

Note on Translation

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Test Report

WICO 018FB123-03

04 March 2026

Determination of Shadow Flicker from Wind Turbines (WTG)

according to the **LAI Guidelines for Shadow Flicker from Wind Turbines**

Test object:

2 wind turbines of type **ENERCON E-160 EP5 E3 R1**

1 wind turbine of type **ENERCON E-138 EP3 E3**

Site:

Böxlund, Schleswig-Holstein, Germany

Project

Title:

Determination of Shadow Flicker from Wind Turbines (WTG)

Site:

Böxlund, Schleswig-Holstein, Germany

Scope of work:

Determination of shadow flicker caused by wind turbines (WTG) in accordance with the **LAI Guidelines for Shadow Flicker from Wind Turbines /1/** in conjunction with the specifications of the **test instruction QMP-12 /5/** of WIND-consult GmbH.

Test object:

2 wind turbines of type **ENERCON E-160 EP5 E3 R1**

1 wind turbine of type **ENERCON E-138 EP3 E3**

Reference documents:

None

Standard:

LAI Guidelines for Shadow Flicker from Wind Turbines /1/

Order

Client:

BWP BB Wind GmbH & Co. KG

Dammacker 32

24980 Schafflund

Germany

Contractor:

WIND-consult GmbH

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Germany

Order number:

WICO 018FB123

Order date:

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table of contents

| | |
|--|----|
| Note on Translation | 1 |
| Determination of Shadow Flicker from Wind Turbines (WTG) | 1 |
| 1 Introduction | 4 |
| 1.1 Scope of work | 4 |
| 1.2 Method of calculation and assessment | 4 |
| 1.2.1 Mathematical and physical principles of shadow flicker | 4 |
| 1.2.2 Method of prediction uncertainty | 6 |
| 1.2.3 Tabular presentation of results | 6 |
| 1.2.4 Graphical representation of the annual shadow distribution of wind turbines | 7 |
| 2 Site and project description | 8 |
| 3 Input data for the calculation | 9 |
| 3.1 Coordinate system and coordinates | 9 |
| 3.2 Source parameters | 9 |
| 3.3 Parameters of the immission locations | 11 |
| 4 Results | 13 |
| 4.1 Duration of shadow at the considered immission locations caused by the wind turbines. 13 | |
| 4.1.1 Additional load | 13 |
| 4.1.2 Existing load | 15 |
| 4.1.3 Total load | 16 |
| 4.2 Shadow maps of the additional load and total load | 19 |
| 4.2.1 Additional load – immission locations in Schleswig-Holstein | 19 |
| 4.2.2 Additional load – immission locations in Denmark | 20 |
| 4.2.3 Total load – immission locations in Schleswig-Holstein | 21 |
| 4.2.4 Total load – immission locations in Denmark | 22 |
| 5 Deviations | 23 |
| 6 Summary | 24 |
| 7 Literature | 25 |
| 8. attachments | 26 |

1 Introduction

1.1 Scope of work

WIND-consult GmbH was commissioned to determine the shadow flicker caused by the wind turbines (WTG) planned by **BWP BB Wind GmbH & Co. KG** at the site **Böxlund** in accordance with the **LAI Guidelines for Shadow Flicker from Wind Turbines /1/** for **21 immission locations in Schleswig-Holstein** and **15 immission locations in Denmark**.

No measures or services deviating from or extending beyond the scope of the order were carried out.

1.2 Method of calculation and assessment

1.2.1 Mathematical and physical principles of shadow flicker

Every opaque object creates a shadow in the path of radiation from a light source, the contours of which correspond to the outer boundary of the object. In the case of a real, extended light source, there is no sharp shadow boundary. Instead, between the completely shaded and limited area (umbra — from the observer's point of view a complete covering of the light source by an opaque object) and the illuminated area, there exists a transition zone (penumbra — from the observer's point of view an incomplete covering of the light source by an opaque object), in which only part of the light source is obscured.

The decisive characteristic of shadow flicker caused by a wind turbine (WTG) is the rapid alternation of light and shadow resulting from the moving rotor blades under windy conditions. This effect may cause a noticeable impact on the surroundings even at larger distances from the wind turbine, i.e. well outside the area of the umbra. A distinction between penumbra and umbra is not relevant with regard to the annoyance effect.

The static shadow of the wind turbine tower or the rotor under calm wind conditions is generally no more disturbing than that of any comparable structure. In order to reliably avoid significant disturbance caused by periodic light effects from wind turbines, the optical immissions must be determined. These depend not only on their intensity, but also on the type and duration of exposure. Therefore, when assessing optical immissions, all wind turbines in the surrounding area that may affect the respective immission location must be taken into account. All wind turbines located outside the area of influence or shadowing range can be excluded with certainty from causing periodic shadow flicker at a given immission location.

According to /1/, the relevant area of influence or shadowing range is defined by the distance from the wind turbine at which **20% of the solar disc area** is covered by the mean rotor blade width. Since the blade width is not constant over the entire rotor blade but decreases towards the blade tip, a **rectangular rotor blade** shall be assumed for the calculation in accordance with /1/. The mean blade width is determined according to Equation 1.1, and the area of influence or shadowing range according to Equation 1.2 /7/.

$$\text{mittlere Blatttiefe} = \frac{1}{2}(\text{max. Blatttiefe} + \text{min. Blatttiefe bei 90\% Rotorradius}) \quad 1.1$$

$$\text{Beschattungsbereich} = \frac{(\text{Mittlere Blatttiefe} \cdot d)}{f} \quad 1.2$$

| Deutsch | Englisch |
|-------------------------------------|--|
| mittlere Blatttiefe | mean blade width |
| max. Blatttiefe | maximum blade width |
| min. Blatttiefe bei 90% Rotorradius | minimum blade width at 90% rotor radius |
| Beschattungsbereich | shadowing range / shadowing distance / area of influence |
| Einwirkungsbereich | area of influence |
| Rotorradius | rotor radius |
| d | distance to wind turbine |
| f | solar disc diameter |

Where:

d: mean distance to the sun (approx. 150,000,000 km),

f: width of the obscured portion of the sun at 20% coverage (approx. 219,556 km).

The impact of periodic shadow flicker is considered to cause significant disturbance according to /1/ if the astronomically maximum possible shadow duration at an immission location exceeds 30 hours per calendar year and 30 minutes per calendar day. If the above limits are exceeded, measures for the temporal limitation of the operation of the wind turbines may have to be implemented.

The calculation of the astronomically possible shadow duration (assumption: continuous sunshine from sunrise (SR) to sunset (SS), i.e. no consideration of cloud cover or atmospheric attenuation) at an immission location caused by the rotor blades of a wind turbine is based on generally known spherical-trigonometric relationships describing the position of the sun during the day and throughout the year (DIN 5034 /2/) as well as on the laws of plane geometry. For the calculation, the rotor swept area of the wind turbine is assumed to be a circular area perpendicular to the line connecting the immission location and the wind turbine tower, and therefore perpendicular to the direction of sunlight, while the immission location is represented by an area of 0.1×0.1 m at an agreed height above ground (2.0 m) (see Figure 1.1).

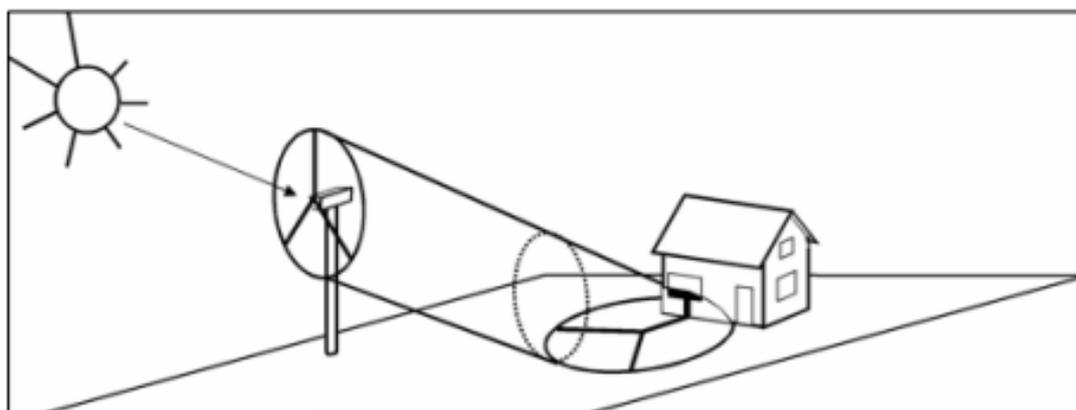


Figure 1.1: Shadow flicker of a wind turbine affecting the surrounding area (source: /6/)

The shadow duration on any given day is defined as the period during which the sun, as seen from the immission location, is positioned behind the rotor swept area. It is calculated from the instantaneous **solar elevation angle** and the **solar azimuth angle** for all days within a previously determined maximum annual period. Shadow flicker for solar positions below **3° above the horizon** can be neglected due to vegetation, buildings, and the atmospheric layers through which the sunlight must pass.

A decisive parameter for determining shadow flicker is the **apparent elevation of the sun HRP within the rotor circle area**, relative to the elevation HIP of the immission location, at the horizontal distance LRI between this point and the rotor plane, for the instantaneous solar elevation angle h_s .

$$H_{RP} = H_{IP} + L_{RI} \cdot \tan h_s \quad 1.3$$

The calculation of shadow flicker is performed stepwise starting from a **minimum solar elevation angle of 3°**.

Another parameter to be determined according to /1/ is the **probable (meteorological) shadow duration**. This results from the **astronomical shadow duration** and long-term averaged, regional, monthly climate data regarding **sunshine duration** and **wind direction distribution**, as well as an approach according to **BEHR /3/** for determining the **effective rotor area**. The meteorological shadow duration is relevant for the practical assessment and is generally significantly lower than the astronomical shadow duration, in particular during the early morning or late afternoon hours, in some cases by up to one order of magnitude. Therefore, according to /1/, the **meteorological shadow duration shall not exceed 8 hours per calendar year**.

1.2.2 Method of prediction uncertainty

According to /1/, no specific instructions are given regarding the determination or application of uncertainties. The calculation model according to /1/ is based on a purely geometric calculation using a **worst-case scenario** approach.

Finally, it should be noted that due to the necessarily simplifying physical-mathematical assumptions and methodological specifications in /1/, uncertainties in the calculation may occur, for example with regard to the **time-of-day assignment of approximately 1.0 minute** and the **annual astronomical shadow duration of approximately 0.5 h/a**.

The determination of additional shading of the immission locations caused by other obstacles is **not part of the calculations**.

1.2.3 Tabular presentation of results

All calculations and graphical representations were carried out using the **SHADOW module of the software WindPRO**, version **4.2.285**. In this process, self-shading of buildings at all immission locations was not considered (so-called "**greenhouse mode**").

The quantitative results of the stepwise calculation of the shadow path of the wind turbines at the respective immission locations are summarized in the tables in **Chapter 4**. They include the **annual astronomical shadow duration**, the **probable shadow duration of an immission location**, and the **number of shadow days**. The most important input parameters and characteristics of the immission locations and the shadow-causing wind turbines are summarized in **Chapter 3**.

The **shadow calendars**, for each wind turbine of the additional load to be assessed, are shown in **Appendix 8.7**. The shadow calendars for the immission locations within the area of influence or shadowing range can be provided upon request. The shadow calendars allow, among other things, detailed decisions to be made regarding the **required shut-down times of selected wind turbines** on the respective shadow days.

1.2.4 Graphical representation of the annual shadow distribution of wind turbines

For a comprehensive assessment of shadow flicker caused by wind turbines, an **area-wide representation of the distribution of the annual astronomical shadow duration** in the entire surroundings of the wind turbines is useful. This applies in particular to **wind farms**. Such a representation as a **shadow map** provides, on the one hand, a quick overview of the size and shape of the area significantly affected by shadow flicker from the wind turbines. On the other hand, it allows a preliminary assessment of additional or future immission locations with regard to possible shadow effects caused by the wind turbines.

For this purpose, the annual sums of the **astronomical shadow duration** caused by the totality of all wind turbines are determined on a grid with suitable step widths within a sufficiently large area around the wind farm, and these values are subsequently assigned to the corresponding geometric locations. For an accurate determination of this shadow field, a **topographic map of the area with digitized elevation data** is used. By appropriate classification of the values of the annual shadow duration and their marking, areas with equal limit ranges of shadow duration caused by all wind turbines can be identified. The shadow maps calculated in this way are presented in **Chapter 4.2**.

Possible immission locations located within the **first shadow range (< 3.0 h/a)** are not affected or only negligibly affected by shadow flicker, so that a detailed shadow analysis for such locations is not required. Immission locations located within the **second shadow range (3.0 h/a to 30.0 h/a)** are generally affected by shadow flicker from one or more wind turbines, but remain below the critical guideline value of **30.0 h/a**. A detailed shadow analysis is recommended in particular if such immission locations are close to the **third shadow range (> 30.0 h/a)**. Immission locations located within the **third shadow range (> 30.0 h/a)** are affected by shadow flicker to such an extent that, on the basis of a necessary detailed shadow analysis, **measures to reduce the shadow duration must be implemented**.

Such a graphical representation also allows a rough assignment of the values with respect to the **time of day** and **season of the year**: Points located to the left (west) of the respective wind turbine are affected by shadow flicker in the **morning**, whereas points located to the right (east) are affected in the **afternoon**. Points located above (north of) the respective wind turbine are affected during the **winter half-year**, while points located below (south of) the turbine are affected during the **summer half-year**.

However, the representation of the **shadow field** does not replace a detailed shadow analysis at a specific immission location. A precise determination of the shadow duration in time is not possible, and due to uncertainties resulting from the grid resolution and the orography, the overall uncertainty — particularly in the vicinity of the **third shadow range (> 30.0 h/a)** — is approximately **5.0 h/a** or **5 min/d**, respectively.

2 Site and project description

At the site **Böxlund**, the construction of two wind turbines (WTG) of type **ENERCON E-160 EP5 E3 R1 / 5560 kW** and one wind turbine of type **ENERCON E-138 EP3 E3 / 4260 kW** is planned.

The wind farm to be investigated is located approximately **2.5 km northwest of the village of Böxlund**. About **3 km south** of the planned wind turbines lies the village of **Weesby**. The respective municipalities are located within the district of **Schleswig-Flensburg**. To the north, the planned wind turbines border the territory of **Denmark** at a distance of approximately **200 m**.

The terrain at the wind farm site is largely **flat and open**. The elevation above mean sea level (m a.s.l.) in the area of the wind turbine locations is approximately **15 m a.s.l.** The digital elevation model used for the calculations is the “**Schleswig-Holstein Elevation Model (DGM5)**”.

An overview of the wind turbines considered as **existing load (pre-load)** and **additional load**, as well as the immission locations taken into account, is shown in **Figure 2.1**. The detailed parameters of the wind turbines and the considered immission locations are listed in **Chapter 3**.

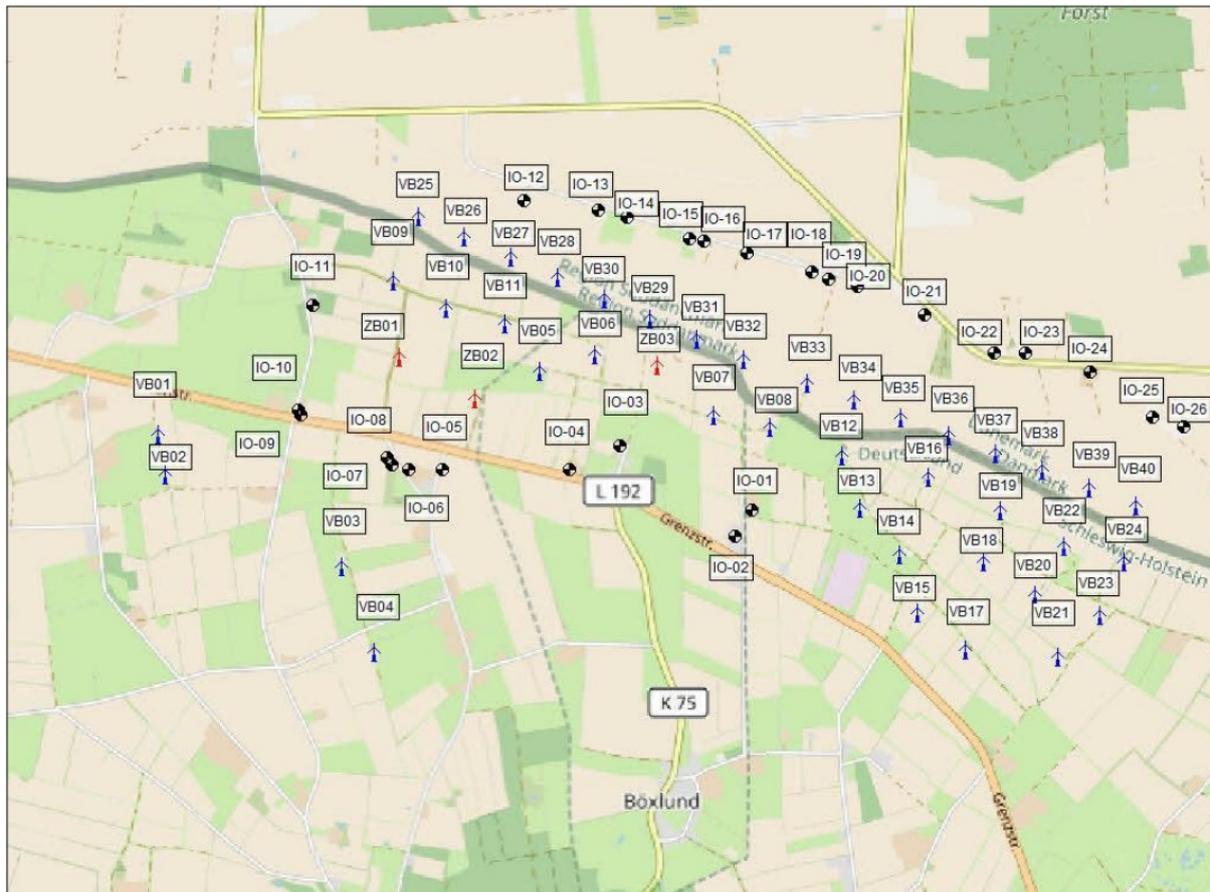


Figure 2.1: Site layout Böxlund

3 Input data for the calculation

3.1 Coordinate system and coordinates

For the calculations, coordinates in the reference system **ETRS 89** with **UTM projection, 6° zone system, zone 32** were used.

The reference height at the immission locations is **2 m above ground level**, taking into account the existing buildings.

3.2 Source parameters

| Deutsch | Englisch |
|--------------------------------|---------------------------------|
| WEA-Typ | WTG type |
| Rotordurchmesser | Rotor diameter |
| Nabenhöhe | Hub height |
| Max. Einwirkungsbereich | Max. shadowing range |
| Max. Blatttiefe | Max. blade width |
| Blatttiefe bei 90% Rotorradius | Blade width at 90% rotor radius |

Table 3.1: Parameters and coordinates of the wind turbines of the additional load

| Bez. | UTM ETRS89 Zone 32 | | | WEA-Typ | Rotor- durch- messer | Naben- höhe | Max. Ein- wirk- ungs- bereich | Max. Blat- tiefe | Blat- tiefe bei 90% Rotor- radius |
|------|--------------------|---------|------|-------------------------|----------------------------|----------------|---|------------------------|--|
| | X | Y | Z | | | | | | |
| | / m | / m | / m | | / m | / m | / m | / m | / m |
| ZB01 | 509965 | 6079600 | 17,6 | ENERCON E-160 EP5 E3 R1 | 160,0 | 120,0 | 1785 | 4,13 | 1,12 |
| ZB02 | 510417 | 6079349 | 18,6 | ENERCON E-160 EP5 E3 R1 | 160,0 | 120,0 | 1785 | 4,13 | 1,12 |
| ZB03 | 511520 | 6079549 | 19,5 | ENERCON E-160 EP5 E3 R1 | 138,3 | 111,0 | 1690 | 3,93 | 1,04 |

Table 3.2: Parameters and coordinates of the wind turbines of the existing load

| Bez. | UTM ETRS89 Zone 32 | | | WEA-Typ | Rotor- durch- messer | Naben- höhe | Max. Ein- wirk- ungs- bereich | Max. Blat- tiefe | Blat- tiefe bei 90% Rotor- radius |
|------|--------------------|---------|------|-----------------|----------------------------|----------------|---|------------------------|--|
| | X | Y | Z | | | | | | |
| | / m | / m | / m | | / m | / m | / m | / m | / m |
| VB01 | 508505 | 6079136 | 14,9 | ENERCON E-101 | 101,0 | 99,0 | 2216 | 4,72 | 1,79 |
| VB02 | 508551 | 6078885 | 16,2 | ENERCON E-101 | 101,0 | 99,0 | 2216 | 4,72 | 1,79 |
| VB03 | 509612 | 6078330 | 18,4 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB04 | 509812 | 6077810 | 19,1 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB05 | 510806 | 6079514 | 18,9 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB06 | 511144 | 6079614 | 21,0 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB07 | 511858 | 6079246 | 20,7 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB08 | 512196 | 6079176 | 20,9 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB09 | 509924 | 6080069 | 17,1 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB10 | 510243 | 6079899 | 17,5 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |

| Bez. | UTM ETRS89 Zone 32 | | | WEA-Typ | Rotor- durch- messer | Naben- höhe | Max. Ein- wirk- ungs- bereich | Max. Blat- tiefe | Blat- tiefe bei 90% Rotor- radius |
|------|--------------------|---------|------|-----------------------|----------------------------|----------------|---|------------------------|--|
| | X | Y | Z | | | | | | |
| | / m | / m | / m | | | | | | |
| VB11 | 510596 | 6079808 | 18,5 | Senvion 3.2M114 | 114,0 | 93,0 | 1752 | 3,99 | 1,16 |
| VB12 | 512631 | 6079003 | 20,8 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB13 | 512736 | 6078683 | 21,1 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB14 | 512978 | 6078401 | 21,5 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB15 | 513084 | 6078045 | 22,8 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB16 | 513153 | 6078872 | 21,4 | Senvion MM92 | 92,5 | 100,0 | 1625 | 3,60 | 1,18 |
| VB17 | 513375 | 6077826 | 24,2 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB18 | 513481 | 6078361 | 22,8 | Vestas V112-3.0 MW | 112,0 | 119,0 | 1709 | 4,00 | 1,03 |
| VB19 | 513587 | 6078671 | 22,6 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB20 | 513796 | 6078158 | 23,9 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB21 | 513934 | 6077779 | 24,1 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB22 | 513971 | 6078453 | 23,4 | Vestas V112-3.0 MW | 112,0 | 119,0 | 1709 | 4,00 | 1,03 |
| VB24 | 514333 | 6078361 | 23,8 | Senvion 3.2M114 | 114,0 | 123,0 | 1750 | 3,99 | 1,16 |
| VB25 | 510077 | 6080455 | 17,8 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB26 | 510356 | 6080332 | 17,9 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB27 | 510636 | 6080208 | 18,7 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB28 | 510917 | 6080087 | 18,8 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB29 | 511477 | 6079836 | 20,0 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB30 | 511196 | 6079959 | 20,1 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB31 | 511757 | 6079713 | 20,0 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB32 | 512035 | 6079588 | 20,6 | NEG Micon NM 64c/1500 | 64,0 | 60,0 | 2500 | | |
| VB33 | 512421 | 6079447 | 20,6 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |
| VB34 | 512705 | 6079340 | 21,3 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |
| VB35 | 512988 | 6079234 | 21,0 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |
| VB36 | 513272 | 6079126 | 22,2 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |
| VB37 | 513556 | 6079019 | 22,4 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |
| VB38 | 513839 | 6078912 | 23,2 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |
| VB39 | 514123 | 6078805 | 23,4 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |
| VB40 | 514405 | 6078698 | 23,5 | Vestas V80-2MW | 80,0 | 60,0 | 1583 | 3,52 | 1,13 |

3.3 Parameters of the immission locations

The immission locations to be considered in **Schleswig-Holstein** (see Table 3.3) were determined based on the results of the site inspection carried out on **06 June 2023** by an employee of **WIND-consult GmbH**, as well as on the basis of cartographic data. The immission locations to be considered in **Denmark** (see Table 3.4) were taken from the **noise immission forecast** prepared by the engineering office **Ingenieurbüro für Akustik Busch GmbH** /9/.

The immission locations are considered as **receptors** with a size of **0.1 × 0.1 m** and an inclination of **0°**. The reference height above ground level is **2 m** in each case.

Table 3.3 shows the **immission location numbers**, the **coordinates**, and the **absolute elevation**.

| Bez. | Adresse | X / m | Y / m | Z / m |
|-------|------------------------|----------|----------|----------|
| IO001 | Erlenweg 4, Böxlund | 512084 | 6078670 | 23,3 |
| IO002 | Erlenweg 5, Böxlund | 511990 | 6078515 | 22,2 |
| IO003 | Grenzauweg 3, Böxlund | 511291 | 6079064 | 20,5 |
| IO004 | Grenzstraße 1, Böxlund | 510984 | 6078916 | 20,8 |
| IO005 | Weesbydamm 14, Weesby | 510226 | 6078926 | 20,6 |
| IO006 | Kjerweg 4, Weesby | 510018 | 6078918 | 19,7 |
| IO007 | Kjerweg 3, Weesby | 509917 | 6078949 | 19,7 |
| IO008 | Kjerweg 1, Weesby | 509890 | 6078996 | 19,2 |
| IO009 | Bögelhus 2, Weesby | 509362 | 6079254 | 17,6 |
| IO010 | Bögelhus 2a, Weesby | 509354 | 6079278 | 17,1 |
| IO011 | Bögelhus 4, Weesby | 509431 | 6079917 | 17,5 |
| IO012 | Kjerweg 2, Weesby | 510126 | 6078810 | 19,7 |
| IO013 | Grenzauweg 4, Böxlund | 511314 | 6078970 | 21,0 |
| IO014 | Grenzauweg 2, Böxlund | 511297 | 6078865 | 21,3 |
| IO015 | Bögelhus 1, Weesby | 509313 | 6079300 | 17,1 |
| IO016 | Bögelhus 3, Weesby | 509137 | 6080535 | 16,7 |
| IO017 | Bögelhus 12, Weesby | 509155 | 6080618 | 16,4 |
| IO018 | Bögelhus 10, Weesby | 509208 | 6080554 | 16,5 |
| IO019 | Bögelhus 8, Weesby | 509338 | 6080334 | 17,2 |
| IO020 | Bögelhus 6, Weesby | 509394 | 6080108 | 18,1 |
| IO021 | Betonstraße 2, Weesby | 509213 | 6079268 | 17,3 |

Table 3.4: Site parameters and coordinates of the immission locations in Denmark

| Bez. | Adresse | X / m | Y / m | Z / m |
|-------------|-------------------------|------------------------|------------------------|------------------------|
| IO022 | Tinglev, Bølåvej 17 | 510716 | 6080549 | 19,2 |
| IO023 | Tinglev, Bølåvej 15 | 511160 | 6080498 | 19,4 |
| IO024 | Tinglev, Bølåvej 13 | 511330 | 6080446 | 21,0 |
| IO025 | Tinglev, Bølåvej 11 | 511716 | 6080325 | 20,3 |
| IO026 | Tinglev, Bølåvej 9 | 511797 | 6080312 | 20,3 |
| IO027 | Tinglev, Bølåvej 7 | 512060 | 6080230 | 20,4 |
| IO028 | Tinglev, Bølåvej 5 | 512451 | 6080117 | 21,6 |
| IO029 | Tinglev, Bølåvej 3 | 512547 | 6080083 | 21,6 |
| IO030 | Tinglev, Bølåvej 1 | 512725 | 6080029 | 21,6 |
| IO031 | Tinglev, Grænsevejen 31 | 513125 | 6079855 | 22,9 |
| IO032 | Tinglev, Grænsevejen 28 | 513550 | 6079631 | 23,3 |
| IO033 | Tinglev, Grænsevejen 22 | 513731 | 6079624 | 23,2 |
| IO034 | Tinglev, Grænsevejen 21 | 514125 | 6079508 | 23,7 |
| IO035 | Tinglev, Grænsevejen 15 | 514504 | 6079236 | 24,4 |
| IO036 | Tinglev, Grænsevejen 13 | 514688 | 6079173 | 24,3 |

4 Results

4.1 Duration of shadow at the considered immission locations caused by the wind turbines

The main results (**astronomical annual shadow duration**, **maximum astronomical daily shadow duration**, **shadow-causing wind turbines**, and **meteorological probable shadow duration**) of the calculations are presented for the wind turbines of the **additional load** in Chapter 4.1.1, for the wind turbines of the **existing load** in Chapter 4.1.2, and for the wind turbines of the **total load** in Chapter 4.1.3, for all immission locations affected by shadow from the respective wind turbines. The corresponding **SHADOW printouts** of the main results are included in **Appendix 8.1 to Appendix 8.5**.

Immission locations at which **no shadow is caused by the additional load** are shown below for information purposes only and are marked in **grey**.

4.1.1 Additional load

Table 4.1: Results of shadow flicker caused by the additional load at the immission locations in Schleswig-Holstein

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungsdauer |
|-------|------------------------|--|-------|-------|---------------------------------------|
| | | / h/a | / d/a | / h/d | / h/a |
| IO001 | Erlenweg 4, Böxlund | 0:00 | 0 | 00:00 | 0:00 |
| IO002 | Erlenweg 5, Böxlund | 8:50 | 40 | 00:20 | 4:02 |
| IO003 | Grenzauweg 3, Böxlund | 43:40 | 74 | 00:54 | 20:01 |
| IO004 | Grenzstraße 1, Böxlund | 27:53 | 65 | 00:36 | 11:30 |
| IO005 | Weesbydamm 14, Weesby | 10:57 | 42 | 00:23 | 5:02 |
| IO006 | Kjerweg 4, Weesby | 6:35 | 31 | 00:20 | 3:04 |
| IO007 | Kjerweg 3, Weesby | 7:34 | 24 | 00:24 | 2:59 |
| IO008 | Kjerweg 1, Weesby | 41:10 | 60 | 00:52 | 17:00 |
| IO009 | Bögelhus 2, Weesby | 82:45 | 128 | 00:56 | 34:45 |
| IO010 | Bögelhus 2a, Weesby | 91:41 | 134 | 00:57 | 38:39 |
| IO011 | Bögelhus 4, Weesby | 61:31 | 81 | 00:59 | 17:31 |
| IO012 | Kjerweg 2, Weesby | 9:25 | 41 | 00:21 | 4:18 |
| IO013 | Grenzauweg 4, Böxlund | 46:22 | 97 | 00:45 | 20:54 |
| IO014 | Grenzauweg 2, Böxlund | 48:18 | 87 | 00:39 | 20:39 |
| IO015 | Bögelhus 1, Weesby | 98:47 | 145 | 00:55 | 42:01 |
| IO016 | Bögelhus 3, Weesby | 38:38 | 85 | 00:50 | 7:39 |
| IO017 | Bögelhus 12, Weesby | 31:33 | 73 | 00:31 | 5:45 |
| IO018 | Bögelhus 10, Weesby | 46:37 | 79 | 00:53 | 8:50 |
| IO019 | Bögelhus 8, Weesby | 62:51 | 97 | 01:04 | 12:51 |

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungs- dauer |
|-------|-----------------------|--|--------------------|-------|--|
| | | / h/a | / d/a | / h/d | / h/a |
| | | IO020 | Bögelhus 6, Weesby | 57:50 | 79 |
| IO021 | Betonstraße 2, Weesby | 85:19 | 145 | 00:47 | 36:41 |

Tabelle 4.2: Ergebnisse Beschattung durch die Zusatzbelastung der Immissionsorte in Dänemark

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungs- dauer |
|-------|-------------------------|--|----------------------|-------|--|
| | | / h/a | / d/a | / h/d | / h/a |
| | | IO022 | Tinglev, Bøllåvej 17 | 60:51 | 77 |
| IO023 | Tinglev, Bøllåvej 15 | 37:00 | 88 | 00:49 | 7:00 |
| IO024 | Tinglev, Bøllåvej 13 | 32:30 | 101 | 00:28 | 6:39 |
| IO025 | Tinglev, Bøllåvej 11 | 29:25 | 79 | 00:35 | 5:31 |
| IO026 | Tinglev, Bøllåvej 9 | 36:44 | 85 | 00:40 | 6:53 |
| IO027 | Tinglev, Bøllåvej 7 | 49:10 | 93 | 00:39 | 9:31 |
| IO028 | Tinglev, Bøllåvej 5 | 14:47 | 41 | 00:30 | 4:05 |
| IO029 | Tinglev, Bøllåvej 3 | 12:11 | 37 | 00:28 | 3:26 |
| IO030 | Tinglev, Bøllåvej 1 | 8:40 | 31 | 00:25 | 2:27 |
| IO031 | Tinglev, Grænsevejen 31 | 4:07 | 21 | 00:18 | 1:15 |
| IO032 | Tinglev, Grænsevejen 28 | 0:00 | 0 | 00:00 | 0:00 |
| IO033 | Tinglev, Grænsevejen 22 | 0:00 | 0 | 00:00 | 0:00 |
| IO034 | Tinglev, Grænsevejen 21 | 0:00 | 0 | 00:00 | 0:00 |
| IO035 | Tinglev, Grænsevejen 15 | 0:00 | 0 | 00:00 | 0:00 |
| IO036 | Tinglev, Grænsevejen 13 | 0:00 | 0 | 00:00 | 0:00 |

| Deutsch | Englisch |
|---|---|
| Adresse | Address |
| Astronomisch maximal mögliche Beschattungsdauer | Astronomically maximum possible shadow duration |
| met. Wahrsch. Beschattungsdauer | Meteorological probable shadow duration |

4.1.2 Existing load

Table 4.3: Results of shadow flicker caused by the existing load at the immission locations in Schleswig-Holstein

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungs- dauer |
|-------|------------------------|--|-------|-------|--|
| | | / h/a | / d/a | / h/d | / h/a |
| IO001 | Erlenweg 4, Böxlund | 110:54 | 228 | 01:03 | 42:24 |
| IO002 | Erlenweg 5, Böxlund | 67:54 | 201 | 00:51 | 26:25 |
| IO003 | Grenzauweg 3, Böxlund | 97:10 | 207 | 00:46 | 41:07 |
| IO004 | Grenzstraße 1, Böxlund | 37:29 | 164 | 00:29 | 15:09 |
| IO005 | Weesbydamm 14, Weesby | 40:21 | 151 | 00:32 | 11:59 |
| IO006 | Kjerweg 4, Weesby | 79:50 | 190 | 00:39 | 21:55 |
| IO007 | Kjerweg 3, Weesby | 77:02 | 191 | 00:41 | 22:52 |
| IO008 | Kjerweg 1, Weesby | 63:18 | 190 | 00:37 | 20:02 |
| IO009 | Bögelhus 2, Weesby | 49:09 | 173 | 00:27 | 17:59 |
| IO010 | Bögelhus 2a, Weesby | 54:09 | 182 | 00:27 | 19:59 |
| IO011 | Bögelhus 4, Weesby | 133:20 | 313 | 01:05 | 51:24 |
| IO012 | Kjerweg 2, Weesby | 41:44 | 134 | 00:39 | 11:25 |
| IO013 | Grenzauweg 4, Böxlund | 90:33 | 190 | 00:46 | 38:07 |
| IO014 | Grenzauweg 2, Böxlund | 63:37 | 179 | 00:39 | 26:06 |
| IO015 | Bögelhus 1, Weesby | 59:18 | 189 | 00:28 | 21:54 |
| IO016 | Bögelhus 3, Weesby | 20:42 | 74 | 00:41 | 5:54 |
| IO017 | Bögelhus 12, Weesby | 23:10 | 75 | 00:43 | 6:16 |
| IO018 | Bögelhus 10, Weesby | 26:47 | 83 | 00:47 | 7:28 |
| IO019 | Bögelhus 8, Weesby | 45:44 | 147 | 00:42 | 13:21 |
| IO020 | Bögelhus 6, Weesby | 83:50 | 227 | 00:57 | 28:21 |
| IO021 | Betonstraße 2, Weesby | 61:41 | 201 | 00:32 | 22:08 |

Table 4.4: Results of shadow flicker caused by the existing load at the immission locations in Denmark

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungsdauer |
|-------|-------------------------|--|-------|-------|---------------------------------------|
| | | / h/a | / d/a | / h/d | / h/a |
| IO022 | Tinglev, Bøllåvej 17 | 146:45 | 166 | 02:00 | 29:41 |
| IO023 | Tinglev, Bøllåvej 15 | 105:42 | 182 | 01:16 | 21:58 |
| IO024 | Tinglev, Bøllåvej 13 | 51:53 | 168 | 00:38 | 11:53 |
| IO025 | Tinglev, Bøllåvej 11 | 95:51 | 177 | 01:18 | 19:31 |
| IO026 | Tinglev, Bøllåvej 9 | 82:34 | 178 | 00:57 | 17:19 |
| IO027 | Tinglev, Bøllåvej 7 | 40:07 | 124 | 00:37 | 8:42 |
| IO028 | Tinglev, Bøllåvej 5 | 54:13 | 129 | 00:53 | 10:45 |
| IO029 | Tinglev, Bøllåvej 3 | 48:08 | 140 | 00:39 | 9:54 |
| IO030 | Tinglev, Bøllåvej 1 | 54:16 | 152 | 01:02 | 10:39 |
| IO031 | Tinglev, Grænsevejen 31 | 80:23 | 148 | 01:02 | 16:14 |
| IO032 | Tinglev, Grænsevejen 28 | 77:04 | 169 | 01:04 | 15:45 |
| IO033 | Tinglev, Grænsevejen 22 | 72:04 | 147 | 00:54 | 14:57 |
| IO034 | Tinglev, Grænsevejen 21 | 68:27 | 169 | 00:47 | 14:44 |
| IO035 | Tinglev, Grænsevejen 15 | 102:00 | 181 | 01:02 | 22:09 |
| IO036 | Tinglev, Grænsevejen 13 | 111:25 | 188 | 01:16 | 23:31 |

4.1.3 Total load

Table 4.5: Results of shadow flicker caused by the total load at the immission locations in Schleswig-Holstein

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungsdauer |
|-------|------------------------|--|-------|-------|---------------------------------------|
| | | / h/a | / d/a | / h/d | / h/a |
| IO001 | Erlenweg 4, Böxlund | 110:54 | 228 | 01:03 | 42:24 |
| IO002 | Erlenweg 5, Böxlund | 76:44 | 227 | 00:51 | 30:28 |
| IO003 | Grenzuweg 3, Böxlund | 140:50 | 207 | 01:39 | 61:09 |
| IO004 | Grenzstraße 1, Böxlund | 65:22 | 209 | 00:36 | 26:40 |
| IO005 | Weesbydamm 14, Weesby | 51:18 | 193 | 00:32 | 17:02 |
| IO006 | Kjerweg 4, Weesby | 86:25 | 221 | 00:39 | 25:00 |
| IO007 | Kjerweg 3, Weesby | 80:09 | 191 | 00:41 | 24:06 |

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungsdauer |
|-------|-----------------------|--|-------------------|-------|---------------------------------------|
| | | / h/a | / d/a | / h/d | / h/a |
| | | IO008 | Kjerweg 1, Weesby | 86:48 | 190 |
| IO009 | Bögelhus 2, Weesby | 126:56 | 219 | 01:14 | 50:41 |
| IO010 | Bögelhus 2a, Weesby | 140:45 | 223 | 01:20 | 56:27 |
| IO011 | Bögelhus 4, Weesby | 194:51 | 355 | 01:13 | 68:55 |
| IO012 | Kjerweg 2, Weesby | 51:09 | 175 | 00:39 | 15:44 |
| IO013 | Grensauweg 4, Böxlund | 136:55 | 190 | 01:23 | 59:01 |
| IO014 | Grensauweg 2, Böxlund | 111:55 | 191 | 01:15 | 46:46 |
| IO015 | Bögelhus 1, Weesby | 154:06 | 228 | 01:20 | 62:04 |
| IO016 | Bögelhus 3, Weesby | 59:20 | 159 | 00:50 | 13:34 |
| IO017 | Bögelhus 12, Weesby | 54:43 | 148 | 00:43 | 12:02 |
| IO018 | Bögelhus 10, Weesby | 73:24 | 162 | 00:53 | 16:18 |
| IO019 | Bögelhus 8, Weesby | 108:35 | 217 | 01:04 | 26:12 |
| IO020 | Bögelhus 6, Weesby | 141:40 | 278 | 01:05 | 42:55 |
| IO021 | Betonstraße 2, Weesby | 143:03 | 230 | 01:10 | 56:59 |

Table 4.6: Results of shadow flicker caused by the existing load at the immission locations in Denmark

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungsdauer |
|-------|-------------------------|--|----------------------|--------|---------------------------------------|
| | | / h/a | / d/a | / h/d | / h/a |
| | | IO022 | Tinglev, Bøllåvej 17 | 164:49 | 166 |
| IO023 | Tinglev, Bøllåvej 15 | 124:54 | 186 | 01:39 | 25:43 |
| IO024 | Tinglev, Bøllåvej 13 | 84:06 | 185 | 00:54 | 18:28 |
| IO025 | Tinglev, Bøllåvej 11 | 119:02 | 177 | 01:52 | 23:30 |
| IO026 | Tinglev, Bøllåvej 9 | 117:16 | 178 | 01:33 | 23:42 |
| IO027 | Tinglev, Bøllåvej 7 | 89:17 | 158 | 01:03 | 18:14 |
| IO028 | Tinglev, Bøllåvej 5 | 64:08 | 138 | 00:53 | 13:29 |
| IO029 | Tinglev, Bøllåvej 3 | 57:40 | 150 | 00:39 | 12:36 |
| IO030 | Tinglev, Bøllåvej 1 | 62:26 | 165 | 01:02 | 12:58 |
| IO031 | Tinglev, Grænsevejen 31 | 84:10 | 161 | 01:02 | 17:24 |
| IO032 | Tinglev, Grænsevejen 28 | 77:04 | 169 | 01:04 | 15:45 |

| Bez. | Adresse | Astronomisch maximal mögliche Beschattungsdauer | | | met. Wahrsch. Beschattungs- dauer |
|-------|-------------------------|--|-------|-------|--|
| | | / h/a | / d/a | / h/d | / h/a |
| IO033 | Tinglev, Grænsevejen 22 | 72:04 | 147 | 00:54 | 14:57 |
| IO034 | Tinglev, Grænsevejen 21 | 68:27 | 169 | 00:47 | 14:44 |
| IO035 | Tinglev, Grænsevejen 15 | 102:00 | 181 | 01:02 | 22:09 |
| IO036 | Tinglev, Grænsevejen 13 | 111:25 | 188 | 01:16 | 23:31 |

4.2 Shadow maps of the additional load and total load

The **annual and daily shadow maps** caused by the wind turbines of the **additional load**, as explained in Section 1.2.4, are shown for the immission locations in **Schleswig-Holstein** in **Figure 4.1** and **Figure 4.2**, and for the immission locations in **Denmark** in **Figure 4.3** and **Figure 4.4**.

The corresponding **annual and daily shadow maps** for the **total load** are shown for the immission locations in **Schleswig-Holstein** in **Figure 4.5** and **Figure 4.6**, and for the immission locations in **Denmark** in **Figure 4.7** and **Figure 4.8**.

In this case, the shadow maps refer to an elevation level in the surroundings of the wind turbines determined on the basis of **orographic data**.

4.2.1 Additional load – immission locations in Schleswig-Holstein

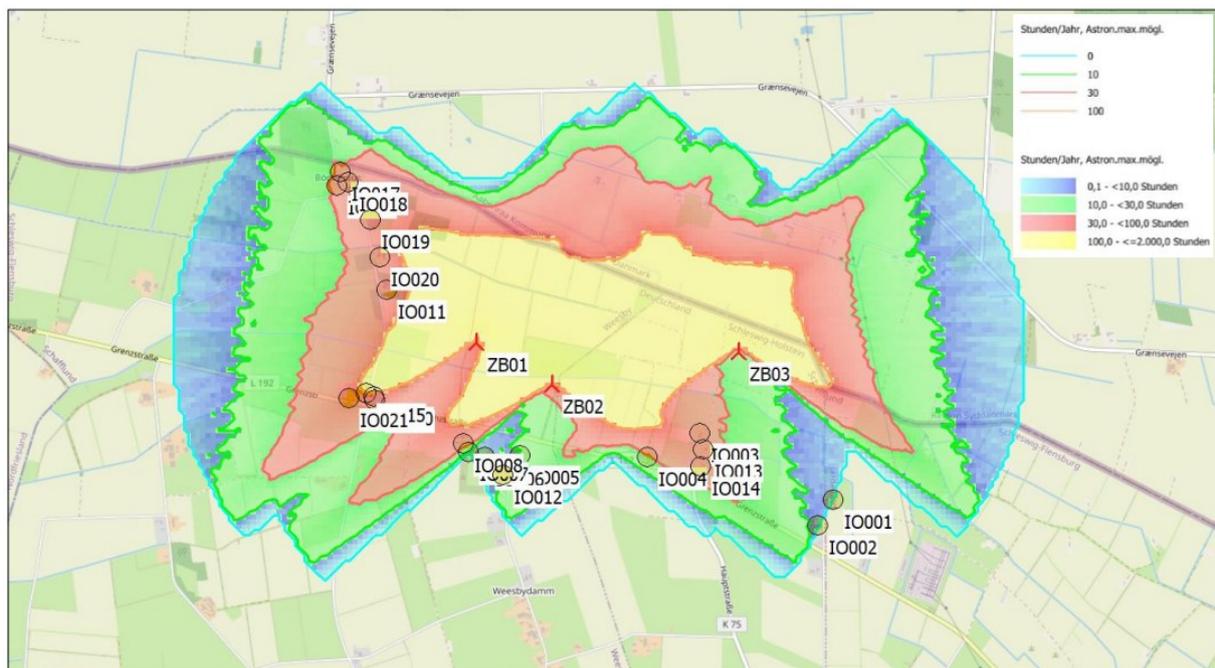


Figure 4.1: Shadow map of the maximum astronomical annual shadow duration caused by the wind turbines of the additional load (immission locations Schleswig-Holstein)

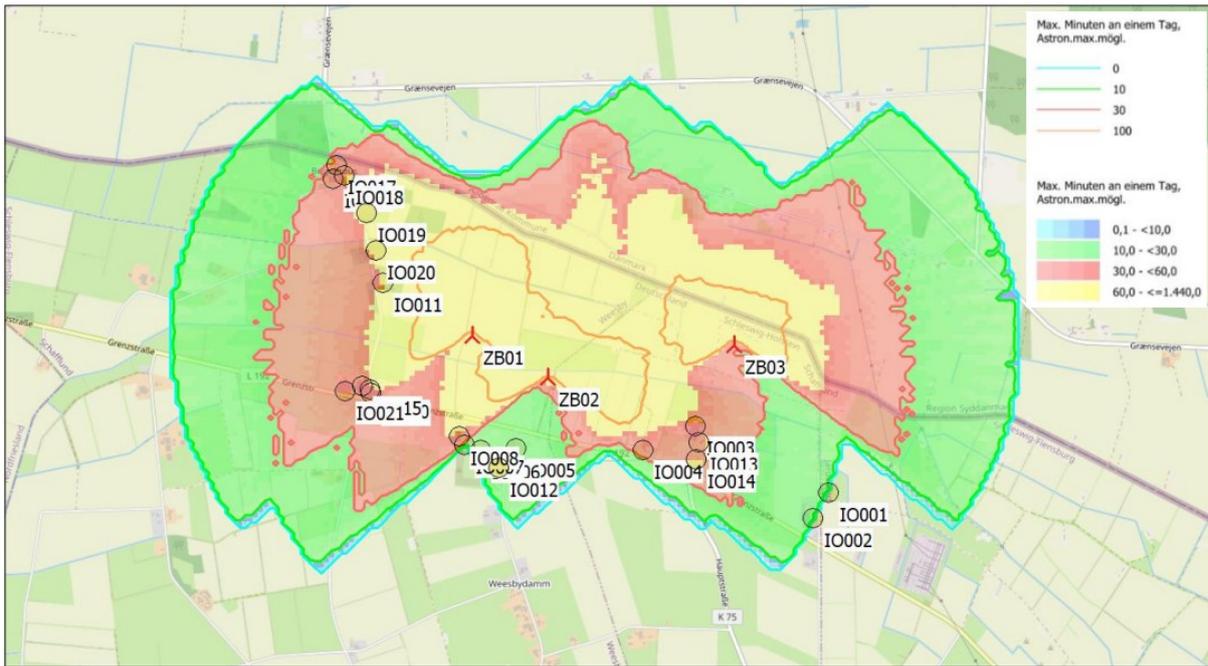


Figure 4.2: Shadow map of the maximum astronomical daily shadow duration caused by the wind turbines of the additional load (immission locations Schleswig-Holstein)

4.2.2 Additional load – immission locations in Denmark

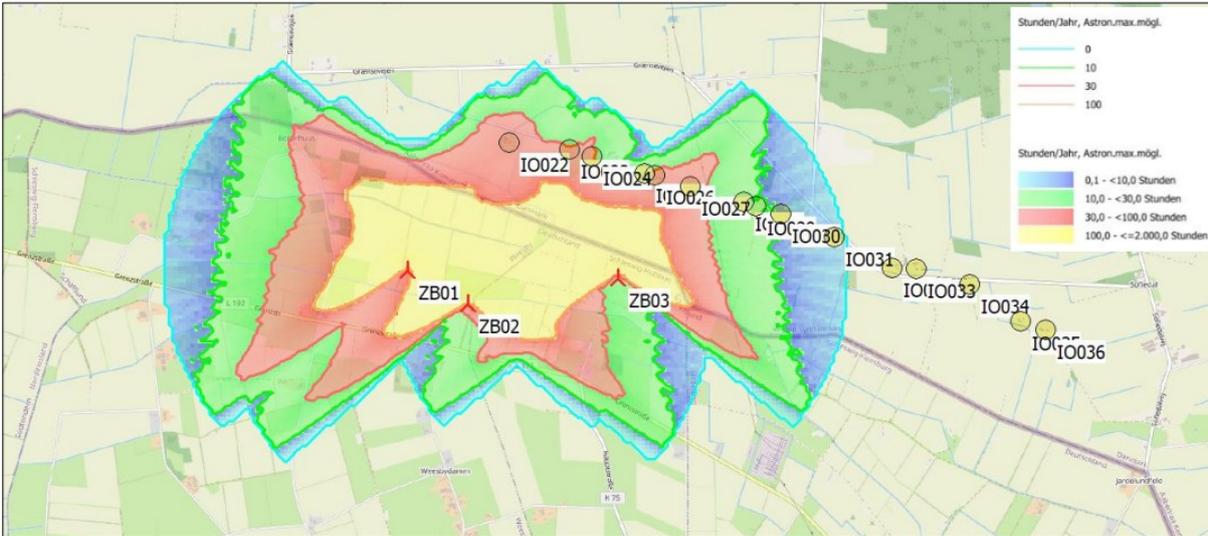


Figure 4.3: Shadow map of the maximum astronomical annual shadow duration caused by the wind turbines of the additional load (immission locations Denmark)

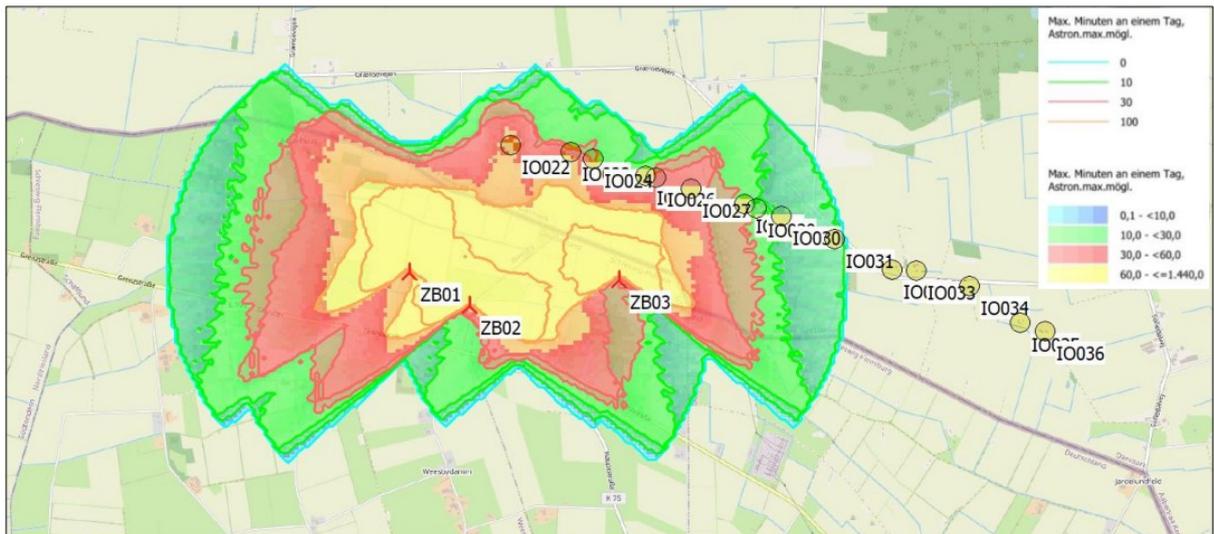


Figure 4.4: Shadow map of the maximum astronomical daily shadow duration caused by the wind turbines of the additional load (immission locations Denmark)

4.2.3 Total load – immission locations in Schleswig-Holstein

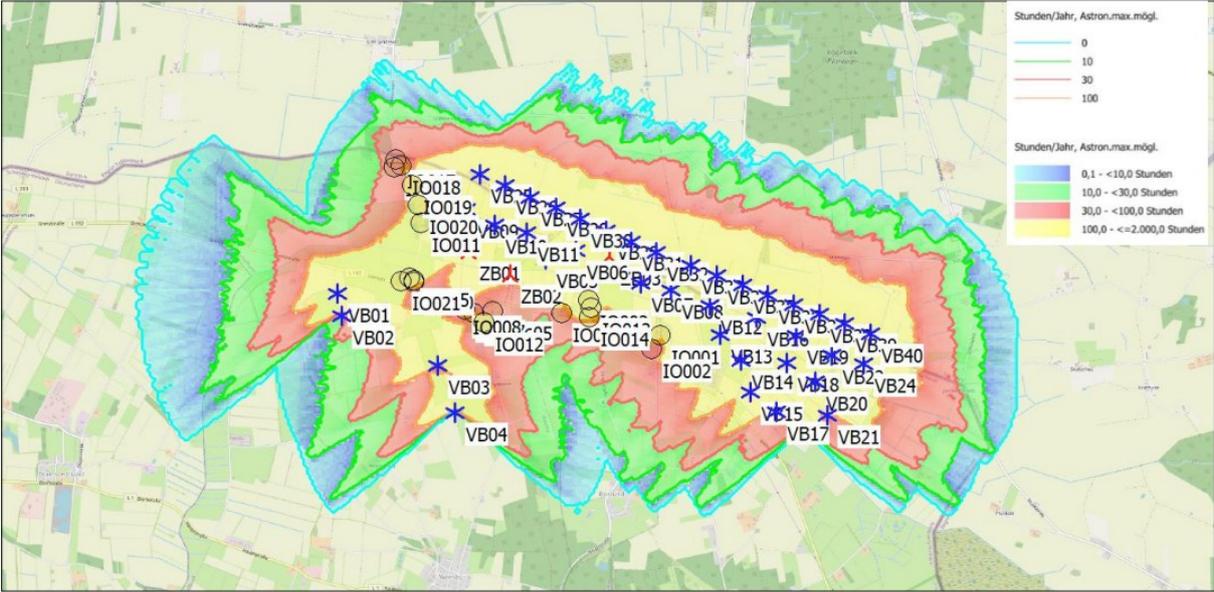


Figure 4.5: Shadow map of the maximum astronomical annual shadow duration caused by the wind turbines of the total load (immission locations Schleswig-Holstein)

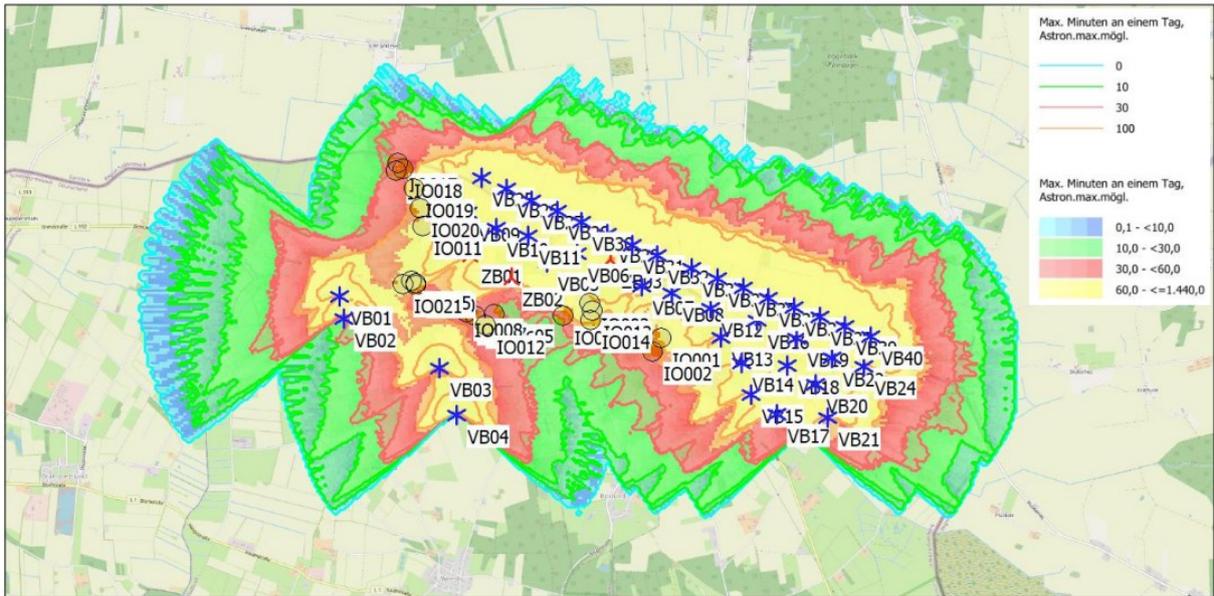


Figure 4.6: Shadow map of the maximum astronomical daily shadow duration caused by the wind turbines of the total load (immission locations Schleswig-Holstein)

4.2.4 Total load – immission locations in Denmark

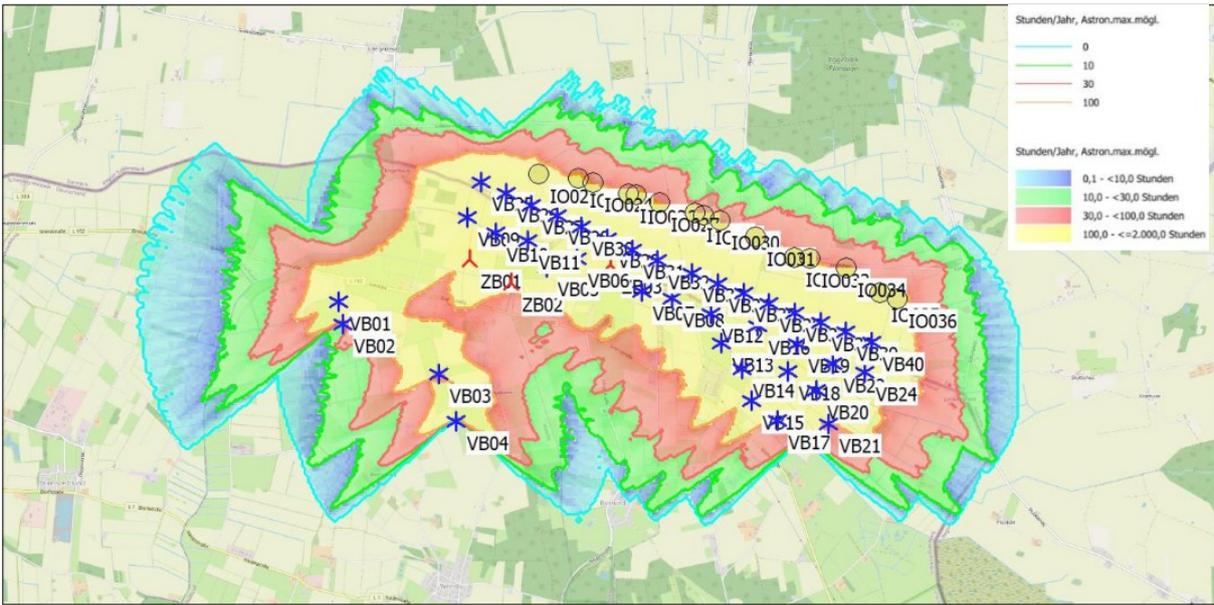


Figure 4.7: Shadow map of the maximum astronomical annual shadow duration caused by the wind turbines of the total load (immission locations Denmark)

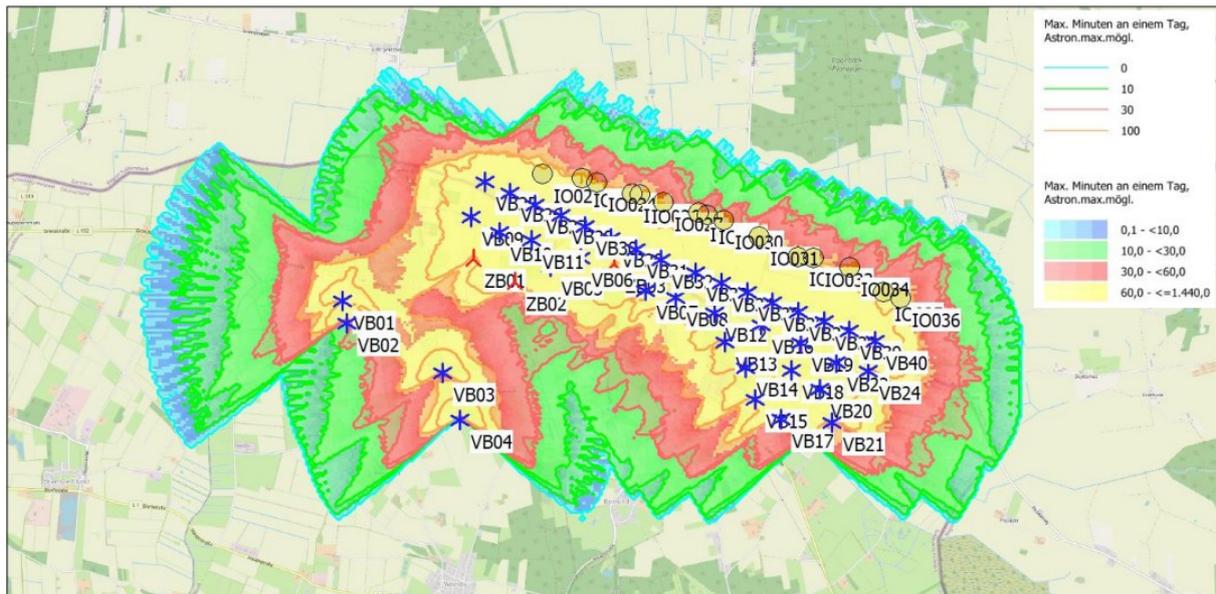


Figure 4.8: Shadow map of the maximum astronomical daily shadow duration caused by the wind turbines of the total load (immission locations Denmark)

5 Deviations

The determination of shadow flicker from wind turbines was carried out **without deviations** and in accordance with /1/.

6 Summary

WIND-consult GmbH was commissioned by **BWP BB Wind GmbH & Co. KG** to carry out an assessment of shadow flicker caused by wind turbines at the site **Böxlund**.

For the planned wind turbines, the shadow impact on **21 immission locations in Schleswig-Holstein** and **15 immission locations in Denmark** was investigated in coordination with the client with regard to the parameters and coordinates of the wind turbines. The annual and daily shadow periods, the accumulated and maximum daily **astronomical shadow duration**, as well as the mean probable **meteorological shadow duration**, were determined in accordance with the wind farm configuration.

The calculations result in a maximum astronomical total shadow duration of approximately **195 h/a** for the immission locations in Schleswig-Holstein and a maximum meteorological total shadow duration of approximately **69 h/a**. These maximum values were determined at **immission location IO11**.

For the immission locations in Denmark, the corresponding values are approximately **164 h/a (astronomical)** and approximately **33 h/a (meteorological)**. These values were determined at **immission location IO022**.

The maximum daily astronomical shadow duration amounts to approximately **1.7 h/d** in Schleswig-Holstein (IO003) and approximately **2.2 h/d** in Denmark (IO022).

The guideline value for the maximum annual astronomical total shadow duration of **30 h/a** and for the maximum daily astronomical total shadow duration of **30 min/d** is not exceeded at any immission location within the area of influence or shadowing range of the wind turbines of the **additional load**.

Due to the above-mentioned predicted exceedances of more than **30 h/a**, technical measures must be implemented to limit the probable (meteorological) shadow duration to a maximum of **8 h/a** and **30 min/d**. It must be ensured that the maximum permissible shadow durations are complied with or undercut at all relevant immission locations.

Compliance with or reduction below the guideline values can in principle be achieved by installing a suitable **automatic shut-down device** at the respective wind turbine. The necessary astronomically determined shut-down times can be taken from the **shadow calendar** of the relevant immission locations after selecting the wind turbines to be shut down. For reasons of space, this calendar is not included here but can be provided upon request.

The statements made apply to the assumptions and parameters on which the model is based. The values of the probable shadow duration are based on long-term monthly climate data from **Schleswig** (distance approx. 41 km from the wind farm centre) and are to be regarded as statistical values.

The present investigation was carried out by **WIND-consult GmbH** impartially and to the best of its knowledge and belief in accordance with the current state of science and technology.

7 Literature

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/2/ DEUTSCHES INSTITUT FÜR NORMUNG E.V.(DIN): TAGESLICHT IN INNENRÄUMEN.DIN5034 FEBRUAR 1985.BERLIN (D):BEUTHVERLAG GMBH, 1985

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/5/ WIND-CONSULT GMBH (WICO): QMP 12: ERMITTLUNG DES SCHATTENWURFS VON WEA AUF FLÄCHEN. QM-PRÜFANWEISUNG UNVERÖFFENTLICHT. BARGESHAGEN (D), AKT. FASSUNG

/6/ WINDPRO DOCUMENTATION:
[HTTPS://HELP.EMD.DK/MEDIAWIKI/INDEX.PHP/FILE:DE_UMWELT_SHAD_\(57.8\).PNG](https://help.emd.dk/mediawiki/index.php/File:DE_UMWELT_SHAD_(57.8).PNG),
ZUGRIFF:31.05.2024

/7/ WINDPRO DOCUMENTATION:
[HTTPS://HELP.EMD.DK/MEDIAWIKI/INDEX.PHP/SCHATTENREICHWEITE_HINTERGRUND](https://help.emd.dk/mediawiki/index.php/Schattenreichweite_Hintergrund),
ZUGRIFF:31.05.2024

/8/ STAATLICHES AMT FÜR LANDWIRTSCHAFT UND UMWELT MITTLERERS MECKLENBURG: IMMISSIONSSCHUTZRECHTLICHER BESCHEID : GENEHMIGUNG NACH §4 BIMSCHG : GESCHÄFTSZEICHEN: 571-1.6.2VG-227. ROSTOCK (D), 27.09.2023

/9/ INGENIEURBÜRO FÜR AKUSTIK BUSCH GMBH: PROGNOSE DER GERÄUSCHIMMISSION, GEPLANTE WINFARM IN DEN GEMEINDEN BÖGELHUUS, BÖXLUND UND JARDELUND, BERICHT NR. 233712GBD03, 24. OKTOBER 2012, KRONSHAGEN

8. attachments

8 Anhänge

8.1 SHADOW-Hauptergebnis Zusatzbelastung – Immissionsorte S-H

Projekt:
018FB123-03

SHADOW - Hauptergebnis
Berechnung: Zusatzbelastung_SH
Annahmen für Schattenwurfberechnung
 Beschattungsbereich der WEA
 Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
 Siehe WEA-Tabelle

Minimale relevante Sonnenhöhe über Horizont: 3 °
 Tage zwischen Berechnungen: 1 Tag(e)
 Berechnungszeitsprung: 1 Minuten

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
 Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.
 Monatliche Aggregation der met. wahrsch. Reduzierung
 Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
 DHM: Höhenraster-Objekt: SchleswigHolstein_Elevation_Model_5m_grid_resol
 Rasterauflösung: 1,0 m
 Topografischer Schatten berücksichtigt

Alle Koordinatenangaben in:
 UTM (north)-ETRS89 Zone: 32

WEA

| Ost | Nord | Z | Beschreibung | WEA-Typ | | Nennleistung [kW] | Rotordurchmesser [m] | NH [m] | Schattendaten | |
|-----|---------|-----------|--------------|---------|-------------------------------|-------------------|----------------------|--------|-----------------------|---------------|
| | | | | Aktuell | Hersteller Typ | | | | Beschatt.-Bereich [m] | U/min [U/min] |
| 1 | 509.965 | 6.079.600 | 17,6 ZB01 | Ja | ENERCON E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 |
| 2 | 510.417 | 6.079.349 | 18,6 ZB02 | Ja | ENERCON E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 |
| 3 | 511.520 | 6.079.549 | 19,5 ZB03 | Ja | ENERCON E-138 EP3 E3-4.260 | 4.260 | 138,3 | 111,0 | 1.690 | 11,1 |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite [m] | Höhe [m] | Höhe ü.Gr. [m] | Neigung des Fensters [°] | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. [m] |
|-------|------------------------|---------|-----------|------|------------|----------|----------------|--------------------------|---------------------|---------------------------|
| IO001 | Erlenweg 4, Böxlund | 512.084 | 6.078.670 | 23,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO002 | Erlenweg 5, Böxlund | 511.990 | 6.078.515 | 22,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO003 | Grenzausweg 3, Böxlund | 511.291 | 6.079.064 | 20,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO004 | Grenzstraße 1, Böxlund | 510.984 | 6.078.916 | 20,8 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO005 | Weesbydamm 14, Weesby | 510.226 | 6.078.926 | 20,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO006 | Kjerweg 4, Weesby | 510.018 | 6.078.918 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO007 | Kjerweg 3, Weesby | 509.917 | 6.078.949 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO008 | Kjerweg 1, Weesby | 509.890 | 6.078.996 | 19,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO009 | Bögelhus 2, Weesby | 509.362 | 6.079.254 | 17,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO010 | Bögelhus 2a, Weesby | 509.354 | 6.079.278 | 17,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO011 | Bögelhus 4, Weesby | 509.431 | 6.079.917 | 17,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO012 | Kjerweg 2, Weesby | 510.126 | 6.078.810 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO013 | Grenzausweg 4, Böxlund | 511.314 | 6.078.970 | 21,0 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO014 | Grenzausweg 2, Böxlund | 511.297 | 6.078.865 | 21,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO015 | Bögelhus 1, Weesby | 509.313 | 6.079.300 | 17,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO016 | Bögelhus 3, Weesby | 509.137 | 6.080.535 | 16,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO017 | Bögelhus 12, Weesby | 509.155 | 6.080.618 | 16,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO018 | Bögelhus 10, Weesby | 509.208 | 6.080.554 | 16,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO019 | Bögelhus 8, Weesby | 509.338 | 6.080.334 | 17,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO020 | Bögelhus 6, Weesby | 509.394 | 6.080.108 | 18,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO021 | Betonstraße 2, Weesby | 509.213 | 6.079.268 | 17,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |

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 Berechnet:
 03.03.2026 13:00/4.2.285

(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Maßstab 1:40.000

▲ Neue WEA ● Schattenrezeptor

windPRO 4.2.285 | EMD International A/S, Tel. +45 96 35 44 44, www.emd.dk, windpro@emd.dk

03.03.2026 16:07 / 1

Projekt:
018FB123-03

Lizenzierter Anwender:
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03.03.2026 13:00/4.2.285

SHADOW - Hauptergebnis

Berechnung: Zusatzbelastung_SH

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | | met. wahrsch. Beschattungsdauer | |
|-------|------------------------|--------------------------------------|----------------------------|--------------------------------|---------------------------------|--------------------------------|
| | | Stunden/Jahr [h/a] | Schattentage/Jahr [d/a] | Max.Schattendauer/Tag [h/d] | Stunden/Jahr [h/a] | Max.Schattendauer/Tag [h/d] |
| IO001 | Erlenweg 4, Böxlund | 0:00 | 0 | 0:00 | 0:00 | 0:00 |
| IO002 | Erlenweg 5, Böxlund | 8:50 | 40 | 0:20 | 4:02 | 0:20 |
| IO003 | Grenzaueweg 3, Böxlund | 43:40 | 74 | 0:54 | 20:01 | 0:54 |
| IO004 | Grenzstraße 1, Böxlund | 27:53 | 65 | 0:36 | 11:30 | 0:36 |
| IO005 | Weesbydamm 14, Weesby | 10:57 | 42 | 0:23 | 5:02 | 0:23 |
| IO006 | Kjerweg 4, Weesby | 6:35 | 31 | 0:20 | 3:04 | 0:20 |
| IO007 | Kjerweg 3, Weesby | 7:34 | 24 | 0:24 | 2:59 | 0:24 |
| IO008 | Kjerweg 1, Weesby | 41:10 | 60 | 0:52 | 17:00 | 0:52 |
| IO009 | Bögelhus 2, Weesby | 82:45 | 128 | 0:56 | 34:45 | 0:56 |
| IO010 | Bögelhus 2a, Weesby | 91:41 | 134 | 0:57 | 38:39 | 0:57 |
| IO011 | Bögelhus 4, Weesby | 61:31 | 81 | 0:59 | 17:31 | 0:59 |
| IO012 | Kjerweg 2, Weesby | 9:25 | 41 | 0:21 | 4:18 | 0:21 |
| IO013 | Grenzaueweg 4, Böxlund | 46:22 | 97 | 0:45 | 20:54 | 0:45 |
| IO014 | Grenzaueweg 2, Böxlund | 48:18 | 87 | 0:39 | 20:39 | 0:39 |
| IO015 | Bögelhus 1, Weesby | 98:47 | 145 | 0:55 | 42:01 | 0:55 |
| IO016 | Bögelhus 3, Weesby | 38:38 | 85 | 0:50 | 7:39 | 0:50 |
| IO017 | Bögelhus 12, Weesby | 31:33 | 73 | 0:31 | 5:45 | 0:31 |
| IO018 | Bögelhus 10, Weesby | 46:37 | 79 | 0:53 | 8:50 | 0:53 |
| IO019 | Bögelhus 8, Weesby | 62:51 | 97 | 1:04 | 12:51 | 1:04 |
| IO020 | Bögelhus 6, Weesby | 57:50 | 79 | 1:05 | 14:34 | 1:05 |
| IO021 | Betonstraße 2, Weesby | 85:19 | 145 | 0:47 | 36:41 | 0:47 |

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal [h/a] | Erwartet [h/a] |
|-----|------|------------------|-------------------|
| 1 | ZB01 | 312:00 | 106:24 |
| 2 | ZB02 | 234:02 | 90:45 |
| 3 | ZB03 | 19:07 | 8:48 |

Summen in Rezeptortabelle und WEA-Tabelle können sich unterscheiden, da eine WEA gleichzeitig an zwei oder mehr Rezeptoren Beschattung verursachen kann und/oder ein Rezeptor gleichzeitig von zwei oder mehr WEA beschattet werden kann.

Die Berechnung der Gesamtsumme für einen Rezeptor arbeitet mit einer gemittelten Richtungskorrektur für alle WEA, die an einem gegebenen Tag zur Beschattung beitragen. Wenn der Schattenwurf durch mehrere WEA an einem Tag nicht gleichzeitig stattfindet, kann die so ermittelte Summe geringfügig von der Summe der Beschattungszeiten abweichen, die für die individuellen WEA berechnet werden.

8.2 SHADOW-Hauptergebnis Zusatzbelastung – Immissionsorte DK

Projekt:
018FB123-03

SHADOW - Hauptergebnis
Berechnung: Zusatzbelastung_DK
Annahmen für Schattenwurfberechnung
 Beschattungsbereich der WEA
 Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
 Siehe WEA-Tabelle

Minimale relevante Sonnenhöhe über Horizont: 3 °
 Tage zwischen Berechnungen: 1 Tag(e)
 Berechnungszeitsprung: 1 Minuten

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
 Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.
 Monatliche Aggregation der met. wahrsch. Reduzierung
 Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
 DHM: Höhenraster-Objekt: SchleswigHolstein_Elevation_Model_5m_grid_resol
 Rasterauflösung: 1,0 m
 Topografischer Schatten berücksichtigt

Alle Koordinatenangaben in:
 UTM (north)-ETRS89 Zone: 32

WEA

| | Ost | | Z | WEA-Typ | | | Hersteller | Typ | Nennleistung [kW] | Rotordurchmesser [m] | Schattendaten | | |
|---|---------|-----------|------|--------------|---------|---------|-----------------------|-------|-------------------|----------------------|---------------|------|-----------------------|
| | | | | Beschreibung | Aktuell | | | | | | | NH | Beschatt.-Bereich [m] |
| 1 | 509.965 | 6.079.600 | 17,6 | ZB01 | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 | |
| 2 | 510.417 | 6.079.349 | 18,6 | ZB02 | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 | |
| 3 | 511.520 | 6.079.549 | 19,5 | ZB03 | Ja | ENERCON | E-138 EP3 E3-4.260 | 4.260 | 138,3 | 111,0 | 1.690 | 11,1 | |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite | Höhe | Höhe ü.Gr. | Neigung des Fensters | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. |
|-------|-------------------------|---------|-----------|------|--------|------|------------|----------------------|---------------------|-----------------------|
| | | [m] | [m] | [m] | [m] | [m] | [m] | [°] | | [m] |
| IO022 | Tinglev, Bøllåvej 17 | 510.716 | 6.080.549 | 19,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO023 | Tinglev, Bøllåvej 15 | 511.160 | 6.080.498 | 19,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO024 | Tinglev, Bøllåvej 13 | 511.330 | 6.080.446 | 21,0 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO025 | Tinglev, Bøllåvej 11 | 511.716 | 6.080.325 | 20,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO026 | Tinglev, Bøllåvej 9 | 511.797 | 6.080.312 | 20,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO027 | Tinglev, Bøllåvej 7 | 512.060 | 6.080.230 | 20,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO028 | Tinglev, Bøllåvej 5 | 512.451 | 6.080.117 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO029 | Tinglev, Bøllåvej 3 | 512.547 | 6.080.083 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO030 | Tinglev, Bøllåvej 1 | 512.725 | 6.080.029 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO031 | Tinglev, Grænsevejen 31 | 513.125 | 6.079.855 | 22,9 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO032 | Tinglev, Grænsevejen 28 | 513.550 | 6.079.631 | 23,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO033 | Tinglev, Grænsevejen 22 | 513.731 | 6.079.624 | 23,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO034 | Tinglev, Grænsevejen 21 | 514.125 | 6.079.508 | 23,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO035 | Tinglev, Grænsevejen 15 | 514.504 | 6.079.236 | 24,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO036 | Tinglev, Grænsevejen 13 | 514.688 | 6.079.173 | 24,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |

Berechnungsergebnisse

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | | met. wahrsch. Beschattungsdauer | |
|-------|----------------------|--------------------------------------|-------------------------|-----------------------------|---------------------------------|--|
| | | Stunden/Jahr [h/a] | Schattentage/Jahr [d/a] | Max.Schattendauer/Tag [h/d] | Stunden/Jahr [h/a] | |
| IO022 | Tinglev, Bøllåvej 17 | 60:51 | 77 | 0:59 | 11:07 | |
| IO023 | Tinglev, Bøllåvej 15 | 37:00 | 88 | 0:49 | 7:00 | |
| IO024 | Tinglev, Bøllåvej 13 | 32:30 | 101 | 0:28 | 6:39 | |
| IO025 | Tinglev, Bøllåvej 11 | 29:25 | 79 | 0:35 | 5:31 | |
| IO026 | Tinglev, Bøllåvej 9 | 36:44 | 85 | 0:40 | 6:53 | |

(Fortsetzung nächste Seite)...

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Maßstab 1:75.000
 Neue WEA Schattenrezeptor

windPRO 4.2.285 | EMD International A/S, Tel. +45 96 35 44 44, www.emd.dk, windpro@emd.dk

03.03.2026 16:14 / 1

Projekt:
018FB123-03

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03.03.2026 13:17/4.2.285

SHADOW - Hauptergebnis

Berechnung: Zusatzbelastung_DK

...(Fortsetzung von vorheriger Seite)

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | | met. wahrsch. Beschattungsdauer | |
|-------|-------------------------|--------------------------------------|----------------------------|--------------------------------|---------------------------------|--|
| | | Stunden/Jahr [h/a] | Schattentage/Jahr [d/a] | Max.Schattendauer/Tag [h/d] | Stunden/Jahr [h/a] | |
| IO027 | Tinglev, Bøllåvej 7 | 49:10 | 93 | 0:39 | 9:31 | |
| IO028 | Tinglev, Bøllåvej 5 | 14:47 | 41 | 0:30 | 4:05 | |
| IO029 | Tinglev, Bøllåvej 3 | 12:11 | 37 | 0:28 | 3:26 | |
| IO030 | Tinglev, Bøllåvej 1 | 8:40 | 31 | 0:25 | 2:27 | |
| IO031 | Tinglev, Grænsevejen 31 | 4:07 | 21 | 0:18 | 1:15 | |
| IO032 | Tinglev, Grænsevejen 28 | 0:00 | 0 | 0:00 | 0:00 | |
| IO033 | Tinglev, Grænsevejen 22 | 0:00 | 0 | 0:00 | 0:00 | |
| IO034 | Tinglev, Grænsevejen 21 | 0:00 | 0 | 0:00 | 0:00 | |
| IO035 | Tinglev, Grænsevejen 15 | 0:00 | 0 | 0:00 | 0:00 | |
| IO036 | Tinglev, Grænsevejen 13 | 0:00 | 0 | 0:00 | 0:00 | |

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal | Erwartet |
|-----|------|---------|----------|
| | | [h/a] | [h/a] |
| 1 | ZB01 | 52:43 | 11:01 |
| 2 | ZB02 | 56:06 | 10:46 |
| 3 | ZB03 | 160:26 | 32:28 |

Summen in Rezeptortabelle und WEA-Tabelle können sich unterscheiden, da eine WEA gleichzeitig an zwei oder mehr Rezeptoren Beschattung verursachen kann und/oder ein Rezeptor gleichzeitig von zwei oder mehr WEA beschattet werden kann.

Die Berechnung der Gesamtsumme für einen Rezeptor arbeitet mit einer gemittelten Richtungskorrektur für alle WEA, die an einem gegebenen Tag zur Beschattung beitragen. Wenn der Schattenwurf durch mehrere WEA an einem Tag nicht gleichzeitig stattfindet, kann die so ermittelte Summe geringfügig von der Summe der Beschattungszeiten abweichen, die für die individuellen WEA berechnet werden.

8.3 SHADOW-Hauptergebnis Vorbelastung – Immissionsorte S-H

Projekt:
018FB123-03

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Bericht:
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SHADOW - Hauptergebnis

Berechnung: Vorbelastung_SH
Annahmen für Schattenwurfberechnung

Beschattungsbereich der WEA
Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
Siehe WEA-Tabelle

Minimale relevante Sonnenhöhe über Horizont 3 °
Tage zwischen Berechnungen 1 Tag(e)
Berechnungszeitsprung 1 Minuten

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.
Monatliche Aggregation der met. wahrsch. Reduzierung
Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
DHM: Höhenraster-Objekt: SchleswigHolstein_Elevation_Model_5m_grid_resol
Rasterauflösung: 1,0 m
Topografischer Schatten berücksichtigt

Alle Koordinatenangaben in:
UTM (north)-ETRS89 Zone: 32



WEA

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | NH | Schattendaten | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|-------|-------------------|-------|
| | | | | | Aktuell | Hersteller | Typ | | | | Beschatt.-Bereich | U/min |
| | | | [m] | | | | [kW] | [m] | [m] | [m] | [U/min] | |
| 1 | 508.505 | 6.079.136 | 14,9 | VB01 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 2 | 508.551 | 6.078.885 | 16,2 | VB02 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 3 | 509.612 | 6.078.330 | 18,4 | VB03 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 4 | 509.812 | 6.077.810 | 19,1 | VB04 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 5 | 510.806 | 6.079.514 | 18,9 | VB05 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 6 | 511.144 | 6.079.614 | 21,0 | VB06 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 7 | 511.858 | 6.079.246 | 20,7 | VB07 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 8 | 512.196 | 6.079.176 | 20,9 | VB08 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 9 | 509.924 | 6.080.069 | 17,1 | VB09 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 10 | 510.243 | 6.079.899 | 17,5 | VB10 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 11 | 510.596 | 6.079.808 | 18,5 | VB11 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 12 | 512.631 | 6.079.003 | 20,8 | VB12 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 13 | 512.736 | 6.078.683 | 21,1 | VB13 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 14 | 512.978 | 6.078.401 | 21,5 | VB14 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 15 | 513.084 | 6.078.045 | 22,8 | VB15 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 16 | 513.153 | 6.078.872 | 21,4 | VB16 | Nein | REpower | MM 92-2.000 | 2.000 | 92,5 | 100,0 | 1.625 | 15,0 |
| 17 | 513.375 | 6.077.826 | 24,2 | VB17 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 18 | 513.481 | 6.078.361 | 22,8 | VB18 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 19 | 513.587 | 6.078.671 | 22,6 | VB19 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 20 | 513.796 | 6.078.158 | 23,9 | VB20 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 21 | 513.934 | 6.077.779 | 24,1 | VB21 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 22 | 513.971 | 6.078.453 | 23,4 | VB22 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 23 | 514.333 | 6.078.361 | 23,8 | VB23 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 24 | 510.077 | 6.080.455 | 17,8 | VB24 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 25 | 510.356 | 6.080.332 | 17,9 | VB25 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 26 | 510.636 | 6.080.208 | 18,7 | VB26 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 27 | 510.917 | 6.080.087 | 18,8 | VB27 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 28 | 511.477 | 6.079.836 | 20,0 | VB28 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 29 | 511.196 | 6.079.959 | 20,1 | VB29 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 30 | 511.757 | 6.079.713 | 20,0 | VB30 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 31 | 512.035 | 6.079.588 | 20,6 | VB31 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 32 | 512.421 | 6.079.447 | 20,6 | VB32 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 33 | 512.705 | 6.079.340 | 21,3 | VB33 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 34 | 512.988 | 6.079.234 | 21,0 | VB34 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 35 | 513.272 | 6.079.126 | 22,2 | VB35 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

(Fortsetzung nächste Seite)...

Projekt:
018FB123-03

Lizenziertes Anwender:
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Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
04.03.2026 09:29/4.2.285

SHADOW - Hauptergebnis

Berechnung: Vorbelastung_SH

...(Fortsetzung von vorheriger Seite)

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | NH | Schattendaten | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|------|-------------------|---------|
| | | | | | Aktuell | Hersteller | Typ | | | | Beschatt.-Bereich | U/min |
| | | | [m] | | | | | | | | [m] | [U/min] |
| 36 | 513.556 | 6.079.019 | 22,4 | VB37 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 37 | 513.839 | 6.078.912 | 23,2 | VB38 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 38 | 514.123 | 6.078.805 | 23,4 | VB39 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 39 | 514.405 | 6.078.698 | 23,5 | VB40 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite | Höhe | Höhe ü.Gr. | Neigung des Fensters | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. |
|-------|------------------------|---------|-----------|------|--------|------|------------|----------------------|---------------------|-----------------------|
| | | | | | [m] | [m] | [m] | [°] | | [m] |
| IO001 | Erlenweg 4, Böxlund | 512.084 | 6.078.670 | 23,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO002 | Erlenweg 5, Böxlund | 511.990 | 6.078.515 | 22,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO003 | Grenzaueg 3, Böxlund | 511.291 | 6.079.064 | 20,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO004 | Grenzstraße 1, Böxlund | 510.984 | 6.078.916 | 20,8 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO005 | Weesbydamm 14, Weesby | 510.226 | 6.078.926 | 20,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO006 | Kjerweg 4, Weesby | 510.018 | 6.078.918 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO007 | Kjerweg 3, Weesby | 509.917 | 6.078.949 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO008 | Kjerweg 1, Weesby | 509.890 | 6.078.996 | 19,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO009 | Bögelhus 2, Weesby | 509.362 | 6.079.254 | 17,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO010 | Bögelhus 2a, Weesby | 509.354 | 6.079.278 | 17,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO011 | Bögelhus 4, Weesby | 509.431 | 6.079.917 | 17,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO012 | Kjerweg 2, Weesby | 510.126 | 6.078.810 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO013 | Grenzaueg 4, Böxlund | 511.314 | 6.078.970 | 21,0 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO014 | Grenzaueg 2, Böxlund | 511.297 | 6.078.865 | 21,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO015 | Bögelhus 1, Weesby | 509.313 | 6.079.300 | 17,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO016 | Bögelhus 3, Weesby | 509.137 | 6.080.535 | 16,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO017 | Bögelhus 12, Weesby | 509.155 | 6.080.618 | 16,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO018 | Bögelhus 10, Weesby | 509.208 | 6.080.554 | 16,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO019 | Bögelhus 8, Weesby | 509.338 | 6.080.334 | 17,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO020 | Bögelhus 6, Weesby | 509.394 | 6.080.108 | 18,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO021 | Betonstraße 2, Weesby | 509.213 | 6.079.268 | 17,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | | met. wahrsch. Beschattungsdauer | |
|-------|------------------------|--------------------------------------|-------------------|-----------------------|---------------------------------|--------------|
| | | Stunden/Jahr | Schattentage/Jahr | Max.Schattendauer/Tag | Stunden/Jahr | Stunden/Jahr |
| | | [h/a] | [d/a] | [h/d] | [h/a] | [h/a] |
| IO001 | Erlenweg 4, Böxlund | 110:54 | 228 | 1:03 | 42:24 | 42:24 |
| IO002 | Erlenweg 5, Böxlund | 67:54 | 201 | 0:51 | 26:25 | 26:25 |
| IO003 | Grenzaueg 3, Böxlund | 97:10 | 207 | 0:46 | 41:07 | 41:07 |
| IO004 | Grenzstraße 1, Böxlund | 37:29 | 164 | 0:29 | 15:09 | 15:09 |
| IO005 | Weesbydamm 14, Weesby | 40:21 | 151 | 0:32 | 11:59 | 11:59 |
| IO006 | Kjerweg 4, Weesby | 79:50 | 190 | 0:39 | 21:55 | 21:55 |
| IO007 | Kjerweg 3, Weesby | 77:02 | 191 | 0:41 | 22:52 | 22:52 |
| IO008 | Kjerweg 1, Weesby | 63:18 | 190 | 0:37 | 20:02 | 20:02 |
| IO009 | Bögelhus 2, Weesby | 49:09 | 173 | 0:27 | 17:59 | 17:59 |
| IO010 | Bögelhus 2a, Weesby | 54:09 | 182 | 0:27 | 19:59 | 19:59 |
| IO011 | Bögelhus 4, Weesby | 133:20 | 313 | 1:05 | 51:24 | 51:24 |
| IO012 | Kjerweg 2, Weesby | 41:44 | 134 | 0:39 | 11:25 | 11:25 |
| IO013 | Grenzaueg 4, Böxlund | 90:33 | 190 | 0:46 | 38:07 | 38:07 |
| IO014 | Grenzaueg 2, Böxlund | 63:37 | 179 | 0:39 | 26:06 | 26:06 |
| IO015 | Bögelhus 1, Weesby | 59:18 | 189 | 0:28 | 21:54 | 21:54 |
| IO016 | Bögelhus 3, Weesby | 20:42 | 74 | 0:41 | 5:54 | 5:54 |
| IO017 | Bögelhus 12, Weesby | 23:10 | 75 | 0:43 | 6:16 | 6:16 |
| IO018 | Bögelhus 10, Weesby | 26:47 | 83 | 0:47 | 7:28 | 7:28 |
| IO019 | Bögelhus 8, Weesby | 45:44 | 147 | 0:42 | 13:21 | 13:21 |
| IO020 | Bögelhus 6, Weesby | 83:50 | 227 | 0:57 | 28:21 | 28:21 |
| IO021 | Betonstraße 2, Weesby | 61:41 | 201 | 0:32 | 22:08 | 22:08 |

Projekt:
018FB123-03

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Berechnet:
04.03.2026 09:29/4.2.285

SHADOW - Hauptergebnis

Berechnung: Vorbelastung_SH

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal | Erwartet |
|-----|------|---------|----------|
| | | [h/a] | [h/a] |
| 1 | VB01 | 52:40 | 14:40 |
| 2 | VB02 | 53:28 | 13:50 |
| 3 | VB03 | 130:28 | 25:50 |
| 4 | VB04 | 4:17 | 0:53 |
| 5 | VB05 | 71:00 | 28:33 |
| 6 | VB06 | 37:40 | 15:57 |
| 7 | VB07 | 135:28 | 59:11 |
| 8 | VB08 | 43:08 | 18:55 |
| 9 | VB09 | 181:56 | 68:40 |
| 10 | VB10 | 87:38 | 30:53 |
| 11 | VB11 | 33:29 | 11:43 |
| 12 | VB12 | 44:17 | 17:16 |
| 13 | VB13 | 67:28 | 27:23 |
| 14 | VB14 | 25:54 | 7:58 |
| 15 | VB15 | 17:59 | 5:01 |
| 16 | VB16 | 12:41 | 5:32 |
| 17 | VB17 | 10:27 | 2:50 |
| 18 | VB18 | 9:21 | 2:52 |
| 19 | VB19 | 8:42 | 3:10 |
| 20 | VB20 | 0:00 | 0:00 |
| 21 | VB21 | 0:00 | 0:00 |
| 22 | VB22 | 0:00 | 0:00 |
| 23 | VB24 | 0:00 | 0:00 |
| 24 | VB25 | 23:08 | 9:17 |
| 25 | VB26 | 10:27 | 4:03 |
| 26 | VB27 | 4:22 | 1:39 |
| 27 | VB28 | 0:32 | 0:11 |
| 28 | VB29 | 0:27 | 0:11 |
| 29 | VB30 | 0:31 | 0:12 |
| 30 | VB31 | 0:00 | 0:00 |
| 31 | VB32 | 13:21 | 5:31 |
| 32 | VB33 | 6:43 | 3:03 |
| 33 | VB34 | 2:01 | 0:52 |
| 34 | VB35 | 13:17 | 5:39 |
| 35 | VB36 | 2:38 | 1:12 |
| 36 | VB37 | 0:26 | 0:11 |
| 37 | VB38 | 0:00 | 0:00 |
| 38 | VB39 | 0:00 | 0:00 |
| 39 | VB40 | 0:00 | 0:00 |

Summen in Rezeptortabelle und WEA-Tabelle können sich unterscheiden, da eine WEA gleichzeitig an zwei oder mehr Rezeptoren Beschattung verursachen kann und/oder ein Rezeptor gleichzeitig von zwei oder mehr WEA beschattet werden kann.

Die Berechnung der Gesamtsumme für einen Rezeptor arbeitet mit einer gemittelten Richtungskorrektur für alle WEA, die an einem gegebenen Tag zur Beschattung beitragen. Wenn der Schattenwurf durch mehrere WEA an einem Tag nicht gleichzeitig stattfindet, kann die so ermittelte Summe geringfügig von der Summe der Beschattungszeiten abweichen, die für die individuellen WEA berechnet werden.

8.4 SHADOW-Hauptergebnis Vorbelastung – Immissionsorte DK

Projekt:
018FB123-03

Lizenzierter Anwender:
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Reuterstrasse 9
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Hoffmann / christian.hoffmann@wind-consult.de
Bereich:
04.03.2026 09:57/4.2.285

SHADOW - Hauptergebnis

Berechnung: Vorbelastung_DK
Annahmen für Schattenwurfberechnung

Beschattungsbereich der WEA
Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
Siehe WEA-Tabelle

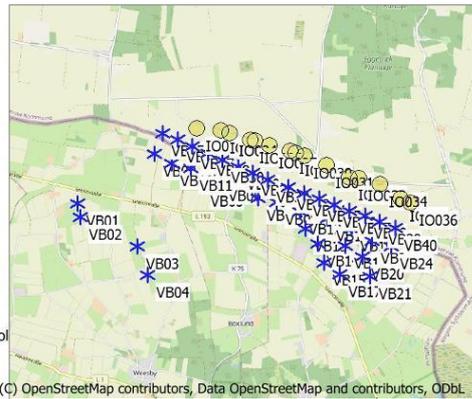
Minimale relevante Sonnenhöhe über Horizont 3 °
Tage zwischen Berechnungen 1 Tag(e)
Berechnungszeitsprung 1 Minuten

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.
Monatliche Aggregation der met. wahrsch. Reduzierung
Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:

DHM: Höhenraster-Objekt: SchleswigHolstein_Elevation_Model_5m_grid_resol
Rasterauflösung: 1,0 m
Topographischer Schatten berücksichtigt

Alle Koordinatenangaben in:
UTM (north)-ETRS89 Zone: 32



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL
Maßstab 1:100.000
* Existierende WEA Schattenrezeptor

WEA

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | Schattendaten | | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|---------------|-------------------|-------|
| | | | | | Aktuell | Hersteller | Typ | | | NH | Beschatt.-Bereich | U/min |
| | [m] | | | | | | [kW] | [m] | [m] | [m] | [U/min] | |
| 1 | 508.505 | 6.079.136 | 14,9 | VB01 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 2 | 508.551 | 6.078.885 | 16,2 | VB02 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 3 | 509.612 | 6.078.330 | 18,4 | VB03 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 4 | 509.812 | 6.077.810 | 19,1 | VB04 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 5 | 510.806 | 6.079.514 | 18,9 | VB05 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 6 | 511.144 | 6.079.614 | 21,0 | VB06 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 7 | 511.858 | 6.079.246 | 20,7 | VB07 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 8 | 512.196 | 6.079.176 | 20,9 | VB08 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 9 | 509.924 | 6.080.069 | 17,1 | VB09 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 10 | 510.243 | 6.079.899 | 17,5 | VB10 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 11 | 510.596 | 6.079.808 | 18,5 | VB11 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 12 | 512.631 | 6.079.003 | 20,8 | VB12 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 13 | 512.736 | 6.078.683 | 21,1 | VB13 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 14 | 512.978 | 6.078.401 | 21,5 | VB14 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 15 | 513.084 | 6.078.045 | 22,8 | VB15 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 16 | 513.153 | 6.078.872 | 21,4 | VB16 | Nein | REpower | MM 92-2.000 | 2.000 | 92,5 | 100,0 | 1.625 | 15,0 |
| 17 | 513.375 | 6.077.826 | 24,2 | VB17 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 18 | 513.481 | 6.078.361 | 22,8 | VB18 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 19 | 513.587 | 6.078.671 | 22,6 | VB19 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 20 | 513.796 | 6.078.158 | 23,9 | VB20 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 21 | 513.934 | 6.077.779 | 24,1 | VB21 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 22 | 513.971 | 6.078.453 | 23,4 | VB22 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 23 | 514.333 | 6.078.361 | 23,8 | VB24 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 24 | 510.077 | 6.080.455 | 17,8 | VB25 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 25 | 510.356 | 6.080.332 | 17,9 | VB26 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 26 | 510.636 | 6.080.208 | 18,7 | VB27 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 27 | 510.917 | 6.080.087 | 18,8 | VB28 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 28 | 511.477 | 6.079.836 | 20,0 | VB29 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 29 | 511.196 | 6.079.959 | 20,1 | VB30 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 30 | 511.757 | 6.079.713 | 20,0 | VB31 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 31 | 512.035 | 6.079.588 | 20,6 | VB32 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 32 | 512.421 | 6.079.447 | 20,6 | VB33 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 33 | 512.705 | 6.079.340 | 21,3 | VB34 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 34 | 512.988 | 6.079.234 | 21,0 | VB35 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 35 | 513.272 | 6.079.126 | 22,2 | VB36 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

(Fortsetzung nächste Seite)...

Projekt:
018FB123-03

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Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
04.03.2026 09:57/4.2.285

SHADOW - Hauptergebnis

Berechnung: Vorbelastung_DK

...(Fortsetzung von vorheriger Seite)

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | NH | Schattendaten | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|------|-------------------|---------|
| | | | | | Aktuell | Hersteller | Typ | | | | Beschatt.-Bereich | U/min |
| | | | [m] | | | | | | | | [m] | [U/min] |
| 36 | 513.556 | 6.079.019 | 22,4 | VB37 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 37 | 513.839 | 6.078.912 | 23,2 | VB38 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 38 | 514.123 | 6.078.805 | 23,4 | VB39 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 39 | 514.405 | 6.078.698 | 23,5 | VB40 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite | Höhe | Höhe ü.Gr. | Neigung des Fensters | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. |
|-------|-------------------------|---------|-----------|------|--------|------|------------|----------------------|---------------------|-----------------------|
| | | | | [m] | [m] | [m] | [m] | [°] | | [m] |
| IO022 | Tinglev, Bøllåvej 17 | 510.716 | 6.080.549 | 19,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO023 | Tinglev, Bøllåvej 15 | 511.160 | 6.080.498 | 19,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO024 | Tinglev, Bøllåvej 13 | 511.330 | 6.080.446 | 21,0 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO025 | Tinglev, Bøllåvej 11 | 511.716 | 6.080.325 | 20,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO026 | Tinglev, Bøllåvej 9 | 511.797 | 6.080.312 | 20,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO027 | Tinglev, Bøllåvej 7 | 512.060 | 6.080.230 | 20,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO028 | Tinglev, Bøllåvej 5 | 512.451 | 6.080.117 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO029 | Tinglev, Bøllåvej 3 | 512.547 | 6.080.083 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO030 | Tinglev, Bøllåvej 1 | 512.725 | 6.080.029 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO031 | Tinglev, Grænsevejen 31 | 513.125 | 6.079.855 | 22,9 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO032 | Tinglev, Grænsevejen 28 | 513.550 | 6.079.631 | 23,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO033 | Tinglev, Grænsevejen 22 | 513.731 | 6.079.624 | 23,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO034 | Tinglev, Grænsevejen 21 | 514.125 | 6.079.508 | 23,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO035 | Tinglev, Grænsevejen 15 | 514.504 | 6.079.236 | 24,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO036 | Tinglev, Grænsevejen 13 | 514.688 | 6.079.173 | 24,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | | met. wahrsch. Beschattungsdauer | |
|-------|-------------------------|--------------------------------------|-------------------|-----------------------|---------------------------------|--------------|
| | | Stunden/Jahr | Schattentage/Jahr | Max.Schattendauer/Tag | Stunden/Jahr | Stunden/Jahr |
| | | [h/a] | [d/a] | [h/d] | [h/a] | [h/a] |
| IO022 | Tinglev, Bøllåvej 17 | 146:45 | 166 | 2:00 | 29:41 | 29:41 |
| IO023 | Tinglev, Bøllåvej 15 | 105:42 | 182 | 1:16 | 21:58 | 21:58 |
| IO024 | Tinglev, Bøllåvej 13 | 51:53 | 168 | 0:38 | 11:53 | 11:53 |
| IO025 | Tinglev, Bøllåvej 11 | 95:51 | 177 | 1:18 | 19:31 | 19:31 |
| IO026 | Tinglev, Bøllåvej 9 | 82:34 | 178 | 0:57 | 17:19 | 17:19 |
| IO027 | Tinglev, Bøllåvej 7 | 40:07 | 124 | 0:37 | 8:42 | 8:42 |
| IO028 | Tinglev, Bøllåvej 5 | 54:13 | 129 | 0:53 | 10:45 | 10:45 |
| IO029 | Tinglev, Bøllåvej 3 | 48:08 | 140 | 0:39 | 9:54 | 9:54 |
| IO030 | Tinglev, Bøllåvej 1 | 54:16 | 152 | 1:02 | 10:39 | 10:39 |
| IO031 | Tinglev, Grænsevejen 31 | 80:23 | 148 | 1:02 | 16:14 | 16:14 |
| IO032 | Tinglev, Grænsevejen 28 | 77:04 | 169 | 1:04 | 15:45 | 15:45 |
| IO033 | Tinglev, Grænsevejen 22 | 72:04 | 147 | 0:54 | 14:57 | 14:57 |
| IO034 | Tinglev, Grænsevejen 21 | 68:27 | 169 | 0:47 | 14:44 | 14:44 |
| IO035 | Tinglev, Grænsevejen 15 | 102:00 | 181 | 1:02 | 22:09 | 22:09 |
| IO036 | Tinglev, Grænsevejen 13 | 111:25 | 188 | 1:16 | 23:31 | 23:31 |

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal | Erwartet |
|-----|------|---------|----------|
| | | [h/a] | [h/a] |
| 1 | VB01 | 0:00 | 0:00 |
| 2 | VB02 | 0:00 | 0:00 |
| 3 | VB03 | 0:00 | 0:00 |
| 4 | VB04 | 0:00 | 0:00 |
| 5 | VB05 | 27:10 | 5:58 |
| 6 | VB06 | 65:19 | 14:05 |
| 7 | VB07 | 64:46 | 12:33 |
| 8 | VB08 | 42:17 | 8:22 |
| 9 | VB09 | 21:47 | 6:05 |
| 10 | VB10 | 59:37 | 12:45 |

(Fortsetzung nächste Seite)...

Projekt:
018FB123-03Lizenzierter Anwender:
WIND-consult GmbH
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+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
04.03.2026 09:57/4.2.285**SHADOW - Hauptergebnis****Berechnung: Vorbelastung_DK**

...(Fortsetzung von vorheriger Seite)

| Nr. | Name | Maximal | Erwartet |
|-----|------|---------|----------|
| | | [h/a] | [h/a] |
| 11 | VB11 | 60:33 | 13:05 |
| 12 | VB12 | 58:19 | 12:21 |
| 13 | VB13 | 32:08 | 6:45 |
| 14 | VB14 | 16:28 | 3:23 |
| 15 | VB15 | 0:00 | 0:00 |
| 16 | VB16 | 50:39 | 10:01 |
| 17 | VB17 | 0:00 | 0:00 |
| 18 | VB18 | 18:36 | 4:07 |
| 19 | VB19 | 50:17 | 10:54 |
| 20 | VB20 | 29:23 | 5:18 |
| 21 | VB21 | 0:00 | 0:00 |
| 22 | VB22 | 47:58 | 9:25 |
| 23 | VB24 | 29:49 | 4:59 |
| 24 | VB25 | 9:44 | 3:05 |
| 25 | VB26 | 28:37 | 8:12 |
| 26 | VB27 | 55:35 | 11:45 |
| 27 | VB28 | 67:49 | 13:31 |
| 28 | VB29 | 52:49 | 10:21 |
| 29 | VB30 | 38:47 | 8:54 |
| 30 | VB31 | 33:46 | 6:51 |
| 31 | VB32 | 47:01 | 9:15 |
| 32 | VB33 | 31:05 | 6:11 |
| 33 | VB34 | 43:37 | 8:41 |
| 34 | VB35 | 22:29 | 5:50 |
| 35 | VB36 | 58:26 | 11:12 |
| 36 | VB37 | 23:56 | 5:24 |
| 37 | VB38 | 22:13 | 5:12 |
| 38 | VB39 | 50:55 | 10:47 |
| 39 | VB40 | 36:56 | 6:26 |

Summen in Rezeptortabelle und WEA-Tabelle können sich unterscheiden, da eine WEA gleichzeitig an zwei oder mehr Rezeptoren Beschattung verursachen kann und/oder ein Rezeptor gleichzeitig von zwei oder mehr WEA beschattet werden kann.

Die Berechnung der Gesamtsumme für einen Rezeptor arbeitet mit einer gemittelten Richtungskorrektur für alle WEA, die an einem gegebenen Tag zur Beschattung beitragen. Wenn der Schattenwurf durch mehrere WEA an einem Tag nicht gleichzeitig stattfindet, kann die so ermittelte Summe geringfügig von der Summe der Beschattungszeiten abweichen, die für die individuellen WEA berechnet werden.

8.5 SHADOW-Hauptergebnis Gesamtbelastung – Immissionsorte S-H

Projekt:
018FB123-03

SHADOW - Hauptergebnis
Berechnung: Gesamtbelastung_SH
Annahmen für Schattenwurfberechnung
 Beschattungsbereich der WEA
 Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
 Siehe WEA-Tabelle

Minimale relevante Sonnenhöhe über Horizont: 3 °
 Tage zwischen Berechnungen: 1 Tag(e)
 Berechnungszeitsprung: 1 Minuten

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
 Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.
 Monatliche Aggregation der met. wahrsch. Reduzierung
 Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
 DHM: Höhenraster-Objekt: SchleswigHolstein_Elevation_Model_5m_grid_resol
 Rasterauflösung: 1,0 m
 Topographischer Schatten berücksichtigt

Alle Koordinatenangaben in:
 UTM (north)-ETRS89 Zone: 32

WEA

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | NH | Schattendaten | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|-------|-------------------|---------|
| | | | | | Aktuell | Hersteller | Typ | | | | Beschatt.-Bereich | U/min |
| | | | [m] | | | | | | | | [m] | [U/min] |
| 1 | 509.965 | 6.079.600 | 17,6 | ZB01 | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 |
| 2 | 510.417 | 6.079.349 | 18,6 | ZB02 | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 |
| 3 | 511.520 | 6.079.549 | 19,5 | ZB03 | Ja | ENERCON | E-138 EP3 E3-4.260 | 4.260 | 138,3 | 111,0 | 1.690 | 11,1 |
| 4 | 508.505 | 6.079.136 | 14,9 | VB01 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 5 | 508.551 | 6.078.885 | 16,2 | VB02 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 6 | 509.612 | 6.078.330 | 18,4 | VB03 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 7 | 509.812 | 6.077.810 | 19,1 | VB04 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 8 | 510.806 | 6.079.514 | 18,9 | VB05 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 9 | 511.144 | 6.079.614 | 21,0 | VB06 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 10 | 511.858 | 6.079.246 | 20,7 | VB07 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 11 | 512.196 | 6.079.176 | 20,9 | VB08 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 12 | 509.924 | 6.080.069 | 17,1 | VB09 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 13 | 510.243 | 6.079.899 | 17,5 | VB10 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 14 | 510.596 | 6.079.808 | 18,5 | VB11 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 15 | 512.631 | 6.079.003 | 20,8 | VB12 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 16 | 512.736 | 6.078.683 | 21,1 | VB13 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 17 | 512.978 | 6.078.401 | 21,5 | VB14 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 18 | 513.084 | 6.078.045 | 22,8 | VB15 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 19 | 513.153 | 6.078.872 | 21,4 | VB16 | Nein | REpower | MM 92-2.000 | 2.000 | 92,5 | 100,0 | 1.625 | 15,0 |
| 20 | 513.375 | 6.077.826 | 24,2 | VB17 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 21 | 513.481 | 6.078.361 | 22,8 | VB18 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 22 | 513.587 | 6.078.671 | 22,6 | VB19 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 23 | 513.796 | 6.078.158 | 23,9 | VB20 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 24 | 513.934 | 6.077.779 | 24,1 | VB21 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 25 | 513.971 | 6.078.453 | 23,4 | VB22 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 26 | 514.333 | 6.078.361 | 23,8 | VB24 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 27 | 510.077 | 6.080.455 | 17,8 | VB25 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 28 | 510.356 | 6.080.332 | 17,9 | VB26 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 29 | 510.636 | 6.080.208 | 18,7 | VB27 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 30 | 510.917 | 6.080.087 | 18,8 | VB28 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 31 | 511.477 | 6.079.836 | 20,0 | VB29 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 32 | 511.196 | 6.079.959 | 20,1 | VB30 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 33 | 511.757 | 6.079.713 | 20,0 | VB31 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 34 | 512.035 | 6.079.588 | 20,6 | VB32 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 35 | 512.421 | 6.079.447 | 20,6 | VB33 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

Lizenzierter Anwender:
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 Berechnet:
 04.03.2026 09:46/4.2.285

(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Maßstab 1:75.000
 * Existierende WEA

(Fortsetzung nächste Seite)...

windPRO 4.2.285 | EMD International A/S, Tel. +45 96 35 44 44, www.emd.dk, windpro@emd.dk 04.03.2026 10:20 / 1

Projekt:
018FB123-03

Lizenzierter Anwender:
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DE-18211 Bargeshagen
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Berechnet:
04.03.2026 09:46/4.2.285

SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung_SH

...(Fortsetzung von vorheriger Seite)

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | NH | Schattendaten | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|------|-------------------|---------|
| | | | | | Aktuell | Hersteller | Typ | | | | Beschatt.-Bereich | U/min |
| | | | [m] | | | | | | | | [m] | [U/min] |
| 36 | 512.705 | 6.079.340 | 21,3 | VB34 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 37 | 512.988 | 6.079.234 | 21,0 | VB35 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 38 | 513.272 | 6.079.126 | 22,2 | VB36 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 39 | 513.556 | 6.079.019 | 22,4 | VB37 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 40 | 513.839 | 6.078.912 | 23,2 | VB38 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 41 | 514.123 | 6.078.805 | 23,4 | VB39 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 42 | 514.405 | 6.078.698 | 23,5 | VB40 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite | Höhe | Höhe ü.Gr. | Neigung des Fensters | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. |
|-------|------------------------|---------|-----------|------|--------|------|------------|----------------------|---------------------|-----------------------|
| | | | | [m] | [m] | [m] | [m] | [°] | | [m] |
| IO001 | Erlenweg 4, Böxlund | 512.084 | 6.078.670 | 23,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO002 | Erlenweg 5, Böxlund | 511.990 | 6.078.515 | 22,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO003 | Grenzaueg 3, Böxlund | 511.291 | 6.079.064 | 20,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO004 | Grenzstraße 1, Böxlund | 510.984 | 6.078.916 | 20,8 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO005 | Weesbydamm 14, Weesby | 510.226 | 6.078.926 | 20,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO006 | Kjerweg 4, Weesby | 510.018 | 6.078.918 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO007 | Kjerweg 3, Weesby | 509.917 | 6.078.949 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO008 | Kjerweg 1, Weesby | 509.890 | 6.078.996 | 19,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO009 | Bögelhus 2, Weesby | 509.362 | 6.079.254 | 17,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO010 | Bögelhus 2a, Weesby | 509.354 | 6.079.278 | 17,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO011 | Bögelhus 4, Weesby | 509.431 | 6.079.917 | 17,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO012 | Kjerweg 2, Weesby | 510.126 | 6.078.810 | 19,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO013 | Grenzaueg 4, Böxlund | 511.314 | 6.078.970 | 21,0 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO014 | Grenzaueg 2, Böxlund | 511.297 | 6.078.865 | 21,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO015 | Bögelhus 1, Weesby | 509.313 | 6.079.300 | 17,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO016 | Bögelhus 3, Weesby | 509.137 | 6.080.535 | 16,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO017 | Bögelhus 12, Weesby | 509.155 | 6.080.618 | 16,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO018 | Bögelhus 10, Weesby | 509.208 | 6.080.554 | 16,5 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO019 | Bögelhus 8, Weesby | 509.338 | 6.080.334 | 17,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO020 | Bögelhus 6, Weesby | 509.394 | 6.080.108 | 18,1 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO021 | Betonstraße 2, Weesby | 509.213 | 6.079.268 | 17,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | | met. wahrsch. Beschattungsdauer | |
|-------|------------------------|--------------------------------------|-------------------|-----------------------|---------------------------------|--|
| | | Stunden/Jahr | Schattentage/Jahr | Max.Schattendauer/Tag | Stunden/Jahr | |
| | | [h/a] | [d/a] | [h/d] | [h/a] | |
| IO001 | Erlenweg 4, Böxlund | 110:54 | 228 | 1:03 | 42:24 | |
| IO002 | Erlenweg 5, Böxlund | 76:44 | 227 | 0:51 | 30:28 | |
| IO003 | Grenzaueg 3, Böxlund | 140:50 | 207 | 1:39 | 61:09 | |
| IO004 | Grenzstraße 1, Böxlund | 65:22 | 209 | 0:36 | 26:40 | |
| IO005 | Weesbydamm 14, Weesby | 51:18 | 193 | 0:32 | 17:02 | |
| IO006 | Kjerweg 4, Weesby | 86:25 | 221 | 0:39 | 25:00 | |
| IO007 | Kjerweg 3, Weesby | 80:09 | 191 | 0:41 | 24:06 | |
| IO008 | Kjerweg 1, Weesby | 86:48 | 190 | 0:52 | 29:33 | |
| IO009 | Bögelhus 2, Weesby | 126:56 | 219 | 1:14 | 50:41 | |
| IO010 | Bögelhus 2a, Weesby | 140:45 | 223 | 1:20 | 56:27 | |
| IO011 | Bögelhus 4, Weesby | 194:51 | 355 | 1:13 | 68:55 | |
| IO012 | Kjerweg 2, Weesby | 51:09 | 175 | 0:39 | 15:44 | |
| IO013 | Grenzaueg 4, Böxlund | 136:55 | 190 | 1:23 | 59:01 | |
| IO014 | Grenzaueg 2, Böxlund | 111:55 | 191 | 1:15 | 46:46 | |
| IO015 | Bögelhus 1, Weesby | 154:06 | 228 | 1:20 | 62:04 | |
| IO016 | Bögelhus 3, Weesby | 59:20 | 159 | 0:50 | 13:34 | |
| IO017 | Bögelhus 12, Weesby | 54:43 | 148 | 0:43 | 12:02 | |
| IO018 | Bögelhus 10, Weesby | 73:24 | 162 | 0:53 | 16:18 | |
| IO019 | Bögelhus 8, Weesby | 108:35 | 217 | 1:04 | 26:12 | |
| IO020 | Bögelhus 6, Weesby | 141:40 | 278 | 1:05 | 42:55 | |
| IO021 | Betonstraße 2, Weesby | 143:03 | 230 | 1:10 | 56:59 | |

Projekt:
018FB123-03

Lizenzierter Anwender:
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Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
04.03.2026 09:46/4.2.285

SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung_SH

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal | Erwartet |
|-----|------|---------|----------|
| | | [h/a] | [h/a] |
| 1 | ZB01 | 312:00 | 106:24 |
| 2 | ZB02 | 234:02 | 90:45 |
| 3 | ZB03 | 19:07 | 8:48 |
| 4 | VB01 | 52:40 | 14:40 |
| 5 | VB02 | 53:28 | 13:50 |
| 6 | VB03 | 130:28 | 25:50 |
| 7 | VB04 | 4:17 | 0:53 |
| 8 | VB05 | 71:00 | 28:33 |
| 9 | VB06 | 37:40 | 15:57 |
| 10 | VB07 | 135:28 | 59:11 |
| 11 | VB08 | 43:08 | 18:55 |
| 12 | VB09 | 181:56 | 68:40 |
| 13 | VB10 | 87:38 | 30:53 |
| 14 | VB11 | 33:29 | 11:43 |
| 15 | VB12 | 44:17 | 17:16 |
| 16 | VB13 | 67:28 | 27:23 |
| 17 | VB14 | 25:54 | 7:58 |
| 18 | VB15 | 17:59 | 5:01 |
| 19 | VB16 | 12:41 | 5:32 |
| 20 | VB17 | 10:27 | 2:50 |
| 21 | VB18 | 9:21 | 2:52 |
| 22 | VB19 | 8:42 | 3:10 |
| 23 | VB20 | 0:00 | 0:00 |
| 24 | VB21 | 0:00 | 0:00 |
| 25 | VB22 | 0:00 | 0:00 |
| 26 | VB24 | 0:00 | 0:00 |
| 27 | VB25 | 23:08 | 9:17 |
| 28 | VB26 | 10:27 | 4:03 |
| 29 | VB27 | 4:22 | 1:39 |
| 30 | VB28 | 0:32 | 0:11 |
| 31 | VB29 | 0:27 | 0:11 |
| 32 | VB30 | 0:31 | 0:12 |
| 33 | VB31 | 0:00 | 0:00 |
| 34 | VB32 | 13:21 | 5:31 |
| 35 | VB33 | 6:43 | 3:03 |
| 36 | VB34 | 2:01 | 0:52 |
| 37 | VB35 | 13:17 | 5:39 |
| 38 | VB36 | 2:38 | 1:12 |
| 39 | VB37 | 0:26 | 0:11 |
| 40 | VB38 | 0:00 | 0:00 |
| 41 | VB39 | 0:00 | 0:00 |
| 42 | VB40 | 0:00 | 0:00 |

Summen in Rezeptortabelle und WEA-Tabelle können sich unterscheiden, da eine WEA gleichzeitig an zwei oder mehr Rezeptoren Beschattung verursachen kann und/oder ein Rezeptor gleichzeitig von zwei oder mehr WEA beschattet werden kann.

Die Berechnung der Gesamtsumme für einen Rezeptor arbeitet mit einer gemittelten Richtungskorrektur für alle WEA, die an einem gegebenen Tag zur Beschattung beitragen. Wenn der Schattenwurf durch mehrere WEA an einem Tag nicht gleichzeitig stattfindet, kann die so ermittelte Summe geringfügig von der Summe der Beschattungszeiten abweichen, die für die individuellen WEA berechnet werden.

8.6 SHADOW-Hauptergebnis Gesamtbelastung – Immissionsorte DK

Projekt:
018FB123-03

SHADOW - Hauptergebnis
Berechnung: Gesamtbelastung_DK
Annahmen für Schattenwurfberechnung
 Beschattungsbereich der WEA
 Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
 Siehe WEA-Tabelle

Minimale relevante Sonnenhöhe über Horizont: 3 °
 Tage zwischen Berechnungen: 1 Tag(e)
 Berechnungszeitsprung: 1 Minuten

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
 Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
 1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.
 Monatliche Aggregation der met. wahrsch. Reduzierung
 Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
 DHM: Höhenraster-Objekt: SchleswigHolstein_Elevation_Model_5m_grid_resol
 Rasterauflösung: 1,0 m
 Topographischer Schatten berücksichtigt

Alle Koordinatenangaben in:
 UTM (north)-ETRS89 Zone: 32

WEA

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | Schattendaten | | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|-------------------|-------|-------|
| | | | | | Aktuell | Hersteller | Typ | | | Beschatt.-Bereich | NH | U/min |
| | | | [m] | | | | | | | | | |
| 1 | 509.965 | 6.079.600 | 17,6 | ZB01 | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 |
| 2 | 510.417 | 6.079.349 | 18,6 | ZB02 | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 120,0 | 1.785 | 9,6 |
| 3 | 511.520 | 6.079.549 | 19,5 | ZB03 | Ja | ENERCON | E-138 EP3 E3-4.260 | 4.260 | 138,3 | 111,0 | 1.690 | 11,1 |
| 4 | 508.505 | 6.079.136 | 14,9 | VB01 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 5 | 508.551 | 6.078.885 | 16,2 | VB02 | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 99,0 | 2.216 | 14,5 |
| 6 | 509.612 | 6.078.330 | 18,4 | VB03 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 7 | 509.812 | 6.077.810 | 19,1 | VB04 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 8 | 510.806 | 6.079.514 | 18,9 | VB05 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 9 | 511.144 | 6.079.614 | 21,0 | VB06 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 10 | 511.858 | 6.079.246 | 20,7 | VB07 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 11 | 512.196 | 6.079.176 | 20,9 | VB08 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 12 | 509.924 | 6.080.069 | 17,1 | VB09 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 13 | 510.243 | 6.079.899 | 17,5 | VB10 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 14 | 510.596 | 6.079.808 | 18,5 | VB11 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 93,0 | 1.752 | 12,1 |
| 15 | 512.631 | 6.079.003 | 20,8 | VB12 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 16 | 512.736 | 6.078.683 | 21,1 | VB13 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 17 | 512.978 | 6.078.401 | 21,5 | VB14 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 18 | 513.084 | 6.078.045 | 22,8 | VB15 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 19 | 513.153 | 6.078.872 | 21,4 | VB16 | Nein | REpower | MM 92-2.000 | 2.000 | 92,5 | 100,0 | 1.625 | 15,0 |
| 20 | 513.375 | 6.077.826 | 24,2 | VB17 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 21 | 513.481 | 6.078.361 | 22,8 | VB18 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 22 | 513.587 | 6.078.671 | 22,6 | VB19 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 23 | 513.796 | 6.078.158 | 23,9 | VB20 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 24 | 513.934 | 6.077.779 | 24,1 | VB21 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 25 | 513.971 | 6.078.453 | 23,4 | VB22 | Nein | VESTAS | V112-3.000 | 3.000 | 112,0 | 119,0 | 1.709 | 12,8 |
| 26 | 514.333 | 6.078.361 | 23,8 | VB24 | Ja | SENVION | 3.2M114-3.200 | 3.200 | 114,0 | 123,0 | 1.750 | 12,1 |
| 27 | 510.077 | 6.080.455 | 17,8 | VB25 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 28 | 510.356 | 6.080.332 | 17,9 | VB26 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 29 | 510.636 | 6.080.208 | 18,7 | VB27 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 30 | 510.917 | 6.080.087 | 18,8 | VB28 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 31 | 511.477 | 6.079.836 | 20,0 | VB29 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 32 | 511.196 | 6.079.959 | 20,1 | VB30 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 33 | 511.757 | 6.079.713 | 20,0 | VB31 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 34 | 512.035 | 6.079.588 | 20,6 | VB32 | Nein | NEG MICON | NM64C/1500-1.500/400 | 1.500 | 64,0 | 60,0 | 2.500 | 17,3 |
| 35 | 512.421 | 6.079.447 | 20,6 | VB33 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

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 Berechnet:
 04.03.2026 10:08/4.2.285

(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Maßstab 1:100.000
 * Existierende WEA
 * Neue WEA
 * Schattenrezeptor

(Fortsetzung nächste Seite)...

windPRO 4.2.285 | EMD International A/S, Tel. +45 96 35 44 44, www.emd.dk, windpro@emd.dk

04.03.2026 10:22 / 1

Projekt:
018FB123-03

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Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
04.03.2026 10:08/4.2.285

SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung_DK

...(Fortsetzung von vorheriger Seite)

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | | Nennleistung | Rotor-durchmesser | NH | Schattendaten | |
|----|---------|-----------|------|--------------|---------|------------|----------------------------|--------------|-------------------|------|-------------------|-------|
| | | | | | Aktuell | Hersteller | Typ | | | | Beschatt.-Bereich | U/min |
| | [m] | | | | | | [kW] | [m] | [m] | [m] | [U/min] | |
| 36 | 512.705 | 6.079.340 | 21,3 | VB34 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 37 | 512.988 | 6.079.234 | 21,0 | VB35 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 38 | 513.272 | 6.079.126 | 22,2 | VB36 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 39 | 513.556 | 6.079.019 | 22,4 | VB37 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 40 | 513.839 | 6.078.912 | 23,2 | VB38 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 41 | 514.123 | 6.078.805 | 23,4 | VB39 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |
| 42 | 514.405 | 6.078.698 | 23,5 | VB40 | Nein | VESTAS | V80-2.0 Gridstreamer-2.000 | 2.000 | 80,0 | 60,0 | 1.583 | 16,7 |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite | Höhe | Höhe ü.Gr. | Neigung des Fensters | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. |
|-------|-------------------------|---------|-----------|------|--------|------|------------|----------------------|---------------------|-----------------------|
| | | | | [m] | [m] | [m] | [m] | [°] | | [m] |
| IO022 | Tinglev, Bøllåvej 17 | 510.716 | 6.080.549 | 19,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO023 | Tinglev, Bøllåvej 15 | 511.160 | 6.080.498 | 19,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO024 | Tinglev, Bøllåvej 13 | 511.330 | 6.080.446 | 21,0 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO025 | Tinglev, Bøllåvej 11 | 511.716 | 6.080.325 | 20,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO026 | Tinglev, Bøllåvej 9 | 511.797 | 6.080.312 | 20,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO027 | Tinglev, Bøllåvej 7 | 512.060 | 6.080.230 | 20,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO028 | Tinglev, Bøllåvej 5 | 512.451 | 6.080.117 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO029 | Tinglev, Bøllåvej 3 | 512.547 | 6.080.083 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO030 | Tinglev, Bøllåvej 1 | 512.725 | 6.080.029 | 21,6 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO031 | Tinglev, Grænsevejen 31 | 513.125 | 6.079.855 | 22,9 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO032 | Tinglev, Grænsevejen 28 | 513.550 | 6.079.631 | 23,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO033 | Tinglev, Grænsevejen 22 | 513.731 | 6.079.624 | 23,2 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO034 | Tinglev, Grænsevejen 21 | 514.125 | 6.079.508 | 23,7 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO035 | Tinglev, Grænsevejen 15 | 514.504 | 6.079.236 | 24,4 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |
| IO036 | Tinglev, Grænsevejen 13 | 514.688 | 6.079.173 | 24,3 | 0,1 | 0,1 | 2,0 | 0,0 | "Gewächshaus-Modus" | 2,0 |

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | | met. wahrsch. Beschattungsdauer | |
|-------|-------------------------|--------------------------------------|-------------------|-----------------------|---------------------------------|--|
| | | Stunden/Jahr | Schattentage/Jahr | Max.Schattendauer/Tag | Stunden/Jahr | |
| | | [h/a] | [d/a] | [h/d] | [h/a] | |
| IO022 | Tinglev, Bøllåvej 17 | 164:49 | 166 | 2:13 | 33:07 | |
| IO023 | Tinglev, Bøllåvej 15 | 124:54 | 186 | 1:39 | 25:43 | |
| IO024 | Tinglev, Bøllåvej 13 | 84:06 | 185 | 0:54 | 18:28 | |
| IO025 | Tinglev, Bøllåvej 11 | 119:02 | 177 | 1:52 | 23:30 | |
| IO026 | Tinglev, Bøllåvej 9 | 117:16 | 178 | 1:33 | 23:42 | |
| IO027 | Tinglev, Bøllåvej 7 | 89:17 | 158 | 1:03 | 18:14 | |
| IO028 | Tinglev, Bøllåvej 5 | 64:08 | 138 | 0:53 | 13:29 | |
| IO029 | Tinglev, Bøllåvej 3 | 57:40 | 150 | 0:39 | 12:36 | |
| IO030 | Tinglev, Bøllåvej 1 | 62:26 | 165 | 1:02 | 12:58 | |
| IO031 | Tinglev, Grænsevejen 31 | 84:10 | 161 | 1:02 | 17:24 | |
| IO032 | Tinglev, Grænsevejen 28 | 77:04 | 169 | 1:04 | 15:45 | |
| IO033 | Tinglev, Grænsevejen 22 | 72:04 | 147 | 0:54 | 14:57 | |
| IO034 | Tinglev, Grænsevejen 21 | 68:27 | 169 | 0:47 | 14:44 | |
| IO035 | Tinglev, Grænsevejen 15 | 102:00 | 181 | 1:02 | 22:09 | |
| IO036 | Tinglev, Grænsevejen 13 | 111:25 | 188 | 1:16 | 23:31 | |

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal | Erwartet |
|-----|------|---------|----------|
| | | [h/a] | [h/a] |
| 1 | ZB01 | 52:43 | 11:01 |
| 2 | ZB02 | 56:06 | 10:46 |
| 3 | ZB03 | 160:26 | 32:28 |
| 4 | VB01 | 0:00 | 0:00 |
| 5 | VB02 | 0:00 | 0:00 |
| 6 | VB03 | 0:00 | 0:00 |
| 7 | VB04 | 0:00 | 0:00 |

(Fortsetzung nächste Seite)...

Projekt:
018FB123-03

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Berechnet:
04.03.2026 10:08/4.2.285

SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung_DK

...(Fortsetzung von vorheriger Seite)

| Nr. | Name | Maximal | Erwartet |
|-----|------|---------|----------|
| | | [h/a] | [h/a] |
| 8 | VB05 | 27:10 | 5:58 |
| 9 | VB06 | 65:19 | 14:05 |
| 10 | VB07 | 64:46 | 12:33 |
| 11 | VB08 | 42:17 | 8:22 |
| 12 | VB09 | 21:47 | 6:05 |
| 13 | VB10 | 59:37 | 12:45 |
| 14 | VB11 | 60:33 | 13:05 |
| 15 | VB12 | 58:19 | 12:21 |
| 16 | VB13 | 32:08 | 6:45 |
| 17 | VB14 | 16:28 | 3:23 |
| 18 | VB15 | 0:00 | 0:00 |
| 19 | VB16 | 50:39 | 10:01 |
| 20 | VB17 | 0:00 | 0:00 |
| 21 | VB18 | 18:36 | 4:07 |
| 22 | VB19 | 50:17 | 10:54 |
| 23 | VB20 | 29:23 | 5:18 |
| 24 | VB21 | 0:00 | 0:00 |
| 25 | VB22 | 47:58 | 9:25 |
| 26 | VB24 | 29:49 | 4:59 |
| 27 | VB25 | 9:44 | 3:05 |
| 28 | VB26 | 28:37 | 8:12 |
| 29 | VB27 | 55:35 | 11:45 |
| 30 | VB28 | 67:49 | 13:31 |
| 31 | VB29 | 52:49 | 10:21 |
| 32 | VB30 | 38:47 | 8:54 |
| 33 | VB31 | 33:46 | 6:51 |
| 34 | VB32 | 47:01 | 9:15 |
| 35 | VB33 | 31:05 | 6:11 |
| 36 | VB34 | 43:37 | 8:41 |
| 37 | VB35 | 22:29 | 5:50 |
| 38 | VB36 | 58:26 | 11:12 |
| 39 | VB37 | 23:56 | 5:24 |
| 40 | VB38 | 22:13 | 5:12 |
| 41 | VB39 | 50:55 | 10:47 |
| 42 | VB40 | 36:56 | 6:26 |

Summen in Rezeptortabelle und WEA-Tabelle können sich unterscheiden, da eine WEA gleichzeitig an zwei oder mehr Rezeptoren Beschattung verursachen kann und/oder ein Rezeptor gleichzeitig von zwei oder mehr WEA beschattet werden kann.

Die Berechnung der Gesamtsumme für einen Rezeptor arbeitet mit einer gemittelten Richtungskorrektur für alle WEA, die an einem gegebenen Tag zur Beschattung beitragen. Wenn der Schattenwurf durch mehrere WEA an einem Tag nicht gleichzeitig stattfindet, kann die so ermittelte Summe geringfügig von der Summe der Beschattungszeiten abweichen, die für die individuellen WEA berechnet werden.

8.7 SHADOW-Kalender pro WEA (Zusatzbelastung) – Immissionsorte S-H

Projekt:
018FB123-03

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Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:00/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_SH **WEA:** 1 - ZB01
Annahmen für Schattenwurfberechnung
Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | Januar | Februar | März | April | Mai | Juni |
|-----------------------------|-------------------------------|-------------------------------|-------------------------------|----------------------|--|--|
| 1 | 08:46 09:25-09:55/30 16:03 | 08:14 08:55-10:01/66 16:56 | 07:15 08:12-09:11/59 17:54 | 06:57 19:56 | 05:45 06:14-06:26/12 20:54 20:11-20:25/14 | 04:52 05:37-06:47/70 21:46 20:39-21:13/34 |
| 2 | 08:46 09:24-09:55/31 16:04 | 08:12 08:55-10:00/65 16:58 | 07:12 08:13-09:11/58 17:56 | 06:55 19:57 | 05:43 06:12-06:30/18 20:55 20:10-20:27/16 | 04:51 05:36-06:47/71 21:48 20:40-21:14/34 |
| 3 | 08:45 09:24-09:56/32 16:06 | 08:11 08:54-09:59/65 17:00 | 07:10 08:12-09:10/58 17:58 | 06:52 19:59 | 05:41 06:10-06:32/22 20:57 20:10-20:29/19 | 04:50 05:36-06:47/71 21:49 20:41-21:15/34 |
| 4 | 08:45 09:23-09:56/33 16:07 | 08:09 08:54-09:58/64 17:02 | 07:07 08:13-09:10/57 18:00 | 06:49 20:01 | 05:39 06:08-06:33/25 20:59 20:10-20:31/21 | 04:49 05:36-06:47/71 21:50 20:41-21:16/35 |
| 5 | 08:45 09:23-09:57/34 16:08 | 08:07 08:54-09:57/63 17:04 | 07:05 08:12-09:09/57 18:02 | 06:47 20:03 | 05:37 06:06-06:35/29 21:01 20:09-20:32/23 | 04:49 05:36-06:48/72 21:51 20:43-21:18/35 |
| 6 | 08:44 09:22-09:57/35 16:09 | 08:05 08:54-09:56/62 17:07 | 07:03 08:13-09:09/56 18:04 | 06:44 20:05 | 05:34 06:04-06:36/32 21:03 20:09-20:34/25 | 04:48 05:36-06:47/71 21:53 20:44-21:19/35 |
| 7 | 08:44 09:21-09:58/37 16:11 | 08:03 08:54-09:54/60 17:09 | 07:00 08:13-09:08/55 18:06 | 06:42 20:07 | 05:32 06:02-06:37/35 21:05 20:09-20:36/27 | 04:47 05:37-06:48/71 21:54 20:45-21:19/34 |
| 8 | 08:43 09:21-09:59/38 16:12 | 08:01 08:54-09:51/57 17:11 | 06:58 08:14-09:07/53 18:08 | 06:39 20:09 | 05:30 06:00-06:38/38 21:07 20:09-20:37/28 | 04:46 05:36-06:48/72 21:55 20:47-21:21/34 |
| 9 | 08:43 09:20-09:59/39 16:14 | 07:59 08:53-09:42/49 17:13 | 06:55 08:14-09:06/52 18:10 | 06:37 20:11 | 05:28 06:00-06:39/39 21:09 20:09-20:39/30 | 04:46 05:36-06:47/71 21:56 20:49-21:21/32 |
| 10 | 08:42 09:19-09:59/40 16:15 | 07:57 08:32-09:43/71 17:15 | 06:53 08:15-09:05/50 18:12 | 06:34 20:13 | 05:26 05:59-06:40/41 21:11 20:10-20:41/31 | 04:45 05:36-06:48/72 21:57 20:50-21:22/32 |
| 11 | 08:41 09:18-10:00/42 16:17 | 07:55 08:29-09:43/74 17:17 | 06:50 08:15-09:03/48 18:14 | 06:32 20:15 | 05:24 05:57-06:40/43 21:12 20:10-20:43/33 | 04:45 05:37-06:48/71 21:57 20:50-21:22/32 |
| 12 | 08:41 09:17-10:00/43 16:18 | 07:53 08:27-09:43/76 17:19 | 06:48 08:17-09:02/45 18:16 | 06:30 20:17 | 05:23 05:55-06:40/45 21:14 20:11-20:44/33 | 04:44 05:36-06:48/72 21:58 20:50-21:22/32 |
| 13 | 08:40 09:17-10:01/44 16:20 | 07:51 08:26-09:43/77 17:21 | 06:45 08:17-09:00/43 18:18 | 06:27 20:19 | 05:21 05:53-06:42/49 21:16 20:11-20:45/34 | 04:44 05:37-06:48/71 21:59 20:50-21:22/32 |
| 14 | 08:39 09:17-10:01/44 16:22 | 07:49 08:23-09:42/79 17:23 | 06:43 08:19-08:59/40 18:20 | 06:25 20:21 | 05:19 05:52-06:42/50 21:18 20:12-20:48/36 | 04:43 05:37-06:49/72 22:00 20:51-21:23/32 |
| 15 | 08:38 09:18-10:01/43 16:23 | 07:47 08:22-09:41/79 17:25 | 06:40 08:20-08:56/36 18:22 | 06:22 20:23 | 05:17 05:50-06:42/52 21:20 20:13-20:49/36 | 04:43 05:37-06:49/72 22:00 20:51-21:23/32 |
| 16 | 08:37 09:17-10:01/44 16:25 | 07:44 08:21-09:41/80 17:27 | 06:38 08:21-08:53/32 18:24 | 06:20 20:25 | 05:15 05:48-06:43/55 21:21 20:15-20:51/36 | 04:43 05:38-06:49/71 22:01 20:50-21:23/32 |
| 17 | 08:36 09:18-10:01/43 16:27 | 07:42 08:19-09:40/81 17:30 | 06:35 08:24-08:50/26 18:26 | 06:17 20:27 | 05:14 05:46-06:43/57 21:23 20:16-20:52/36 | 04:43 05:37-06:48/71 22:02 20:51-21:23/32 |
| 18 | 08:35 09:11-09:17/6 16:29 | 07:40 08:19-09:39/80 17:32 | 06:33 08:27-08:45/18 18:28 | 06:15 20:28 | 05:12 05:45-06:44/59 21:25 20:18-20:53/35 | 04:43 05:37-06:49/72 22:02 20:51-21:23/32 |
| 19 | 08:34 09:08-10:01/53 16:31 | 07:38 08:18-09:38/80 17:34 | 06:30 20:30 | 06:13 20:30 | 05:10 05:43-06:44/61 21:27 20:23-20:55/32 | 04:43 05:38-06:50/72 22:02 20:51-21:23/32 |
| 20 | 08:32 09:07-10:02/55 16:32 | 07:36 08:17-09:37/80 17:36 | 06:28 20:32 | 06:10 20:32 | 05:09 05:43-06:45/62 21:28 20:24-20:57/33 | 04:43 05:38-06:50/72 22:03 20:52-21:24/32 |
| 21 | 08:31 09:05-10:01/56 16:34 | 07:33 08:16-09:35/79 17:38 | 06:25 20:34 | 06:08 20:34 | 05:07 05:41-06:45/64 21:30 20:24-20:58/34 | 04:43 05:38-06:50/72 22:03 20:52-21:24/32 |
| 22 | 08:30 09:04-10:02/58 16:36 | 07:31 08:16-09:34/78 17:40 | 06:22 20:36 | 06:05 20:36 | 05:05 05:41-06:45/64 21:32 20:25-21:00/35 | 04:43 05:38-06:50/72 22:03 20:52-21:25/33 |
| 23 | 08:28 09:02-10:02/60 16:38 | 07:29 08:15-09:31/76 17:42 | 06:20 20:38 | 06:03 20:38 | 05:04 05:40-06:46/66 21:33 20:27-21:02/35 | 04:43 05:38-06:50/72 22:04 20:52-21:24/32 |
| 24 | 08:27 09:00-10:02/62 16:40 | 07:26 08:15-09:29/74 17:44 | 06:17 20:40 | 06:01 20:40 | 05:02 05:39-06:45/66 21:35 20:28-21:03/35 | 04:43 05:39-06:51/72 22:04 20:52-21:24/32 |
| 25 | 08:26 08:59-10:02/63 16:42 | 07:24 08:14-09:25/71 17:46 | 06:15 20:42 | 05:58 20:42 | 05:01 05:39-06:46/67 21:36 20:31-21:04/33 | 04:44 05:39-06:51/72 22:04 20:53-21:25/32 |
| 26 | 08:24 08:58-10:02/64 16:44 | 07:22 08:14-09:12/58 17:48 | 06:12 20:44 | 05:56 20:44 | 05:00 05:38-06:46/68 21:38 20:36-21:06/30 | 04:44 05:39-06:50/71 22:04 20:53-21:25/32 |
| 27 | 08:22 08:57-10:02/65 16:46 | 07:19 08:13-09:11/58 17:50 | 06:10 20:46 | 05:54 20:17-20:18/1 | 04:58 05:38-06:46/68 21:39 20:36-21:07/31 | 04:44 05:40-06:51/71 22:04 20:53-21:26/33 |
| 28 | 08:21 08:56-10:02/66 16:48 | 07:17 08:13-09:12/59 17:52 | 06:07 20:48 | 05:52 20:15-20:20/5 | 04:57 05:38-06:47/69 21:41 20:37-21:09/32 | 04:45 05:40-06:51/71 22:04 20:53-21:25/32 |
| 29 | 08:19 08:57-10:02/65 16:50 | 07:15 19:50 | 06:05 20:50 | 05:49 20:13-20:22/9 | 04:56 05:37-06:47/70 21:42 20:38-21:10/32 | 04:46 05:40-06:52/72 22:03 20:54-21:26/32 |
| 30 | 08:18 08:56-10:02/66 16:52 | 07:12 19:52 | 06:02 20:52 | 05:47 20:12-20:24/12 | 04:55 05:37-06:47/70 21:44 20:38-21:11/33 | 04:46 05:40-06:51/71 22:03 20:53-21:26/33 |
| 31 | 08:16 08:56-10:02/66 16:54 | 07:10 19:54 | 06:00 20:54 | 05:45 20:12-20:24/12 | 04:53 05:37-06:47/70 21:45 20:39-21:12/33 | 04:45 05:39-06:48/71 22:03 20:53-21:26/33 |
| Sonnenscheinstunden | 244 | 269 | 365 | 421 | 498 | 517 |
| Anzahl Minuten mit Schatten | 1501 | 1977 | 843 | 27 | 2507 | 3127 |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| Tag im Monat | Sonnenaufgang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
|--------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
| | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |

Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
Reuterstrasse 9
DE-18211 Bargeschagen
+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:00/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_SH **WEA:** 1 - ZB01

Annahmen für Schattenwurfberechnung

Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | July | August | September | Oktober | November | Dezember |
|-----------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| 1 | 04:47 05:41-06:52/71 | 05:28 06:04-06:52/48 | 06:25 | 07:21 08:57-09:38/41 | 07:22 07:59-09:13/74 | 08:19 08:58-09:41/43 |
| | 22:03 20:54-21:26/32 | 21:26 20:21-20:55/34 | 20:17 | 19:01 | 16:48 | 16:00 |
| 2 | 04:48 05:41-06:53/72 | 05:30 06:06-06:50/44 | 06:27 | 07:23 08:55-09:40/45 | 07:24 08:02-09:12/70 | 08:21 09:00-09:42/42 |
| | 22:02 20:54-21:27/33 | 21:24 20:21-20:54/33 | 20:15 | 18:58 | 16:45 | 15:59 |
| 3 | 04:48 05:42-06:53/71 | 05:32 06:08-06:50/42 | 06:29 | 07:25 08:54-09:41/47 | 07:26 08:23-09:12/49 | 08:22 09:02-09:43/41 |
| | 22:02 20:55-21:27/32 | 21:22 20:21-20:53/32 | 20:12 | 18:56 | 16:43 | 15:58 |
| 4 | 04:49 05:41-06:53/72 | 05:34 06:09-06:49/40 | 06:31 | 07:27 08:53-09:42/49 | 07:28 08:23-09:20/57 | 08:24 09:04-09:43/39 |
| | 22:01 20:54-21:26/32 | 21:20 20:19-20:50/31 | 20:10 | 18:53 | 16:41 | 15:54 |
| 5 | 04:50 05:42-06:53/71 | 05:35 06:10-06:48/38 | 06:33 | 07:29 08:52-09:42/50 | 07:30 08:24-09:24/60 | 08:26 09:05-09:43/38 |
| | 22:01 20:54-21:26/32 | 21:18 20:19-20:49/30 | 20:07 | 18:51 | 16:39 | 15:57 |
| 6 | 04:51 05:42-06:53/71 | 05:37 06:11-06:48/37 | 06:34 | 07:30 08:50-09:43/53 | 07:32 08:24-09:26/62 | 08:27 09:07-09:44/37 |
| | 22:00 20:52-21:26/34 | 21:17 20:19-20:47/28 | 20:05 | 18:48 | 16:37 | 15:56 |
| 7 | 04:52 05:42-06:54/72 | 05:39 06:12-06:46/34 | 06:36 | 07:32 08:50-09:44/54 | 07:34 08:24-09:27/63 | 08:28 09:08-09:43/35 |
| | 22:00 20:51-21:25/34 | 21:14 20:19-20:45/26 | 20:02 | 18:46 | 16:35 | 15:56 |
| 8 | 04:53 05:43-06:54/71 | 05:41 06:14-06:45/31 | 06:38 | 07:34 08:49-09:44/55 | 07:36 08:24-09:28/64 | 08:30 09:10-09:44/34 |
| | 21:59 20:50-21:25/35 | 21:12 20:19-20:43/24 | 20:00 | 18:43 | 16:34 | 15:55 |
| 9 | 04:54 05:43-06:54/71 | 05:43 06:16-06:44/28 | 06:40 | 07:36 08:48-09:44/56 | 07:38 08:24-09:29/65 | 08:31 09:11-09:44/33 |
| | 21:58 20:49-21:24/35 | 21:10 20:19-20:42/23 | 19:57 | 18:41 | 16:32 | 15:55 |
| 10 | 04:55 05:43-06:54/71 | 05:44 06:17-06:42/25 | 06:42 | 07:38 08:47-09:44/57 | 07:40 08:26-09:31/65 | 08:32 09:13-09:45/32 |
| | 21:57 20:49-21:23/34 | 21:08 20:18-20:39/21 | 19:55 | 18:38 | 16:30 | 15:55 |
| 11 | 04:56 05:44-06:54/70 | 05:46 06:19-06:40/21 | 06:44 | 07:40 08:47-09:45/58 | 07:42 08:26-09:32/66 | 08:34 09:14-09:45/31 |
| | 21:56 20:48-21:22/34 | 21:06 20:19-20:37/18 | 19:52 | 18:36 | 16:28 | 15:54 |
| 12 | 04:58 05:44-06:55/71 | 05:48 06:21-06:38/17 | 06:46 | 07:42 08:46-09:45/59 | 07:44 08:27-09:33/66 | 08:35 09:15-09:45/30 |
| | 21:55 20:47-21:21/34 | 21:04 20:19-20:35/16 | 19:50 | 18:34 | 16:26 | 15:54 |
| 13 | 04:59 05:44-06:55/71 | 05:50 06:23-06:34/11 | 06:47 | 07:44 08:46-09:44/58 | 07:46 08:27-09:33/66 | 08:36 09:16-09:45/29 |
| | 21:54 20:47-21:20/33 | 21:02 20:19-20:33/14 | 19:47 | 18:31 | 16:24 | 15:54 |
| 14 | 05:00 05:46-06:56/70 | 05:52 20:20-20:31/11 | 06:49 | 07:46 08:46-09:44/58 | 07:48 08:29-09:34/65 | 08:37 09:17-09:45/28 |
| | 21:53 20:47-21:20/33 | 21:00 | 19:44 | 18:29 | 16:23 | 15:54 |
| 15 | 05:01 05:46-06:55/69 | 05:54 20:21-20:29/8 | 06:51 | 07:48 08:45-09:44/59 | 07:50 08:30-09:35/65 | 08:38 09:19-09:47/28 |
| | 21:52 20:47-21:19/32 | 20:57 | 19:42 | 18:26 | 16:21 | 15:54 |
| 16 | 05:03 05:46-06:55/69 | 05:55 20:23-20:27/4 | 06:53 | 07:50 08:45-09:44/59 | 07:52 08:30-09:35/65 | 08:39 09:19-09:46/27 |
| | 21:51 20:46-21:18/32 | 20:55 | 19:39 | 18:24 | 16:19 | 15:54 |
| 17 | 05:04 05:46-06:55/69 | 05:57 | 06:55 | 07:52 09:44-09:52/8 | 07:54 08:31-09:35/64 | 08:40 09:20-09:47/27 |
| | 21:50 20:45-21:17/32 | 20:53 | 19:37 | 18:21 08:45-09:43/58 | 16:18 | 15:54 |
| 18 | 05:06 05:48-06:56/68 | 05:59 | 06:57 | 07:54 08:45-09:57/72 | 07:56 08:32-09:36/64 | 08:41 09:21-09:47/26 |
| | 21:48 20:46-21:16/30 | 20:51 | 19:34 | 18:19 | 16:16 | 15:54 |
| 19 | 05:07 05:48-06:55/67 | 06:01 | 06:59 | 07:56 08:46-10:01/75 | 07:58 08:34-09:36/62 | 08:41 09:22-09:48/26 |
| | 21:47 20:45-21:15/30 | 20:48 | 19:32 | 18:17 | 16:15 | 15:54 |
| 20 | 05:09 05:48-06:55/67 | 06:03 | 07:00 | 07:58 08:46-10:03/77 | 08:00 08:37-09:37/60 | 08:42 09:23-09:49/26 |
| | 21:46 20:39-21:13/34 | 20:46 | 19:29 | 18:14 | 16:13 | 15:54 |
| 21 | 05:10 05:50-06:56/66 | 06:05 | 07:02 | 08:00 08:47-10:05/78 | 08:02 08:39-09:37/58 | 08:43 09:23-09:48/25 |
| | 21:44 20:38-21:12/34 | 20:44 | 19:27 | 18:12 | 16:12 | 15:55 |
| 22 | 05:12 05:50-06:55/65 | 06:07 | 07:04 | 08:02 08:47-10:06/79 | 08:03 08:41-09:37/56 | 08:43 09:24-09:49/25 |
| | 21:43 20:36-21:11/35 | 20:41 | 19:24 | 18:10 | 16:10 | 15:55 |
| 23 | 05:13 05:51-06:56/65 | 06:08 | 07:06 | 08:04 08:47-10:07/80 | 08:05 08:43-09:38/55 | 08:44 09:24-09:49/25 |
| | 21:41 20:35-21:10/35 | 20:39 | 19:21 | 18:07 | 16:09 | 15:56 |
| 24 | 05:15 05:52-06:55/63 | 06:10 | 07:08 | 08:06 08:48-10:08/80 | 08:07 08:45-09:38/53 | 08:44 09:25-09:50/25 |
| | 21:40 20:34-21:08/34 | 20:37 | 19:19 | 18:05 | 16:08 | 15:56 |
| 25 | 05:16 05:53-06:55/62 | 06:12 | 07:10 | 07:08 07:49-09:09/80 | 08:09 08:48-08:55/7 | 08:45 09:25-09:51/26 |
| | 21:38 20:34-21:07/33 | 20:34 | 19:16 | 17:03 | 16:07 08:56-09:39/43 | 15:57 |
| 26 | 05:18 05:54-06:54/60 | 06:14 | 07:12 09:12-09:26/14 | 07:10 07:49-09:09/80 | 08:11 08:56-09:40/44 | 08:45 09:25-09:51/26 |
| | 21:37 20:33-21:05/32 | 20:32 | 19:14 | 17:01 | 16:05 | 15:58 |
| 27 | 05:20 05:56-06:55/59 | 06:16 | 07:13 09:08-09:31/23 | 07:12 07:51-09:11/80 | 08:13 08:56-09:40/44 | 08:45 09:25-09:51/26 |
| | 21:35 20:28-21:04/36 | 20:29 | 19:11 | 16:58 | 16:04 | 15:58 |
| 28 | 05:21 05:57-06:54/57 | 06:18 | 07:15 09:04-09:34/30 | 07:14 07:52-09:11/79 | 08:14 08:57-09:41/44 | 08:46 09:25-09:52/27 |
| | 21:33 20:26-21:02/36 | 20:27 | 19:09 | 16:56 | 16:03 | 15:59 |
| 29 | 05:23 05:59-06:54/55 | 06:20 | 07:17 09:02-09:36/34 | 07:16 07:53-09:11/78 | 08:16 08:57-09:41/44 | 08:46 09:25-09:52/27 |
| | 21:32 20:25-21:01/36 | 20:25 | 19:06 | 16:54 | 16:02 | 16:00 |
| 30 | 05:25 06:01-06:52/51 | 06:21 | 07:19 08:59-09:37/38 | 07:18 07:55-09:12/77 | 08:18 08:58-09:42/44 | 08:46 09:25-09:53/28 |
| | 21:30 20:23-20:59/36 | 20:22 | 19:04 | 16:52 | 16:01 | 16:01 |
| 31 | 05:27 06:03-06:52/49 | 06:23 | | 07:20 07:56-09:12/76 | | 08:46 09:25-09:54/29 |
| | 21:28 20:23-20:58/35 | 20:20 | | 16:50 | | 16:02 |
| Sonnenscheinstunden | 519 | 464 | 384 | 328 | 256 | 227 |
| Anzahl Minuten mit Schatten | 3095 | 769 | 139 | 2015 | 1779 | 941 |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| Tag im Monat | Sonnenaufgang (SS:MM) Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten Schattenende/Minuten mit Schatten |
|--------------|--|--|--|--|
|--------------|--|--|--|--|



Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
Reuterstrasse 9
DE-18211 Bargeschagen
+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:00/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_SH **WEA:** 2 - ZB02

Annahmen für Schattenwurfberechnung

Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | Januar | Februar | März | April | Mai | Juni | |
|-----------------------------|--------|----------------------|----------------------|----------------------|----------------------|------------------------------------|-------------------------------------|
| 1 | 08:46 | 08:14 08:46-09:24/38 | 07:15 08:25-08:34/9 | 06:57 07:24-07:48/24 | 05:45 19:44-20:25/41 | 04:52 20:08-21:03/55 | |
| | 16:03 | 16:56 | 17:54 | 19:55 | 20:54 | 21:46 05:31-06:09/38 | |
| 2 | 08:46 | 08:12 08:44-09:24/40 | 07:12 | 06:54 07:21-07:48/27 | 05:43 19:43-20:27/44 | 04:51 20:09-21:03/54 | |
| | 16:04 | 16:58 | 17:56 | 19:57 | 20:55 | 21:48 05:30-06:10/40 | |
| 3 | 08:45 | 08:11 08:42-09:23/41 | 07:10 | 06:52 07:19-07:49/30 | 05:41 19:43-20:29/46 | 04:50 20:09-21:02/53 21:04-21:13/9 | |
| | 16:06 | 17:00 | 17:58 | 19:59 | 20:57 | 21:49 05:29-06:11/42 | |
| 4 | 08:45 | 08:09 08:40-09:22/42 | 07:07 | 06:49 07:16-07:49/33 | 05:39 19:43-20:31/48 | 04:49 20:10-21:16/66 | |
| | 16:07 | 17:02 | 18:00 | 20:01 | 20:59 | 21:50 05:28-06:11/43 | |
| 5 | 08:45 | 08:07 08:38-09:20/42 | 07:05 | 06:47 07:14-07:49/35 | 05:36 19:42-20:32/50 | 04:49 20:11-21:18/67 | |
| | 16:08 | 17:04 | 18:02 | 20:03 | 21:01 | 21:51 05:29-06:13/44 | |
| 6 | 08:44 | 08:05 08:38-09:08/30 | 07:03 | 06:44 07:11-07:48/37 | 05:34 19:42-20:34/52 | 04:48 20:12-21:19/67 | |
| | 16:09 | 17:07 09:09-09:18/9 | 18:04 | 20:05 | 21:03 | 21:52 05:28-06:13/45 | |
| 7 | 08:44 | 08:03 08:39-09:08/29 | 07:00 | 06:42 07:09-07:49/40 | 05:32 19:42-20:36/54 | 04:47 20:12-21:19/67 | |
| | 16:11 | 17:09 08:34-08:36/2 | 18:06 | 20:07 | 21:05 | 21:54 05:27-06:13/46 | |
| 8 | 08:43 | 09:21-09:22/1 | 08:01 08:32-09:08/36 | 06:58 | 06:39 07:07-07:48/41 | 05:30 19:42-20:37/55 | 04:46 20:14-21:21/67 |
| | 16:12 | 17:11 | 18:08 | 20:09 | 21:07 | 21:55 05:28-06:14/46 | |
| 9 | 08:43 | 09:20-09:23/3 | 07:59 08:29-09:07/38 | 06:55 | 06:37 07:06-07:48/42 | 05:28 19:42-20:39/57 | 04:46 20:14-21:21/67 |
| | 16:14 | 17:13 | 18:10 | 20:11 | 21:09 | 21:56 05:27-06:14/47 | |
| 10 | 08:42 | 09:19-09:24/5 | 07:57 08:27-09:07/40 | 06:53 | 06:34 07:05-07:46/41 | 05:26 19:43-20:41/58 | 04:45 20:16-21:22/66 |
| | 16:15 | 17:15 | 18:12 | 20:13 | 21:10 | 21:57 05:27-06:15/48 | |
| 11 | 08:41 | 09:18-09:24/6 | 07:55 08:25-09:07/42 | 06:50 | 06:32 07:05-07:46/41 | 05:24 19:43-20:43/60 | 04:45 20:17-21:23/66 |
| | 16:17 | 17:17 | 18:14 | 20:15 | 21:12 | 21:57 05:28-06:16/48 | |
| 12 | 08:40 | 09:17-09:25/8 | 07:53 08:23-09:07/44 | 06:48 | 06:30 07:06-07:45/39 | 05:23 19:43-20:44/61 | 04:44 20:18-21:23/65 |
| | 16:18 | 17:19 | 18:16 | 20:17 | 21:14 | 21:58 05:26-06:16/50 | |
| 13 | 08:40 | 09:16-09:26/10 | 07:51 08:21-09:06/45 | 06:45 | 06:27 07:05-07:43/38 | 05:21 19:43-20:45/62 | 04:44 20:19-21:24/65 |
| | 16:20 | 17:21 | 18:18 | 20:19 | 21:16 | 21:59 05:25-06:17/52 | |
| 14 | 08:39 | 09:15-09:27/12 | 07:49 08:18-09:04/46 | 06:43 | 06:25 07:05-07:42/37 | 05:19 19:44-20:48/64 | 04:43 20:21-21:25/64 |
| | 16:22 | 17:23 | 18:20 | 20:21 | 21:18 | 22:00 05:24-06:17/53 | |
| 15 | 08:38 | 09:14-09:28/14 | 07:47 08:16-09:03/47 | 06:40 | 06:22 07:05-07:40/35 | 05:17 19:45-20:49/64 | 04:43 20:28-21:26/58 05:24-06:18/54 |
| | 16:23 | 17:25 | 18:22 | 20:23 | 21:20 | 22:00 20:23-20:27/4 | |
| 16 | 08:37 | 09:12-09:28/16 | 07:44 08:15-09:02/47 | 06:38 | 06:20 07:05-07:39/34 | 05:15 19:46-20:51/65 | 04:43 20:27-21:26/59 |
| | 16:25 | 17:27 | 18:24 | 20:25 | 21:21 | 22:01 05:24-06:18/54 | |
| 17 | 08:36 | 09:11-09:28/17 | 07:42 08:15-08:58/43 | 06:35 | 06:17 07:06-07:38/32 | 05:14 19:46-20:52/66 | 04:43 20:27-21:26/59 |
| | 16:27 | 17:30 | 18:26 | 20:26 | 21:23 | 22:02 05:23-06:18/55 | |
| 18 | 08:35 | 09:10-09:29/19 | 07:40 08:15-08:47/32 | 06:33 | 06:15 07:06-07:36/30 | 05:12 19:46-20:53/67 | 04:43 20:28-21:27/59 |
| | 16:29 | 17:32 | 18:28 | 20:28 | 21:25 | 22:02 05:23-06:18/55 | |
| 19 | 08:33 | 09:08-09:29/21 | 07:38 08:15-08:48/33 | 06:30 | 06:13 07:07-07:34/27 | 05:10 19:48-20:55/67 | 04:43 20:28-21:27/59 |
| | 16:31 | 17:34 | 18:30 | 20:30 | 21:27 | 22:02 05:22-06:18/56 | |
| 20 | 08:32 | 09:07-09:30/23 | 07:36 08:14-08:47/33 | 06:27 | 06:10 07:09-07:32/23 | 05:09 19:49-20:57/68 | 04:43 20:29-21:28/59 |
| | 16:32 | 17:36 | 18:32 | 20:32 | 21:28 | 22:03 05:23-06:20/57 | |
| 21 | 08:31 | 09:05-09:29/24 | 07:33 08:15-08:47/32 | 06:25 | 06:08 07:10-07:29/19 | 05:07 19:50-20:58/68 | 04:43 20:29-21:28/59 |
| | 16:34 | 17:38 | 18:34 | 20:34 | 21:30 | 22:03 05:23-06:20/57 | |
| 22 | 08:30 | 09:04-09:30/26 | 07:31 08:16-08:47/31 | 06:22 | 06:05 07:12-07:27/15 | 05:05 19:51-21:00/69 | 04:43 20:29-21:28/59 |
| | 16:36 | 17:40 | 18:36 | 20:36 | 21:32 | 22:03 05:23-06:20/57 | |
| 23 | 08:28 | 09:02-09:30/28 | 07:29 08:16-08:45/29 | 06:20 | 06:03 07:17-07:22/5 | 05:04 19:53-21:01/68 | 04:43 20:29-21:28/59 |
| | 16:38 | 17:42 | 18:38 | 20:38 | 21:33 19:53-20:11/18 | 21:33 05:48-05:50/2 | 22:04 05:23-06:20/57 |
| 24 | 08:27 | 09:00-09:29/29 | 07:26 08:17-08:45/28 | 06:17 | 06:01 19:51-20:13/22 | 05:02 19:53-21:01/68 | 04:43 20:29-21:28/59 |
| | 16:40 | 17:44 | 18:40 | 20:40 | 21:35 05:41-05:56/15 | 22:04 05:24-06:20/56 | |
| 25 | 08:25 | 08:59-09:30/31 | 07:24 08:17-08:43/26 | 06:15 | 05:58 19:49-20:14/25 | 05:01 19:56-21:01/65 | 04:44 20:30-21:29/59 |
| | 16:42 | 17:46 | 18:42 | 20:42 | 21:36 05:39-05:59/20 | 22:04 05:24-06:20/56 | |
| 26 | 08:24 | 08:58-09:29/31 | 07:22 08:18-08:42/24 | 06:12 | 05:56 19:47-20:16/29 | 05:00 19:58-21:01/63 | 04:44 20:29-21:28/59 |
| | 16:44 | 17:48 | 18:44 | 20:44 | 21:38 05:37-06:01/24 | 22:04 05:25-06:20/55 | |
| 27 | 08:22 | 08:55-09:28/33 | 07:19 08:19-08:40/21 | 06:10 06:36-06:38/2 | 05:54 19:46-20:18/32 | 04:58 20:03-21:02/59 | 04:44 20:30-21:29/59 |
| | 16:46 | 17:50 | 18:46 | 20:46 | 21:39 05:35-06:03/28 | 22:04 05:26-06:21/55 | |
| 28 | 08:21 | 08:53-09:28/35 | 07:17 08:22-08:38/16 | 06:07 06:34-06:43/9 | 05:52 19:46-20:20/34 | 04:57 20:05-21:02/57 | 04:45 20:30-21:28/58 05:26-06:20/54 |
| | 16:48 | 17:52 | 18:48 | 20:48 | 21:41 05:34-06:05/31 | 22:03 20:26-20:28/2 | |
| 29 | 08:19 | 08:52-09:26/34 | 07:05 07:31-07:44/13 | 05:49 19:45-20:22/37 | 04:56 20:06-21:02/56 | 04:46 20:25-21:29/64 | |
| | 16:50 | 17:54 | 18:50 | 20:50 | 21:42 05:33-06:06/33 | 22:03 05:27-06:21/54 | |
| 30 | 08:18 | 08:50-09:25/35 | 07:02 07:29-07:46/17 | 05:47 19:44-20:24/40 | 04:55 20:07-21:02/55 | 04:46 20:23-21:28/65 | |
| | 16:52 | 17:56 | 18:52 | 20:52 | 21:44 05:32-06:07/35 | 22:03 05:28-06:20/52 | |
| 31 | 08:16 | 08:48-09:25/37 | 07:00 07:26-07:47/21 | 05:44 | 04:53 20:07-21:03/56 | 04:46 20:23-21:28/65 | |
| | 16:54 | 17:58 | 18:54 | 20:54 | 21:45 05:31-06:08/37 | 22:03 05:28-06:20/52 | |
| Sonnenscheinstunden | 244 | 269 | 365 | 421 | 498 | 517 | 3383 |
| Anzahl Minuten mit Schatten | 498 | 1006 | 71 | 985 | 2058 | 3383 | |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| Tag im Monat | Sonnenaufgang (SS:MM) | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|



Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
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+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:00/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_SH **WEA:** 2 - ZB02
Annahmen für Schattenwurfberechnung
Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | July | August | September | Oktober | November | Dezember |
|-----------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| 1 | 04:47 20:23-21:28/65 | 05:28 19:54-20:55/61 | 06:25 07:05-07:44/39 | 07:21 20:17 | 07:22 07:55-08:37/42 | 08:19 08:58-09:07/9 |
| | 22:03 05:29-06:20/51 | 21:26 | 19:01 | 19:01 | 16:48 | 16:00 |
| 2 | 04:48 20:22-21:28/66 | 05:30 19:53-20:54/61 | 06:27 07:04-07:45/41 | 07:23 20:15 | 07:24 07:57-08:37/40 | 08:21 09:00-09:07/7 |
| | 22:02 05:31-06:21/50 | 21:24 | 20:15 | 18:58 | 16:45 | 15:59 |
| 3 | 04:48 20:21-21:28/67 | 05:32 19:53-20:53/60 | 06:29 07:03-07:44/41 | 07:25 20:12 | 07:26 07:59-08:37/38 | 08:22 09:02-09:07/5 |
| | 22:02 05:32-06:21/49 | 21:22 | 20:12 | 18:56 | 16:43 | 15:58 |
| 4 | 04:49 20:20-21:27/67 | 05:34 19:52-20:50/58 | 06:31 07:04-07:45/41 | 07:27 20:10 | 07:28 08:01-08:37/36 | 08:24 09:04-09:07/3 |
| | 22:01 05:32-06:20/48 | 21:20 | 20:10 | 18:53 | 16:41 | 15:58 |
| 5 | 04:50 20:20-21:26/66 | 05:35 19:52-20:49/57 | 06:33 07:04-07:45/41 | 07:28 20:07 | 07:30 08:08-08:38/30 | 08:25 09:05-09:06/1 |
| | 22:01 05:33-06:20/47 | 21:18 | 20:07 | 18:51 | 16:39 08:04-08:05/1 | 15:57 |
| 6 | 04:51 20:19-21:26/67 | 05:37 19:53-20:47/54 | 06:34 07:05-07:45/40 | 07:30 20:05 | 07:32 08:08-08:38/30 | 08:27 15:55 |
| | 22:00 05:34-06:20/46 | 21:16 | 20:05 | 18:48 | 16:37 08:39-08:48/9 | 15:56 |
| 7 | 04:52 20:19-21:25/66 | 05:39 19:52-20:45/53 | 06:36 07:06-07:44/38 | 07:32 20:02 | 07:34 08:08-08:50/42 | 08:28 15:56 |
| | 22:00 05:34-06:20/46 | 21:14 | 20:02 | 18:46 | 16:35 | 15:56 |
| 8 | 04:53 20:18-21:25/67 | 05:41 19:52-20:43/51 | 06:38 07:08-07:44/36 | 07:34 20:00 | 07:36 08:10-08:52/42 | 08:30 15:55 |
| | 21:59 05:35-06:19/44 | 21:12 | 20:00 | 18:43 | 16:33 | 15:55 |
| 9 | 04:54 20:18-21:24/66 | 05:43 19:52-20:41/49 | 06:40 07:10-07:43/33 | 07:36 20:05 | 07:38 08:12-08:53/41 | 08:31 15:55 |
| | 21:58 05:36-06:19/43 | 21:10 | 19:57 | 18:41 | 16:32 | 15:55 |
| 10 | 04:55 20:17-21:22/65 | 05:44 19:51-20:39/48 | 06:42 07:12-07:43/31 | 07:38 20:00 | 07:40 08:15-08:55/40 | 08:32 15:55 |
| | 21:57 05:36-06:19/43 | 21:08 | 19:55 | 18:38 | 16:30 | 15:55 |
| 11 | 04:56 20:17-21:10/53 | 21:13-21:19/6 | 05:46 19:52-20:37/45 | 06:44 07:14-07:42/28 | 07:40 16:32 | 07:42 08:17-08:55/38 |
| | 21:56 05:37-06:18/41 | 21:06 | 19:52 | 18:36 | 16:28 | 15:54 |
| 12 | 04:58 20:16-21:10/54 | 05:48 19:52-20:35/43 | 06:46 07:15-07:40/25 | 07:42 19:50 | 07:44 08:19-08:56/37 | 08:35 15:54 |
| | 21:55 05:38-06:17/39 | 21:04 | 19:50 | 18:34 | 16:26 | 15:54 |
| 13 | 04:59 20:15-21:10/55 | 05:50 19:52-20:33/41 | 06:47 07:17-07:39/22 | 07:44 19:50 | 07:46 08:21-08:56/35 | 08:36 15:54 |
| | 21:54 05:38-06:19/38 | 21:02 | 19:47 | 18:31 | 16:24 | 15:54 |
| 14 | 05:00 20:15-21:11/55 | 05:52 19:52-20:31/39 | 06:49 07:19-07:37/18 | 07:46 08:56-09:08/12 | 07:48 08:24-08:58/34 | 08:37 15:54 |
| | 21:53 05:40-06:16/36 | 21:00 | 19:44 | 18:29 | 16:23 | 15:54 |
| 15 | 05:01 20:15-21:11/56 | 05:54 19:53-20:29/36 | 06:51 07:21-07:35/14 | 07:48 08:53-09:11/18 | 07:50 08:26-09:00/34 | 08:38 15:54 |
| | 21:52 05:41-06:15/34 | 20:57 | 19:42 | 18:26 | 16:21 | 15:54 |
| 16 | 05:03 20:14-21:11/57 | 05:55 19:53-20:27/34 | 06:53 07:23-07:33/10 | 07:50 08:51-09:13/22 | 07:52 08:28-09:01/33 | 08:39 15:54 |
| | 21:51 05:42-06:14/32 | 20:55 | 19:39 | 18:24 | 16:19 | 15:54 |
| 17 | 05:04 20:14-21:11/57 | 05:57 19:53-20:24/31 | 06:55 07:24-07:28/4 | 07:52 08:49-09:14/25 | 07:54 08:31-09:02/31 | 08:40 15:54 |
| | 21:50 05:43-06:13/30 | 20:53 | 19:37 | 18:21 | 16:18 | 15:54 |
| 18 | 05:06 20:10-21:11/61 | 05:59 19:54-20:22/28 | 06:57 19:34 | 07:54 08:48-09:15/27 | 07:56 08:32-09:03/31 | 08:41 15:54 |
| | 21:48 05:46-06:12/26 | 20:51 | 19:34 | 18:19 | 16:16 | 15:54 |
| 19 | 05:07 20:06-21:11/65 | 06:01 19:56-20:21/25 | 06:59 19:32 | 07:56 08:48-09:17/29 | 07:58 08:34-09:04/30 | 08:41 15:54 |
| | 21:47 05:47-06:10/23 | 20:48 | 19:32 | 18:17 | 16:15 | 15:54 |
| 20 | 05:09 20:04-21:10/66 | 06:03 19:57-20:19/22 | 07:00 19:29 | 07:58 08:47-09:17/30 | 08:00 08:37-09:05/28 | 08:42 15:54 |
| | 21:46 05:49-06:07/18 | 20:46 | 19:29 | 18:14 | 16:13 | 15:54 |
| 21 | 05:10 20:03-21:11/68 | 06:05 07:21-07:28/7 | 07:02 18:00 | 08:46-09:17/31 | 08:02 08:39-09:05/26 | 08:43 15:55 |
| | 21:44 05:53-06:05/12 | 20:44 19:58-20:16/18 | 19:27 18:12 | 16:13 | 15:55 | 15:55 |
| 22 | 05:12 20:02-21:10/68 | 06:07 07:17-07:32/15 | 07:04 19:24 | 08:02 08:45-09:17/32 | 08:03 08:41-09:06/25 | 08:43 15:55 |
| | 21:43 | 20:41 20:00-20:14/14 | 19:24 18:10 | 16:10 | 15:55 | 15:55 |
| 23 | 05:13 20:01-21:10/69 | 06:08 07:14-07:34/20 | 07:06 18:04 | 08:45-09:17/32 | 08:05 08:43-09:06/23 | 08:44 15:55 |
| | 21:41 | 20:39 20:03-20:12/9 | 19:21 18:07 | 16:09 | 15:56 | 15:56 |
| 24 | 05:15 20:00-21:08/68 | 06:10 07:13-07:36/23 | 07:08 18:06 | 08:45-09:17/32 | 08:07 08:45-09:06/21 | 08:44 15:55 |
| | 21:40 | 20:37 19:19 | 18:05 | 16:08 | 15:56 | 15:56 |
| 25 | 05:16 19:59-21:07/68 | 06:12 07:10-07:37/27 | 07:10 18:07 | 07:44-08:17/33 | 08:09 08:47-09:06/19 | 08:45 15:57 |
| | 21:38 | 20:34 19:16 | 17:03 | 16:06 | 15:57 | 15:57 |
| 26 | 05:18 19:58-21:05/67 | 06:14 07:09-07:39/30 | 07:12 17:01 | 07:10 07:44-08:29/45 | 08:11 08:49-09:07/18 | 08:45 15:58 |
| | 21:37 | 20:32 19:14 | 17:01 | 16:05 | 15:58 | 15:58 |
| 27 | 05:20 19:57-21:04/67 | 06:16 07:08-07:40/32 | 07:13 17:11 | 07:12 07:45-08:32/47 | 08:12 08:51-09:07/16 | 08:45 15:58 |
| | 21:35 | 20:29 19:11 | 16:58 | 16:04 | 15:58 | 15:58 |
| 28 | 05:21 19:56-21:02/66 | 06:18 07:07-07:41/34 | 07:15 17:09 | 07:14 07:46-08:33/47 | 08:14 08:53-09:07/14 | 08:45 15:59 |
| | 21:33 | 20:27 19:09 | 16:56 | 16:03 | 15:59 | 15:59 |
| 29 | 05:23 19:56-21:01/65 | 06:20 07:06-07:41/35 | 07:17 17:16 | 07:16 07:48-08:34/46 | 08:16 08:55-09:07/12 | 08:46 16:00 |
| | 21:32 | 20:25 19:06 | 16:54 | 16:02 | 15:59 | 15:59 |
| 30 | 05:25 19:55-20:59/64 | 06:21 07:05-07:42/37 | 07:19 17:18 | 07:18 07:50-08:35/45 | 08:18 08:57-09:07/10 | 08:46 16:01 |
| | 21:30 | 20:22 19:04 | 16:52 | 16:01 | 15:59 | 16:01 |
| 31 | 05:26 19:55-20:58/63 | 06:23 07:05-07:43/38 | 19:04 17:20 | 07:52-08:36/44 | 16:01 16:02 | 16:02 |
| | 21:28 | 20:20 16:50 | 16:50 | 16:00 | 16:02 | 16:02 |
| Sonnenscheinstunden | 519 | 464 | 384 | 328 | 256 | 227 |
| Anzahl Minuten mit Schatten | 2776 | 1235 | 502 | 597 | 906 | 25 |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| Tag im Monat | Sonnenaufgang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
|--------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
| | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |



Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
Reuterstrasse 9
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Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:00/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_SH **WEA:** 3 - ZB03
Annahmen für Schattenwurfberechnung
Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember | | |
|-----------------------------|--------|---------|-------|-------|---------------|----------------|-------|--------|----------------|----------------|----------|----------|-------|-------|
| 1 | 08:46 | 08:14 | 07:15 | 06:57 | 05:45 | 06:14-06:22/8 | 04:52 | 04:47 | 05:28 | 06:02-06:27/25 | 06:25 | 07:21 | 07:22 | 08:19 |
| 2 | 16:03 | 16:56 | 17:54 | 19:55 | 20:53 | | 21:46 | 22:03 | 21:26 | 20:17 | 19:01 | 16:47 | 16:00 | |
| 3 | 08:45 | 08:12 | 07:12 | 06:54 | 05:43 | 06:12-06:23/11 | 04:51 | 04:47 | 05:30 | 06:04-06:29/25 | 06:27 | 07:23 | 07:24 | 08:21 |
| 4 | 16:04 | 16:58 | 17:56 | 19:57 | 20:55 | | 21:48 | 22:02 | 21:24 | 20:15 | 18:58 | 16:45 | 15:59 | |
| 5 | 08:45 | 08:11 | 07:10 | 06:52 | 05:41 | 06:10-06:23/13 | 04:50 | 04:48 | 05:32 | 06:06-06:30/24 | 06:29 | 07:25 | 07:26 | 08:22 |
| 6 | 16:05 | 17:00 | 17:58 | 19:59 | 20:57 | | 21:49 | 22:02 | 21:22 | 20:12 | 18:56 | 16:43 | 15:58 | |
| 7 | 08:45 | 08:09 | 07:07 | 06:49 | 05:39 | 06:08-06:23/15 | 04:49 | 04:49 | 05:33 | 06:07-06:30/23 | 06:31 | 07:27 | 07:28 | 08:24 |
| 8 | 16:07 | 17:02 | 18:00 | 20:01 | 20:59 | | 21:50 | 22:01 | 21:20 | 20:10 | 18:53 | 16:41 | 15:58 | |
| 9 | 08:45 | 08:07 | 07:05 | 06:47 | 05:36 | 06:06-06:23/17 | 04:48 | 04:50 | 05:35 | 06:09-06:31/22 | 06:33 | 07:28 | 07:30 | 08:25 |
| 10 | 16:08 | 17:04 | 18:02 | 20:03 | 21:01 | | 21:51 | 22:01 | 21:18 | 20:07 | 18:51 | 16:39 | 15:57 | |
| 11 | 08:44 | 08:05 | 07:02 | 06:44 | 05:34 | 06:04-06:23/19 | 04:48 | 04:51 | 05:37 | 06:11-06:32/21 | 06:34 | 07:30 | 07:32 | 08:27 |
| 12 | 16:09 | 17:06 | 18:04 | 20:05 | 21:03 | | 21:52 | 22:00 | 21:16 | 20:05 | 18:48 | 16:37 | 15:56 | |
| 13 | 08:44 | 08:03 | 07:00 | 06:42 | 05:32 | 06:02-06:22/20 | 04:47 | 04:52 | 05:39 | 06:12-06:32/20 | 06:36 | 07:32 | 07:34 | 08:28 |
| 14 | 16:11 | 17:09 | 18:06 | 20:07 | 21:05 | | 21:54 | 21:59 | 21:14 | 20:02 | 18:46 | 16:35 | 15:56 | |
| 15 | 08:43 | 08:01 | 06:58 | 06:39 | 05:30 | 06:00-06:21/21 | 04:46 | 04:53 | 05:41 | 06:14-06:32/18 | 06:38 | 07:34 | 07:36 | 08:30 |
| 16 | 16:12 | 17:11 | 18:08 | 20:09 | 21:07 | | 21:55 | 21:59 | 21:12 | 20:00 | 18:43 | 16:33 | 15:55 | |
| 17 | 08:43 | 07:59 | 06:55 | 06:37 | 05:28 | 05:58-06:21/23 | 04:46 | 04:54 | 05:42 | 06:16-06:32/16 | 06:40 | 07:36 | 07:38 | 08:31 |
| 18 | 16:14 | 17:13 | 18:10 | 20:11 | 21:09 | | 21:56 | 21:58 | 21:10 | 19:57 | 18:41 | 16:32 | 15:55 | |
| 19 | 08:42 | 07:57 | 06:53 | 06:34 | 05:26 | 05:57-06:21/24 | 04:45 | 04:55 | 05:44 | 06:17-06:31/14 | 06:42 | 07:38 | 07:40 | 08:32 |
| 20 | 16:15 | 17:15 | 18:12 | 20:13 | 21:10 | | 21:56 | 21:57 | 21:08 | 19:55 | 18:38 | 16:30 | 15:54 | |
| 21 | 08:41 | 07:55 | 06:50 | 06:32 | 05:24 | 05:55-06:19/24 | 04:44 | 04:56 | 05:46 | 06:19-06:31/12 | 06:44 | 07:40 | 07:42 | 08:33 |
| 22 | 16:17 | 17:17 | 18:14 | 20:15 | 21:12 | | 21:57 | 21:56 | 21:06 | 19:52 | 18:36 | 16:28 | 15:54 | |
| 23 | 08:40 | 07:53 | 06:48 | 06:29 | 05:22 | 05:53-06:18/25 | 04:44 | 04:58 | 05:48 | 06:21-06:31/10 | 06:45 | 07:42 | 07:44 | 08:35 |
| 24 | 16:18 | 17:19 | 18:16 | 20:17 | 21:14 | | 21:58 | 21:55 | 21:04 | 19:49 | 18:33 | 16:26 | 15:54 | |
| 25 | 08:40 | 07:51 | 06:45 | 06:27 | 05:21 | 05:51-06:17/26 | 04:44 | 04:59 | 05:50 | 06:23-06:31/8 | 06:47 | 07:44 | 07:46 | 08:36 |
| 26 | 16:20 | 17:21 | 18:18 | 20:19 | 21:16 | | 21:59 | 21:54 | 21:02 | 19:47 | 18:31 | 16:24 | 15:54 | |
| 27 | 08:39 | 07:49 | 06:43 | 06:25 | 05:19 | 05:50-06:15/25 | 04:43 | 05:00 | 05:52 | 06:24-06:29/5 | 06:49 | 07:46 | 07:48 | 08:37 |
| 28 | 16:22 | 17:23 | 18:20 | 20:21 | 21:18 | | 22:00 | 21:53 | 21:00 | 19:44 | 18:29 | 16:23 | 15:54 | |
| 29 | 08:38 | 07:47 | 06:40 | 06:22 | 05:17 | 05:48-06:14/26 | 04:43 | 05:01 | 05:54 | 06:26-06:28/2 | 06:51 | 07:48 | 07:50 | 08:38 |
| 30 | 16:23 | 17:25 | 18:22 | 20:23 | 21:20 | | 22:00 | 21:52 | 20:57 | 19:42 | 18:26 | 16:21 | 15:54 | |
| 31 | 08:37 | 07:44 | 06:38 | 06:20 | 05:15 | 05:47-06:14/27 | 04:43 | 05:03 | 05:55 | 06:27-06:29/5 | 06:53 | 07:50 | 07:52 | 08:39 |
| 32 | 16:25 | 17:27 | 18:24 | 20:24 | 21:21 | | 22:01 | 21:51 | 20:55 | 19:39 | 18:24 | 16:19 | 15:54 | |
| 33 | 08:36 | 07:42 | 06:35 | 06:17 | 05:13 | 05:45-06:13/28 | 04:43 | 05:04 | 05:57 | 06:01-06:07/6 | 06:57 | 07:54 | 07:56 | 08:40 |
| 34 | 16:27 | 17:29 | 18:26 | 20:26 | 21:23 | | 22:01 | 21:50 | 20:53 | 19:37 | 18:21 | 16:18 | 15:54 | |
| 35 | 08:35 | 07:40 | 06:32 | 06:15 | 05:12 | 05:45-06:13/28 | 04:42 | 05:06 | 06:00-06:10/10 | 06:59 | 07:54 | 07:56 | 08:41 | |
| 36 | 16:29 | 17:32 | 18:28 | 20:28 | 21:25 | | 22:02 | 21:48 | 20:51 | 19:34 | 18:19 | 16:16 | 15:54 | |
| 37 | 08:33 | 07:38 | 06:30 | 06:12 | 05:10 | 05:44-06:12/28 | 04:42 | 05:07 | 05:58-06-11/13 | 06:01 | 06:58 | 07:56 | 07:58 | 08:41 |
| 38 | 16:30 | 17:34 | 18:30 | 20:30 | 21:26 | | 22:02 | 21:47 | 20:48 | 19:32 | 18:17 | 16:15 | 15:54 | |
| 39 | 08:32 | 07:36 | 06:27 | 06:10 | 05:08 | 05:45-06:12/27 | 04:42 | 05:08 | 05:57-06-11/14 | 06:03 | 07:00 | 07:58 | 08:00 | 08:42 |
| 40 | 16:32 | 17:36 | 18:32 | 20:32 | 21:28 | | 22:03 | 21:46 | 20:46 | 19:29 | 18:14 | 16:13 | 15:54 | |
| 41 | 08:31 | 07:33 | 06:25 | 06:08 | 05:07 | 05:45-06-11/26 | 04:43 | 05:10 | 05:57-06-18/21 | 06:05 | 07:02 | 08:00 | 08:01 | 08:43 |
| 42 | 16:34 | 17:38 | 18:34 | 20:34 | 21:30 | | 22:03 | 21:44 | 20:44 | 19:26 | 18:12 | 16:12 | 15:55 | |
| 43 | 08:30 | 07:31 | 06:22 | 06:05 | 05:05 | 05:46-06-10/24 | 04:43 | 05:12 | 05:56-06-19/23 | 06:07 | 07:04 | 08:02 | 08:03 | 08:43 |
| 44 | 16:36 | 17:40 | 18:36 | 20:36 | 21:32 | | 22:03 | 21:43 | 20:41 | 19:24 | 18:10 | 16:10 | 15:55 | |
| 45 | 08:28 | 07:29 | 06:20 | 06:03 | 05:04 | 05:47-06-09/22 | 04:43 | 05:13 | 05:56-06-21/25 | 06:08 | 07:06 | 08:04 | 08:05 | 08:44 |
| 46 | 16:38 | 17:42 | 18:38 | 20:38 | 21:33 | | 22:03 | 21:41 | 20:39 | 19:21 | 18:07 | 16:09 | 15:56 | |
| 47 | 08:27 | 07:26 | 06:17 | 06:01 | 05:02 | 05:47-06-06/19 | 04:43 | 05:15 | 05:55-06-21/26 | 06:10 | 07:08 | 08:06 | 08:07 | 08:44 |
| 48 | 16:40 | 17:44 | 18:40 | 20:40 | 21:35 | | 22:04 | 21:40 | 20:37 | 19:19 | 18:05 | 16:08 | 15:56 | |
| 49 | 08:25 | 07:24 | 06:15 | 05:58 | 05:01 | 05:48-06-02/14 | 04:44 | 05:16 | 05:55-06-23/28 | 06:12 | 07:10 | 08:08 | 08:09 | 08:45 |
| 50 | 16:42 | 17:46 | 18:42 | 20:42 | 21:36 | | 22:04 | 21:38 | 20:34 | 19:16 | 18:03 | 16:06 | 15:57 | |
| 51 | 08:24 | 07:22 | 06:12 | 05:56 | 05:00 | 05:49-06-01/12 | 04:44 | 05:18 | 05:55-06-23/28 | 06:14 | 07:11 | 08:09 | 08:11 | 08:45 |
| 52 | 16:44 | 17:48 | 18:44 | 20:44 | 21:38 | | 22:04 | 21:37 | 20:32 | 19:14 | 18:01 | 16:05 | 15:57 | |
| 53 | 08:22 | 07:19 | 06:10 | 05:54 | 04:58 | 05:51-06-00/9 | 04:44 | 05:20 | 05:55-06-24/29 | 06:16 | 07:13 | 08:12 | 08:12 | 08:45 |
| 54 | 16:46 | 17:50 | 18:46 | 20:46 | 21:39 | | 22:04 | 21:35 | 20:29 | 19:11 | 18:00 | 16:04 | 15:58 | |
| 55 | 08:21 | 07:17 | 06:07 | 05:52 | 04:57 | 05:53-05:58/5 | 04:45 | 05:21 | 05:56-06-24/28 | 06:18 | 07:15 | 08:14 | 08:14 | 08:45 |
| 56 | 16:48 | 17:52 | 18:48 | 20:48 | 21:41 | | 22:03 | 21:33 | 20:27 | 19:09 | 18:00 | 16:03 | 15:59 | |
| 57 | 08:19 | | 07:05 | 05:49 | 06:18-06-20/2 | 04:56 | 04:45 | 05:23 | 05:58-06-25/27 | 06:20 | 07:17 | 08:16 | 08:16 | 08:46 |
| 58 | 16:50 | | 19:50 | 20:50 | 21:42 | | 22:03 | 21:31 | 20:24 | 19:06 | 18:00 | 16:04 | 15:60 | 16:00 |
| 59 | 08:18 | | 07:02 | 05:47 | 06:16-06-22/6 | 04:55 | 04:46 | 05:25 | 05:59-06-25/26 | 06:21 | 07:19 | 08:18 | 08:18 | 08:46 |
| 60 | 16:52 | | 19:52 | 20:52 | 21:44 | | 22:03 | 21:30 | 20:22 | 19:03 | 18:02 | 16:01 | 16:01 | 16:01 |
| 61 | 08:16 | | 06:59 | | 04:53 | | | 05:26 | 06:01-06-25/24 | 06:23 | | 07:20 | | 08:46 |
| 62 | 16:54 | | 19:53 | | 21:45 | | | 21:28 | | 20:20 | | 16:50 | | 16:02 |
| Sonnenscheinstunden | 244 | 269 | 365 | 421 | 498 | 566 | 517 | 519 | 464 | 384 | 328 | 256 | 227 | 0 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 8 | 0 | 0 | 328 | 245 | 0 | 0 | 0 | 0 | 0 | 0 |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| Tag im Monat | Sonnenaufgang (SS:MM) | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
| | | | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |



8.8 SHADOW-Kalender pro WEA (Zusatzbelastung) – Immissionsorte DK

Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
Reuterstrasse 9
DE-18211 Bargeshagen
+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_DK **WEA: 1 - ZB01**
Annahmen für Schattenwurfberechnung
Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|---|-------------------------------|-------------------------------|--|--|--|--|--|--|--|--|--|--|
| 1 | 08:46 14:58-15:27/29 16:03 | 08:14 16:09-16:26/17 16:56 | 07:15 06:57 05:45 17:54 19:56 20:54 | 06:57 05:45 04:52 17:54 19:56 20:54 | 05:45 04:52 04:47 17:54 19:56 20:54 | 04:52 04:47 04:47 17:54 19:56 20:54 | 04:47 04:47 04:47 17:54 19:56 20:54 |
| 2 | 08:46 14:58-15:27/29 16:04 | 08:12 16:09-16:28/19 16:58 | 07:12 06:55 05:43 17:58 19:59 20:57 | 06:55 05:43 04:51 17:58 19:59 20:57 | 05:43 04:51 04:48 17:58 19:59 20:57 | 04:51 04:48 04:48 17:58 19:59 20:57 | 04:48 04:48 04:48 17:58 19:59 20:57 |
| Sonnenscheinstunden 244 269 475 365 421 498 517 0 519 0 464 0 384 0 328 185 256 781 227 863 | | | | | | | | | | | | |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| | | | | |
|--------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
| Tag im Monat | Sonnenaufgang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
| | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |



Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
Reuterstrasse 9
DE-18211 Bargeschagen
+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:17/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_DK **WEA: 2 - ZB02**
Annahmen für Schattenwurfberechnung
Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|---|----------------------|----------------------|-------------------|-------------------|-------------------|----------------------|----------------------|--------|-----------|---------|----------|----------|
| 1 | 08:46 15:08-15:27/19 | 08:14 16:11-16:26/15 | 07:15 06:57 05:45 | 04:52 04:47 05:28 | 06:25 07:21 | 07:22 15:46-16:10/24 | 08:19 14:52-15:20/28 | | | | | |
| 16:03 | 14:39-15:06/27 | 16:56 | 17:54 19:55 20:54 | 21:46 22:03 21:26 | 22:03 21:26 20:17 | 19:01 | 16:48 | | | | | |
| 2 | 08:46 15:07-15:27/20 | 08:12 16:11-16:28/17 | 07:12 06:54 05:43 | 04:51 04:48 05:30 | 06:27 07:23 | 07:24 15:44-16:10/26 | 08:21 14:53-15:20/27 | | | | | |
| 16:04 | 14:39-15:06/27 | 16:58 | 17:56 19:57 20:55 | 21:48 22:02 21:24 | 20:15 18:58 | 16:45 | 15:59 14:29-14:49/20 | | | | | |
| 3 | 08:45 15:08-15:29/21 | 08:11 16:11-16:30/19 | 07:10 06:52 05:41 | 04:50 04:48 05:32 | 06:29 07:25 | 07:26 15:43-16:11/28 | 08:22 14:53-15:21/28 | | | | | |
| 16:06 | 14:40-15:06/26 | 17:00 | 17:58 19:59 20:57 | 21:49 22:02 21:22 | 20:12 18:56 | 16:43 | 15:58 14:29-14:50/21 | | | | | |
| 4 | 08:45 15:08-15:30/22 | 08:09 16:11-16:33/22 | 07:07 06:49 05:39 | 04:49 04:49 05:34 | 06:31 07:27 | 07:28 15:42-16:11/29 | 08:24 14:54-15:22/28 | | | | | |
| 16:07 | 14:40-15:06/26 | 17:02 | 18:00 20:01 20:59 | 21:50 22:01 21:20 | 20:10 18:53 | 16:41 | 15:58 14:29-14:51/22 | | | | | |
| 5 | 08:45 15:09-15:32/23 | 08:07 16:11-16:35/24 | 07:05 06:47 05:36 | 04:49 04:50 05:35 | 06:33 07:28 | 07:30 15:41-16:09/28 | 08:25 14:54-15:21/27 | | | | | |
| 16:08 | 14:41-15:07/26 | 17:04 | 18:02 20:03 21:01 | 21:01 21:18 20:07 | 18:51 | 16:39 | 15:57 14:28-14:51/23 | | | | | |
| 6 | 08:44 15:09-15:33/24 | 08:05 16:12-16:37/25 | 07:03 06:44 05:34 | 04:48 04:51 05:37 | 06:34 07:30 | 07:32 15:41-16:07/26 | 08:27 14:55-15:21/26 | | | | | |
| 16:09 | 14:42-15:07/25 | 17:07 | 18:04 20:05 21:03 | 21:52 22:00 21:16 | 20:05 18:48 | 16:37 | 15:54 14:28-14:53/25 | | | | | |
| 7 | 08:44 15:09-15:34/25 | 08:03 16:12-16:40/28 | 07:00 06:42 05:32 | 04:47 04:52 05:39 | 06:36 07:32 | 07:34 15:41-16:05/24 | 08:28 14:55-15:20/25 | | | | | |
| 16:11 | 14:42-15:06/24 | 17:09 | 18:06 20:07 21:05 | 21:54 22:00 21:14 | 20:02 18:46 | 16:35 | 15:56 14:28-14:53/25 | | | | | |
| 8 | 08:43 15:10-15:37/27 | 08:01 16:12-16:41/29 | 06:58 06:39 05:30 | 04:46 04:53 05:41 | 06:38 07:34 | 07:36 15:41-16:03/22 | 08:30 14:56-15:19/23 | | | | | |
| 16:12 | 14:44-15:07/23 | 17:11 | 18:08 20:09 21:07 | 21:55 21:59 21:12 | 20:00 18:43 | 16:33 | 15:55 14:29-14:54/25 | | | | | |
| 9 | 08:43 15:10-15:38/28 | 07:59 16:13-16:41/28 | 06:55 06:37 05:28 | 04:46 04:54 05:43 | 06:40 07:36 | 07:38 15:41-16:00/19 | 08:31 14:56-15:18/22 | | | | | |
| 16:14 | 14:44-15:07/23 | 17:13 | 18:10 20:11 21:09 | 21:56 21:58 21:10 | 19:57 18:41 | 16:32 | 15:55 14:28-14:54/26 | | | | | |
| 10 | 08:42 15:10-15:38/28 | 07:57 16:15-16:40/25 | 06:53 06:34 05:26 | 04:45 04:55 05:44 | 06:42 07:38 | 07:40 15:42-15:59/17 | 08:32 14:57-15:19/22 | | | | | |
| 16:15 | 14:45-15:07/22 | 17:15 | 18:12 20:13 21:10 | 21:57 21:57 21:08 | 19:55 18:38 | 16:30 | 15:55 14:29-14:55/26 | | | | | |
| 11 | 08:41 15:11-15:38/27 | 07:55 16:17-16:40/23 | 06:50 06:32 05:24 | 04:45 04:56 05:46 | 06:44 07:40 | 07:42 15:42-15:57/15 | 08:34 14:57-15:18/21 | | | | | |
| 16:17 | 14:46-15:06/20 | 17:17 | 18:14 20:15 21:12 | 21:57 21:56 21:06 | 19:52 18:36 | 16:28 | 15:54 14:29-14:56/27 | | | | | |
| 12 | 08:40 15:11-15:39/28 | 07:53 16:20-16:39/19 | 06:48 06:30 05:23 | 04:44 04:58 05:48 | 06:46 07:42 | 07:44 15:42-15:55/13 | 08:35 14:58-15:17/19 | | | | | |
| 16:18 | 14:47-15:06/19 | 17:19 | 18:16 20:17 21:14 | 21:58 21:55 21:04 | 19:50 18:34 | 16:26 | 15:54 14:29-14:56/27 | | | | | |
| 13 | 08:40 15:12-15:39/27 | 07:51 16:23-16:37/14 | 06:45 06:27 05:21 | 04:44 04:59 05:50 | 06:47 07:44 | 07:46 15:42-15:52/10 | 08:36 14:58-15:17/19 | | | | | |
| 16:20 | 14:49-15:06/17 | 17:21 | 18:18 20:19 21:16 | 21:59 21:54 21:02 | 19:47 18:31 | 16:24 | 15:54 14:29-14:57/28 | | | | | |
| 14 | 08:39 15:12-15:39/27 | 07:49 16:26-16:35/9 | 06:43 06:25 05:19 | 04:43 05:00 05:52 | 06:49 07:46 | 07:48 15:43-15:50/7 | 08:37 14:58-15:16/18 | | | | | |
| 16:22 | 14:50-15:05/15 | 17:23 | 18:20 20:21 21:18 | 22:00 21:53 21:00 | 19:44 18:29 | 16:23 | 15:54 14:29-14:57/28 | | | | | |
| 15 | 08:38 15:12-15:39/27 | 07:47 | 06:40 06:22 05:17 | 04:43 05:01 05:54 | 06:51 07:48 | 07:50 15:46-15:49/4 | 08:38 14:59-15:16/17 | | | | | |
| 16:23 | 14:52-15:03/11 | 17:25 | 18:22 20:23 21:20 | 22:00 21:52 20:57 | 19:42 18:26 | 16:21 | 15:54 14:30-14:58/28 | | | | | |
| 16 | 08:37 15:13-15:39/26 | 07:44 | 06:38 06:20 05:15 | 04:43 05:03 05:55 | 06:53 07:50 | 07:52 15:46-15:47/1 | 08:39 15:00-15:16/16 | | | | | |
| 16:25 | 14:55-15:01/6 | 17:27 | 18:24 20:25 21:21 | 22:01 21:51 20:55 | 19:39 18:24 | 16:19 | 15:54 14:30-14:58/28 | | | | | |
| 17 | 08:36 15:14-15:40/26 | 07:42 | 06:35 06:17 05:14 | 04:43 05:04 05:57 | 06:55 07:52 | 07:54 15:00-15:05/5 | 08:40 15:00-15:16/16 | | | | | |
| 16:27 | | 17:30 | 18:26 20:26 21:23 | 22:02 21:50 20:53 | 19:37 18:21 | 16:18 | 15:54 14:31-14:59/28 | | | | | |
| 18 | 08:35 15:15-15:40/25 | 07:40 | 06:33 06:15 05:12 | 04:43 05:06 05:59 | 06:57 07:54 | 07:56 14:57-15:08/11 | 08:41 15:01-15:17/16 | | | | | |
| 16:29 | | 17:32 | 18:28 20:28 21:25 | 22:02 21:48 20:51 | 19:34 18:19 | 16:16 | 15:54 14:31-14:59/28 | | | | | |
| 19 | 08:33 15:15-15:39/24 | 07:38 | 06:30 06:13 05:10 | 04:43 05:07 06:01 | 06:59 07:56 | 07:58 14:55-15:10/15 | 08:41 15:02-15:17/15 | | | | | |
| 16:31 | | 17:34 | 18:30 20:30 21:27 | 22:02 21:47 20:48 | 19:32 18:17 | 16:15 | 15:54 14:32-15:00/28 | | | | | |
| 20 | 08:32 15:16-15:39/23 | 07:36 | 06:27 06:10 05:09 | 04:43 05:09 06:03 | 07:00 07:58 | 08:00 | 08:42 15:03-15:18/15 | | | | | |
| 16:33 | | 17:36 | 18:32 20:32 21:28 | 22:03 21:46 20:46 | 19:29 18:14 | 16:13 | 15:54 14:33-15:01/28 | | | | | |
| 21 | 08:31 15:17-15:39/22 | 07:33 | 06:25 06:08 05:07 | 04:43 05:10 06:05 | 07:02 08:00 | 08:02 14:54-15:14/20 | 08:43 15:02-15:17/15 | | | | | |
| 16:34 | | 17:38 | 18:34 20:34 21:30 | 22:03 21:44 20:44 | 19:27 18:12 | 16:12 | 15:55 14:33-15:01/28 | | | | | |
| 22 | 08:30 15:18-15:39/21 | 07:31 | 06:22 06:05 05:05 | 04:43 05:12 06:07 | 07:04 08:02 | 08:03 14:53-15:15/22 | 08:43 15:03-15:18/15 | | | | | |
| 16:36 | | 17:40 | 18:36 20:36 21:32 | 22:03 21:43 20:41 | 19:24 18:10 | 16:10 | 15:55 14:33-15:02/29 | | | | | |
| 23 | 08:28 15:19-15:38/19 | 07:29 | 06:20 06:03 05:04 | 04:43 05:13 06:08 | 07:06 08:04 | 08:05 14:53-15:16/23 | 08:44 15:03-15:18/15 | | | | | |
| 16:38 | | 17:42 | 18:38 20:38 21:33 | 22:04 21:41 20:39 | 19:21 18:07 | 16:09 | 15:56 14:33-15:02/29 | | | | | |
| 24 | 08:27 15:21-15:36/15 | 07:26 | 06:17 06:01 05:02 | 04:43 05:15 06:10 | 07:08 08:06 | 08:07 14:52-15:16/24 | 08:44 15:03-15:18/15 | | | | | |
| 16:40 | | 17:44 | 18:40 20:40 21:35 | 22:04 21:40 20:37 | 19:19 18:05 | 16:08 | 15:56 14:34-15:02/28 | | | | | |
| 25 | 08:25 15:23-15:35/12 | 07:24 | 06:15 06:01 05:01 | 04:44 05:16 06:12 | 07:10 08:08 | 08:09 14:52-15:17/25 | 08:45 15:05-15:20/15 | | | | | |
| 16:42 | | 17:46 | 18:42 20:42 21:36 | 22:04 21:38 20:34 | 19:16 17:03 | 16:06 | 15:57 14:35-15:03/28 | | | | | |
| 26 | 08:24 15:26-15:32/6 | 07:22 | 06:12 06:06 05:06 | 04:44 05:18 06:14 | 07:12 08:10 | 08:11 14:52-15:18/26 | 08:45 15:05-15:20/15 | | | | | |
| 16:44 | | 17:48 | 18:44 20:44 21:38 | 22:04 21:37 20:32 | 19:14 17:01 | 16:05 | 15:58 14:35-15:03/28 | | | | | |
| 27 | 08:22 16:13-16:14/1 | 07:19 | 06:10 06:04 05:04 | 04:44 05:20 06:16 | 07:13 08:12 | 08:12 14:52-15:18/26 | 08:45 15:05-15:21/16 | | | | | |
| 16:46 | | 17:50 | 18:46 20:46 21:39 | 22:04 21:35 20:29 | 19:11 16:58 | 16:04 | 14:34-14:40/6 | | | | | |
| 28 | 08:21 16:12-16:16/4 | 07:17 | 06:07 06:02 05:02 | 04:45 05:21 06:18 | 07:15 08:14 | 08:14 14:52-15:19/27 | 08:45 15:05-15:22/17 | | | | | |
| 16:48 | | 17:52 | 18:48 20:48 21:41 | 22:03 21:33 20:27 | 19:09 16:56 | 16:03 | 14:32-14:43/11 | | | | | |
| 29 | 08:19 16:12-16:19/7 | | 07:05 06:59 05:56 | 04:46 05:23 06:20 | 07:17 08:16 | 08:16 14:52-15:20/28 | 08:46 15:06-15:23/17 | | | | | |
| 16:50 | | 17:56 | 18:50 20:50 21:42 | 22:03 21:32 20:25 | 19:06 16:54 | 16:02 | 14:31-14:45/14 | | | | | |
| 30 | 08:18 16:11-16:21/10 | | 07:02 06:57 05:55 | 04:46 05:25 06:21 | 07:19 08:18 | 08:18 14:52-15:19/27 | 08:46 15:06-15:24/18 | | | | | |
| 16:52 | | 17:58 | 18:52 20:52 21:44 | 22:03 21:30 20:22 | 19:04 16:52 | 16:01 | 14:30-14:47/17 | | | | | |
| 31 | 08:16 16:11-16:24/13 | | 07:00 06:53 05:51 | 04:46 05:26 06:23 | 07:20 08:19 | 08:19 14:52-15:19/27 | 08:46 15:07-15:25/18 | | | | | |
| 16:54 | | 17:59 | 18:54 20:54 21:45 | 22:04 21:28 20:20 | 19:00 16:50 | 16:02 | 14:38-15:05/27 | | | | | |
| Sonnenscheinstunden 244 | | | | | | | | | | | | |
| Anzahl Minuten mit Schatten 964 269 297 365 421 498 517 519 464 384 328 44 256 638 227 1423 | | | | | | | | | | | | |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| | | | | |
|--------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
| Tag im Monat | Sonnenaufgang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
| | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |

Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
Reuterstrasse 9
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+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:17/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_DK **WEA:** 3 - ZB03
Annahmen für Schattenwurfberechnung
Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | Januar | Februar | März | April | Mai | Juni |
|-----------------------------|-------------------------------------|----------------------|----------------------|-------|-------|-------|
| 1 | 08:46 14:55-15:25/30 10:48-11:00/12 | 08:14 15:07-15:36/29 | 07:15 17:01-17:26/25 | 06:57 | 05:45 | 04:52 |
| | 16:03 13:13-14:13/60 09:25-09:50/25 | 16:56 | 17:54 16:46-16:59/13 | 19:55 | 20:53 | 21:46 |
| 2 | 08:45 14:55-15:26/31 10:48-10:59/11 | 08:12 15:08-15:35/27 | 07:12 17:02-17:26/24 | 06:54 | 05:43 | 04:51 |
| | 16:04 13:14-14:13/59 09:24-09:50/26 | 16:58 | 17:56 | 19:57 | 20:55 | 21:48 |
| 3 | 08:45 14:56-15:28/32 10:51-10:58/7 | 08:11 15:10-15:33/23 | 07:10 17:02-17:24/22 | 06:52 | 05:41 | 04:50 |
| | 16:05 13:15-14:14/59 09:25-09:51/26 | 17:00 | 17:58 | 19:59 | 20:57 | 21:49 |
| 4 | 08:45 14:56-15:28/32 09:25-09:51/26 | 08:09 15:12-15:32/20 | 07:07 17:03-17:24/21 | 06:49 | 05:39 | 04:49 |
| | 16:07 13:16-14:13/57 | 17:02 | 18:00 | 20:01 | 20:59 | 21:50 |
| 5 | 08:45 14:56-15:29/33 09:26-09:52/26 | 08:07 15:15-15:29/14 | 07:05 17:03-17:22/19 | 06:47 | 05:36 | 04:48 |
| | 16:08 13:17-14:14/57 | 17:04 | 18:02 | 20:03 | 21:01 | 21:51 |
| 6 | 08:44 14:56-15:29/33 09:26-09:52/26 | 08:05 16:33-16:37/4 | 07:02 17:05-17:21/16 | 06:44 | 05:34 | 04:48 |
| | 16:09 13:18-14:14/56 | 17:06 15:20-15:24/4 | 18:04 | 20:05 | 21:03 | 21:52 |
| 7 | 08:44 14:56-15:30/34 09:26-09:52/26 | 08:03 16:31-16:40/9 | 07:00 17:07-17:17/10 | 06:42 | 05:32 | 04:47 |
| | 16:11 13:19-14:14/55 | 17:09 | 18:06 | 20:07 | 21:05 | 21:54 |
| 8 | 08:43 14:57-15:31/34 09:27-09:53/26 | 08:01 16:29-16:41/12 | 06:58 | 06:39 | 05:30 | 04:46 |
| | 16:12 13:21-14:14/53 | 17:11 | 18:08 | 20:09 | 21:07 | 21:55 |
| 9 | 08:43 14:57-15:32/35 09:27-09:54/27 | 07:59 16:28-16:44/16 | 06:55 17:43-17:45/2 | 06:37 | 05:28 | 04:46 |
| | 16:14 13:22-14:14/52 | 17:13 | 18:10 | 20:11 | 21:09 | 21:56 |
| 10 | 08:42 14:57-15:32/35 09:27-09:54/27 | 07:57 16:27-16:46/19 | 06:53 17:43-17:48/5 | 06:34 | 05:26 | 04:45 |
| | 16:15 13:23-14:14/51 | 17:15 | 18:12 | 20:13 | 21:10 | 21:56 |
| 11 | 08:41 14:57-15:33/36 13:25-13:42/17 | 07:55 16:27-16:49/22 | 06:50 17:41-17:49/8 | 06:32 | 05:24 | 04:44 |
| | 16:17 13:44-14:13/29 09:28-09:54/26 | 17:17 | 18:14 | 20:15 | 21:12 | 21:57 |
| 12 | 08:40 14:57-15:34/37 13:27-13:41/14 | 07:53 16:26-16:51/25 | 06:48 17:40-17:51/11 | 06:29 | 05:22 | 04:44 |
| | 16:18 13:45-14:13/28 09:28-09:54/26 | 17:19 | 18:16 | 20:17 | 21:14 | 21:58 |
| 13 | 08:40 14:57-15:34/37 13:31-13:39/8 | 07:51 16:25-16:53/28 | 06:45 17:40-17:53/13 | 06:27 | 05:21 | 04:44 |
| | 16:20 13:47-14:13/26 09:29-09:55/26 | 17:21 | 18:18 | 20:19 | 21:16 | 21:59 |
| 14 | 08:39 14:58-15:35/37 09:30-09:55/25 | 07:49 16:25-16:55/30 | 06:43 17:39-17:55/16 | 06:25 | 05:19 | 04:43 |
| | 16:22 13:48-14:12/24 | 17:23 | 18:20 | 20:21 | 21:18 | 22:00 |
| 15 | 08:38 14:57-15:35/38 09:29-09:54/25 | 07:47 16:25-16:58/33 | 06:40 17:40-17:58/18 | 06:22 | 05:17 | 04:43 |
| | 16:23 13:49-14:10/21 | 17:25 | 18:22 | 20:23 | 21:20 | 22:00 |
| 16 | 08:37 14:58-15:36/38 09:30-09:55/25 | 07:44 16:25-17:00/35 | 06:38 17:40-17:57/17 | 06:20 | 05:15 | 04:43 |
| | 16:25 13:51-14:10/19 | 17:27 | 18:24 | 20:24 | 21:21 | 22:01 |
| 17 | 08:36 14:58-15:36/38 09:31-09:55/24 | 07:42 16:25-17:02/37 | 06:35 17:41-17:56/15 | 06:17 | 05:13 | 04:43 |
| | 16:27 13:54-14:08/14 | 17:29 | 18:26 | 20:26 | 21:23 | 22:01 |
| 18 | 08:35 14:58-15:36/38 09:33-09:55/22 | 07:40 16:25-17:05/40 | 06:32 17:42-17:54/12 | 06:15 | 05:12 | 04:42 |
| | 16:29 13:57-14:05/8 | 17:32 | 18:28 | 20:28 | 21:25 | 22:02 |
| 19 | 08:33 14:58-15:37/39 | 07:38 16:26-17:07/41 | 06:30 17:45-17:52/7 | 06:12 | 05:10 | 04:42 |
| | 16:30 09:33-09:54/21 | 17:34 | 18:30 | 20:30 | 21:26 | 22:02 |
| 20 | 08:32 14:59-15:38/39 | 07:36 16:26-17:08/42 | 06:27 | 06:10 | 05:08 | 04:42 |
| | 16:32 09:34-09:54/20 | 17:36 | 18:32 | 20:32 | 21:28 | 22:03 |
| 21 | 08:31 14:59-15:38/39 | 07:33 16:27-17:11/44 | 06:25 | 06:08 | 05:07 | 04:43 |
| | 16:34 09:35-09:53/18 | 17:38 | 18:34 | 20:34 | 21:30 | 22:03 |
| 22 | 08:30 15:00-15:38/38 | 07:31 16:27-17:13/46 | 06:22 | 06:05 | 05:05 | 04:43 |
| | 16:36 09:37-09:53/16 | 17:40 | 18:36 | 20:36 | 21:32 | 22:03 |
| 23 | 08:28 15:00-15:38/38 | 07:29 16:29-17:16/47 | 06:20 | 06:03 | 05:04 | 04:43 |
| | 16:38 09:38-09:51/13 | 17:42 | 18:38 | 20:38 | 21:33 | 22:03 |
| 24 | 08:27 15:00-15:38/38 | 07:26 16:31-17:18/47 | 06:17 | 06:01 | 05:02 | 04:43 |
| | 16:40 09:40-09:49/9 | 17:44 | 18:40 | 20:40 | 21:35 | 22:04 |
| 25 | 08:25 15:01-15:38/37 | 07:24 16:33-17:20/47 | 06:15 | 05:58 | 05:01 | 04:44 |
| | 16:42 | 17:46 | 18:42 | 20:42 | 21:36 | 22:04 |
| 26 | 08:24 15:02-15:38/36 | 07:22 16:42-17:22/40 | 06:12 | 05:56 | 05:00 | 04:44 |
| | 16:44 | 17:48 | 18:44 | 20:44 | 21:38 | 22:04 |
| 27 | 08:22 15:02-15:38/36 | 07:19 16:43-17:24/41 | 06:10 | 05:54 | 04:58 | 04:44 |
| | 16:46 | 17:50 | 18:46 | 20:46 | 21:39 | 22:04 |
| 28 | 08:21 15:03-15:37/34 | 07:17 16:45-17:26/41 | 06:07 | 05:52 | 04:57 | 04:45 |
| | 16:48 | 17:52 | 18:48 | 20:48 | 21:41 | 22:03 |
| 29 | 08:19 15:03-15:37/34 | | 07:05 | 05:49 | 04:56 | 04:45 |
| | 16:50 | | 19:50 | 20:50 | 21:42 | 22:03 |
| 30 | 08:18 15:05-15:37/32 | | 07:02 | 05:47 | 04:55 | 04:46 |
| | 16:52 | | 19:52 | 20:52 | 21:44 | 22:03 |
| 31 | 08:16 15:06-15:36/30 | | 06:59 | | 04:53 | |
| | 16:54 | | 19:53 | | 21:45 | |
| Sonnenscheinstunden | 244 | 269 | 365 | 421 | 498 | 517 |
| Anzahl Minuten mit Schatten | 2452 | 863 | 274 | 0 | 0 | 0 |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| Tag im Monat | Sonnenaufgang (SS:MM) | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|



Projekt:
018FB123-03

Lizenzierter Anwender:
WIND-consult GmbH
Reuterstrasse 9
DE-18211 Bargeshagen
+49 (0) 38203-50725
Hoffmann / christian.hoffmann@wind-consult.de
Berechnet:
03.03.2026 13:17/4.2.285

SHADOW - Kalender pro WEA

Berechnung: Zusatzbelastung_DK **WEA:** 3 - ZB03
Annahmen für Schattenwurfberechnung
Referenzjahr für Kalender 2026

Sonnenscheinwahrscheinlichkeit S (Mittlere tägliche Sonnenstunden) [SCHLESWIG]
Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dez
1,51 2,64 3,27 5,80 7,66 6,74 7,28 6,92 4,61 3,08 1,94 1,14

Keine Betriebseinschränkung. Annahme: WEA sind immer in Betrieb in pessimaler Windrichtung.

| | July | August | September | Oktober | November | Dezember | | | | | |
|-----------------------------|-------|--------|-----------|---------|----------------|----------|----------------|----------------|----------------|----------------|----------------|
| 1 | 04:47 | 05:28 | 06:25 | 07:21 | 18:19-18:34/15 | 07:22 | 15:55-16:17/22 | 08:19 | 14:38-15:15/37 | 13:09-13:22/13 | |
| | 22:03 | 21:26 | 20:17 | 19:01 | 16:47 | 16:00 | 13:27-13:54/27 | 09:10-09:36/26 | 08:21 | 14:39-15:15/36 | 13:08-13:24/16 |
| 2 | 04:47 | 05:30 | 06:27 | 07:23 | 18:19-18:31/12 | 07:24 | 15:57-16:16/19 | 08:21 | 14:39-15:15/36 | 13:08-13:24/16 | |
| | 22:02 | 21:24 | 20:15 | 18:58 | 16:45 | 16:00 | 13:26-13:56/30 | 09:10-09:36/26 | 08:22 | 14:40-15:16/36 | 09:11-09:37/26 |
| 3 | 04:48 | 05:32 | 06:29 | 07:25 | 18:19-18:29/10 | 07:26 | 15:58-16:13/15 | 08:22 | 14:40-15:16/36 | 09:11-09:37/26 | |
| | 22:02 | 21:22 | 20:12 | 18:56 | 16:43 | 16:00 | 13:27-13:57/30 | 09:11-09:37/26 | 08:24 | 14:40-15:15/35 | 09:11-09:38/27 |
| 4 | 04:49 | 05:33 | 06:31 | 07:27 | 18:19-18:26/7 | 07:28 | 15:59-16:11/12 | 08:24 | 14:40-15:15/35 | 09:11-09:38/27 | |
| | 22:01 | 21:20 | 20:10 | 18:53 | 16:41 | 16:00 | 13:28-13:58/30 | 09:11-09:38/27 | 08:25 | 14:41-15:16/35 | 09:11-09:38/27 |
| 5 | 04:50 | 05:35 | 06:33 | 07:28 | 18:20-18:24/4 | 07:30 | 16:00-16:09/9 | 08:25 | 14:41-15:16/35 | 09:11-09:38/27 | |
| | 22:01 | 21:18 | 20:07 | 18:51 | 16:39 | 16:00 | 13:29-13:59/30 | 09:11-09:38/27 | 08:27 | 14:42-15:16/34 | 09:12-09:38/26 |
| 6 | 04:51 | 05:37 | 06:34 | 07:30 | 18:20-18:24/4 | 07:32 | 16:03-16:07/4 | 08:27 | 14:42-15:16/34 | 09:12-09:38/26 | |
| | 22:00 | 21:16 | 20:05 | 18:48 | 16:37 | 16:00 | 13:30-14:00/55 | 08:28 | 14:42-15:16/34 | 09:12-09:38/26 | |
| 7 | 04:52 | 05:39 | 06:36 | 07:32 | 17:46-17:51/5 | 07:34 | 14:45-14:59/14 | 08:28 | 14:42-15:16/34 | 09:12-09:38/26 | |
| | 21:59 | 21:14 | 20:02 | 18:46 | 16:35 | 16:00 | 13:31-14:01/57 | 08:29 | 14:43-15:17/34 | 09:13-09:39/26 | |
| 8 | 04:53 | 05:41 | 06:38 | 07:34 | 17:42-17:55/13 | 07:36 | 14:42-15:02/20 | 08:30 | 14:44-15:17/34 | 09:13-09:39/26 | |
| | 21:59 | 21:12 | 20:00 | 18:43 | 16:33 | 16:00 | 13:32-14:02/57 | 08:31 | 14:44-15:17/34 | 09:13-09:39/26 | |
| 9 | 04:54 | 05:42 | 06:40 | 07:36 | 17:40-17:56/16 | 07:38 | 14:40-15:03/23 | 08:31 | 14:44-15:17/34 | 09:13-09:39/26 | |
| | 21:58 | 21:10 | 19:57 | 18:41 | 16:32 | 16:00 | 13:33-14:03/58 | 08:32 | 14:44-15:17/34 | 09:13-09:39/26 | |
| 10 | 04:55 | 05:44 | 06:42 | 07:38 | 17:38-17:58/20 | 07:40 | 14:39-15:06/27 | 08:32 | 14:44-15:17/34 | 09:13-09:39/26 | |
| | 21:57 | 21:08 | 19:55 | 18:38 | 16:30 | 16:00 | 13:34-14:04/58 | 08:33 | 14:44-15:17/34 | 09:13-09:39/26 | |
| 11 | 04:56 | 05:46 | 06:44 | 07:40 | 17:37-17:58/21 | 07:42 | 14:38-15:07/29 | 08:33 | 14:44-15:17/34 | 09:13-09:39/26 | |
| | 21:56 | 21:06 | 19:52 | 18:36 | 16:28 | 16:00 | 13:35-14:05/59 | 08:35 | 14:46-15:17/31 | 10:38-10:50/12 | |
| 12 | 04:58 | 05:48 | 06:45 | 07:42 | 17:36-17:59/23 | 07:44 | 14:37-15:07/30 | 08:35 | 14:46-15:17/31 | 10:38-10:50/12 | |
| | 21:55 | 21:04 | 19:49 | 18:33 | 16:26 | 16:00 | 13:36-14:06/60 | 08:36 | 14:47-15:17/30 | 10:37-10:51/14 | |
| 13 | 04:59 | 05:50 | 06:47 | 07:44 | 17:35-17:59/24 | 07:46 | 14:36-15:08/32 | 08:36 | 14:47-15:17/30 | 10:37-10:51/14 | |
| | 21:54 | 21:02 | 19:47 | 18:31 | 17:22-17:30/8 | 16:24 | 14:37-15:09/34 | 08:37 | 14:47-15:16/29 | 10:37-10:52/15 | |
| 14 | 05:00 | 05:52 | 06:49 | 07:46 | 17:34-17:59/25 | 07:48 | 14:35-15:09/34 | 08:37 | 14:47-15:16/29 | 10:37-10:52/15 | |
| | 21:53 | 21:00 | 19:44 | 18:29 | 17:19-17:33/14 | 16:23 | 14:36-15:10/34 | 08:39 | 14:48-15:16/28 | 10:37-10:55/18 | |
| 15 | 05:01 | 05:54 | 06:51 | 07:48 | 17:16-17:58/42 | 07:50 | 14:36-15:10/34 | 08:38 | 14:48-15:16/28 | 10:37-10:55/18 | |
| | 21:52 | 20:57 | 19:42 | 18:26 | 16:21 | 16:00 | 13:37-14:07/61 | 08:40 | 14:49-15:16/27 | 10:37-10:55/18 | |
| 16 | 05:03 | 05:55 | 06:53 | 07:50 | 17:15-17:56/41 | 07:52 | 14:35-15:11/36 | 08:40 | 14:49-15:16/27 | 10:37-10:55/18 | |
| | 21:51 | 20:55 | 19:39 | 18:24 | 16:19 | 16:00 | 13:38-14:08/62 | 08:41 | 14:50-15:17/27 | 10:38-10:56/18 | |
| 17 | 05:04 | 05:57 | 06:55 | 07:52 | 17:07-17:53/46 | 07:54 | 14:35-15:11/36 | 08:41 | 14:50-15:17/27 | 10:38-10:56/18 | |
| | 21:50 | 20:53 | 19:37 | 18:21 | 16:18 | 16:00 | 13:39-14:09/63 | 08:42 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 18 | 05:06 | 05:59 | 06:57 | 07:54 | 17:03-17:51/48 | 07:56 | 14:34-15:12/38 | 08:42 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:48 | 20:51 | 19:34 | 18:19 | 16:16 | 16:00 | 13:40-14:10/64 | 08:43 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 19 | 05:07 | 06:01 | 06:58 | 07:56 | 17:01-17:48/47 | 07:58 | 14:34-15:12/38 | 08:43 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:47 | 20:48 | 19:32 | 18:17 | 16:15 | 16:00 | 13:41-14:11/65 | 08:44 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 20 | 05:08 | 06:03 | 07:00 | 07:58 | 16:59-17:45/46 | 08:00 | 14:34-15:12/38 | 08:44 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:46 | 20:46 | 19:29 | 18:14 | 16:13 | 16:00 | 13:42-14:12/66 | 08:45 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 21 | 05:10 | 06:05 | 07:02 | 08:00 | 16:58-17:44/46 | 08:01 | 14:35-15:13/38 | 08:45 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:44 | 20:44 | 19:26 | 18:12 | 16:12 | 16:00 | 13:43-14:13/67 | 08:46 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 22 | 05:12 | 06:07 | 07:04 | 08:02 | 17:39-17:41/2 | 08:03 | 14:35-15:14/39 | 08:46 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:43 | 20:41 | 19:24 | 18:10 | 16:57-17:38/41 | 16:10 | 09:11-09:29/18 | 08:47 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 23 | 05:13 | 06:08 | 07:06 | 08:04 | 16:56-17:38/42 | 08:05 | 14:35-15:14/39 | 08:47 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:41 | 20:39 | 19:21 | 18:07 | 16:09 | 16:00 | 13:44-14:14/68 | 08:48 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 24 | 05:15 | 06:10 | 07:08 | 08:06 | 16:55-17:36/41 | 08:07 | 14:36-15:14/38 | 08:48 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:40 | 20:37 | 19:19 | 18:05 | 16:08 | 16:00 | 13:45-14:15/69 | 08:49 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 25 | 05:16 | 06:12 | 07:10 | 08:08 | 15:55-16:34/39 | 08:09 | 14:36-15:14/38 | 08:49 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:38 | 20:34 | 19:16 | 17:03 | 16:06 | 16:00 | 13:46-14:16/70 | 08:50 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 26 | 05:18 | 06:14 | 07:11 | 08:10 | 15:54-16:31/37 | 08:11 | 14:36-15:15/39 | 08:50 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:37 | 20:32 | 19:14 | 17:01 | 16:05 | 16:00 | 13:47-14:17/71 | 08:51 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 27 | 05:20 | 06:16 | 07:13 | 08:12 | 15:54-16:29/35 | 08:12 | 14:37-15:15/38 | 08:51 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:35 | 20:29 | 19:11 | 16:58 | 16:04 | 16:00 | 13:48-14:18/72 | 08:52 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 28 | 05:21 | 06:18 | 07:15 | 08:14 | 15:55-16:27/32 | 08:14 | 14:37-15:15/38 | 08:52 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:33 | 20:27 | 19:09 | 16:56 | 16:03 | 16:00 | 13:49-14:19/73 | 08:53 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 29 | 05:23 | 06:20 | 07:17 | 08:16 | 15:55-16:25/30 | 08:16 | 14:38-15:15/37 | 08:53 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:31 | 20:24 | 19:06 | 16:54 | 16:02 | 16:00 | 13:50-14:20/74 | 08:54 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 30 | 05:25 | 06:21 | 07:19 | 08:18 | 15:55-16:22/27 | 08:18 | 14:38-15:15/37 | 08:54 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:30 | 20:22 | 19:03 | 16:52 | 16:01 | 16:00 | 13:51-14:21/75 | 08:55 | 14:51-15:17/26 | 10:38-10:57/19 | |
| 31 | 05:26 | 06:23 | 07:20 | 08:20 | 15:55-16:20/25 | 08:20 | 14:38-15:15/37 | 08:55 | 14:51-15:17/26 | 10:38-10:57/19 | |
| | 21:28 | 20:20 | 18:59 | 16:50 | 16:00 | 16:00 | 13:52-14:22/76 | 08:56 | 14:51-15:17/26 | 10:38-10:57/19 | |
| Sonnenscheinstunden | 519 | 464 | 384 | 328 | 256 | 1248 | 227 | 3830 | | | |
| Anzahl Minuten mit Schatten | 0 | 464 | 75 | 884 | | | | | | | |

Tabellen-Layout: Die Daten für jeden Tag sind in folgender Matrix wiedergegeben (Sommerzeit wie Bezugsjahr):

| Tag im Monat | Sonnenaufgang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |
|--------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
| | Sonnenuntergang (SS:MM) | Zeitpunkt (SS:MM) | Schattenanfang-Zeitpunkt (SS:MM) | Schattenende/Minuten mit Schatten |



8.9 Fotodokumentation

In der folgenden Fotodokumentation sind lediglich die Immissionsorte aufgeführt, bei denen die Zusatzbelastung einen maßgeblichen Anteil an der Überschreitung der täglichen und jährlichen Beschattungsdauer gemäß den LAI-Schattenwurfhinweisen hat. Eine vollständige Fotodokumentation aller Immissionsorte kann bei Bedarf angefordert werden.

IO-03 Grenzauweg 3, Böxlund



IO-04 Grenzstraße 1, Böxlund



IO-05 Weesbydamm 14, Weesby



IO-08 Kjerweg 1, Weesby



IO-09 Bögelhuus 2, Weesby



IO-10 Bögelhuus 2a, Weesby



IO-11 Bögelhuus 4, Weesby



IO-15 Bögelhus 1, Weesby



IO-19 Bögelhus 8, Weesby



IO-21 Betonstraße 2, Weesby

