

## SHADOW - Main Result

Calculation: 2023-01-25\_Urakkaneva\_Shadow\_real case\_9xV172-7.2MW\_HH169\_no forest

### Assumptions for shadow calculations

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence 3 °

Day step for calculation 1 days

Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0,77	2,30	4,42	6,93	8,90	9,87	9,23	6,84	4,43	2,25	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:

Urakkaneva WAsP

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
623	466	404	423	523	796	1.037	1.065	1.015	892	698	649	8.590

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

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

Height contours used: Height Contours: 2020-12-22\_Urakkaneva\_Orography

Receptor grid resolution: 1,0 m

All coordinates are in

UTM (north)-ETRS89 Zone: 35



Scale 1:100.000

▲ New WTG

★ Existing WTG

● Shadow receptor

### WTGs

	Easting	Northing	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
			[m]									
HIR01	395.638	7.103.907	90,0	VESTAS V150-4.2 4200 150.0 !...	Yes	VESTAS	V150-4.2-4.200	4.200	150,0	155,0	1.902	12,0
HIR02	396.514	7.103.767	95,0	VESTAS V150-4.2 4200 150.0 !...	Yes	VESTAS	V150-4.2-4.200	4.200	150,0	155,0	1.902	12,0
HIR03	395.550	7.103.150	90,0	VESTAS V150-4.2 4200 150.0 !...	Yes	VESTAS	V150-4.2-4.200	4.200	150,0	155,0	1.902	12,0
HIR04	394.929	7.103.873	86,6	VESTAS V150-4.2 4200 150.0 !...	Yes	VESTAS	V150-4.2-4.200	4.200	150,0	155,0	1.902	12,0
WTG1	396.210	7.101.094	94,2	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG2	397.111	7.101.106	95,5	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG3	397.634	7.100.697	99,0	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG4	396.621	7.100.560	95,9	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG5	397.234	7.100.072	97,3	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG6	395.776	7.100.518	94,5	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG7	395.945	7.099.964	95,0	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG8	396.528	7.099.617	95,3	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1
WTG9	397.062	7.099.281	96,6	VESTAS V172-7.2 7200 172.0 !...	Yes	VESTAS	V172-7.2-7.200	7.200	172,0	169,0	1.904	12,1

### Shadow receptor-Input

No.	Name	Easting	Northing	Z	Width	Height	Elevation	Slope of	Direction mode	Eye height
				[m]	[m]	[m]	a.g.l. [m]	of window [°]		(ZVI) a.g.l. [m]
A	Asuinrakennus (Hakuperäntie 202)	397.098	7.096.526	95,0	1,0	1,0	1,0	90,0	"Green house mode"	2,0
B	Asuinrakennus (Hakuperäntie 169)	396.724	7.096.452	91,8	1,0	1,0	1,0	90,0	"Green house mode"	2,0
C	Asuinrakennus (Säilyntie 285)	393.762	7.098.532	81,3	1,0	1,0	1,0	90,0	"Green house mode"	2,0
D	Asuinrakennus (Säilyntie 264)	393.460	7.098.729	85,0	1,0	1,0	1,0	90,0	"Green house mode"	2,0
E	Lomarakennus (Raudaskallion metsatie)	393.183	7.099.996	90,0	1,0	1,0	1,0	90,0	"Green house mode"	2,0
F	Lomarakennus (Hirvinevanhaara 147)	394.644	7.102.345	90,5	1,0	1,0	1,0	90,0	"Green house mode"	2,0
G	Lomarakennus (Pohjanneva)	397.651	7.096.966	99,4	1,0	1,0	1,0	90,0	"Green house mode"	2,0

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**Calculation:** 2023-01-25\_Urakkaneva\_Shadow\_real case\_9xV172-7.2MW\_HH169\_no forest

### Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year [h/year]
A	A Asuinrakennus (Hakuperäntie 202)		0:00
B	B Asuinrakennus (Hakuperäntie 169)		0:00
C	C Asuinrakennus (Säilyntie 285)		0:00
D	D Asuinrakennus (Säilyntie 264)		0:00
E	E Lomarakennus (Raudaskallion metsatie)		0:00
F	F Lomarakennus (Hirvinevanhaara 147)		6:51
G	G Lomarakennus (Pohjanneva)		0:00

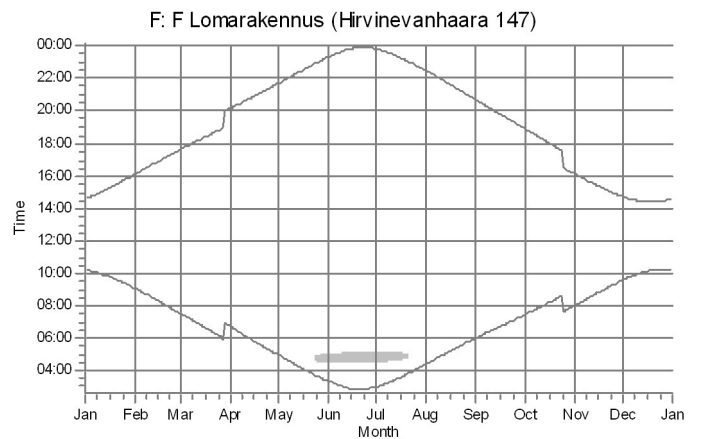
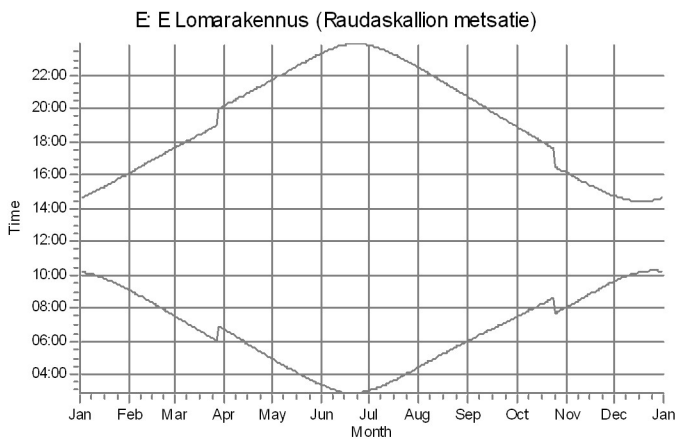
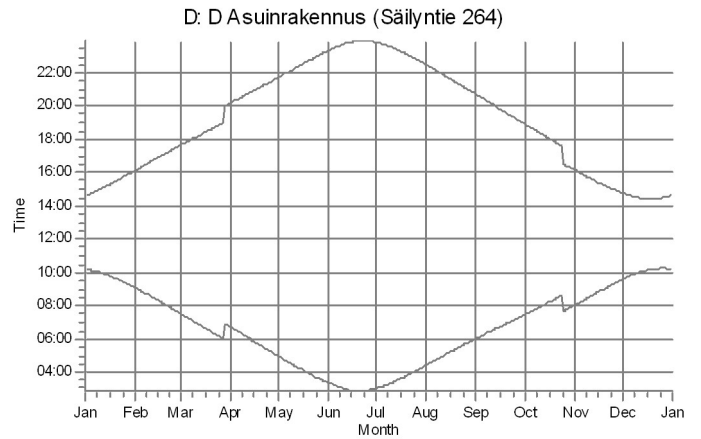
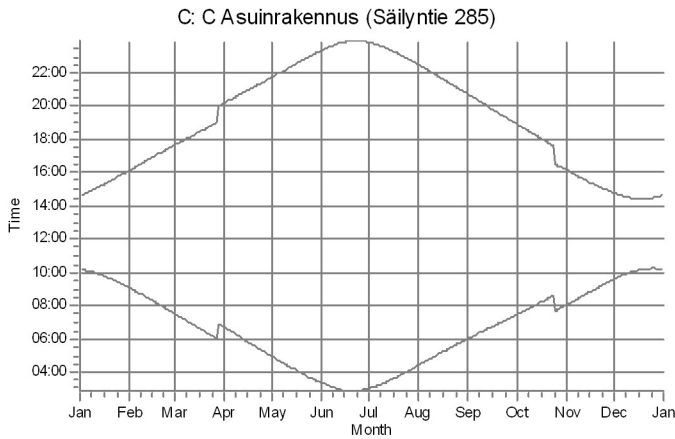
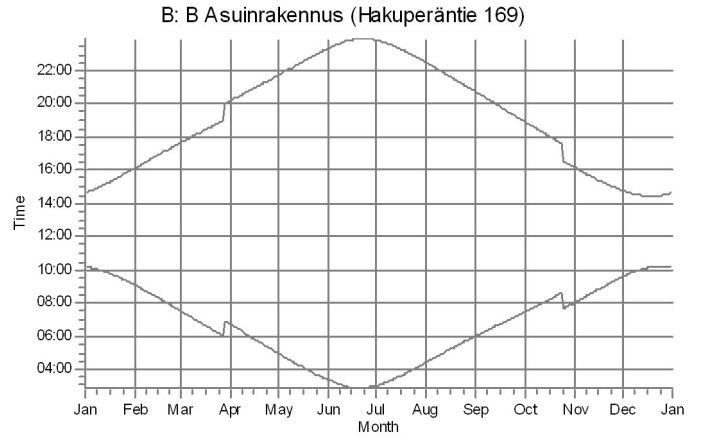
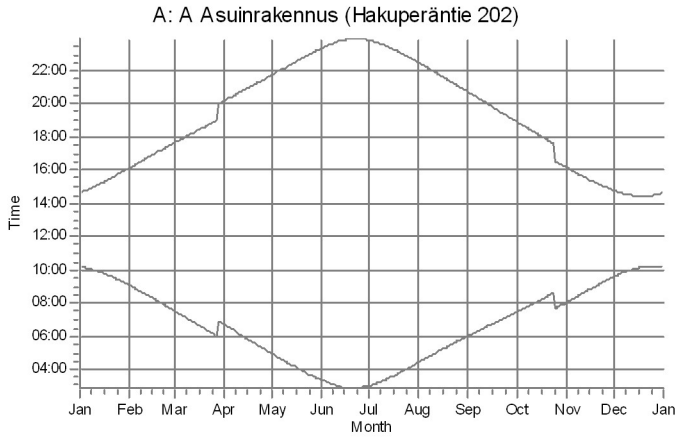
Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Expected [h/year]
HIR01	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (61)	0:00
HIR02	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (62)	0:00
HIR03	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (63)	6:51
HIR04	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (64)	0:00
WTG1	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (753)	0:00
WTG2	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (754)	0:00
WTG3	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (755)	0:00
WTG4	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (756)	0:00
WTG5	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (757)	0:00
WTG6	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (758)	0:00
WTG7	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (759)	0:00
WTG8	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (760)	0:00
WTG9	VESTAS V172-7.2 7200 172.0 !O! hub: 169,0 m (TOT: 255,0 m) (761)	0:00

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

## SHADOW - Calendar, graphical

Calculation: 2023-01-25\_Urakkaneva\_Shadow\_real case\_9xV172-7.2MW\_HH169\_no forest

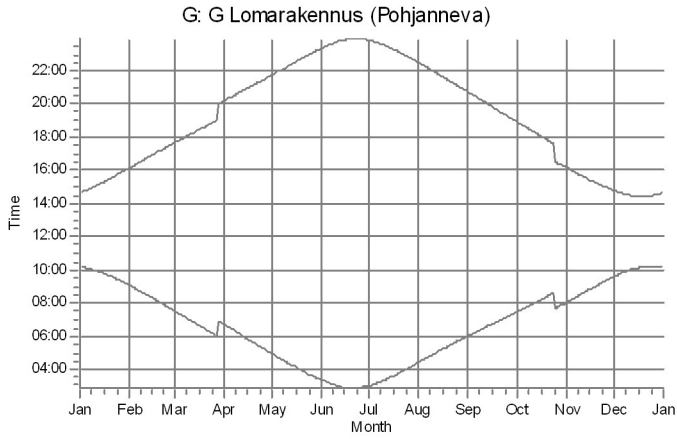


### WTGs

HIR03: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (63)

## SHADOW - Calendar, graphical

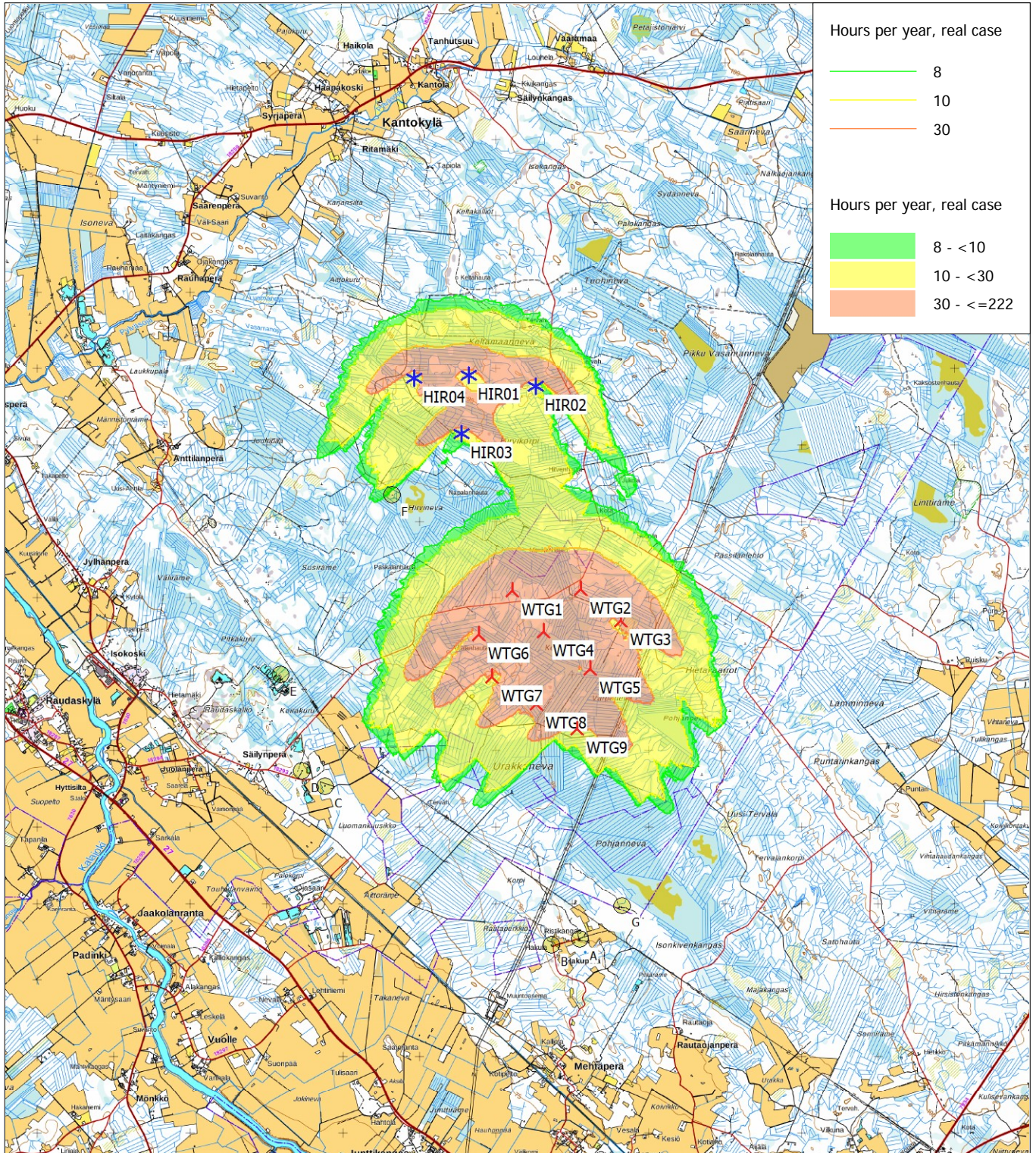
**Calculation:** 2023-01-25\_Urakkaneva\_Shadow\_real case\_9xV172-7.2MW\_HH169\_no forest



WTGs

## SHADOW - Map

Calculation: 2023-01-25\_Urakkaneva\_Shadow\_real case\_9xV172-7.2MW\_HH169\_no forest



0 1 2 3 4 km

Map: NLS\_terrain\_map , Print scale 1:75.000, Map center UTM (north)-ETRS89 Zone: 35 East: 396.280 North: 7.101.240

▲ New WTG      \* Existing WTG      ● Shadow receptor

Flicker map level: Height Contours: 2020-12-22\_Urakkaneva\_Orography\_NLS 10m.wpo (3)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 2,0 m