

Project:  
feredrikshavn

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Licensed user:  
**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

### SHADOW - Main Result

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn

#### Assumptions for shadow calculations

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0,13	0,22	0,32	0,40	0,42	0,46	0,42	0,49	0,39	0,29	0,18	0,10

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
300	381	494	600	698	520	626	971	1.271	1.135	682	391	8.068

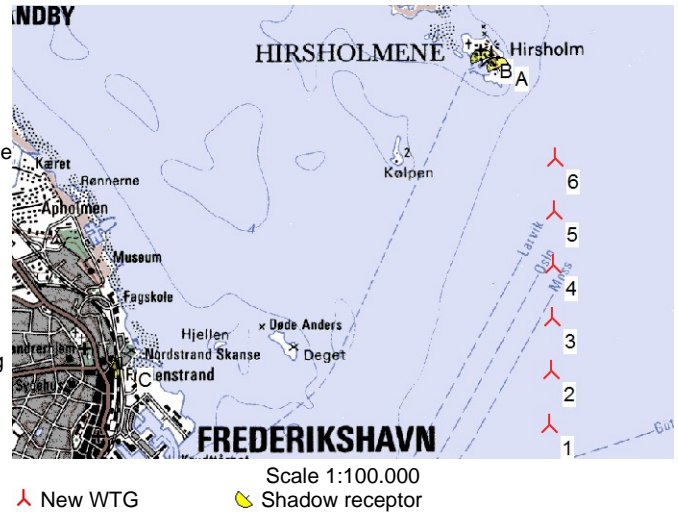
To avoid flicker from WTGs not visible a ZVI calculation is performed before the flicker calculation. The ZVI calculation is based on the following assumptions

Height contours used: Height Contours: N57E010.WPO (3)

Obstacles used in calculation

Eye height: 1,7 m

Grid resolution: 10 m



#### WTGs

UTM WGS84 Zone: 32				WTG type									
East	North	Z	Row data/Description	Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	RPM [RPM]			
1	598.282	6.367.728	0,0 Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (1)Yes	Yes	Siemens	SWT-3.6-107	3.600	107,0	80,0	13,0			
2	598.289	6.368.441	0,0 Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (2)Yes	Yes	Siemens	SWT-3.6-107	3.600	107,0	80,0	13,0			
3	598.290	6.369.143	0,0 Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (3)Yes	Yes	Siemens	SWT-3.6-107	3.600	107,0	80,0	13,0			
4	598.285	6.369.844	0,0 Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (4)Yes	Yes	Siemens	SWT-3.6-107	3.600	107,0	80,0	13,0			
5	598.286	6.370.546	0,0 Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (5)Yes	Yes	Siemens	SWT-3.6-107	3.600	107,0	80,0	13,0			
6	598.287	6.371.248	0,0 Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (6)Yes	Yes	Siemens	SWT-3.6-107	3.600	107,0	80,0	13,0			

#### Shadow receptor-Input

UTM WGS84 Zone: 32											
No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode	
		[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]		
A	Hirsholm 1	597.503	6.372.432	0,0	3,0	2,0	1,0	-22,7	90,0	Fixed direction	
B	Hirsholm 2	597.284	6.372.527	0,0	3,0	2,0	1,0	-18,5	90,0	Fixed direction	
C	Ferderikshavn	592.596	6.368.349	2,0	3,0	2,0	1,0	-77,9	90,0	Fixed direction	

#### Calculation Results

Shadow receptor

No.	Name	Shadow, worst case			Shadow, expected values	
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	
A	Hirsholm 1	10:22	40	0:19	0:34	
B	Hirsholm 2	5:25	39	0:14	0:20	
C	Ferderikshavn	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]
1	Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (1)	0:00
2	Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (2)	0:00
3	Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (3)	0:00
4	Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (4)	0:00
5	Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (5)	0:00
6	Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (6)	15:47

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 DK-7000 Fredericia  
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**SHADOW - Calendar**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn

Shadow receptor: A - Hirsholm 1

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00	09:49 (6)	08:21	07:14	06:49	05:30	04:30	04:24	05:12	06:17	07:20	08:33
	15:43	17 10:06 (6)	16:43	17:48	19:56	21:02	22:02	22:19	21:35	20:18	18:55	16:34
2	09:00	09:49 (6)	08:19	07:12	06:47	05:28	04:29	04:25	05:14	06:19	07:22	08:35
	15:44	17 10:06 (6)	16:45	17:50	19:58	21:04	22:04	22:19	21:33	20:15	18:52	16:32
3	08:59	09:51 (6)	08:17	07:09	06:44	05:25	04:28	04:25	05:16	06:21	07:24	08:36
	15:46	16 10:07 (6)	16:47	17:52	20:01	21:06	22:05	22:18	21:31	20:13	18:49	16:30
4	08:59	09:51 (6)	08:15	07:06	06:41	05:23	04:27	04:26	05:18	06:23	07:26	08:38
	15:47	15 10:06 (6)	16:50	17:55	20:03	21:08	22:06	22:17	21:29	20:10	18:47	16:27
5	08:58	09:52 (6)	08:13	07:04	06:38	05:21	04:26	04:27	05:20	06:25	07:28	08:40
	15:48	14 10:06 (6)	16:52	17:57	20:05	21:10	22:08	22:17	21:26	20:07	18:44	16:25
6	08:58	09:53 (6)	08:11	07:01	06:36	05:18	04:25	04:29	05:22	06:28	07:31	08:41
	15:50	13 10:06 (6)	16:54	17:59	20:07	21:13	22:09	22:16	21:24	20:04	18:41	16:23
7	08:57	09:54 (6)	08:08	06:58	06:33	05:16	04:24	04:30	05:24	06:30	07:33	08:42
	15:51	12 10:06 (6)	16:57	18:01	20:09	21:15	22:10	22:15	21:22	20:02	18:38	16:21
8	08:56	09:55 (6)	08:06	06:56	06:30	05:14	04:23	04:31	05:26	06:32	07:35	08:44
	15:53	11 10:06 (6)	16:59	18:04	20:12	21:17	22:11	22:14	21:20	19:59	18:36	16:19
9	08:55	09:56 (6)	08:04	06:53	06:27	05:11	04:22	04:32	05:29	06:34	07:37	08:46
	15:55	9 10:05 (6)	17:01	18:06	20:14	21:19	22:12	22:13	21:17	19:56	18:33	16:16
10	08:55	09:59 (6)	08:02	06:50	06:25	05:09	04:22	04:34	05:31	06:36	07:39	08:47
	15:56	5 10:04 (6)	17:04	18:08	20:16	21:21	22:14	22:12	21:15	19:53	18:30	16:14
11	08:54		07:59	06:47	06:22	05:07	04:21	04:35	05:33	06:38	07:41	08:48
	15:58		17:06	18:10	20:18	21:23	22:15	22:11	21:12	19:51	18:28	16:12
12	08:53		07:57	06:45	06:19	05:05	04:20	04:36	05:35	06:40	07:43	08:50
	16:00		17:08	18:13	20:20	21:25	22:15	22:10	21:10	19:48	18:25	16:10
13	08:52		07:55	06:42	06:17	05:03	04:20	04:38	05:37	06:42	07:46	08:51
	16:02		17:11	18:15	20:22	21:27	22:16	22:08	21:08	19:45	18:22	16:08
14	08:50		07:52	06:39	06:14	05:01	04:20	04:39	05:39	06:44	07:48	08:52
	16:04		17:13	18:17	20:25	21:29	22:17	22:07	21:05	19:42	18:20	16:06
15	08:49		07:50	06:36	06:11	04:59	04:19	04:41	05:41	06:46	07:50	08:53
	16:06		17:16	18:19	20:27	21:31	22:18	22:06	21:03	19:39	18:17	16:04
16	08:48		07:48	06:34	06:09	04:57	04:19	04:43	05:43	06:48	07:52	08:54
	16:08		17:18	18:21	20:29	21:33	22:18	22:04	21:00	19:37	18:14	16:03
17	08:47		07:45	06:31	06:06	04:55	04:19	04:44	05:45	06:50	07:54	08:54
	16:10		17:20	18:24	20:31	21:35	22:19	22:03	20:58	19:34	18:12	16:01
18	08:45		07:43	06:28	06:03	04:53	04:19	04:46	05:48	06:53	07:57	08:56
	16:12		17:23	18:26	20:33	21:37	22:19	22:01	20:55	19:31	18:09	16:00
19	08:44		07:40	06:25	06:01	04:51	04:19	04:48	05:50	06:55	07:59	08:59
	16:14		17:25	18:28	20:36	21:39	22:20	22:00	20:53	19:28	18:06	16:00
20	08:42		07:38	06:23	05:58	04:49	04:19	04:49	05:52	06:57	08:01	09:01
	16:16		17:27	18:30	20:38	21:41	22:20	21:58	20:50	19:25	18:04	16:00
21	08:41		07:35	06:20	05:55	04:47	04:19	04:51	05:54	06:59	08:03	09:03
	16:18		17:30	18:32	20:40	21:43	22:21	21:56	20:47	19:23	18:01	16:00
22	08:39		07:33	06:17	05:53	04:45	04:19	04:53	05:56	07:01	08:06	09:06
	16:20		17:32	18:35	20:42	21:45	22:21	21:55	20:45	19:20	17:59	16:00
23	08:38		07:30	06:14	05:50	04:44	04:19	04:55	05:58	07:03	08:08	09:07
	16:22		17:34	18:37	20:44	21:47	22:21	21:53	20:42	19:17	17:56	16:00
24	08:36		07:27	06:12	05:48	04:42	04:19	04:57	06:00	07:05	08:10	09:09
	16:25		17:36	18:39	20:46	21:49	22:21	21:51	20:40	19:14	17:54	16:00
25	08:34		07:25	06:09	05:45	04:40	04:20	04:58	06:02	07:07	08:12	09:09
	16:27		17:39	18:41	20:49	21:51	22:21	21:49	20:37	19:12	17:51	16:00
26	08:33		07:22	06:06	05:43	04:39	04:20	05:00	06:04	07:09	08:14	09:10
	16:29		17:41	18:43	20:51	21:52	22:21	21:47	20:34	19:09	17:49	16:00
27	08:31		07:20	06:03	05:40	04:37	04:21	05:02	06:07	07:11	08:16	09:11
	16:31		17:43	18:45	20:53	21:54	22:21	21:45	20:32	19:06	17:46	16:00
28	08:29		07:17	06:00	05:38	04:36	04:21	05:04	06:09	07:13	08:18	09:13
	16:34		17:46	18:48	20:55	21:56	22:20	21:43	20:29	19:03	17:44	16:00
29	08:27			06:58	05:35	04:34	04:22	05:06	06:11	07:16	08:21	09:16
	16:36			19:50	20:57	21:57	22:20	21:41	20:26	19:00	17:41	16:00
30	08:25			06:55	05:33	04:33	04:23	05:08	06:13	07:18	08:23	09:18
	16:38			19:52	21:00	21:59	22:20	21:39	20:24	18:58	17:39	16:00
31	08:23			06:52		04:32		05:10	06:15		07:26	08:31
	16:40			19:54		22:01		21:37	20:21		16:37	17:41
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209
Total, worst case												493
Sun reduction												0,10
Oper. time red.												0,92
Wind dir. red.												0,57
Total reduction												0,05
Total, real												26

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

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

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Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn Shadow receptor: B - Hirsholm 2

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December		
1	09:00 15:43	09:42 (6) 09:47 (6)	08:21 16:43	07:14 17:48	06:49 19:56	05:30 21:02	04:30 22:02	04:24 22:19	05:12 21:35	06:17 20:18	07:20 18:55	07:28 16:34	08:33 15:40	09:18 (6) 09:32 (6)
2	09:00 15:44	09:41 (6) 09:47 (6)	08:19 16:45	07:12 17:50	06:47 19:58	05:28 21:04	04:29 22:04	04:25 22:19	05:14 21:33	06:19 20:15	07:22 18:52	07:30 16:32	08:35 15:39	09:18 (6) 09:32 (6)
3	08:59 15:46	09:41 (6) 09:48 (6)	08:17 16:47	07:09 17:52	06:44 20:01	05:25 21:06	04:28 22:05	04:25 22:18	05:16 21:31	06:21 20:13	07:24 18:49	07:33 16:30	08:36 15:38	09:19 (6) 09:33 (6)
4	08:59 15:47	09:40 (6) 09:48 (6)	08:15 16:50	07:06 17:55	06:41 20:03	05:23 21:08	04:27 22:06	04:26 22:17	05:18 21:29	06:23 20:10	07:26 18:47	07:35 16:27	08:38 15:40	09:20 (6) 09:33 (6)
5	08:58 15:48	09:39 (6) 09:48 (6)	08:13 16:52	07:04 17:57	06:38 20:05	05:21 21:10	04:26 22:08	04:27 22:17	05:20 21:26	06:25 20:07	07:28 18:44	07:37 16:25	08:38 15:37	09:22 (6) 09:34 (6)
6	08:58 15:50	09:38 (6) 09:48 (6)	08:11 16:54	07:01 17:59	06:36 20:07	05:18 21:13	04:25 22:09	04:29 22:16	05:22 21:24	06:28 20:04	07:31 18:41	07:40 16:23	08:41 15:36	09:24 (6) 09:34 (6)
7	08:57 15:51	09:37 (6) 09:49 (6)	08:08 16:57	06:58 18:01	06:33 20:09	05:16 21:15	04:24 22:10	04:30 22:15	05:24 21:22	06:30 20:02	07:33 18:38	07:42 16:21	08:43 15:35	09:26 (6) 09:35 (6)
8	08:56 15:53	09:36 (6) 09:49 (6)	08:06 16:59	06:56 18:04	06:30 20:12	05:14 21:17	04:23 22:11	04:31 22:14	05:27 21:20	06:32 19:59	07:35 18:36	07:44 16:19	08:44 15:35	09:28 (6) 09:36 (6)
9	08:56 15:55	09:35 (6) 09:49 (6)	08:04 17:01	06:53 18:06	06:27 20:14	05:12 21:19	04:22 22:13	04:32 22:13	05:29 21:17	06:34 19:56	07:37 18:33	07:46 16:16	08:46 15:34	09:29 (6) 09:36 (6)
10	08:55 15:56	09:35 (6) 09:49 (6)	08:02 17:04	06:50 18:08	06:25 20:16	05:09 21:21	04:22 22:14	04:34 22:12	05:31 21:15	06:36 19:53	07:39 18:30	07:49 16:14	08:47 15:34	09:31 (6) 09:37 (6)
11	08:54 15:58	09:36 (6) 09:50 (6)	07:59 17:06	06:47 18:10	06:22 20:18	05:07 21:23	04:21 22:15	04:35 22:11	05:33 21:12	06:38 19:51	07:41 18:28	07:51 16:12	08:48 15:33	09:32 (6) 09:37 (6)
12	08:53 16:00	09:36 (6) 09:49 (6)	07:57 17:09	06:45 18:13	06:19 20:20	05:05 21:25	04:20 22:15	04:36 22:10	05:35 21:10	06:40 19:48	07:43 18:25	07:53 16:10	08:50 15:33	09:34 (6) 09:38 (6)
13	08:52 16:02	09:38 (6) 09:49 (6)	07:55 17:11	06:42 18:15	06:17 20:22	05:03 21:27	04:20 22:16	04:38 22:08	05:37 21:08	06:42 19:45	07:46 18:22	07:55 16:08	08:51 15:33	09:35 (6) 09:38 (6)
14	08:51 16:04	09:39 (6) 09:48 (6)	07:52 17:13	06:39 18:17	06:14 20:25	05:01 21:29	04:20 22:17	04:39 22:07	05:39 21:05	06:44 19:42	07:48 18:20	07:58 16:06	08:52 15:32	09:36 (6) 09:38 (6)
15	08:49 16:06	09:41 (6) 09:47 (6)	07:50 17:16	06:36 18:19	06:11 20:27	04:59 21:31	04:19 22:18	04:41 22:06	05:41 21:03	06:46 19:39	07:50 18:17	08:00 16:04	08:53 15:32	09:37 (6) 09:39 (6)
16	08:48 16:08	07:48 17:18	06:34 18:21	06:09 20:29	04:57 21:33	04:19 22:18	04:43 22:04	05:43 21:00	06:48 19:37	07:52 18:14	08:02 16:03	08:02 15:32	08:54 15:32	09:38 (6) 09:40 (6)
17	08:47 16:10	07:45 17:20	06:31 18:24	06:06 20:31	04:55 21:35	04:19 22:19	04:44 22:03	05:45 20:58	06:50 19:34	07:54 18:12	08:04 16:01	08:04 15:32	08:55 15:32	09:39 (6)
18	08:45 16:12	07:43 17:23	06:28 18:26	06:03 20:33	04:53 21:37	04:19 22:19	04:46 22:01	05:48 20:55	06:53 19:31	07:57 18:09	08:06 15:59	08:06 15:33	08:56 15:33	09:40 (6)
19	08:44 16:14	07:43 17:25	06:28 18:28	06:03 20:36	04:53 21:39	04:19 22:20	04:46 22:00	05:48 20:53	06:53 19:28	07:57 18:06	08:06 15:57	08:06 15:33	08:57 15:33	09:41 (6)
20	08:43 16:16	07:38 17:27	06:23 18:30	05:58 20:38	04:49 21:41	04:19 22:20	04:49 21:58	05:52 20:50	06:57 19:25	08:01 18:04	08:11 15:56	08:11 15:33	08:57 15:33	09:42 (6)
21	08:41 16:18	07:35 17:30	06:20 18:32	05:55 20:40	04:47 21:43	04:19 22:21	04:51 21:56	05:54 20:47	06:59 19:23	08:03 18:01	08:13 15:54	08:13 15:33	08:58 15:33	09:43 (6)
22	08:39 16:20	07:33 17:32	06:17 18:35	05:53 20:42	04:45 21:45	04:19 22:21	04:53 21:55	05:56 20:45	07:01 19:20	08:06 17:59	08:15 15:52	08:15 15:34	08:59 15:34	09:44 (6)
23	08:38 16:22	07:30 17:34	06:14 18:37	05:50 20:44	04:44 21:47	04:19 22:21	04:55 21:53	05:58 20:42	07:03 19:17	08:08 17:56	08:17 15:51	08:17 15:34	08:59 15:34	09:45 (6)
24	08:36 16:25	07:27 17:36	06:12 18:39	05:48 20:47	04:42 21:49	04:19 22:21	04:57 21:51	06:00 20:40	07:05 19:14	08:05 17:54	08:19 15:49	08:19 15:35	08:59 15:35	09:46 (6)
25	08:34 16:27	07:25 17:39	06:09 18:41	05:45 20:49	04:40 21:51	04:20 22:21	04:58 21:49	06:02 20:37	07:07 19:12	08:12 16:51	08:21 15:48	08:21 15:36	09:00 15:36	09:47 (6)
26	08:33 16:29	07:22 17:41	06:06 18:43	05:43 20:51	04:39 21:52	04:20 22:21	05:00 21:47	06:04 20:34	07:09 19:09	08:15 16:49	08:23 15:46	08:23 15:36	09:00 15:36	09:48 (6)
27	08:31 16:31	07:20 17:43	06:03 18:45	05:40 20:53	04:37 21:54	04:21 22:21	05:02 21:45	06:07 20:32	07:11 19:06	08:17 16:46	08:25 15:45	08:25 15:37	09:00 15:37	09:49 (6)
28	08:29 16:34	07:17 17:46	06:00 18:48	05:38 20:55	04:36 21:56	04:21 22:20	05:04 21:43	06:09 20:29	07:13 19:03	08:19 16:44	08:27 15:44	08:27 15:38	09:00 15:38	09:45 (6)
29	08:27 16:36	06:58 19:50	05:35 20:57	04:34 21:57	04:22 22:20	04:22 22:20	05:06 21:41	06:11 20:26	07:16 19:00	08:21 16:41	08:29 15:43	08:29 15:39	09:00 15:39	09:46 (6)
30	08:25 16:38	06:55 19:52	05:33 21:00	04:33 21:59	04:23 22:20	04:23 22:20	05:08 21:39	06:13 20:24	07:18 18:58	08:24 16:39	08:31 15:42	08:31 15:42	09:00 15:40	09:47 (6)
31	08:23 16:40	06:52 19:54	05:32 21:00	04:32 22:01	04:22 22:01	04:22 22:01	05:10 21:37	06:15 20:21	07:26 16:37	08:32 15:41	08:32 15:41	08:32 15:41	09:00 15:41	09:48 (6)
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209	135	10
Total, worst case	151										39		135	
Sun reduction	0,13										0,18		0,10	
Oper. time red.	0,92										0,92		0,92	
Wind dir. red.	0,57										0,57		0,57	
Total reduction	0,07										0,09		0,05	
Total, real	10										4		7	

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

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

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Licensed user:  
**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn Shadow receptor: C - Ferderikshavn

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time  
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00	08:21	07:15	06:50	05:31	04:31	04:24	05:13	06:17	07:20	07:28	08:33
	15:44	16:43	17:48	19:57	21:02	22:02	22:19	21:35	20:18	18:55	16:35	15:41
2	09:00	08:19	07:12	06:47	05:28	04:30	04:25	05:15	06:20	07:22	07:31	08:35
	15:45	16:46	17:51	19:59	21:04	22:04	22:19	21:33	20:16	18:52	16:32	15:40
3	08:59	08:17	07:09	06:44	05:26	04:29	04:26	05:17	06:22	07:24	07:33	08:36
	15:46	16:48	17:53	20:01	21:06	22:05	22:18	21:31	20:13	18:50	16:30	15:39
4	08:59	08:15	07:07	06:42	05:23	04:27	04:27	05:19	06:24	07:27	07:35	08:38
	15:47	16:50	17:55	20:03	21:08	22:06	22:17	21:29	20:10	18:47	16:28	15:38
5	08:58	08:13	07:04	06:39	05:21	04:26	04:28	05:21	06:26	07:29	07:37	08:40
	15:49	16:53	17:57	20:05	21:11	22:08	22:17	21:27	20:07	18:44	16:26	15:37
6	08:58	08:11	07:01	06:36	05:19	04:25	04:29	05:23	06:28	07:31	07:40	08:41
	15:50	16:55	18:00	20:07	21:13	22:09	22:16	21:24	20:05	18:42	16:23	15:37
7	08:57	08:09	06:59	06:33	05:17	04:25	04:30	05:25	06:30	07:33	07:42	08:43
	15:52	16:57	18:02	20:10	21:15	22:10	22:15	21:22	20:02	18:39	16:21	15:36
8	08:56	08:06	06:56	06:31	05:14	04:24	04:32	05:27	06:32	07:35	07:44	08:44
	15:54	17:00	18:04	20:12	21:17	22:14	22:14	21:20	19:59	18:36	16:19	15:35
9	08:56	08:04	06:53	06:28	05:12	04:23	04:33	05:29	06:34	07:37	07:47	08:46
	15:55	17:02	18:06	20:14	21:19	22:13	22:13	21:17	19:56	18:33	16:17	15:35
10	08:55	08:02	06:50	06:25	05:10	04:22	04:34	05:31	06:36	07:39	07:49	08:47
	15:57	17:04	18:08	20:16	21:21	22:14	22:12	21:15	19:54	18:31	16:15	15:34
11	08:54	08:00	06:48	06:22	05:08	04:22	04:36	05:33	06:38	07:42	07:51	08:48
	15:59	17:07	18:11	20:18	21:23	22:15	22:11	21:13	19:51	18:28	16:13	15:34
12	08:53	07:57	06:45	06:20	05:05	04:21	04:37	05:35	06:40	07:44	07:53	08:50
	16:01	17:09	18:13	20:21	21:25	22:15	22:10	21:10	19:48	18:25	16:11	15:33
13	08:52	07:55	06:42	06:17	05:03	04:21	04:38	05:37	06:42	07:46	07:56	08:51
	16:02	17:11	18:15	20:23	21:27	22:16	22:08	21:08	19:45	18:23	16:09	15:33
14	08:51	07:53	06:40	06:14	05:01	04:20	04:40	05:40	06:45	07:48	07:58	08:52
	16:04	17:14	18:17	20:25	21:30	22:17	22:07	21:05	19:43	18:20	16:07	15:33
15	08:49	07:50	06:37	06:12	04:59	04:20	04:42	05:42	06:47	07:50	08:00	08:53
	16:06	17:16	18:20	20:27	21:32	22:18	22:06	21:03	19:40	18:17	16:05	15:33
16	08:48	07:48	06:34	06:09	04:57	04:20	04:43	05:44	06:49	07:52	08:02	08:54
	16:08	17:18	18:22	20:29	21:34	22:18	22:04	21:00	19:37	18:15	16:03	15:33
17	08:47	07:45	06:31	06:06	04:55	04:19	04:45	05:46	06:51	07:55	08:04	08:55
	16:10	17:21	18:24	20:31	21:36	22:19	22:03	20:58	19:34	18:12	16:01	15:33
18	08:46	07:43	06:29	06:04	04:53	04:19	04:46	05:48	06:53	07:57	08:07	08:56
	16:12	17:23	18:26	20:34	21:38	22:19	22:01	20:55	19:31	18:09	16:00	15:33
19	08:44	07:40	06:26	06:01	04:51	04:19	04:48	05:50	06:55	07:59	08:09	08:57
	16:14	17:25	18:28	20:36	21:40	22:20	22:00	20:53	19:29	18:07	15:58	15:33
20	08:43	07:38	06:23	05:58	04:50	04:19	04:50	05:52	06:57	08:01	08:11	08:57
	16:16	17:28	18:30	20:38	21:41	22:20	21:58	20:50	19:26	18:04	15:56	15:34
21	08:41	07:35	06:20	05:56	04:48	04:19	04:52	05:54	06:59	08:04	08:13	08:58
	16:19	17:30	18:33	20:40	21:43	22:21	21:57	20:48	19:23	18:02	15:54	15:34
22	08:40	07:33	06:17	05:53	04:46	04:20	04:53	05:56	07:01	08:06	08:15	08:59
	16:21	17:32	18:35	20:42	21:45	22:21	21:55	20:45	19:20	17:59	15:53	15:35
23	08:38	07:30	06:15	05:51	04:44	04:20	04:55	05:59	07:03	08:08	08:17	08:59
	16:23	17:35	18:37	20:45	21:47	22:21	21:53	20:42	19:17	17:57	15:51	15:35
24	08:36	07:28	06:12	05:48	04:43	04:20	04:57	06:01	07:05	08:10	08:19	08:59
	16:25	17:37	18:39	20:47	21:49	22:21	21:51	20:40	19:15	17:54	15:50	15:36
25	08:35	07:25	06:09	05:46	04:41	04:20	04:59	06:03	07:08	08:13	08:21	09:00
	16:27	17:39	18:41	20:49	21:51	22:21	21:49	20:37	19:12	16:52	15:48	15:36
26	08:33	07:22	06:06	05:43	04:39	04:21	05:01	06:05	07:10	08:15	08:23	09:00
	16:30	17:41	18:44	20:51	21:52	22:21	21:47	20:34	19:09	16:49	15:47	15:37
27	08:31	07:20	06:04	05:41	04:38	04:21	05:03	06:07	07:12	08:17	08:25	09:00
	16:32	17:44	18:46	20:53	21:54	22:21	21:46	20:32	19:06	16:47	15:46	15:38
28	08:29	07:17	06:01	05:38	04:36	04:22	05:05	06:09	07:14	08:19	08:27	09:00
	16:34	17:46	18:48	20:55	21:56	22:20	21:44	20:29	19:04	16:44	15:44	15:39
29	08:27		06:58	05:36	04:35	04:23	05:07	06:11	07:16	08:21	08:29	09:00
	16:36		19:50	20:58	21:58	22:20	21:42	20:26	19:01	16:42	15:43	15:40
30	08:25		06:55	05:33	04:33	04:23	05:09	06:13	07:18	08:24	08:31	09:00
	16:39		19:52	21:00	21:59	22:20	21:40	20:24	18:58	16:39	15:42	15:41
31	08:23		06:53		04:32		05:11	06:15		07:26		09:00
	16:41		19:54		22:01		21:37	20:21		16:37		15:42
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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

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

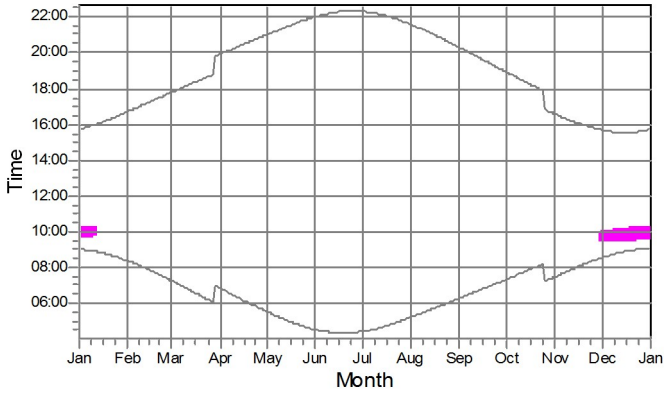
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**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33  
Calculated:  
01-11-2007 14:40/2.5.7.83

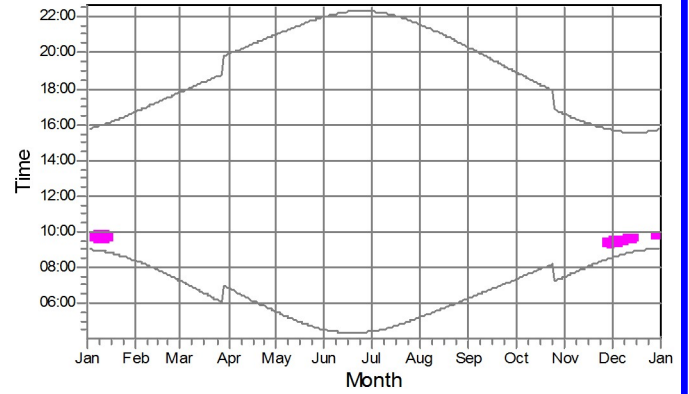
**SHADOW - Calendar, graphical**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn

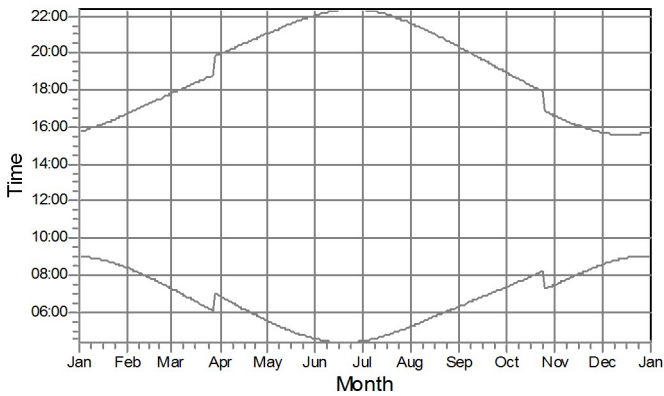
A: Hirsholm 1



B: Hirsholm 2



C: Ferderikshavn



WTGs

6: Siemens SWT-3.6-107 3600 107.0 !O! hub: 80,0 m (6)



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**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar per WTG**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn WTG: 1 - Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (1)

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00	08:21	07:14	06:49	05:30	04:31	04:24	05:12	06:17	07:20	07:28	08:32
	15:43	16:43	17:48	19:56	21:02	22:02	22:19	21:35	20:18	18:55	16:34	15:41
2	08:59	08:19	07:12	06:47	05:28	04:29	04:25	05:14	06:19	07:22	07:30	08:34
	15:44	16:45	17:50	19:58	21:04	22:03	22:18	21:33	20:15	18:52	16:32	15:40
3	08:59	08:17	07:09	06:44	05:25	04:28	04:26	05:16	06:21	07:24	07:33	08:36
	15:46	16:48	17:52	20:01	21:06	22:05	22:18	21:31	20:13	18:49	16:30	15:39
4	08:58	08:15	07:06	06:41	05:23	04:27	04:27	05:18	06:23	07:26	07:35	08:38
	15:47	16:50	17:55	20:03	21:08	22:06	22:17	21:28	20:10	18:47	16:28	15:38
5	08:58	08:13	07:04	06:38	05:21	04:26	04:28	05:20	06:25	07:28	07:37	08:39
	15:49	16:52	17:57	20:05	21:10	22:07	22:16	21:26	20:07	18:44	16:25	15:37
6	08:57	08:10	07:01	06:36	05:18	04:25	04:29	05:23	06:28	07:30	07:39	08:41
	15:50	16:55	17:59	20:07	21:12	22:09	22:15	21:24	20:04	18:41	16:23	15:36
7	08:57	08:08	06:58	06:33	05:16	04:24	04:30	05:25	06:30	07:33	07:42	08:42
	15:52	16:57	18:01	20:09	21:14	22:10	22:15	21:22	20:02	18:38	16:21	15:36
8	08:56	08:06	06:56	06:30	05:14	04:23	04:31	05:27	06:32	07:35	07:44	08:44
	15:53	16:59	18:04	20:11	21:17	22:11	22:14	21:19	19:59	18:36	16:19	15:35
9	08:55	08:04	06:53	06:27	05:12	04:23	04:33	05:29	06:34	07:37	07:46	08:45
	15:55	17:02	18:06	20:14	21:19	22:12	22:13	21:17	19:56	18:33	16:17	15:34
10	08:54	08:02	06:50	06:25	05:09	04:22	04:34	05:31	06:36	07:39	07:48	08:47
	15:57	17:04	18:08	20:16	21:21	22:13	22:12	21:15	19:53	18:30	16:15	15:34
11	08:53	07:59	06:47	06:22	05:07	04:21	04:35	05:33	06:38	07:41	07:51	08:48
	15:58	17:06	18:10	20:18	21:23	22:14	22:10	21:12	19:50	18:28	16:12	15:33
12	08:52	07:57	06:45	06:19	05:05	04:21	04:37	05:35	06:40	07:43	07:53	08:49
	16:00	17:09	18:13	20:20	21:25	22:15	22:09	21:10	19:48	18:25	16:10	15:33
13	08:51	07:55	06:42	06:17	05:03	04:20	04:38	05:37	06:42	07:46	07:55	08:50
	16:02	17:11	18:15	20:22	21:27	22:16	22:08	21:07	19:45	18:22	16:08	15:33
14	08:50	07:52	06:39	06:14	05:01	04:20	04:40	05:39	06:44	07:48	07:57	08:52
	16:04	17:13	18:17	20:24	21:29	22:17	22:07	21:05	19:42	18:20	16:07	15:33
15	08:49	07:50	06:36	06:11	04:59	04:20	04:41	05:41	06:46	07:50	08:00	08:53
	16:06	17:16	18:19	20:27	21:31	22:17	22:05	21:02	19:39	18:17	16:05	15:33
16	08:48	07:47	06:34	06:09	04:57	04:19	04:43	05:43	06:48	07:52	08:02	08:54
	16:08	17:18	18:21	20:29	21:33	22:18	22:04	21:00	19:37	18:14	16:03	15:33
17	08:46	07:45	06:31	06:06	04:55	04:19	04:44	05:46	06:50	07:54	08:04	08:55
	16:10	17:20	18:24	20:31	21:35	22:19	22:02	20:57	19:34	18:12	16:01	15:33
18	08:45	07:42	06:28	06:03	04:53	04:19	04:46	05:48	06:53	07:56	08:06	08:55
	16:12	17:23	18:26	20:33	21:37	22:19	22:01	20:55	19:31	18:09	15:59	15:33
19	08:44	07:40	06:25	06:01	04:51	04:19	04:48	05:50	06:55	07:59	08:08	08:56
	16:14	17:25	18:28	20:35	21:39	22:19	21:59	20:52	19:28	18:06	15:57	15:33
20	08:42	07:37	06:23	05:58	04:49	04:19	04:50	05:52	06:57	08:01	08:10	08:57
	16:16	17:27	18:30	20:38	21:41	22:20	21:58	20:50	19:25	18:04	15:56	15:33
21	08:41	07:35	06:20	05:55	04:47	04:19	04:51	05:54	06:59	08:03	08:13	08:58
	16:18	17:30	18:32	20:40	21:43	22:20	21:56	20:47	19:23	18:01	15:54	15:34
22	08:39	07:32	06:17	05:53	04:46	04:19	04:53	05:56	07:01	08:05	08:15	08:58
	16:20	17:32	18:34	20:42	21:45	22:20	21:54	20:45	19:20	17:59	15:53	15:34
23	08:37	07:30	06:14	05:50	04:44	04:19	04:55	05:58	07:03	08:08	08:17	08:59
	16:23	17:34	18:37	20:44	21:47	22:20	21:53	20:42	19:17	17:56	15:51	15:35
24	08:36	07:27	06:12	05:48	04:42	04:20	04:57	06:00	07:05	08:10	08:19	08:59
	16:25	17:36	18:39	20:46	21:48	22:20	21:51	20:39	19:14	17:54	15:50	15:35
25	08:34	07:25	06:09	05:45	04:41	04:20	04:59	06:02	07:07	08:12	08:21	08:59
	16:27	17:39	18:41	20:48	21:50	22:20	21:49	20:37	19:11	17:51	15:48	15:36
26	08:32	07:22	06:06	05:43	04:39	04:21	05:01	06:04	07:09	08:14	08:23	09:00
	16:29	17:41	18:43	20:51	21:52	22:20	21:47	20:34	19:09	17:49	15:47	15:37
27	08:31	07:19	06:03	05:40	04:37	04:21	05:02	06:07	07:11	08:16	08:25	09:00
	16:31	17:43	18:45	20:53	21:54	22:20	21:45	20:31	19:06	17:46	15:45	15:38
28	08:29	07:17	06:00	05:38	04:36	04:22	05:04	06:09	07:13	08:18	08:27	09:00
	16:34	17:46	18:48	20:55	21:55	22:20	21:43	20:29	19:03	17:44	15:44	15:39
29	08:27		06:58	05:35	04:35	04:22	05:06	06:11	07:16	08:21	08:29	09:00
	16:36		19:50	20:57	21:57	22:20	21:41	20:26	19:00	17:41	15:43	15:39
30	08:25		06:55	05:33	04:33	04:23	05:08	06:13	07:18	08:23	08:31	09:00
	16:38		19:52	20:59	21:59	22:19	21:39	20:23	18:58	17:39	15:42	15:41
31	08:23		06:52		04:32		05:10	06:15		07:26		09:00
	16:41		19:54		22:00		21:37	20:21		16:37		15:42
Potential sun hours	229	263	366	429	514	537	536	473	385	322	243	209
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Licensed user:  
**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar per WTG**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn **WTG:** 2 - Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (2)

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time  
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00	08:21	07:14	06:49	05:30	04:30	04:24	05:12	06:17	07:20	07:28	08:32
	15:43	16:43	17:48	19:56	21:02	22:02	22:19	21:35	20:18	18:55	16:34	15:41
2	08:59	08:19	07:12	06:47	05:28	04:29	04:25	05:14	06:19	07:22	07:30	08:34
	15:44	16:45	17:50	19:58	21:04	22:03	22:18	21:33	20:15	18:52	16:32	15:40
3	08:59	08:17	07:09	06:44	05:25	04:28	04:26	05:16	06:21	07:24	07:33	08:36
	15:46	16:47	17:52	20:01	21:06	22:05	22:18	21:31	20:13	18:49	16:30	15:39
4	08:59	08:15	07:06	06:41	05:23	04:27	04:27	05:18	06:23	07:26	07:35	08:38
	15:47	16:50	17:55	20:03	21:08	22:06	22:17	21:28	20:10	18:47	16:27	15:38
5	08:58	08:13	07:04	06:38	05:21	04:26	04:28	05:20	06:25	07:28	07:37	08:39
	15:49	16:52	17:57	20:05	21:10	22:07	22:16	21:26	20:07	18:44	16:25	15:37
6	08:57	08:10	07:01	06:36	05:18	04:25	04:29	05:22	06:28	07:30	07:39	08:41
	15:50	16:54	17:59	20:07	21:12	22:09	22:16	21:24	20:04	18:41	16:23	15:36
7	08:57	08:08	06:58	06:33	05:16	04:24	04:30	05:25	06:30	07:33	07:42	08:42
	15:52	16:57	18:01	20:09	21:14	22:10	22:15	21:22	20:02	18:38	16:21	15:35
8	08:56	08:06	06:56	06:30	05:14	04:23	04:31	05:27	06:32	07:35	07:44	08:44
	15:53	16:59	18:04	20:11	21:17	22:11	22:14	21:19	19:59	18:36	16:19	15:35
9	08:55	08:04	06:53	06:27	05:12	04:23	04:33	05:29	06:34	07:37	07:46	08:45
	15:55	17:02	18:06	20:14	21:19	22:12	22:13	21:17	19:56	18:33	16:17	15:34
10	08:54	08:02	06:50	06:25	05:09	04:22	04:34	05:31	06:36	07:39	07:48	08:47
	15:57	17:04	18:08	20:16	21:21	22:13	22:12	21:15	19:53	18:30	16:14	15:34
11	08:53	07:59	06:47	06:22	05:07	04:21	04:35	05:33	06:38	07:41	07:51	08:48
	15:58	17:06	18:10	20:18	21:23	22:14	22:11	21:12	19:50	18:28	16:12	15:33
12	08:52	07:57	06:45	06:19	05:05	04:21	04:37	05:35	06:40	07:43	07:53	08:49
	16:00	17:09	18:13	20:20	21:25	22:15	22:09	21:10	19:48	18:25	16:10	15:33
13	08:51	07:55	06:42	06:17	05:03	04:20	04:38	05:37	06:42	07:46	07:55	08:51
	16:02	17:11	18:15	20:22	21:27	22:16	22:08	21:07	19:45	18:22	16:08	15:33
14	08:50	07:52	06:39	06:14	05:01	04:20	04:40	05:39	06:44	07:48	07:57	08:52
	16:04	17:13	18:17	20:24	21:29	22:17	22:07	21:05	19:42	18:20	16:07	15:33
15	08:49	07:50	06:36	06:11	04:59	04:19	04:41	05:41	06:46	07:50	08:00	08:53
	16:06	17:16	18:19	20:27	21:31	22:17	22:05	21:02	19:39	18:17	16:05	15:33
16	08:48	07:47	06:34	06:09	04:57	04:19	04:43	05:43	06:48	07:52	08:02	08:54
	16:08	17:18	18:21	20:29	21:33	22:18	22:04	21:00	19:37	18:14	16:03	15:33
17	08:46	07:45	06:31	06:06	04:55	04:19	04:44	05:45	06:50	07:54	08:04	08:55
	16:10	17:20	18:24	20:31	21:35	22:19	22:03	20:57	19:34	18:12	16:01	15:33
18	08:45	07:42	06:28	06:03	04:53	04:19	04:46	05:48	06:52	07:57	08:06	08:56
	16:12	17:23	18:26	20:33	21:37	22:19	22:01	20:55	19:31	18:09	15:59	15:33
19	08:44	07:40	06:25	06:01	04:51	04:19	04:48	05:50	06:55	07:59	08:08	08:56
	16:14	17:25	18:28	20:35	21:39	22:20	21:59	20:52	19:28	18:06	15:57	15:33
20	08:42	07:37	06:23	05:58	04:49	04:19	04:49	05:52	06:57	08:01	08:11	08:57
	16:16	17:27	18:30	20:38	21:41	22:20	21:58	20:50	19:25	18:04	15:56	15:33
21	08:41	07:35	06:20	05:55	04:47	04:19	04:51	05:54	06:59	08:03	08:13	08:58
	16:18	17:30	18:32	20:40	21:43	22:20	21:56	20:47	19:23	18:01	15:54	15:34
22	08:39	07:32	06:17	05:53	04:46	04:19	04:53	05:56	07:01	08:05	08:15	08:58
	16:20	17:32	18:34	20:42	21:45	22:20	21:54	20:45	19:20	17:59	15:52	15:34
23	08:38	07:30	06:14	05:50	04:44	04:19	04:55	05:58	07:03	08:08	08:17	08:59
	16:23	17:34	18:37	20:44	21:47	22:20	21:53	20:42	19:17	17:56	15:51	15:35
24	08:36	07:27	06:12	05:48	04:42	04:20	04:57	06:00	07:05	08:10	08:19	08:59
	16:25	17:36	18:39	20:46	21:49	22:21	21:51	20:39	19:14	17:54	15:49	15:35
25	08:34	07:25	06:09	05:45	04:40	04:20	04:59	06:02	07:07	08:12	08:21	08:59
	16:27	17:39	18:41	20:48	21:50	22:21	21:49	20:37	19:11	17:51	15:48	15:36
26	08:32	07:22	06:06	05:43	04:39	04:21	05:00	06:04	07:09	08:14	08:23	09:00
	16:29	17:41	18:43	20:51	21:52	22:20	21:47	20:34	19:09	17:49	15:47	15:37
27	08:31	07:20	06:03	05:40	04:37	04:21	05:02	06:07	07:11	08:16	08:25	09:00
	16:31	17:43	18:45	20:53	21:54	22:20	21:45	20:31	19:06	17:46	15:45	15:38
28	08:29	07:17	06:00	05:38	04:36	04:22	05:04	06:09	07:13	08:18	08:27	09:00
	16:34	17:46	18:48	20:55	21:55	22:20	21:43	20:29	19:03	17:44	15:44	15:38
29	08:27		06:58	05:35	04:34	04:22	05:06	06:11	07:16	08:21	08:29	09:00
	16:36		19:50	20:57	21:57	22:20	21:41	20:26	19:00	17:41	15:43	15:39
30	08:25		06:55	05:33	04:33	04:23	05:08	06:13	07:18	08:23	08:31	09:00
	16:38		19:52	20:59	21:59	22:19	21:39	20:23	18:58	17:39	15:42	15:40
31	08:23		06:52		04:32		05:10	06:15		07:26		09:00
	16:41		19:54		22:00		21:37	20:21		16:37		15:42
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar per WTG**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn **WTG:** 3 - Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (3)

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time  
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00	08:21	07:14	06:49	05:30	04:30	04:24	05:12	06:17	07:20	07:28	08:32
	15:43	16:43	17:48	19:56	21:02	22:02	22:19	21:35	20:18	18:55	16:34	15:41
2	08:59	08:19	07:12	06:47	05:28	04:29	04:25	05:14	06:19	07:22	07:30	08:34
	15:44	16:45	17:50	19:58	21:04	22:03	22:18	21:33	20:15	18:52	16:32	15:40
3	08:59	08:17	07:09	06:44	05:25	04:28	04:26	05:16	06:21	07:24	07:33	08:36
	15:46	16:47	17:52	20:01	21:06	22:05	22:18	21:31	20:13	18:49	16:30	15:39
4	08:59	08:15	07:06	06:41	05:23	04:27	04:27	05:18	06:23	07:26	07:35	08:38
	15:47	16:50	17:55	20:03	21:08	22:06	22:17	21:28	20:10	18:47	16:27	15:38
5	08:58	08:13	07:04	06:38	05:21	04:26	04:28	05:20	06:25	07:28	07:37	08:39
	15:49	16:52	17:57	20:05	21:10	22:07	22:16	21:26	20:07	18:44	16:25	15:37
6	08:57	08:11	07:01	06:36	05:18	04:25	04:29	05:22	06:28	07:30	07:39	08:41
	15:50	16:54	17:59	20:07	21:12	22:09	22:16	21:24	20:04	18:41	16:23	15:36
7	08:57	08:08	06:58	06:33	05:16	04:24	04:30	05:25	06:30	07:33	07:42	08:43
	15:52	16:57	18:01	20:09	21:15	22:10	22:15	21:22	20:02	18:38	16:21	15:35
8	08:56	08:06	06:56	06:30	05:14	04:23	04:31	05:27	06:32	07:35	07:44	08:44
	15:53	16:59	18:04	20:11	21:17	22:11	22:14	21:19	19:59	18:36	16:19	15:35
9	08:55	08:04	06:53	06:27	05:12	04:23	04:32	05:29	06:34	07:37	07:46	08:45
	15:55	17:02	18:06	20:14	21:19	22:12	22:13	21:17	19:56	18:33	16:17	15:34
10	08:54	08:02	06:50	06:25	05:09	04:22	04:34	05:31	06:36	07:39	07:48	08:47
	15:57	17:04	18:08	20:16	21:21	22:13	22:12	21:15	19:53	18:30	16:14	15:34
11	08:53	07:59	06:47	06:22	05:07	04:21	04:35	05:33	06:38	07:41	07:51	08:48
	15:58	17:06	18:10	20:18	21:23	22:14	22:11	21:12	19:50	18:28	16:12	15:33
12	08:52	07:57	06:45	06:19	05:05	04:21	04:37	05:35	06:40	07:43	07:53	08:49
	16:00	17:09	18:13	20:20	21:25	22:15	22:09	21:10	19:48	18:25	16:10	15:33
13	08:51	07:55	06:42	06:17	05:03	04:20	04:38	05:37	06:42	07:46	07:55	08:51
	16:02	17:11	18:15	20:22	21:27	22:16	22:08	21:07	19:45	18:22	16:08	15:33
14	08:50	07:52	06:39	06:14	05:01	04:20	04:40	05:39	06:44	07:48	07:57	08:52
	16:04	17:13	18:17	20:24	21:29	22:17	22:07	21:05	19:42	18:20	16:06	15:33
15	08:49	07:50	06:36	06:11	04:59	04:19	04:41	05:41	06:46	07:50	08:00	08:53
	16:06	17:16	18:19	20:27	21:31	22:17	22:05	21:02	19:39	18:17	16:05	15:33
16	08:48	07:47	06:34	06:09	04:57	04:19	04:43	05:43	06:48	07:52	08:02	08:54
	16:08	17:18	18:21	20:29	21:33	22:18	22:04	21:00	19:37	18:14	16:03	15:33
17	08:47	07:45	06:31	06:06	04:55	04:19	04:44	05:45	06:50	07:54	08:04	08:55
	16:10	17:20	18:24	20:31	21:35	22:19	22:03	20:57	19:34	18:12	16:01	15:33
18	08:45	07:42	06:28	06:03	04:53	04:19	04:46	05:48	06:52	07:57	08:06	08:56
	16:12	17:23	18:26	20:33	21:37	22:19	22:01	20:55	19:31	18:09	15:59	15:33
19	08:44	07:40	06:25	06:01	04:51	04:19	04:48	05:50	06:55	07:59	08:08	08:56
	16:14	17:25	18:28	20:35	21:39	22:20	21:59	20:52	19:28	18:06	15:57	15:33
20	08:42	07:37	06:23	05:58	04:49	04:19	04:49	05:52	06:57	08:01	08:11	08:57
	16:16	17:27	18:30	20:38	21:41	22:20	21:58	20:50	19:25	18:04	15:56	15:33
21	08:41	07:35	06:20	05:55	04:47	04:19	04:51	05:54	06:59	08:03	08:13	08:58
	16:18	17:30	18:32	20:40	21:43	22:20	21:56	20:47	19:23	18:01	15:54	15:34
22	08:39	07:32	06:17	05:53	04:46	04:19	04:53	05:56	07:01	08:05	08:15	08:58
	16:20	17:32	18:34	20:42	21:45	22:20	21:54	20:45	19:20	17:59	15:52	15:34
23	08:38	07:30	06:14	05:50	04:44	04:19	04:55	05:58	07:03	08:08	08:17	08:59
	16:22	17:34	18:37	20:44	21:47	22:21	21:53	20:42	19:17	17:56	15:51	15:35
24	08:36	07:27	06:12	05:48	04:42	04:20	04:57	06:00	07:05	08:10	08:19	08:59
	16:25	17:36	18:39	20:46	21:49	22:21	21:51	20:39	19:14	17:54	15:49	15:35
25	08:34	07:25	06:09	05:45	04:40	04:20	04:59	06:02	07:07	08:12	08:21	08:59
	16:27	17:39	18:41	20:49	21:50	22:21	21:49	20:37	19:11	17:51	15:48	15:36
26	08:32	07:22	06:06	05:43	04:39	04:21	05:00	06:04	07:09	08:14	08:23	09:00
	16:29	17:41	18:43	20:51	21:52	22:20	21:47	20:34	19:09	17:49	15:47	15:37
27	08:31	07:20	06:03	05:40	04:37	04:21	05:02	06:07	07:11	08:16	08:25	09:00
	16:31	17:43	18:45	20:53	21:54	22:20	21:45	20:31	19:06	17:46	15:45	15:38
28	08:29	07:17	06:00	05:38	04:36	04:22	05:04	06:09	07:13	08:18	08:27	09:00
	16:34	17:46	18:48	20:55	21:56	22:20	21:43	20:29	19:03	17:44	15:44	15:38
29	08:27		06:58	05:35	04:34	04:22	05:06	06:11	07:16	08:21	08:29	09:00
	16:36		19:50	20:57	21:57	22:20	21:41	20:26	19:00	17:41	15:43	15:39
30	08:25		06:55	05:33	04:33	04:23	05:08	06:13	07:18	08:23	08:31	09:00
	16:38		19:52	20:59	21:59	22:19	21:39	20:23	18:58	17:39	15:42	15:40
31	08:23		06:52		04:32		05:10	06:15		07:26		09:00
	16:40		19:54		22:00		21:37	20:21		16:37		15:42
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker



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Licensed user:  
**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar per WTG**

**Calculation:** Skygge bergning for 6X offshore møller i Frederikshavn **WTG:** 4 - Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (4)

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00	08:21	07:14	06:49	05:30	04:30	04:24	05:12	06:17	07:20	07:28	08:33
	15:43	16:43	17:48	19:56	21:02	22:02	22:19	21:35	20:18	18:55	16:34	15:41
2	08:59	08:19	07:12	06:47	05:28	04:29	04:25	05:14	06:19	07:22	07:30	08:34
	15:44	16:45	17:50	19:58	21:04	22:03	22:18	21:33	20:15	18:52	16:32	15:40
3	08:59	08:17	07:09	06:44	05:25	04:28	04:26	05:16	06:21	07:24	07:33	08:36
	15:46	16:47	17:52	20:01	21:06	22:05	22:18	21:31	20:13	18:49	16:30	15:39
4	08:59	08:15	07:06	06:41	05:23	04:27	04:27	05:18	06:23	07:26	07:35	08:38
	15:47	16:50	17:55	20:03	21:08	22:06	22:17	21:28	20:10	18:47	16:27	15:38
5	08:58	08:13	07:04	06:38	05:21	04:26	04:28	05:20	06:25	07:28	07:37	08:39
	15:48	16:52	17:57	20:05	21:10	22:08	22:16	21:26	20:07	18:44	16:25	15:37
6	08:57	08:11	07:01	06:36	05:18	04:25	04:29	05:22	06:27	07:30	07:39	08:41
	15:50	16:54	17:59	20:07	21:12	22:09	22:16	21:24	20:04	18:41	16:23	15:36
7	08:57	08:08	06:58	06:33	05:16	04:24	04:30	05:24	06:30	07:33	07:42	08:43
	15:52	16:57	18:01	20:09	21:15	22:10	22:15	21:22	20:02	18:38	16:21	15:35
8	08:56	08:06	06:56	06:30	05:14	04:23	04:31	05:27	06:32	07:35	07:44	08:44
	15:53	16:59	18:04	20:11	21:17	22:11	22:14	21:19	19:59	18:36	16:19	15:35
9	08:55	08:04	06:53	06:27	05:12	04:22	04:32	05:29	06:34	07:37	07:46	08:45
	15:55	17:01	18:06	20:14	21:19	22:12	22:13	21:17	19:56	18:33	16:17	15:34
10	08:54	08:02	06:50	06:25	05:09	04:22	04:34	05:31	06:36	07:39	07:48	08:47
	15:57	17:04	18:08	20:16	21:21	22:13	22:12	21:15	19:53	18:30	16:14	15:34
11	08:53	07:59	06:47	06:22	05:07	04:21	04:35	05:33	06:38	07:41	07:51	08:48
	15:58	17:06	18:10	20:18	21:23	22:14	22:11	21:12	19:50	18:28	16:12	15:33
12	08:52	07:57	06:45	06:19	05:05	04:21	04:37	05:35	06:40	07:43	07:53	08:49
	16:00	17:09	18:13	20:20	21:25	22:15	22:09	21:10	19:48	18:25	16:10	15:33
13	08:51	07:55	06:42	06:17	05:03	04:20	04:38	05:37	06:42	07:46	07:55	08:51
	16:02	17:11	18:15	20:22	21:27	22:16	22:08	21:07	19:45	18:22	16:08	15:33
14	08:50	07:52	06:39	06:14	05:01	04:20	04:40	05:39	06:44	07:48	07:57	08:52
	16:04	17:13	18:17	20:25	21:29	22:17	22:07	21:05	19:42	18:20	16:06	15:33
15	08:49	07:50	06:36	06:11	04:59	04:19	04:41	05:41	06:46	07:50	08:00	08:53
	16:06	17:16	18:19	20:27	21:31	22:17	22:06	21:02	19:39	18:17	16:05	15:33
16	08:48	07:47	06:34	06:09	04:57	04:19	04:43	05:43	06:48	07:52	08:02	08:54
	16:08	17:18	18:21	20:29	21:33	22:18	22:04	21:00	19:37	18:14	16:03	15:32
17	08:47	07:45	06:31	06:06	04:55	04:19	04:44	05:45	06:50	07:54	08:04	08:55
	16:10	17:20	18:24	20:31	21:35	22:19	22:03	20:57	19:34	18:12	16:01	15:33
18	08:45	07:42	06:28	06:03	04:53	04:19	04:46	05:48	06:52	07:57	08:06	08:56
	16:12	17:23	18:26	20:33	21:37	22:19	22:01	20:55	19:31	18:09	15:59	15:33
19	08:44	07:40	06:25	06:01	04:51	04:19	04:48	05:50	06:55	07:59	08:08	08:56
	16:14	17:25	18:28	20:35	21:39	22:20	22:00	20:52	19:28	18:06	15:57	15:33
20	08:42	07:37	06:23	05:58	04:49	04:19	04:49	05:52	06:57	08:01	08:11	08:57
	16:16	17:27	18:30	20:38	21:41	22:20	21:58	20:50	19:25	18:04	15:56	15:33
21	08:41	07:35	06:20	05:55	04:47	04:19	04:51	05:54	06:59	08:03	08:13	08:58
	16:18	17:30	18:32	20:40	21:43	22:20	21:56	20:47	19:23	18:01	15:54	15:34
22	08:39	07:32	06:17	05:53	04:45	04:19	04:53	05:56	07:01	08:05	08:15	08:58
	16:20	17:32	18:34	20:42	21:45	22:20	21:54	20:45	19:20	17:59	15:52	15:34
23	08:38	07:30	06:14	05:50	04:44	04:19	04:55	05:58	07:03	08:08	08:17	08:59
	16:22	17:34	18:37	20:44	21:47	22:21	21:53	20:42	19:17	17:56	15:51	15:35
24	08:36	07:27	06:12	05:48	04:42	04:20	04:57	06:00	07:05	08:10	08:19	08:59
	16:25	17:36	18:39	20:46	21:49	22:21	21:51	20:39	19:14	17:54	15:49	15:35
25	08:34	07:25	06:09	05:45	04:40	04:20	04:59	06:02	07:07	08:12	08:21	09:00
	16:27	17:39	18:41	20:49	21:50	22:21	21:49	20:37	19:11	17:51	15:48	15:36
26	08:32	07:22	06:06	05:43	04:39	04:20	05:00	06:04	07:09	08:14	08:23	09:00
	16:29	17:41	18:43	20:51	21:52	22:21	21:47	20:34	19:09	17:49	15:47	15:37
27	08:31	07:20	06:03	05:40	04:37	04:21	05:02	06:07	07:11	08:16	08:25	09:00
	16:31	17:43	18:45	20:53	21:54	22:20	21:45	20:31	19:06	17:46	15:45	15:37
28	08:29	07:17	06:00	05:38	04:36	04:22	05:04	06:09	07:13	08:18	08:27	09:00
	16:34	17:46	18:48	20:55	21:56	22:20	21:43	20:29	19:03	17:44	15:44	15:38
29	08:27		06:58	05:35	04:34	04:22	05:06	06:11	07:16	08:21	08:29	09:00
	16:36		19:50	20:57	21:57	22:20	21:41	20:26	19:00	17:41	15:43	15:39
30	08:25		06:55	05:33	04:33	04:23	05:08	06:13	07:18	08:23	08:31	09:00
	16:38		19:52	20:59	21:59	22:19	21:39	20:23	18:58	17:39	15:42	15:40
31	08:23		06:52		04:32		05:10	06:15		07:26		09:00
	16:40		19:54		22:00		21:37	20:21		16:37		15:41
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:  
feredrikshavn

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07-02-2008 12:41 / 10

Licensed user:  
**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar per WTG**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn **WTG:** 5 - Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (5)

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
Minimum sun height over horizon for influence 3 °  
Day step for calculation 1 days  
Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00	08:21	07:14	06:49	05:30	04:30	04:24	05:12	06:17	07:20	07:28	08:33
	15:43	16:43	17:48	19:56	21:02	22:02	22:19	21:35	20:18	18:55	16:34	15:40
2	08:59	08:19	07:12	06:47	05:28	04:29	04:25	05:14	06:19	07:22	07:30	08:34
	15:44	16:45	17:50	19:58	21:04	22:03	22:19	21:33	20:15	18:52	16:32	15:39
3	08:59	08:17	07:09	06:44	05:25	04:28	04:26	05:16	06:21	07:24	07:33	08:36
	15:46	16:47	17:52	20:01	21:06	22:05	22:18	21:31	20:13	18:49	16:30	15:39
4	08:59	08:15	07:06	06:41	05:23	04:27	04:27	05:18	06:23	07:26	07:35	08:38
	15:47	16:50	17:55	20:03	21:08	22:06	22:17	21:29	20:10	18:47	16:27	15:38
5	08:58	08:13	07:04	06:38	05:21	04:26	04:28	05:20	06:25	07:28	07:37	08:39
	15:48	16:52	17:57	20:05	21:10	22:08	22:17	21:26	20:07	18:44	16:25	15:37
6	08:58	08:11	07:01	06:36	05:18	04:25	04:29	05:22	06:27	07:30	07:39	08:41
	15:50	16:54	17:59	20:07	21:12	22:09	22:16	21:24	20:04	18:41	16:23	15:36
7	08:57	08:08	06:58	06:33	05:16	04:24	04:30	05:24	06:30	07:33	07:42	08:43
	15:52	16:57	18:01	20:09	21:15	22:10	22:15	21:22	20:02	18:38	16:21	15:35
8	08:56	08:06	06:56	06:30	05:14	04:23	04:31	05:27	06:32	07:35	07:44	08:44
	15:53	16:59	18:04	20:11	21:17	22:11	22:14	21:19	19:59	18:36	16:19	15:35
9	08:55	08:04	06:53	06:27	05:12	04:22	04:32	05:29	06:34	07:37	07:46	08:46
	15:55	17:01	18:06	20:14	21:19	22:12	22:13	21:17	19:56	18:33	16:16	15:34
10	08:54	08:02	06:50	06:25	05:09	04:22	04:34	05:31	06:36	07:39	07:49	08:47
	15:57	17:04	18:08	20:16	21:21	22:13	22:12	21:15	19:53	18:30	16:14	15:34
11	08:54	07:59	06:47	06:22	05:07	04:21	04:35	05:33	06:38	07:41	07:51	08:48
	15:58	17:06	18:10	20:18	21:23	22:14	22:11	21:12	19:51	18:28	16:12	15:33
12	08:53	07:57	06:45	06:19	05:05	04:21	04:36	05:35	06:40	07:43	07:53	08:49
	16:00	17:09	18:13	20:20	21:25	22:15	22:09	21:10	19:48	18:25	16:10	15:33
13	08:51	07:55	06:42	06:17	05:03	04:20	04:38	05:37	06:42	07:46	07:55	08:51
	16:02	17:11	18:15	20:22	21:27	22:16	22:08	21:07	19:45	18:22	16:08	15:33
14	08:50	07:52	06:39	06:14	05:01	04:20	04:39	05:39	06:44	07:48	07:57	08:52
	16:04	17:13	18:17	20:25	21:29	22:17	22:07	21:05	19:42	18:20	16:06	15:33
15	08:49	07:50	06:36	06:11	04:59	04:19	04:41	05:41	06:46	07:50	08:00	08:53
	16:06	17:16	18:19	20:27	21:31	22:18	22:06	21:03	19:39	18:17	16:05	15:32
16	08:48	07:47	06:34	06:09	04:57	04:19	04:43	05:43	06:48	07:52	08:02	08:54
	16:08	17:18	18:21	20:29	21:33	22:18	22:04	21:00	19:37	18:14	16:03	15:32
17	08:47	07:45	06:31	06:06	04:55	04:19	04:44	05:45	06:50	07:54	08:04	08:55
	16:10	17:20	18:24	20:31	21:35	22:19	22:03	20:57	19:34	18:12	16:01	15:33
18	08:45	07:42	06:28	06:03	04:53	04:19	04:46	05:48	06:52	07:57	08:06	08:56
	16:12	17:23	18:26	20:33	21:37	22:19	22:01	20:55	19:31	18:09	15:59	15:33
19	08:44	07:40	06:25	06:01	04:51	04:19	04:48	05:50	06:55	07:59	08:08	08:56
	16:14	17:25	18:28	20:35	21:39	22:20	22:00	20:52	19:28	18:06	15:57	15:33
20	08:42	07:38	06:23	05:58	04:49	04:19	04:49	05:52	06:57	08:01	08:11	08:57
	16:16	17:27	18:30	20:38	21:41	22:20	21:58	20:50	19:25	18:04	15:56	15:33
21	08:41	07:35	06:20	05:55	04:47	04:19	04:51	05:54	06:59	08:03	08:13	08:58
	16:18	17:29	18:32	20:40	21:43	22:20	21:56	20:47	19:23	18:01	15:54	15:34
22	08:39	07:32	06:17	05:53	04:45	04:19	04:53	05:56	07:01	08:05	08:15	08:58
	16:20	17:32	18:34	20:42	21:45	22:21	21:55	20:45	19:20	17:59	15:52	15:34
23	08:38	07:30	06:14	05:50	04:44	04:19	04:55	05:58	07:03	08:08	08:17	08:59
	16:22	17:34	18:37	20:44	21:47	22:21	21:53	20:42	19:17	17:56	15:51	15:35
24	08:36	07:27	06:12	05:48	04:42	04:20	04:57	06:00	07:05	08:10	08:19	08:59
	16:25	17:36	18:39	20:46	21:49	22:21	21:51	20:39	19:14	17:54	15:49	15:35
25	08:34	07:25	06:09	05:45	04:40	04:20	04:58	06:02	07:07	08:12	08:21	09:00
	16:27	17:39	18:41	20:49	21:50	22:21	21:49	20:37	19:11	17:51	15:48	15:36
26	08:32	07:22	06:06	05:43	04:39	04:20	05:00	06:04	07:09	08:14	08:23	09:00
	16:29	17:41	18:43	20:51	21:52	22:21	21:47	20:34	19:09	17:49	15:47	15:37
27	08:31	07:20	06:03	05:40	04:37	04:21	05:02	06:07	07:11	08:16	08:25	09:00
	16:31	17:43	18:45	20:53	21:54	22:20	21:45	20:31	19:06	17:46	15:45	15:37
28	08:29	07:17	06:00	05:38	04:36	04:22	05:04	06:09	07:13	08:18	08:27	09:00
	16:34	17:46	18:48	20:55	21:56	22:20	21:43	20:29	19:03	17:44	15:44	15:38
29	08:27		06:58	05:35	04:34	04:22	05:06	06:11	07:16	08:21	08:29	09:00
	16:36		19:50	20:57	21:57	22:20	21:41	20:26	19:00	17:41	15:43	15:39
30	08:25		06:55	05:33	04:33	04:23	05:08	06:13	07:18	08:23	08:31	09:00
	16:38		19:52	20:59	21:59	22:19	21:39	20:23	18:58	17:39	15:42	15:40
31	08:23		06:52		04:32		05:10	06:15		07:26		09:00
	16:40		19:54		22:00		21:37	20:21		16:37		15:41
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:  
feredrikshavn

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07-02-2008 12:41 / 11

Licensed user:  
**DONG Energy**  
Kraftværksvej 53  
DK-7000 Fredericia  
79 23 33 33

Calculated:  
01-11-2007 14:40/2.5.7.83

**SHADOW - Calendar per WTG**

**Calculation:** Skygge bergning for 6X offshore møller i Frederikshavn **WTG:** 6 - Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (6)

**Assumptions for shadow calculations**

Maximum distance for influence 2.000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 0,13 0,22 0,32 0,40 0,42 0,46 0,42 0,49 0,39 0,29 0,18 0,10

Operational time  
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 300 381 494 600 698 520 626 971 1.271 1.135 682 391 8.068

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:00 09:42-09:47/5	08:21 07:14	06:49 05:30	04:30 04:24	05:12 06:17	07:20 07:28	08:33 09:18-09:32/14					
2	09:00 09:41-09:47/6	08:19 07:12	06:47 05:28	04:29 04:25	05:14 06:19	07:22 07:30	08:34 09:18-09:32/14					
3	08:59 09:41-09:48/7	08:17 07:09	06:44 05:25	04:28 04:25	05:16 06:21	07:24 07:33	08:36 09:19-09:33/14					
4	08:59 09:40-09:48/8	08:15 07:06	06:41 05:23	04:27 04:26	05:18 06:23	07:26 07:35	08:38 09:20-09:33/13					
5	08:58 09:39-09:48/9	08:13 07:04	06:38 05:21	04:26 04:28	05:20 06:25	07:28 07:37	08:39 09:22-09:34/12					
6	08:58 09:38-09:48/10	08:11 07:01	06:36 05:18	04:25 04:29	05:22 06:27	07:30 07:39	08:41 09:24-09:34/10					
7	08:57 09:37-09:49/12	08:08 06:58	06:33 05:16	04:24 04:30	05:24 06:30	07:33 07:42	08:43 09:26-09:35/9					
8	08:56 09:36-09:49/13	08:06 06:56	06:30 05:14	04:23 04:31	05:26 06:32	07:35 07:44	08:44 09:28-09:36/8					
9	08:55 09:35-09:49/14	08:04 06:53	06:27 05:12	04:22 04:32	05:29 06:34	07:37 07:46	08:46 09:29-09:36/7					
10	08:55 09:35-09:49/14	08:02 06:50	06:25 05:09	04:22 04:34	05:31 06:36	07:39 07:49	08:47 09:31-09:37/6					
11	08:54 09:36-09:50/14	07:59 06:47	06:22 05:07	04:21 04:35	05:33 06:38	07:41 07:51	08:48 09:32-09:37/5					
12	08:53 09:36-09:49/13	07:57 06:45	06:19 05:05	04:21 04:36	05:35 06:40	07:43 07:53	08:50 09:34-09:38/4					
13	08:52 09:38-09:49/11	07:55 06:42	06:17 05:03	04:20 04:38	05:37 06:42	07:46 07:55	08:51 09:35-09:38/3					
14	08:50 09:39-09:48/9	07:52 06:39	06:14 05:01	04:20 04:39	05:39 06:44	07:48 07:58	08:52 09:36-09:38/2					
15	08:49 09:41-09:47/6	07:50 06:36	06:11 04:59	04:19 04:41	05:41 06:46	07:50 08:00	08:53 09:37-09:39/1					
16	08:48 07:47	06:34 06:09	04:57 04:19	04:43 05:43	06:48 07:52	08:02 08:12	08:54 09:38-09:40/2					
17	08:47 07:45	06:31 06:06	04:55 04:19	04:44 05:45	06:50 07:54	08:04 08:14	08:55 09:41-09:59/18					
18	08:45 07:43	06:28 06:03	04:53 04:19	04:46 05:47	06:52 07:57	08:06 08:16	08:56 09:42-10:00/18					
19	08:44 07:40	06:25 06:01	04:51 04:19	04:48 05:50	06:55 07:59	08:08 08:18	08:56 09:42-10:01/19					
20	08:42 07:38	06:23 05:58	04:49 04:19	04:49 05:52	06:57 08:01	08:11 08:21	08:57 09:42-10:01/19					
21	08:41 07:35	06:20 05:55	04:47 04:19	04:51 05:54	06:59 08:03	08:13 08:23	08:58 09:43-10:02/19					
22	08:39 07:32	06:17 05:53	04:45 04:19	04:53 05:56	07:01 08:05	08:15 08:25	08:58 09:44-10:03/19					
23	08:38 07:30	06:14 05:50	04:44 04:19	04:55 05:58	07:03 08:08	08:17 08:27	08:59 09:44-10:03/19					
24	08:36 07:27	06:12 05:48	04:42 04:19	04:57 06:00	07:05 08:10	08:19 08:29	08:59 09:44-10:03/19					
25	08:34 07:25	06:09 05:45	04:40 04:20	04:58 06:02	07:07 08:12	08:21 08:31	09:00 09:45-10:03/18					
26	08:33 07:22	06:06 05:43	04:39 04:20	05:00 06:04	07:09 08:14	08:23 08:33	09:00 09:46-10:04/18					
27	08:31 07:20	06:03 05:40	04:37 04:21	05:02 06:06	07:11 08:16	08:25 09:20-09:26/6	09:00 09:46-10:05/19					
28	08:29 07:17	06:00 05:38	04:36 04:21	05:04 06:09	07:13 08:18	08:27 09:19-09:28/9	09:00 09:43-09:45/2					
29	08:27 07:14	05:58 05:35	04:34 04:22	05:06 06:11	07:16 08:21	09:18-09:29/11	09:00 09:43-09:45/2					
30	08:25 07:12	05:55 05:33	04:33 04:23	05:08 06:13	07:18 08:23	09:17-09:30/13	09:00 09:43-09:46/3					
31	08:23 07:10	05:52 05:29	04:31 04:22	05:09 06:14	07:19 08:24	09:18-09:30/13	09:00 09:43-09:46/3					
Potential sun hours	229	263	366	429	514	537	536	473	385	322	242	209
Sum of minutes with flicker	280	0	0	0	0	0	0	0	0	0	39	628

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

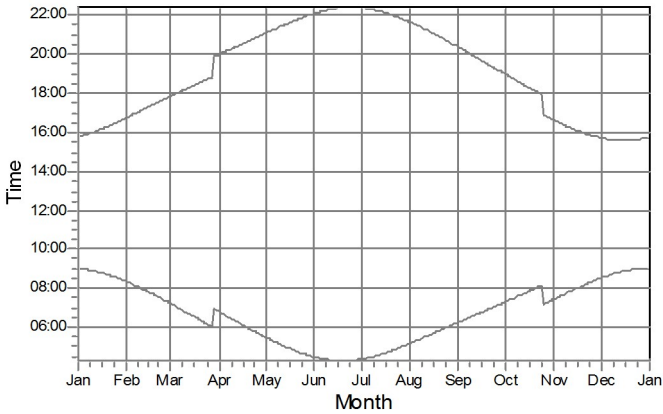
Project:  
**Frederikshavn**

Printed/Page  
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 Licensed user:  
**DONG Energy**  
 Kraftværksvej 53  
 DK-7000 Fredericia  
 79 23 33 33  
 Calculated:  
 01-11-2007 14:40/2.5.7.83

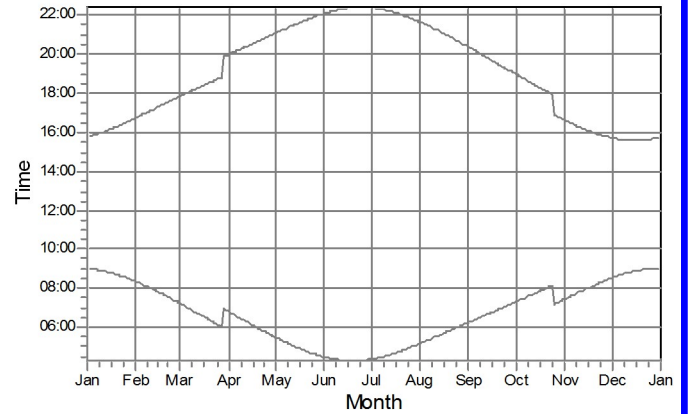
**SHADOW - Calendar per WTG, graphical**

**Calculation:** Skygge bergning for 6X offshore møller i Frederikshavn

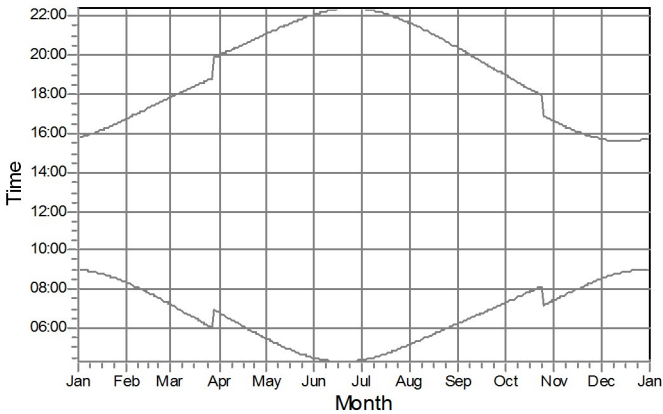
1: Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (1)



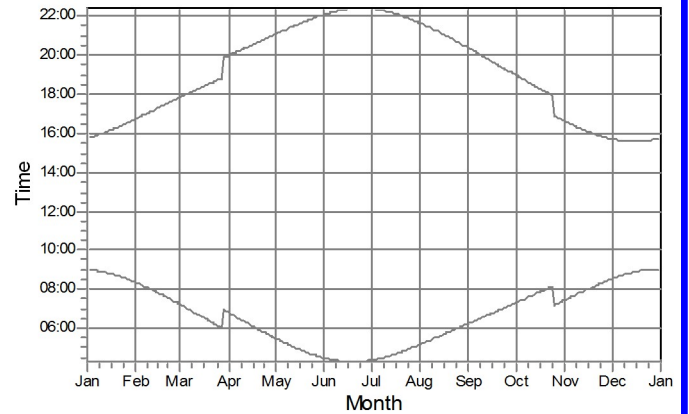
2: Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (2)



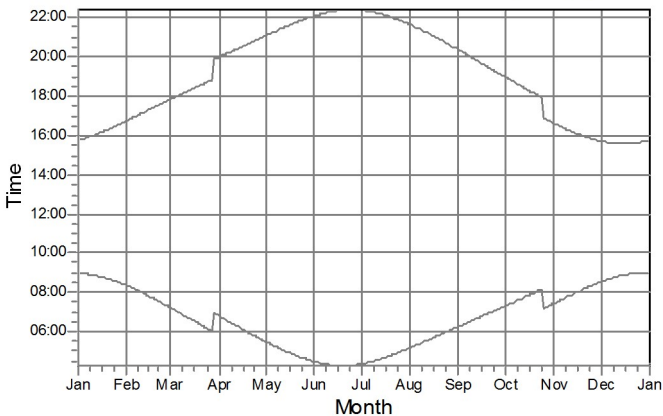
3: Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (3)



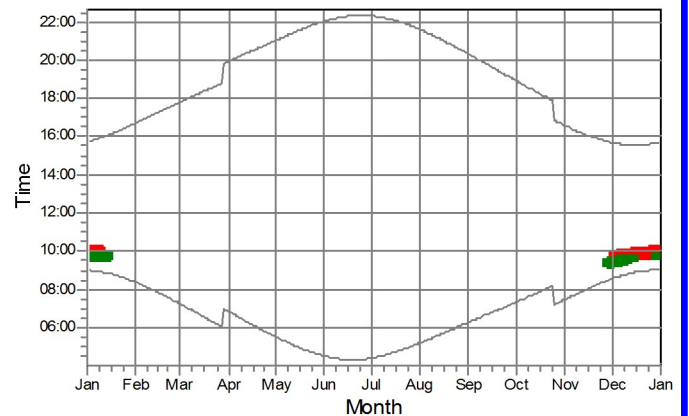
4: Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (4)



5: Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (5)



6: Siemens SWT-3.6-107 3600 107.0 IO! hub: 80,0 m (6)



Shadow receptor

■ A: Hirsholm 1

■ B: Hirsholm 2



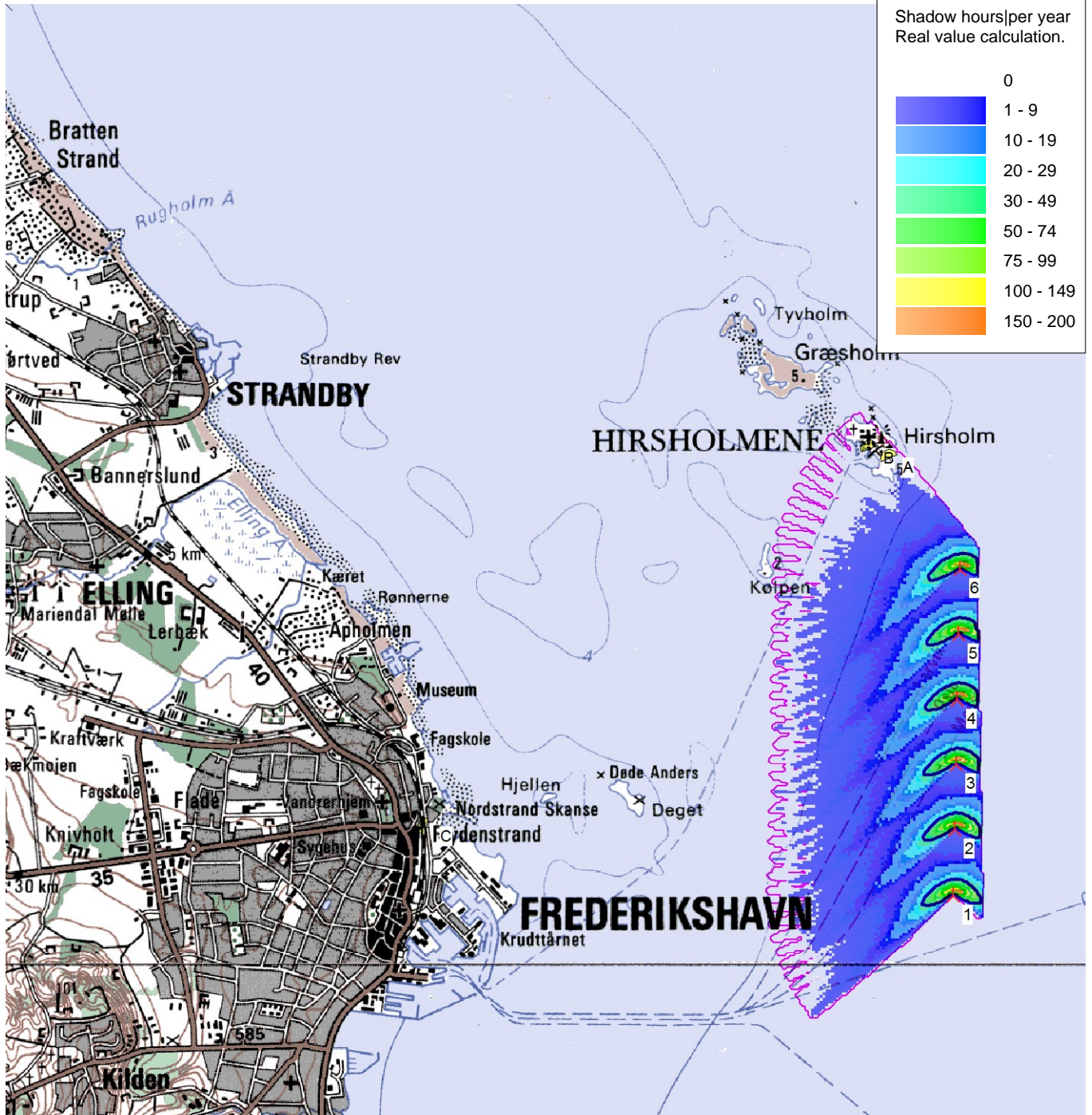
Project:  
 frederikshavn

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 Licensed user:  
**DONG Energy**  
 Kraftværksvej 53  
 DK-7000 Fredericia  
 79 23 33 33  
 Calculated:  
 01-11-2007 14:40/2.5.7.83

**SHADOW - KMS map: DISC06\_6 Nordjylland.IT**

Calculation: Skygge bergning for 6X offshore møller i Frederikshavn

File: DISC06\_6 Nordjylland.IT



0 1000 2000 3000 4000 m

Map: Skagen 1318, Print scale 1:65.000, Map center UTM WGS 84 Zone: 32 East: 593.703 North: 6.371.138

New WTG

Shadow receptor

Isolines showing shadow in Shadow hours|per year. Real value calculation.

0 40 80 120 160 200