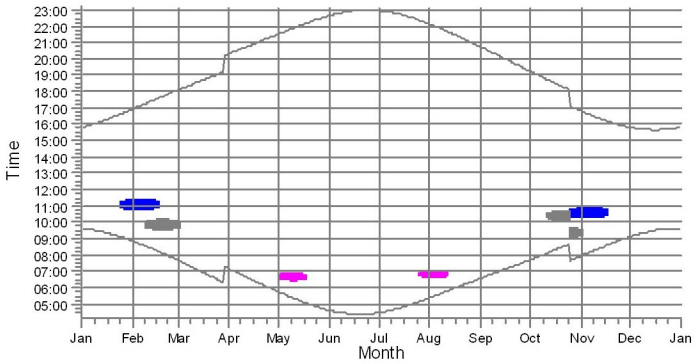
I: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (105)



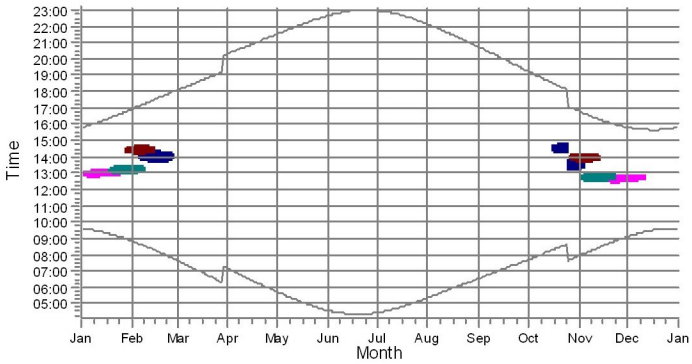
J: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (106)



K: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (107)



L: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (108)



WTGs

- 2: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)
- 3: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (3)
- 4: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (4)
- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)
- 9: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (9)
- 10: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (10)
- 11: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (11)

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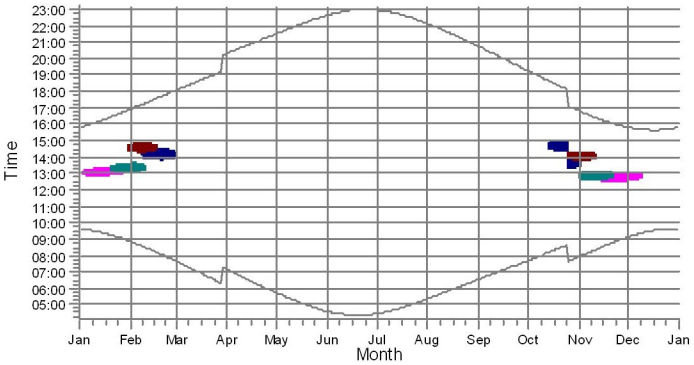
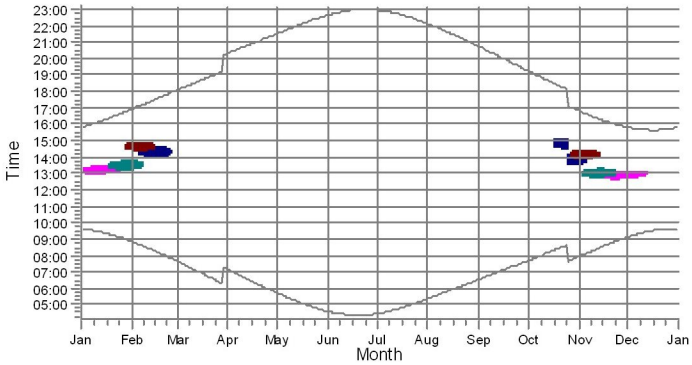
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

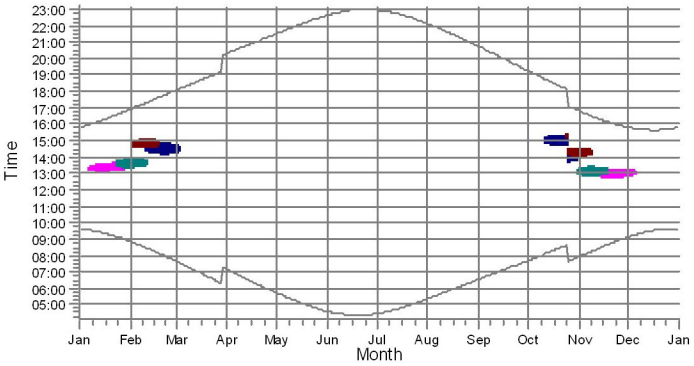
M: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (109)



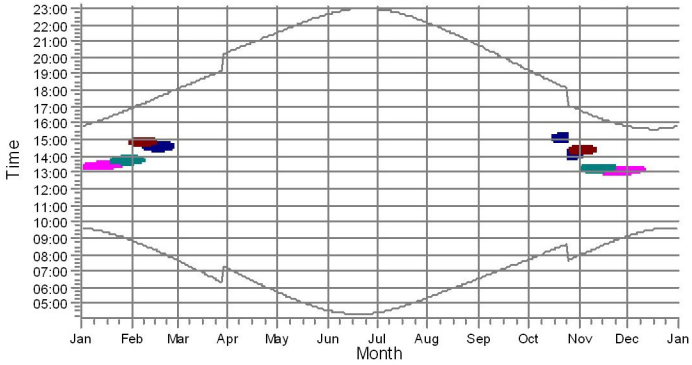
N: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (110)



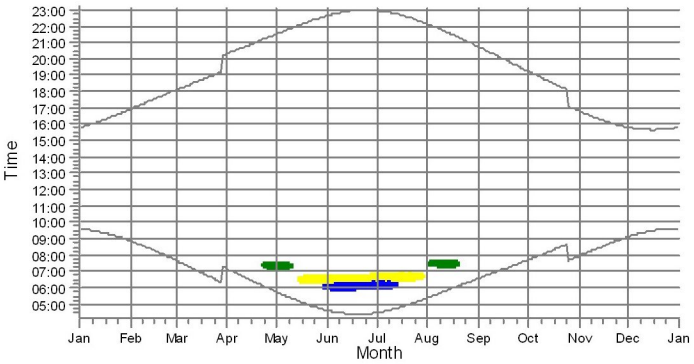
O: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (111)



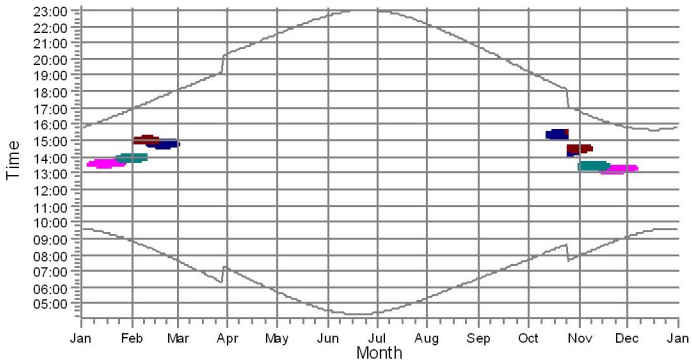
P: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (112)



Q: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (113)



R: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (114)



WTGs

- 1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)
- 2: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)
- 3: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (3)
- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)

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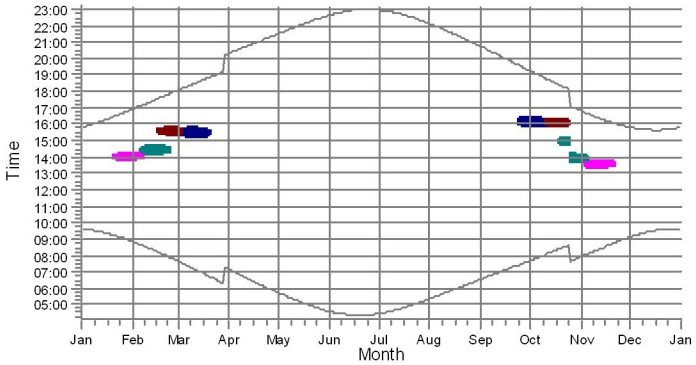
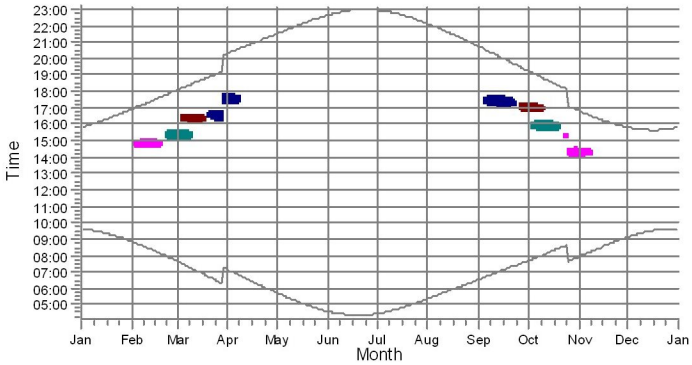
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

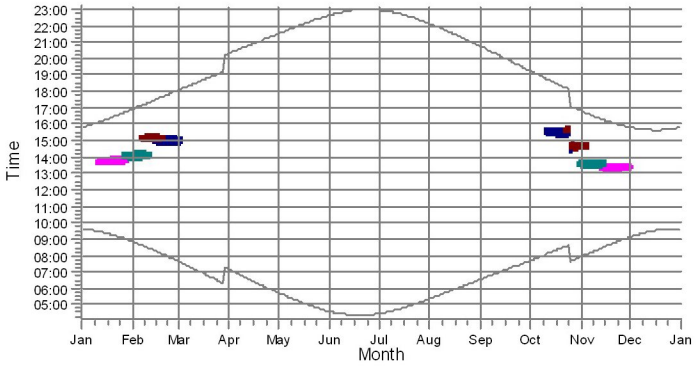
S: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (115)



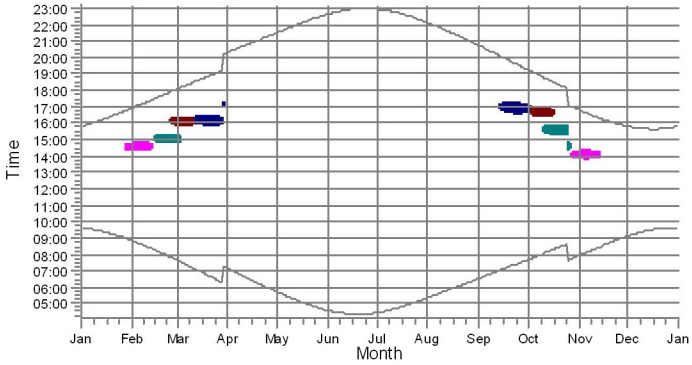
T: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (116)



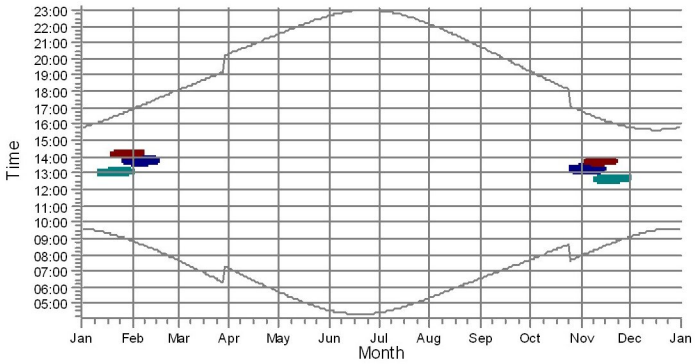
U: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (117)



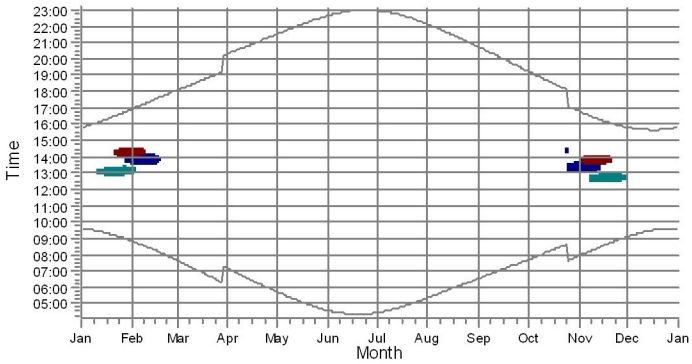
V: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (118)



W: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (119)



X: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (120)



WTGs

- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)

Project:
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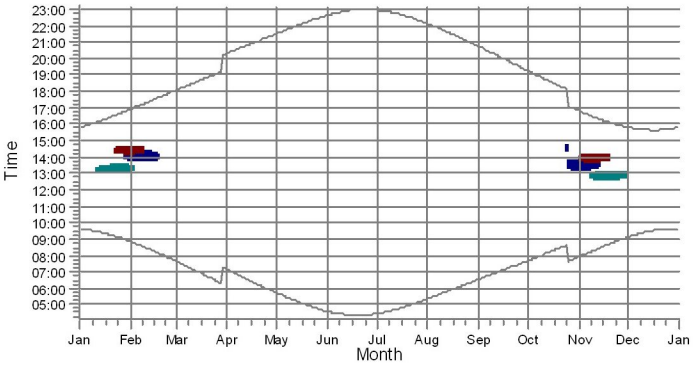
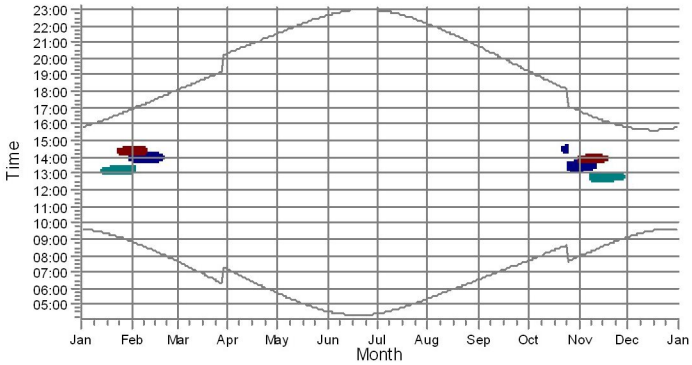
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

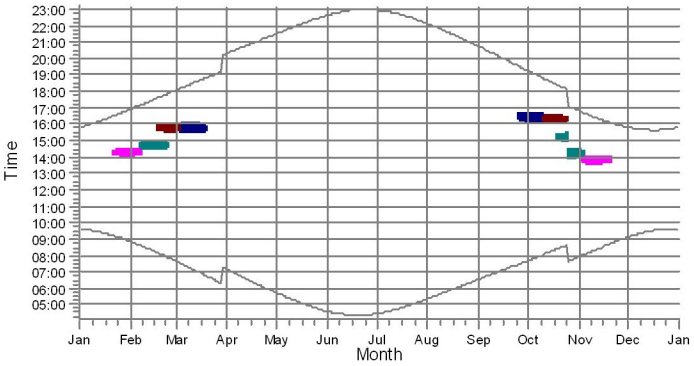
Y: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (121)



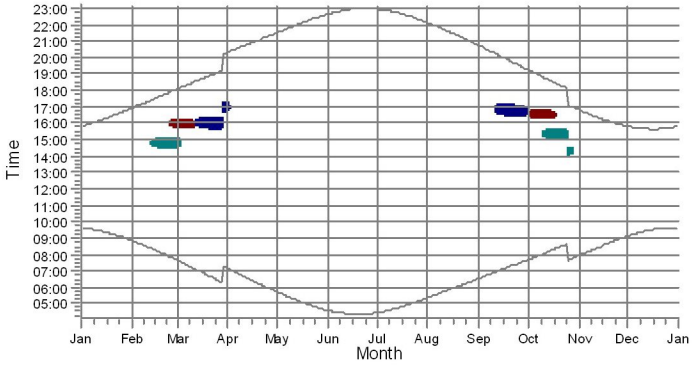
Z: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (122)



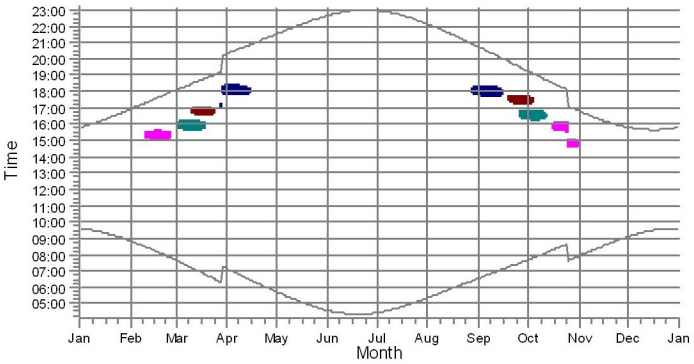
AA: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (123)



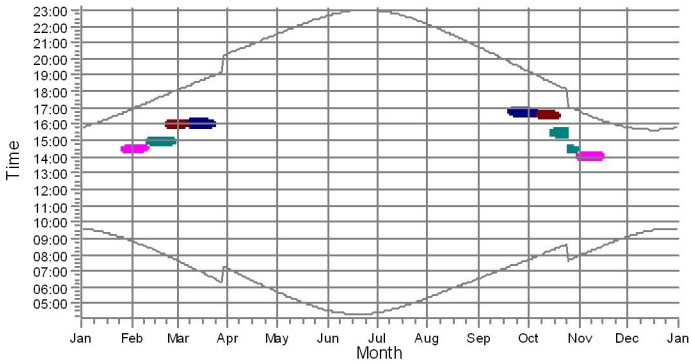
AB: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (124)



AC: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (125)



AD: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (126)



WTGs

- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)

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Calculated:
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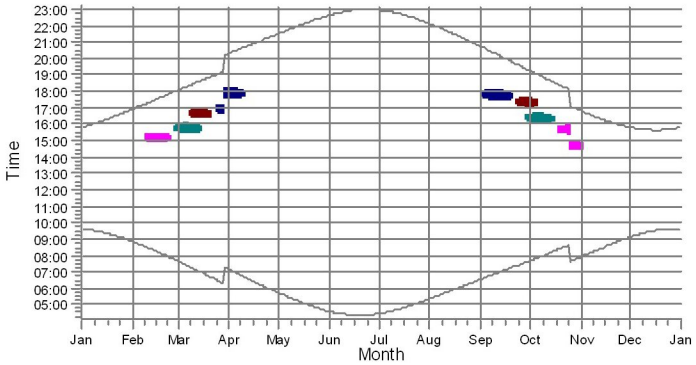
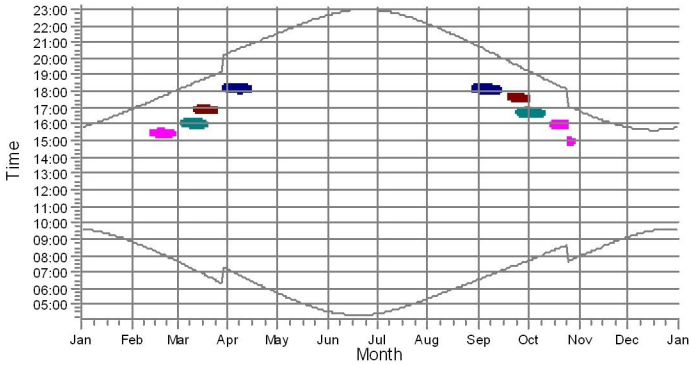
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

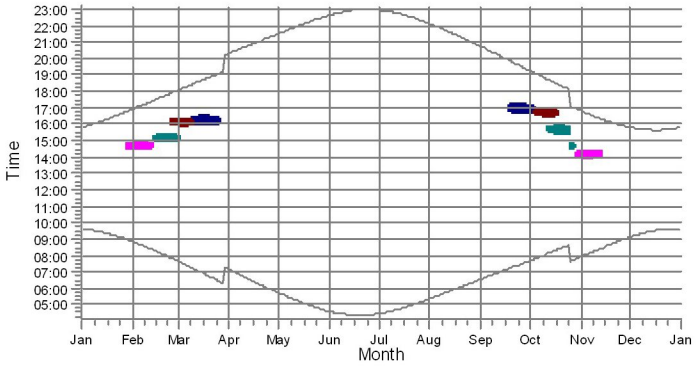
AE: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (127)



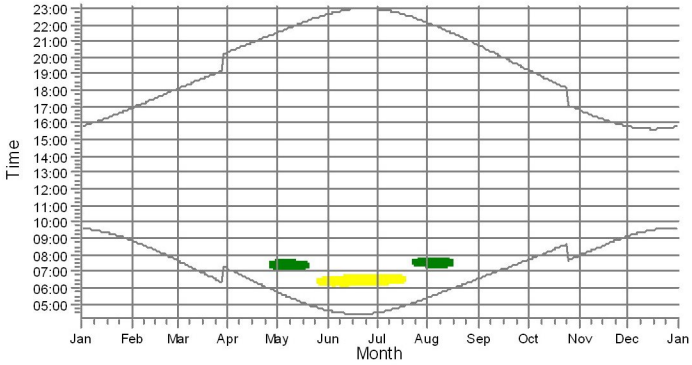
AF: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (128)



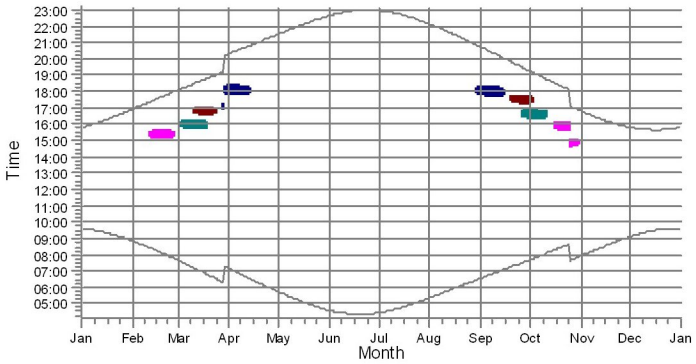
AG: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (129)



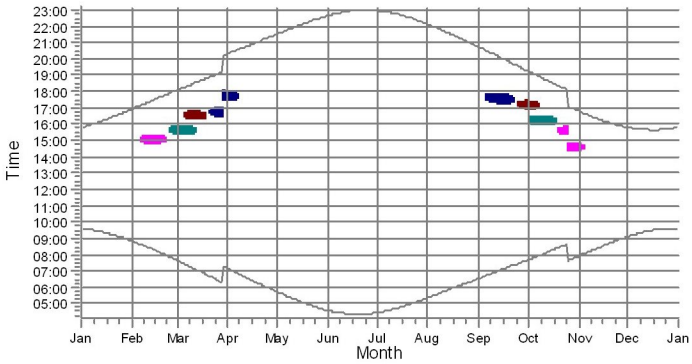
AH: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (130)



AI: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (131)



AJ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (132)



WTGs

- 1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)
- 2: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)
- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)

Project:
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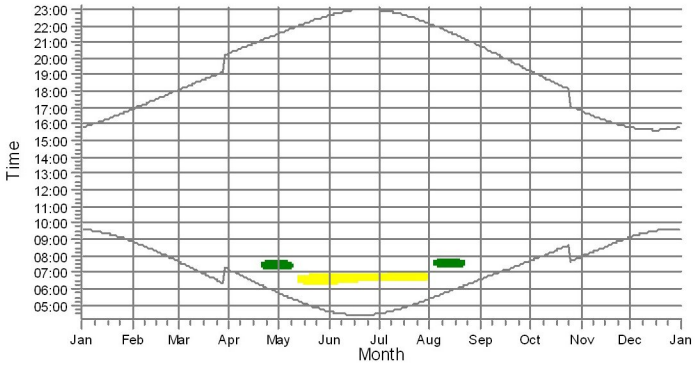
Calculated:
14.04.2019 20:40/3.2.743

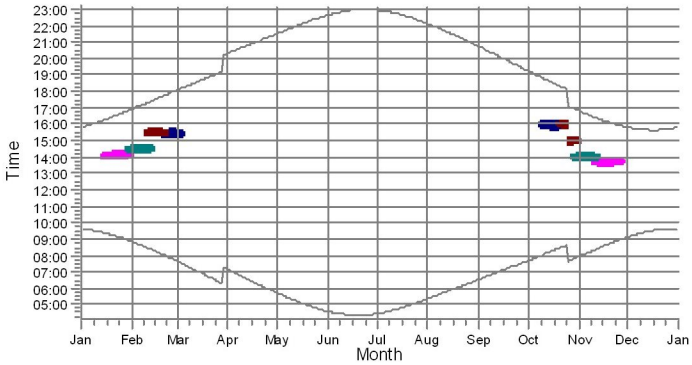
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

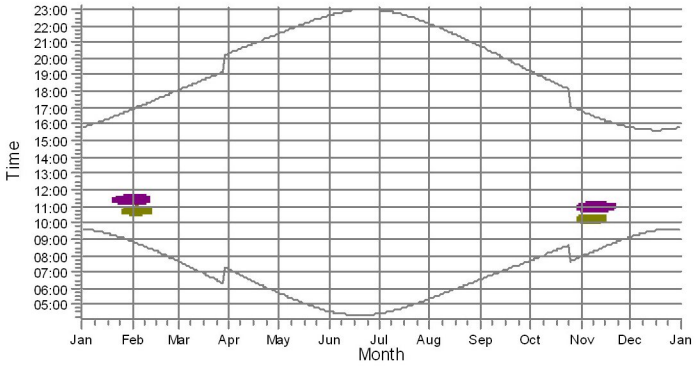
AK: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (133)



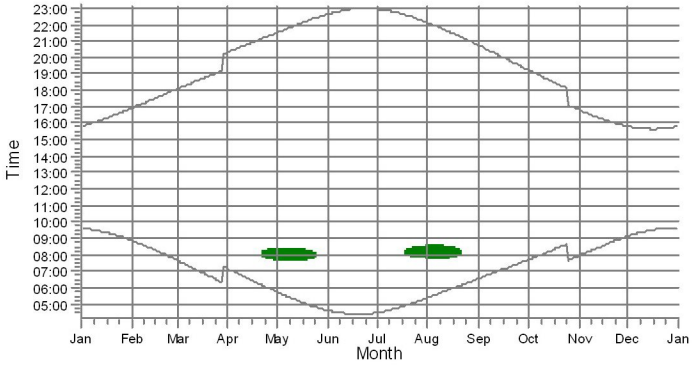
AL: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (134)



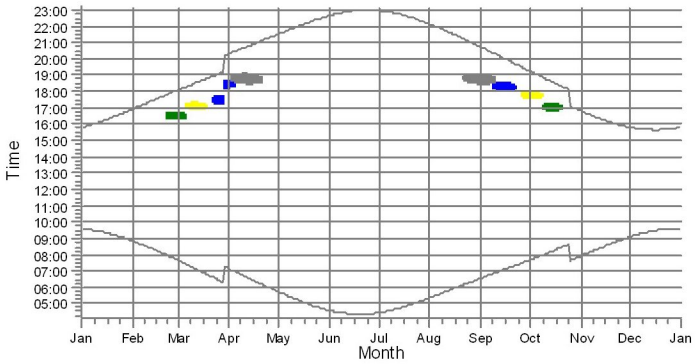
AM: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (135)



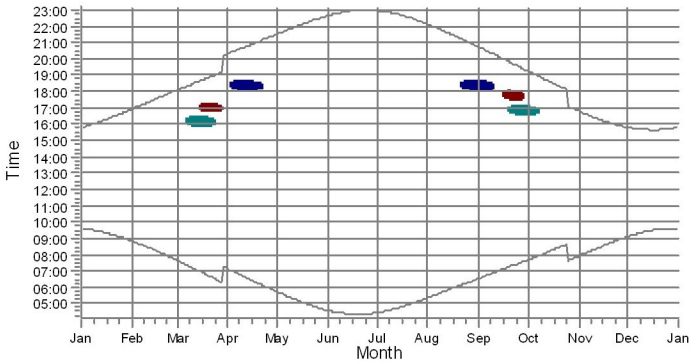
AN: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (136)



AO: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (137)



AP: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (138)



WTGs

- 1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)
- 2: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)
- 3: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (3)
- 4: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (4)
- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)
- 10: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (10)
- 11: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (11)

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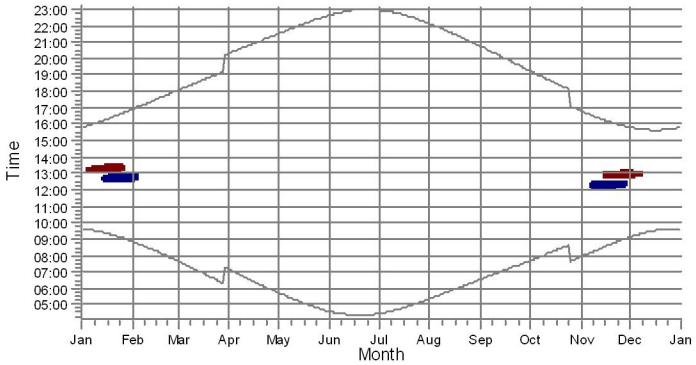
14.04.2019 20:40/3.2.743

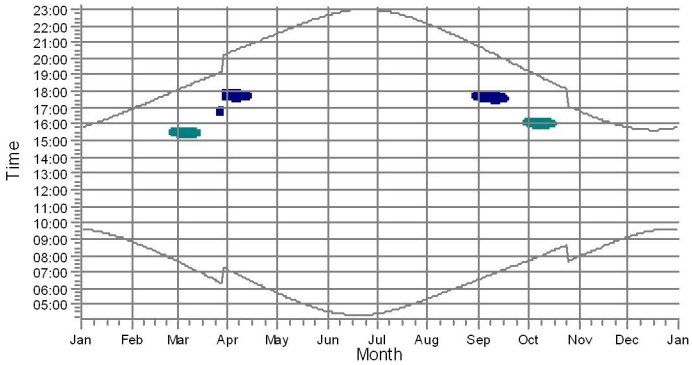
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

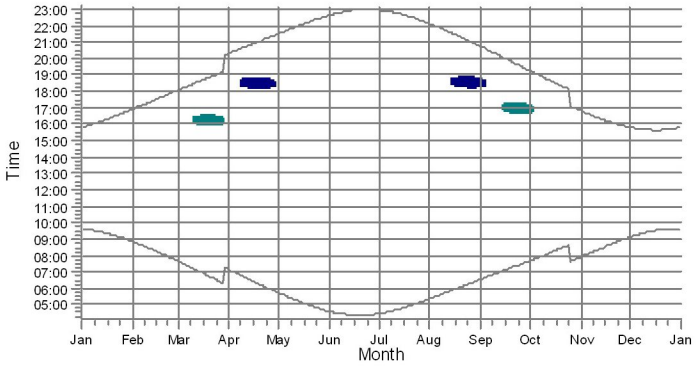
AQ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (139)



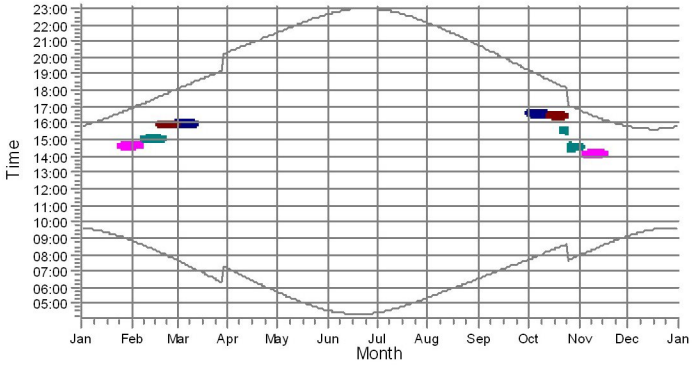
AR: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (140)



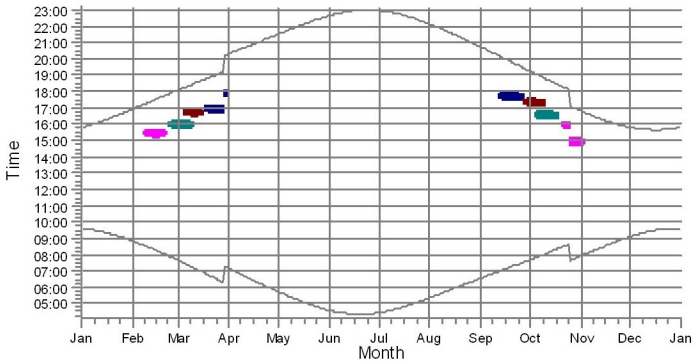
AS: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (141)



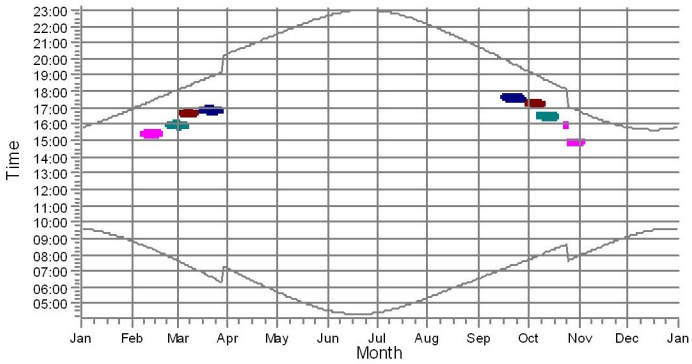
AT: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (142)



AU: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (143)



AV: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (144)



WTGs

- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)

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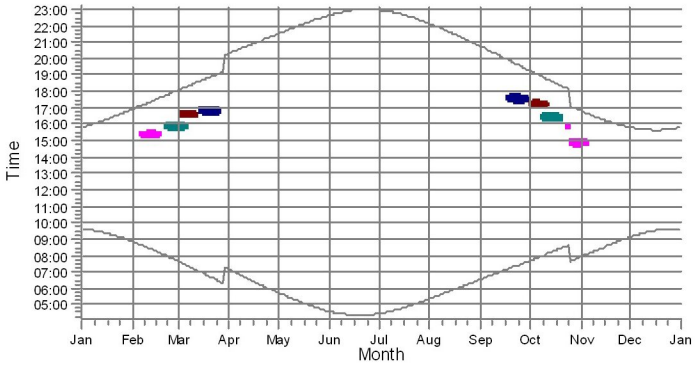
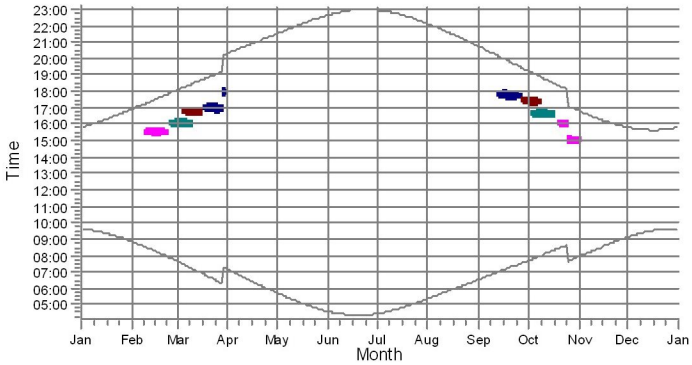
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

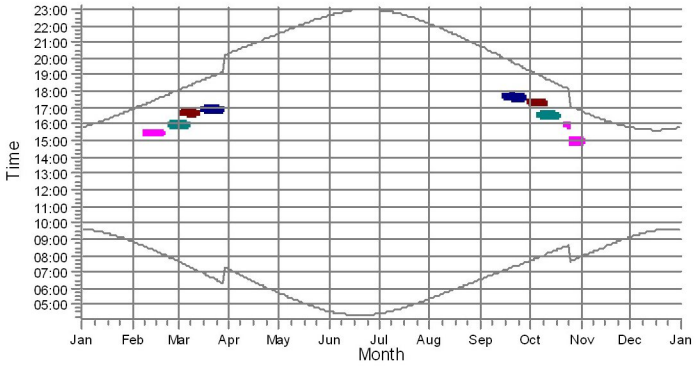
AW: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (145)



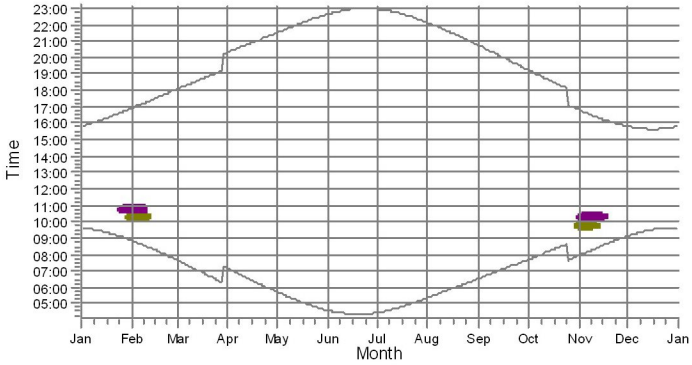
AX: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (146)



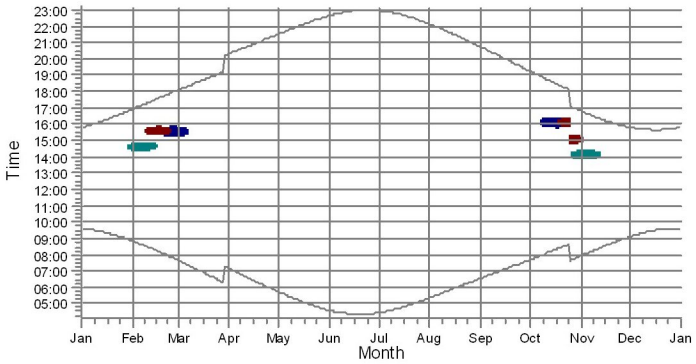
AY: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (147)



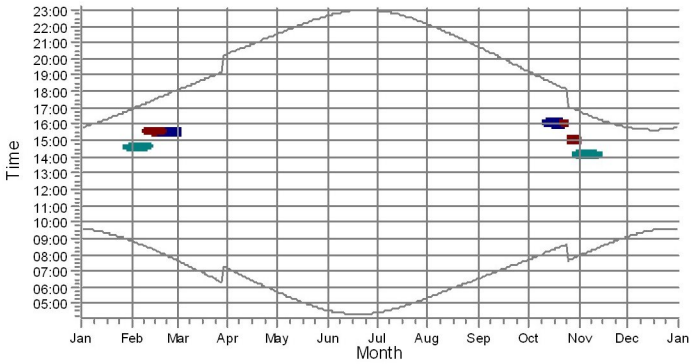
AZ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (148)



BA: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (149)



BB: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (150)



WTGs

- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)
- 10: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (10)
- 11: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (11)

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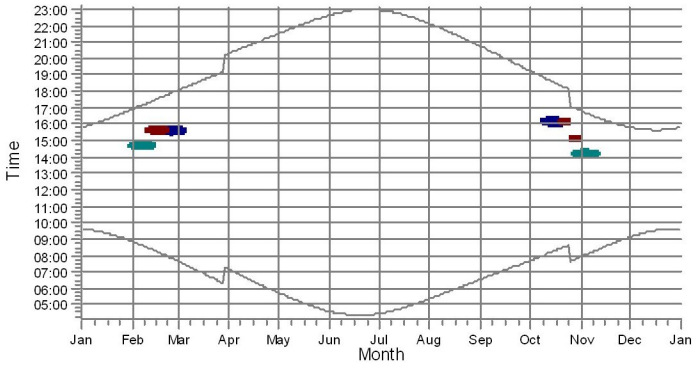
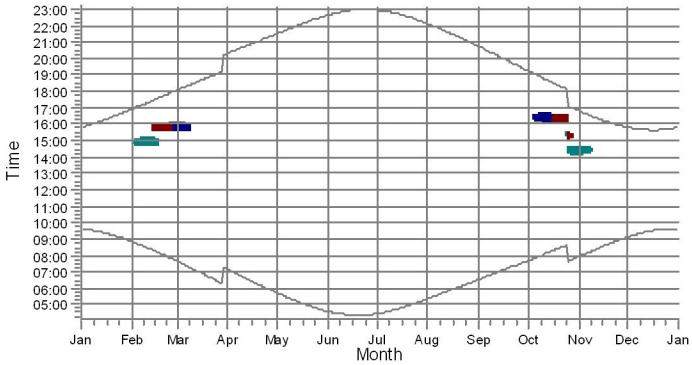
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

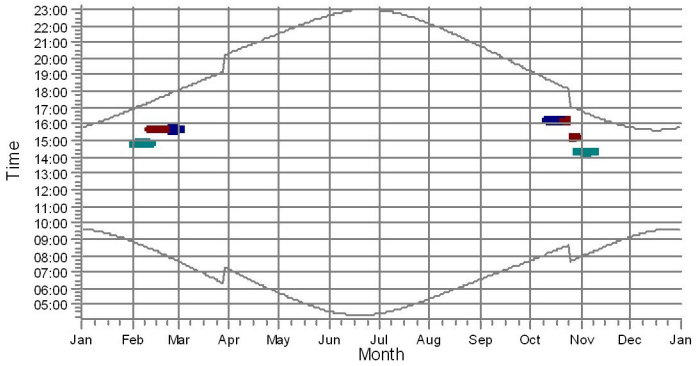
BC: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (151)



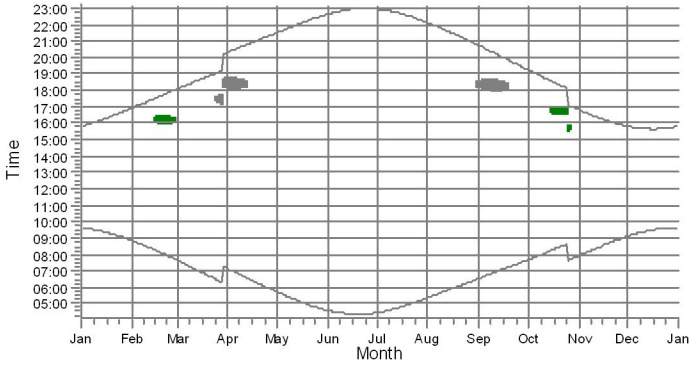
BD: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (152)



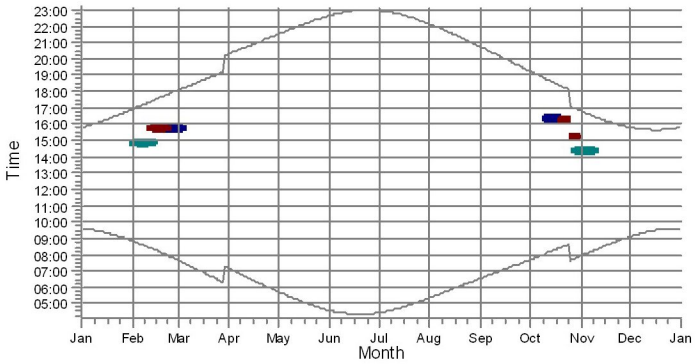
BE: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (153)



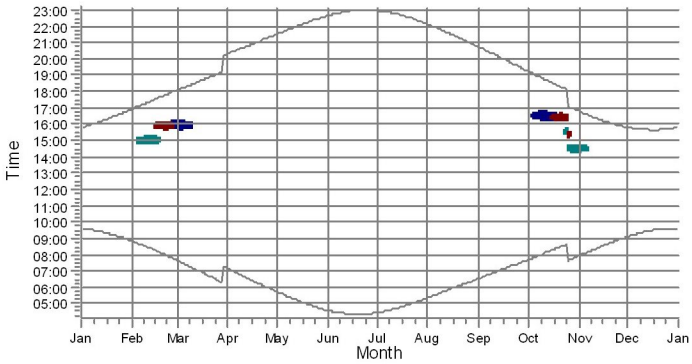
BF: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (154)



BG: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (155)



BH: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (156)



WTGs

- 1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)
- 4: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (4)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)
- 8: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)

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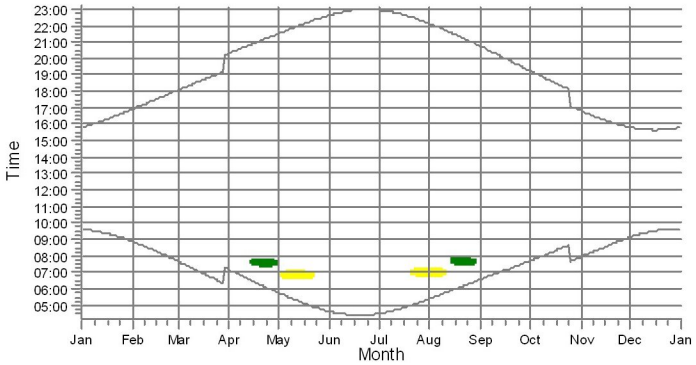
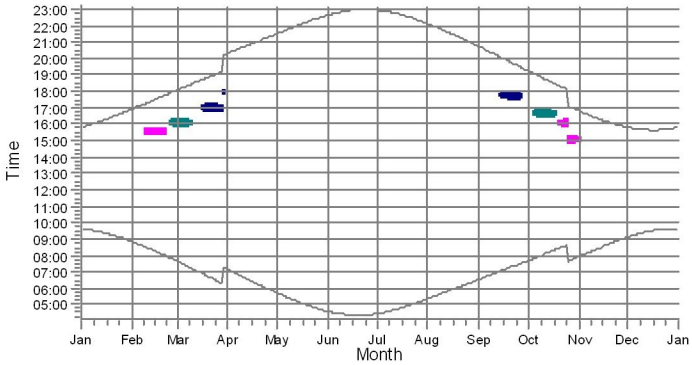
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

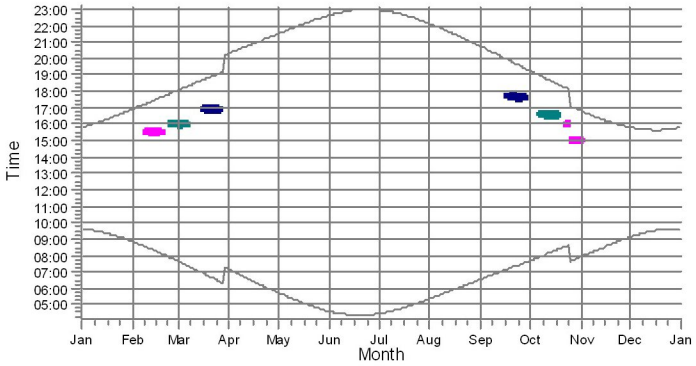
BI: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (157)



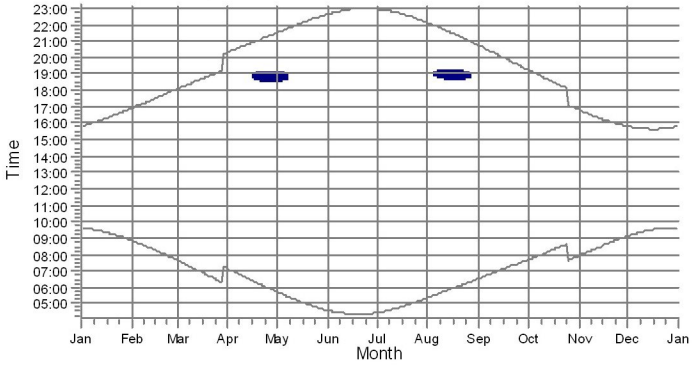
BJ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (158)



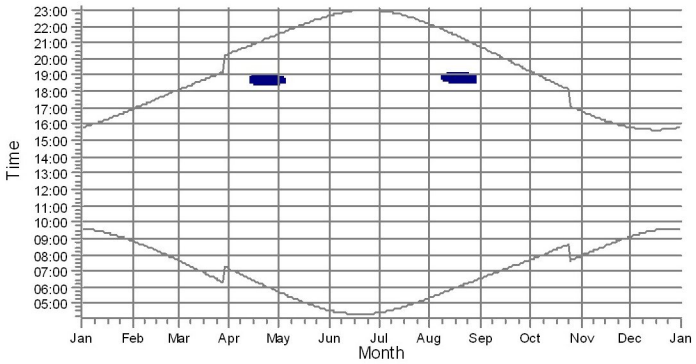
BK: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (159)



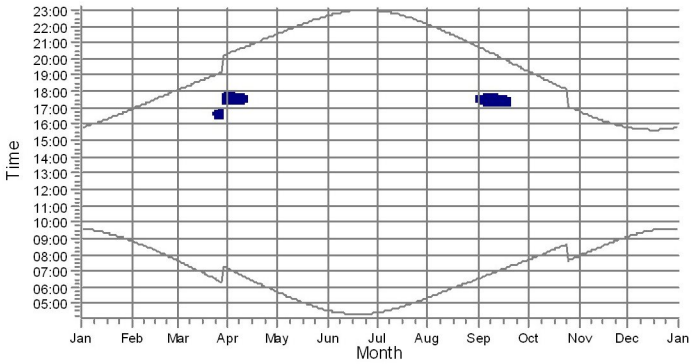
BL: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (160)



BM: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (161)



BN: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (162)



WTGs

- 1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)
- 2: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)
- 5: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)

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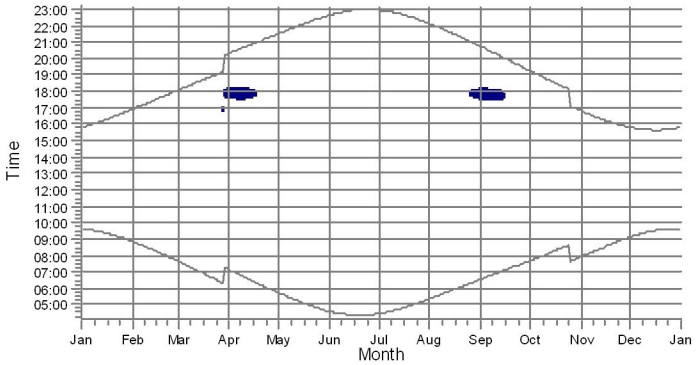
Calculated:
14.04.2019 20:40/3.2.743

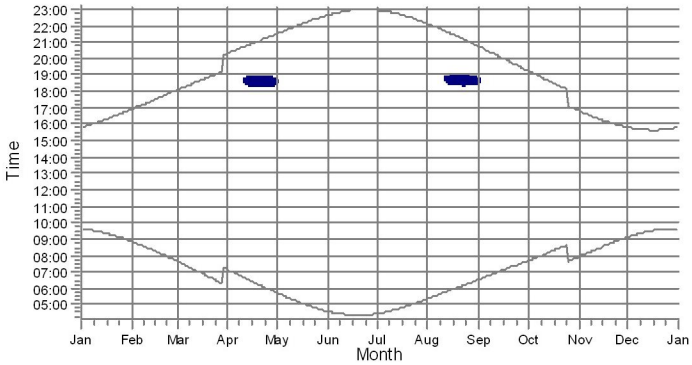
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

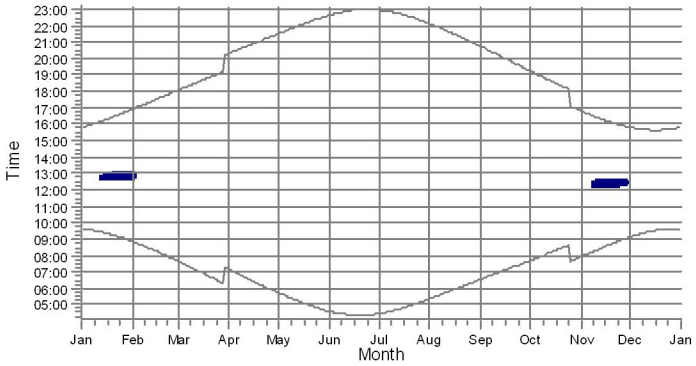
BO: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (163)



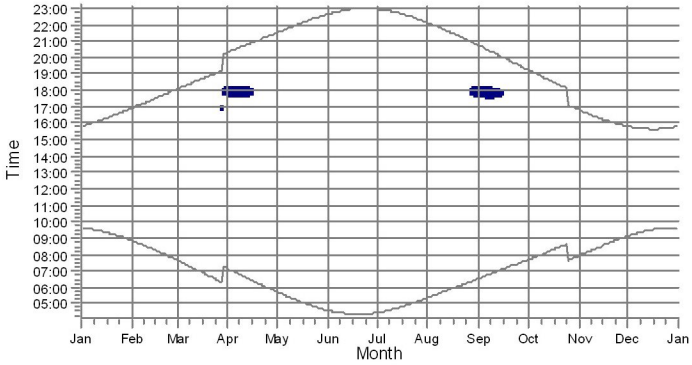
BP: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (164)



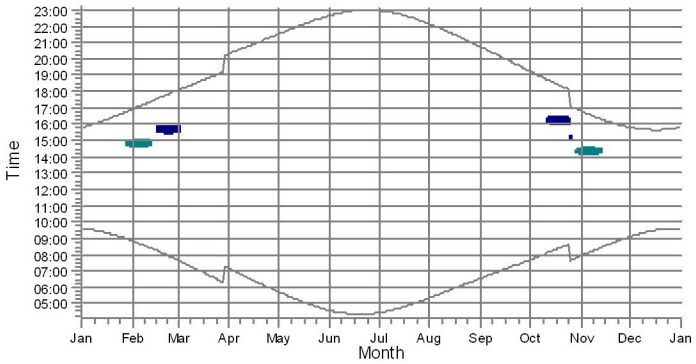
BQ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (165)



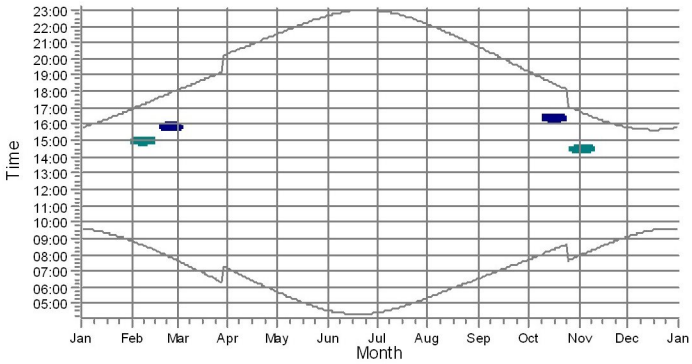
BR: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (166)



BS: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (167)



BT: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (168)



WTGs

6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)

7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)

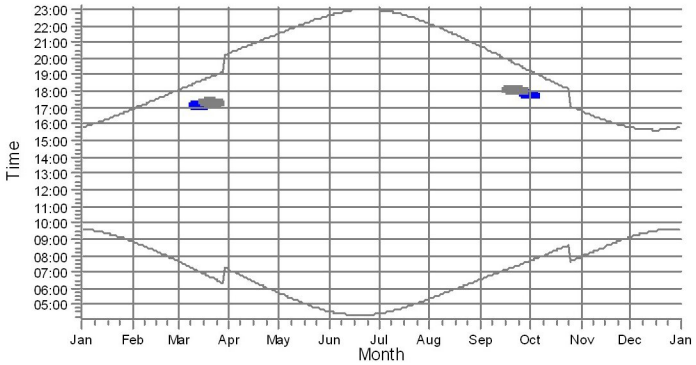
Project:
Tysvaer

Licensed user:
Meventus AS
Konsgård Allé 59
NO-4632 Kristiansand
+47 3860 7115
Data / data@meventus.com
Calculated:
14.04.2019 20:40/3.2.743

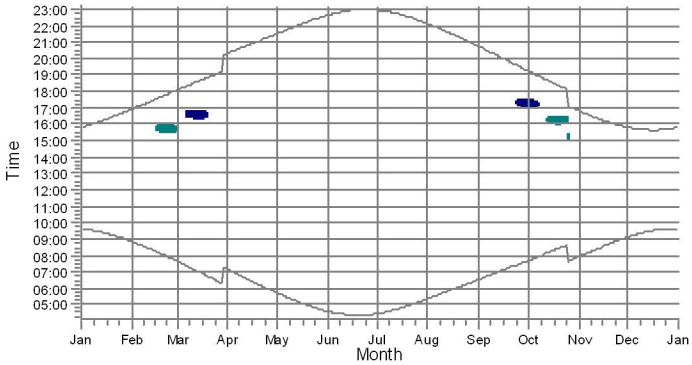
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

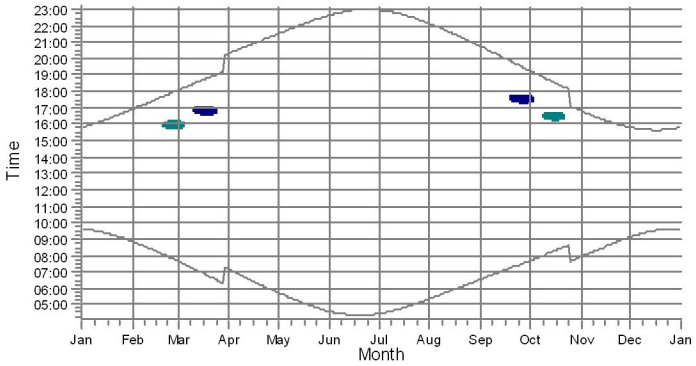
BU: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (169)



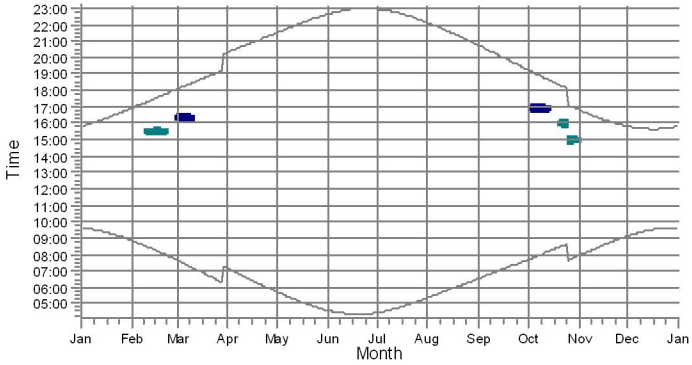
BV: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (170)



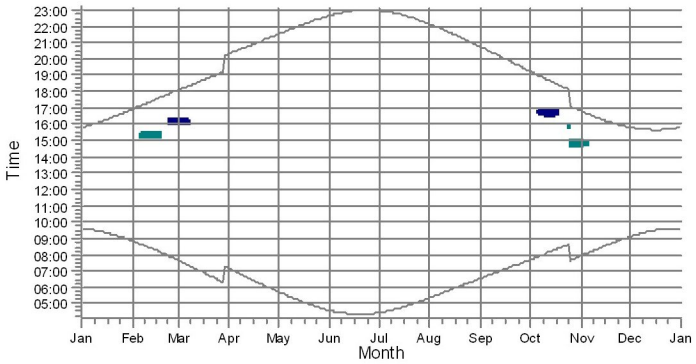
BW: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (171)



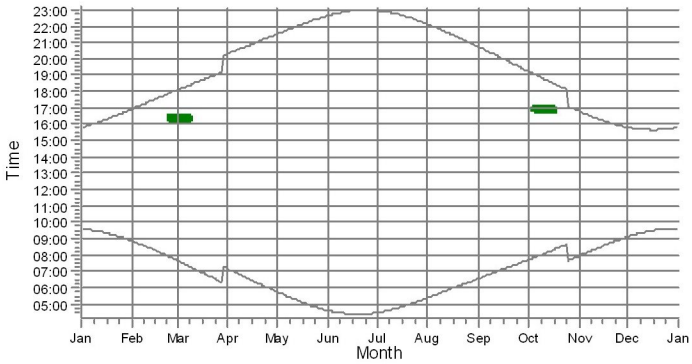
BX: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (172)



BY: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (173)



BZ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (174)



WTGs

- 1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)
- 3: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (3)
- 4: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (4)
- 6: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)
- 7: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)

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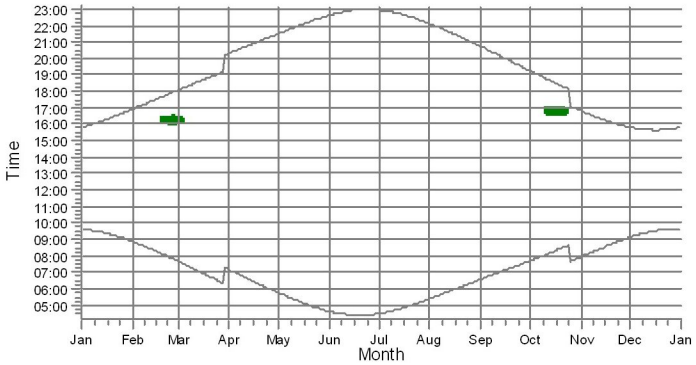
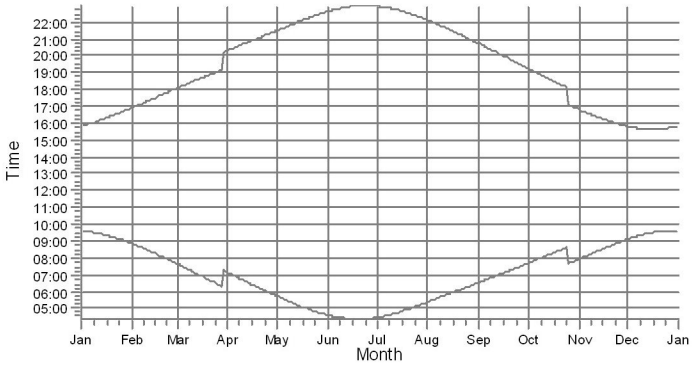
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

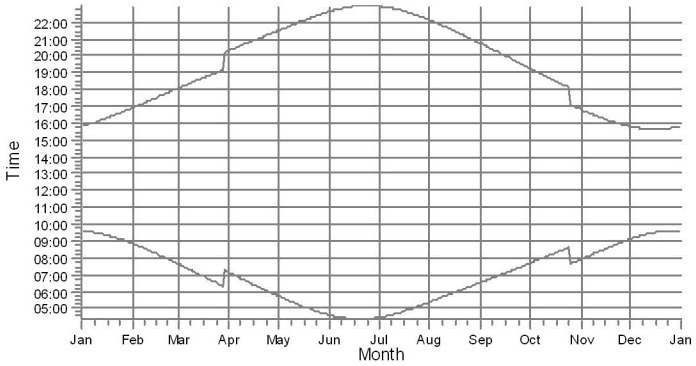
CA: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (175)



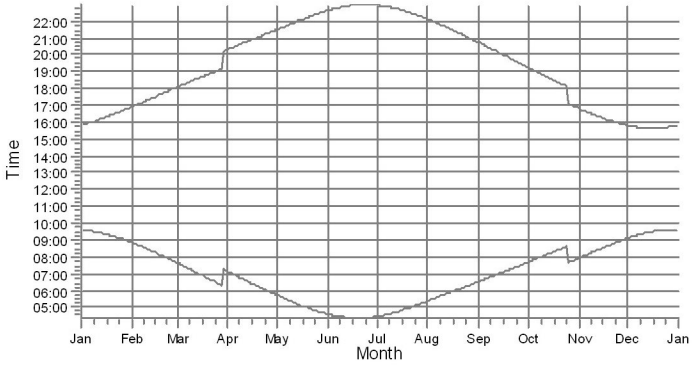
CB: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (176)



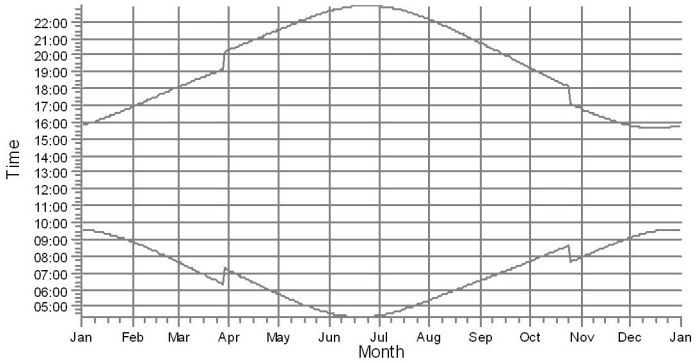
CC: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (177)



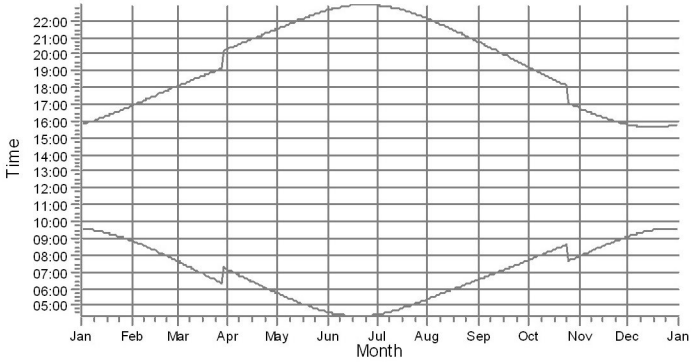
CD: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (178)



CE: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (179)



CF: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (180)



WTGs

1: Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)

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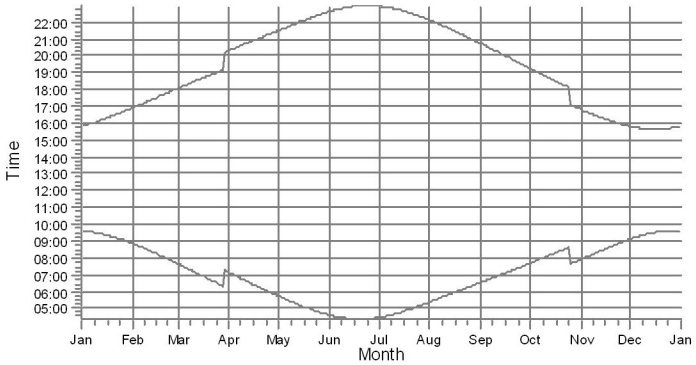
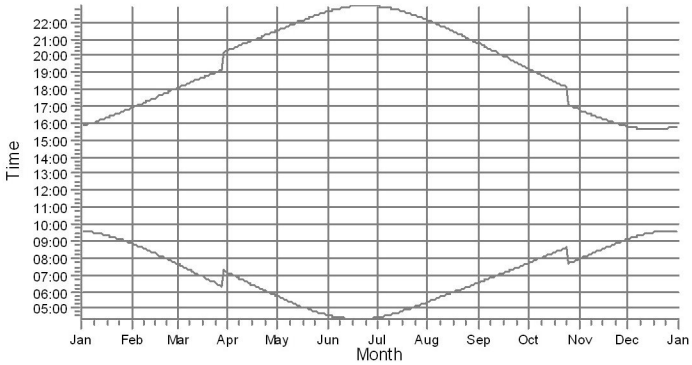
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

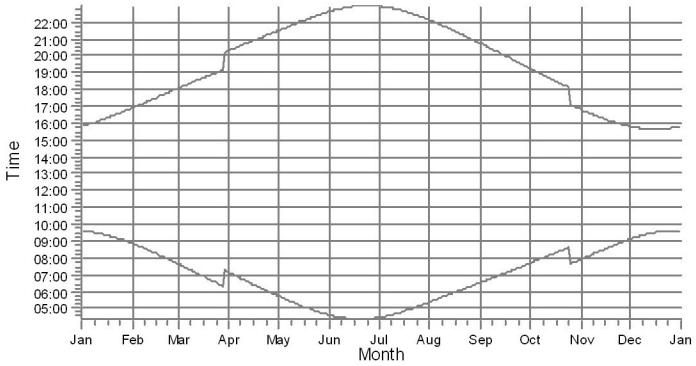
CG: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (181)



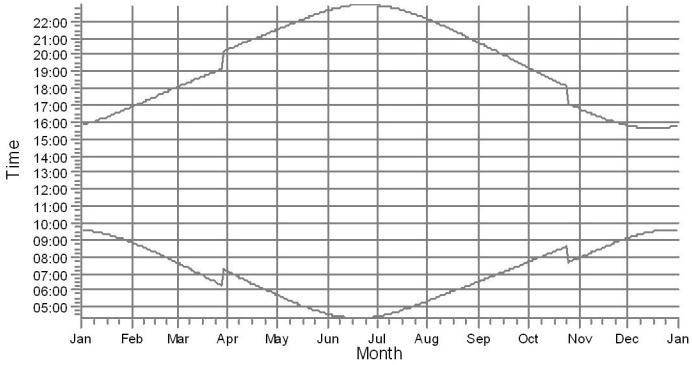
CH: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (182)



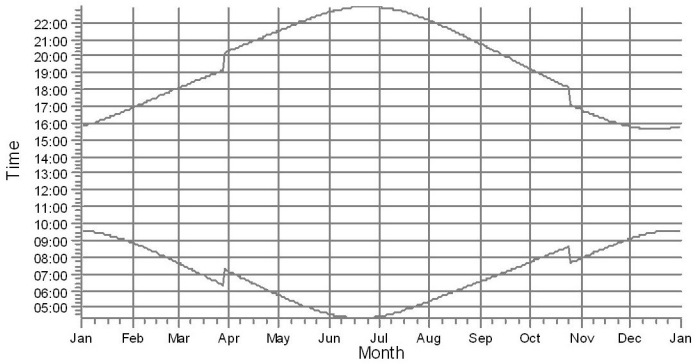
CI: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (183)



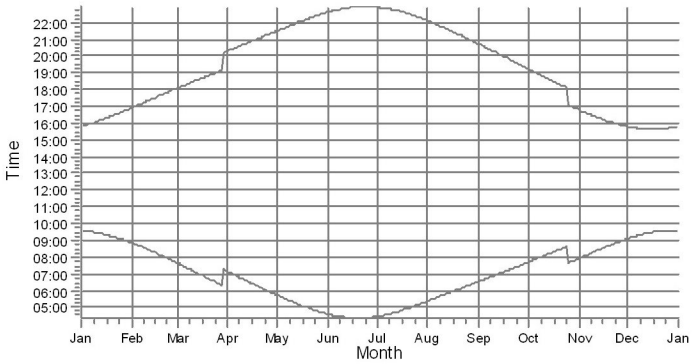
CJ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (184)



CK: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (185)



CL: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (186)



WTGs

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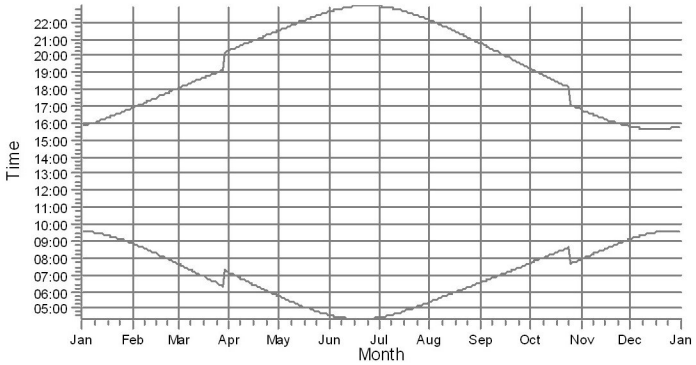
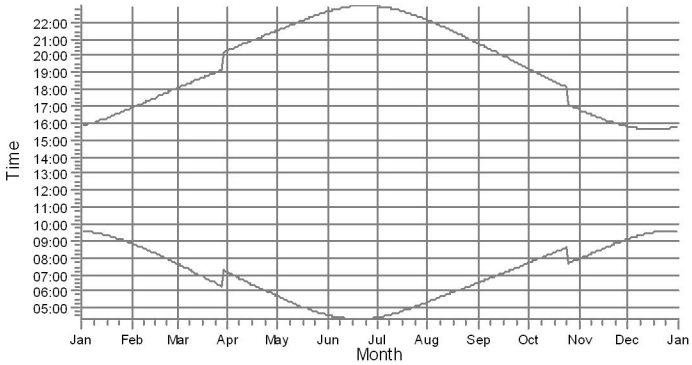
SHADOW - Calendar, graphical

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW

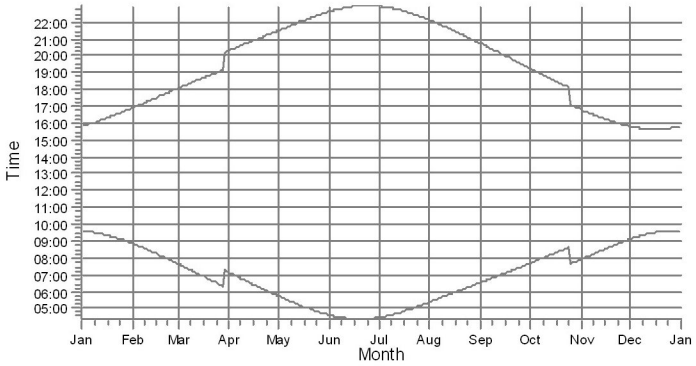
CM: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (187)



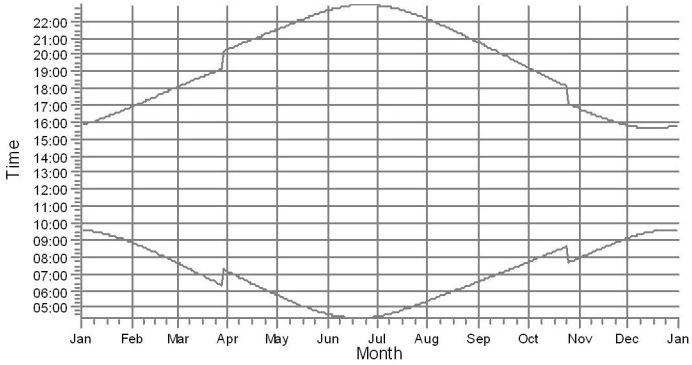
CN: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (188)



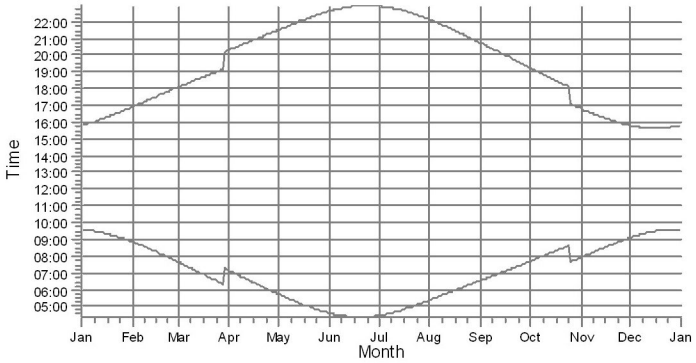
CO: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (189)



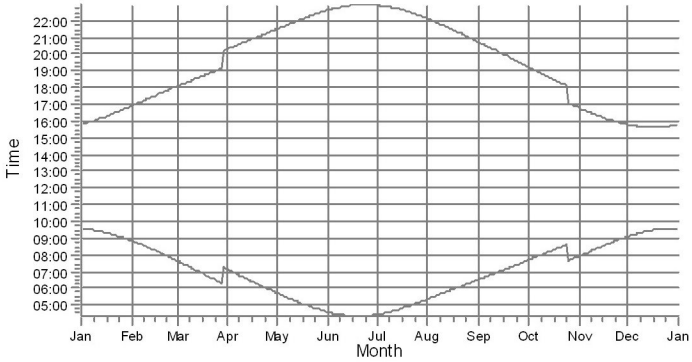
CP: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (190)



CQ: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (191)



CR: Shadow Receptor: 2.0 × 2.0 Azimuth: 0.0° Slope: 90.0° (192)



WTGs

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15.04.2019 09:46/3.2.743

SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW (with curtailment)

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

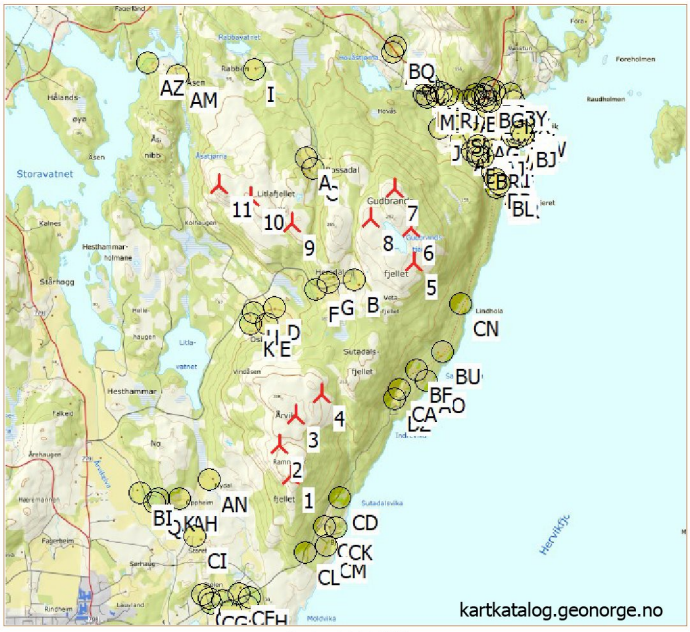
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
572	117	109	383	764	1,101	1,063	562	430	466	490	943	7,000

Flicker curtailment by stopping specific turbines

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: Height_DTM
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:75,000
New WTG Shadow receptor

WTGs

	Easting	Northing	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	304,046	6,577,449	211.0	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
2	303,951	6,577,756	194.3	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
3	304,127	6,578,046	217.5	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
4	304,391	6,578,248	191.4	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
5	305,374	6,579,503	244.7	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
6	305,364	6,579,845	262.0	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
7	305,226	6,580,247	260.4	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
8	304,974	6,579,960	261.8	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
9	304,188	6,579,956	215.8	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
10	303,792	6,580,231	199.1	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5
11	303,482	6,580,369	190.3	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 ...	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	1,746	12.5

Shadow receptor-Input

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
A	304,363	6,580,595	148.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
B	304,778	6,579,362	175.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
C	304,426	6,580,485	161.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
D	303,970	6,579,124	95.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
E	303,887	6,578,964	103.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
F	304,394	6,579,288	133.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
G	304,522	6,579,345	156.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
H	303,753	6,579,093	84.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
I	303,893	6,581,500	70.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
J	305,702	6,580,825	39.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
K	303,725	6,578,980	82.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
L	305,566	6,581,159	39.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
M	305,599	6,581,129	38.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
N	305,667	6,581,195	38.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
O	305,696	6,581,124	29.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
P	305,743	6,581,169	43.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0

To be continued on next page...

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SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW (with curtailment)

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
Q	302,678	6,577,252	23.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
R	305,801	6,581,141	37.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
S	305,887	6,580,880	21.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
T	306,074	6,580,629	19.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
U	305,850	6,581,111	32.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
V	306,046	6,580,749	20.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
W	305,541	6,581,331	48.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
X	305,560	6,581,297	48.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Y	305,613	6,581,278	55.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
Z	305,581	6,581,265	45.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AA	305,987	6,580,880	28.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AB	305,922	6,580,706	31.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AC	306,226	6,580,512	17.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AD	306,048	6,580,824	22.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AE	306,217	6,580,580	10.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AF	306,272	6,580,496	14.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AG	306,111	6,580,791	17.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AH	302,926	6,577,281	37.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AI	306,271	6,580,526	8.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AJ	306,212	6,580,636	2.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AK	302,716	6,577,288	27.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AL	305,999	6,581,087	31.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AM	303,122	6,581,476	27.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AN	303,231	6,577,449	32.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AO	305,446	6,578,325	9.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AP	306,239	6,580,417	25.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AQ	305,273	6,581,596	54.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AR	306,069	6,580,552	25.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AS	306,208	6,580,354	23.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AT	306,192	6,581,001	11.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AU	306,432	6,580,695	5.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AV	306,436	6,580,736	6.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AW	306,438	6,580,761	5.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AX	306,477	6,580,690	2.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AY	306,466	6,580,731	5.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
AZ	302,838	6,581,615	28.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BA	306,056	6,581,093	28.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BB	306,079	6,581,138	34.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BC	306,102	6,581,110	28.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BD	306,173	6,581,067	20.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BE	306,155	6,581,131	29.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BF	305,356	6,578,435	23.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BG	306,184	6,581,124	29.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BH	306,227	6,581,064	18.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BI	302,537	6,577,353	21.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BJ	306,527	6,580,713	1.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BK	306,514	6,580,747	3.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BL	306,265	6,580,240	15.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BM	306,231	6,580,285	22.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BN	306,017	6,580,580	28.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BO	306,073	6,580,516	29.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BP	306,224	6,580,320	23.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BQ	305,303	6,581,653	49.9	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BR	306,120	6,580,518	21.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BS	306,210	6,581,199	28.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BT	306,267	6,581,170	23.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BU	305,623	6,578,601	19.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BV	306,483	6,580,899	4.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BW	306,537	6,580,816	2.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BX	306,456	6,581,051	6.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BY	306,432	6,581,132	14.3	2.0	2.0	2.0	90.0	"Green house mode"	4.0
BZ	305,114	6,578,156	28.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CA	305,173	6,578,252	36.8	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CB	303,549	6,576,179	13.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CC	304,358	6,576,926	33.6	2.0	2.0	2.0	90.0	"Green house mode"	4.0

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15.04.2019 09:46/3.2.743

SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW (with curtailment)

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
CD	304,518	6,577,201	32.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CE	303,184	6,576,228	5.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CF	303,469	6,576,305	10.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CG	303,169	6,576,276	8.0	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CH	303,577	6,576,257	16.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CI	303,059	6,576,901	15.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CJ	306,234	6,580,201	20.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CK	304,468	6,576,910	16.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CL	304,155	6,576,682	37.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CM	304,362	6,576,737	16.1	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CN	305,824	6,579,068	21.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CO	303,305	6,576,243	11.7	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CP	303,105	6,576,312	4.2	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CQ	303,373	6,576,142	6.4	2.0	2.0	2.0	90.0	"Green house mode"	4.0
CR	306,292	6,580,217	10.5	2.0	2.0	2.0	90.0	"Green house mode"	4.0

Calculation Results

Shadow receptor

	Shadow, worst case					Shadow, expected values	
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Avoided hours per year [h/year]	Avoided days per year [days/year]	Shadow hours per year [h/year]	Avoided hours per year [h/year]
A*	22:10	73	0:29	111:39	106	6:25	27:02
AA*	34:37	102	0:29	7:28	12	7:16	1:26
AB*	35:43	95	0:34	6:39		7:21	1:16
AC*	34:48	108	0:32	6:58	4	7:08	1:27
AD*	35:37	115	0:32	5:46		7:27	1:06
AE*	32:33	99	0:28	7:22	12	6:40	1:31
AF*	32:22	99	0:27	7:12	10	6:39	1:31
AG*	28:25	104	0:32	10:49	10	5:55	2:13
AH*	29:27	97	0:28	8:08	4	6:14	1:46
AI*	31:53	102	0:31	6:45	5	6:32	1:25
AJ*	33:44	110	0:39	4:29		6:58	0:55
AK*	28:36	115	0:25	7:29		6:06	1:40
AL*	34:33	103	0:34	1:07		7:28	0:13
AM	25:33	46	0:49			7:36	
AN	30:45	65	0:37			7:27	
AO	33:14	110	0:28			7:16	
AP*	31:00	82	0:34	3:15		6:28	0:41
AQ	24:56	64	0:38			6:30	
AR	30:31	78	0:32			6:18	
AS	29:23	76	0:30			6:18	
AT*	26:46	99	0:28	3:41		5:32	0:43
AU*	25:17	90	0:33	3:23	7	5:08	0:42
AV*	25:27	88	0:32	2:26	7	5:09	0:30
AW*	25:45	91	0:31	1:45	3	5:14	0:21
AX*	23:57	84	0:32	3:10	7	4:52	0:39
AY*	24:29	86	0:32	2:35	7	4:58	0:32
AZ	17:53	40	0:40			5:25	
B*	28:47	111	0:23	111:27	51	7:20	25:56
BA*	23:58	72	0:31	0:53		5:01	0:10
BB*	23:29	70	0:30	0:03		4:56	0:00
BC*	22:34	71	0:30	0:47		4:41	0:09
BD*	19:51	67	0:30	2:38	2	4:01	0:30
BE*	21:11	67	0:30	0:38		4:22	0:07
BF	21:18	64	0:30			4:26	
BG*	20:37	68	0:29	0:51		4:13	0:10
BH*	19:17	67	0:29	2:16		3:52	0:26
BI*	18:44	71	0:22	0:26		4:09	0:06
BJ	20:36	79	0:22			4:11	
BK	20:37	80	0:21			4:10	
BL	15:53	43	0:29			3:52	
BM	16:08	42	0:30			3:49	
BN	17:58	42	0:33			3:46	

To be continued on next page...

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SHADOW - Main Result

Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW (with curtailment)

...continued from previous page

	Shadow, worst case					Shadow, expected values	
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Avoided hours per year [h/year]	Avoided days per year [days/year]	Shadow hours per year [h/year]	Avoided hours per year [h/year]
BO	17:26	42	0:32			3:43	
BP	15:48	42	0:30			3:39	
BQ	12:50	44	0:23			3:24	
BR	15:49	40	0:31			3:22	
BS	16:00	60	0:22			3:20	
BT	15:18	57	0:22			3:07	
BU	14:13	43	0:30			3:02	
BV	13:47	53	0:21			2:46	
BW	13:32	52	0:21			2:42	
BX	13:05	51	0:20			2:38	
BY	13:06	52	0:20			2:38	
BZ	9:15	30	0:24			1:50	
C*	23:04	48	0:50	96:01	123	6:57	23:54
CA	8:12	28	0:22			1:36	
CB	0:00	0	0:00			0:00	
CC	0:00	0	0:00			0:00	
CD	0:00	0	0:00			0:00	
CE	0:00	0	0:00			0:00	
CF	0:00	0	0:00			0:00	
CG	0:00	0	0:00			0:00	
CH	0:00	0	0:00			0:00	
CI	0:00	0	0:00			0:00	
CJ	0:00	0	0:00			0:00	
CK	0:00	0	0:00			0:00	
CL	0:00	0	0:00			0:00	
CM	0:00	0	0:00			0:00	
CN	0:00	0	0:00			0:00	
CO	0:00	0	0:00			0:00	
CP	0:00	0	0:00			0:00	
CQ	0:00	0	0:00			0:00	
CR	0:00	0	0:00			0:00	
D*	25:01	56	0:36	78:38	151	6:47	20:23
E*	25:10	140	0:21	73:22	80	6:14	20:14
F*	30:30	69	0:40	64:13	92	7:28	15:22
G*	30:31	116	0:40	60:14	43	7:25	14:14
H*	23:26	75	0:23	41:37	81	6:26	11:54
I*	25:40	74	0:26	39:20	12	6:46	9:59
J*	27:48	75	0:29	33:45	57	6:36	7:03
K*	26:13	73	0:41	17:03	33	7:55	4:27
L*	23:23	78	0:25	26:58	36	6:02	6:07
M*	26:57	110	0:26	23:34	4	6:47	5:19
N*	28:27	108	0:34	18:48	5	7:00	4:13
O*	23:43	82	0:28	22:42	28	5:49	5:03
P*	28:08	109	0:29	17:39	4	6:46	3:54
Q*	36:14	76	0:37	10:27	36	7:34	2:17
R*	32:25	110	0:30	10:39		7:31	2:18
S*	36:03	106	0:26	10:09	12	7:46	2:01
T*	35:26	88	0:40	11:07	34	7:18	2:25
U*	33:15	103	0:28	7:38	4	7:32	1:37
V*	33:22	104	0:30	10:31	16	7:01	2:06
W*	32:44	74	0:53	4:05		7:58	0:57
X*	27:49	74	0:43	9:16	2	6:46	2:09
Y*	23:23	66	0:39	13:56	10	5:39	3:10
Z*	21:34	66	0:39	15:25	10	5:16	3:32

** Receptors where shadow flicker is reduced by curtailment*

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

No.	Name	Worst case [h/year]	Stopped due to flicker curtailment [h/year]	Expected [h/year]
1	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (1)	77:23	10:27	18:01
2	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (2)	101:43	26:23	24:03
3	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (3)	77:13	79:12	18:25
4	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (4)	79:34	85:10	20:18

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SHADOW - Main Result

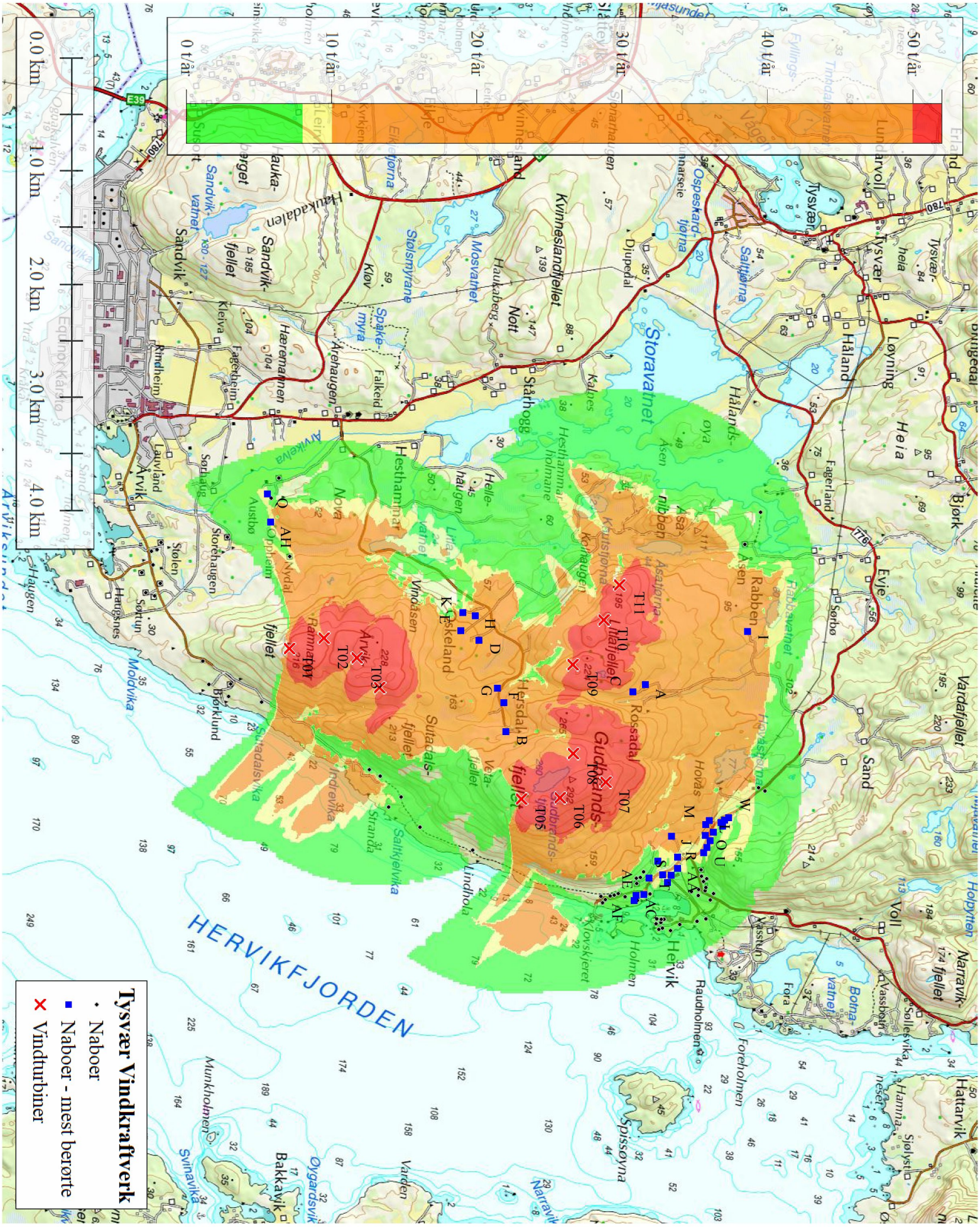
Calculation: 201904_Tysvær_11xS130_4.3MW_85mHH_SHADOW (with curtailment)

...continued from previous page

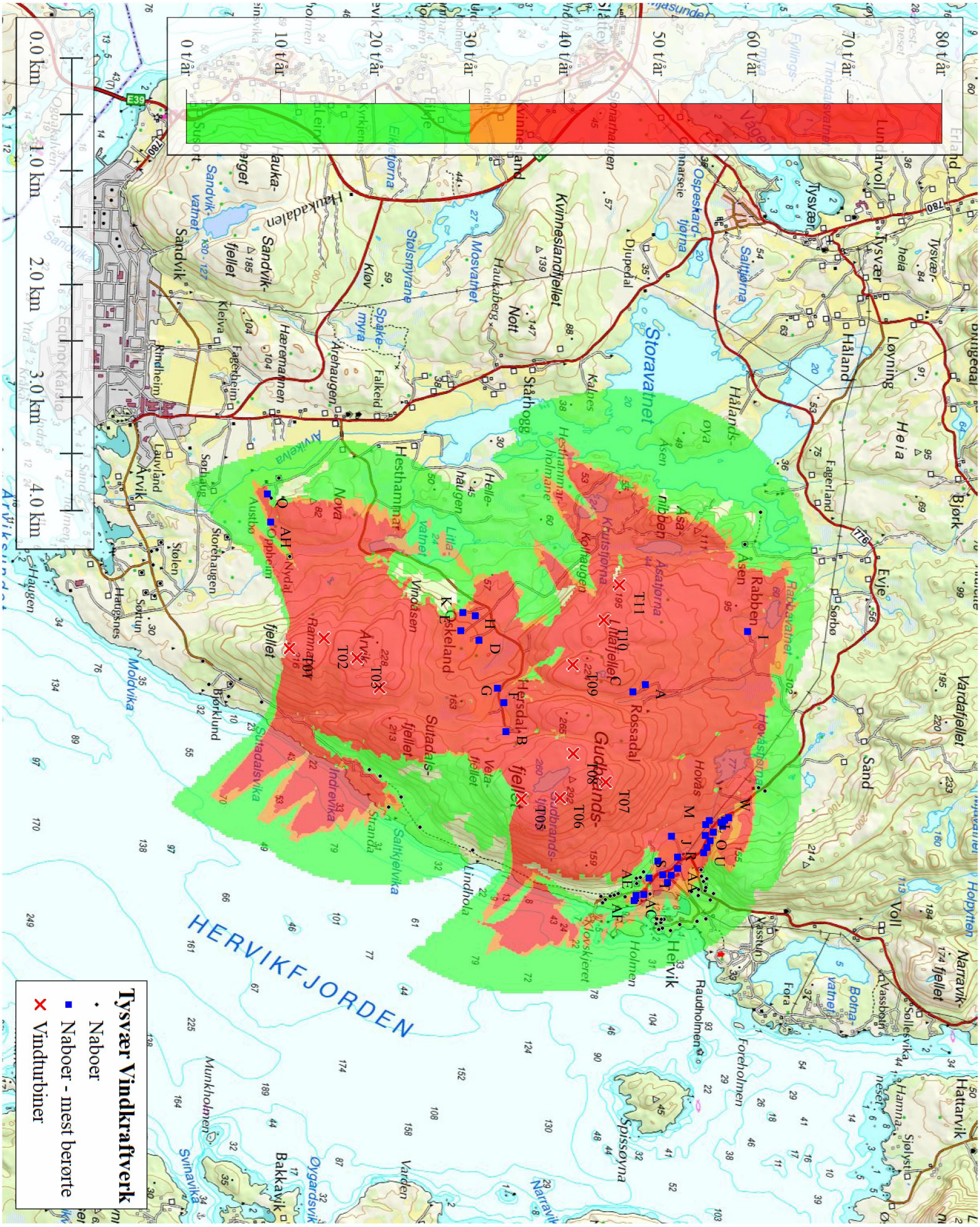
No.	Name	Worst case [h/year]	Stopped due to flicker curtailment [h/year]	Expected [h/year]
5	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (5)	122:04	97:52	28:18
6	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (6)	216:40	21:20	48:59
7	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (7)	246:22	74:48	54:04
8	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (8)	69:04	97:20	16:02
9	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (9)	3:03	123:14	0:55
10	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (10)	42:56	54:35	12:01
11	Siemens SWT-DD-130 4300 130.0 !O! hub: 85.0 m (TOT: 150.0 m) (11)	34:06	32:11	10:10

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.

Vedlegg 1.3 Skyggekastkart for sannsynlig skyggekast



Vedlegg 1.4 Skyggekastkart for teoretisk maksimalt skyggekast


Tysvær Vindkraftverk
Naboer
Naboer - mest berørte
Vindturbiner
0 t/år
10 t/år
20 t/år
30 t/år
40 t/år
50 t/år
60 t/år
70 t/år
80 t/år
0.0 km
1.0 km
2.0 km
3.0 km
4.0 km
HERVIKFJORDEN
Storavatnet
Gudbrandsfjellet
Sutadalsfjellet
Rammafjellet
Arnfjellet
Nova
Hervik
Tysvær
Sandvik
Arvik
Haugen
Opheim
Nydal
Rabbavatnet
Rabben
Rossadal
Hersdal
Kjøskeland
Hesthammar
Kvinneslandfjellet
Nott
Ståhogg
Haukaberg
Mosvatnet
Kleiva
Fagerheim
Haerenamnen
Arehaugen
Falkeid
Kleiv
Stølsmyrane
Spåkemyra
Ospeskardtjørna
Djupedal
Hålandsøya
Håland
Løyning
Heia
Fagerland
Evje
Sørbø
Sand
Voll
Vassbotn
Fora
Raudholmen
Foreholmen
Spissøyna
Bakkavik
Munkholmen
Svinavika
Varden
Lindhola
Saltkjelvika
Sutadalsvika
Moldvika
Arvikelva
Vardafjellet
Narravik-fjellet
Hattarvik
Holpytten
Botnavatnet
Hovdas
Hovastøna
Holmen
Austbø
Storehaugen
Sørhaugen
Lauvland
Rindheim
Haukadalen
Sandvikfjellet
Sandvikvatnet
Haukafjellet
Ospeskardtjørna
Saltjørna
Kvinneslandfjellet
Kåtnes
Asatjørna
Asa-nibben
Kaustjørna
Kolhaugen
Helle-haugen
Hesthammarholmane
Litlavatnet
Vindåsen
Indrevika
Stranda
Vela-fjellet
Sudbrandsfjellet
Hovskjeret
Asen
Ålen
Fylvingsvatnet
Lundarvoll
Tysværheia
Tysvær
Bjørk
Løyning
Hålandsøya
Djupedal
Kvinneslandfjellet
Nott
Haukaberg
Mosvatnet
Kleiva
Fagerheim
Haerenamnen
Arehaugen
Falkeid
Kleiv
Stølsmyrane
Spåkemyra
Ospeskardtjørna
Saltjørna
Kåtnes
Asatjørna
Asa-nibben
Kaustjørna
Kolhaugen
Helle-haugen
Hesthammarholmane
Litlavatnet
Vindåsen
Indrevika
Stranda
Vela-fjellet
Sudbrandsfjellet
Hovskjeret
Asen
Ålen
Rabben
Rossadal
Hersdal
Kjøskeland
Hesthammar
Nova
Arnfjellet
Rammafjellet
Opheim
Nydal
Austbø
Storehaugen
Sørhaugen
Lauvland
Rindheim
Haukadalen
Sandvikfjellet
Sandvikvatnet
Haukafjellet
Hervik
Tysvær
Sandvik
Arvik
Haugen
Hovdas
Hovastøna
Holmen
Rabbavatnet
Vardafjellet
Narravik-fjellet
Hattarvik
Holpytten
Botnavatnet
Voll
Vassbotn
Fora
Raudholmen
Foreholmen
Spissøyna
Bakkavik
Munkholmen
Svinavika
Varden
Lindhola
Saltkjelvika
Sutadalsvika
Moldvika
Arvikelva
Vardafjellet
Narravik-fjellet
Hattarvik
Holpytten
Botnavatnet
Hovdas
Hovastøna
Holmen
Austbø
Storehaugen
Sørhaugen
Lauvland
Rindheim
Haukadalen
Sandvikfjellet
Sandvikvatnet
Haukafjellet
Hervik
Tysvær
Sandvik
Arvik
Haugen
Opheim
Nydal
Rabbavatnet
Rabben
Rossadal
Hersdal
Kjøskeland
Hesthammar
Nova
Arnfjellet
Rammafjellet
Kvinneslandfjellet
Nott
Ståhogg
Haukaberg
Mosvatnet
Kleiva
Fagerheim
Haerenamnen
Arehaugen
Falkeid
Kleiv
Stølsmyrane
Spåkemyra
Ospeskardtjørna
Saltjørna
Kåtnes
Asatjørna
Asa-nibben
Kaustjørna
Kolhaugen
Helle-haugen
Hesthammarholmane
Litlavatnet
Vindåsen
Indrevika
Stranda
Vela-fjellet
Sudbrandsfjellet
Hovskjeret
Asen
Ålen
Fylvingsvatnet
Lundarvoll
Tysværheia
Tysvær
Bjørk
Løyning
Hålandsøya
Djupedal
Fagerland
Evje
Sørbø
Sand