

SCHATTENWURFPROGNOSE NR. R-2-2023-0368.02

über die optischen Immissionen in der Umgebung von acht geplanten
Windenergieanlagen des Typs Enercon E-175 EP5 TES im Windpark
Rüthen Wald bei 59602 Kallenhardt

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1.) Zusammenfassung

Die vorliegende Untersuchung bezieht sich auf den Betrieb von acht geplanten Windenergieanlagen (WEA) vom Typ Enercon E-175 EP5 TES im Windpark Rüthen Wald. Es wird die Schattenausbreitung der astronomisch maximal möglichen Beschattungsdauer nach den Vorgaben der Bund/Länder-Arbeitsgemeinschaft Immissionsschutz (LAI) [1] im Rahmen der Gesamtbelastung an den ermittelten Immissionsorten untersucht. Am Standort Kallenhardt befinden sich 41 existierende oder sich im Genehmigungsverfahren befindende WEA, die als Vorbelastung zu berücksichtigen sind oder in Erwägung gezogen werden.

Bei Normalbetrieb der WEA ergeben die Berechnungen unzulässige Überschreitungen der Immissionsrichtwerte durch den kumulativen periodischen Schattenwurf (Gesamtbelastung mit Einfluss der Zusatzbelastung). Im Rahmen dieser Berechnung werden insgesamt zwei Schattenrezeptoren untersucht. Der jährliche Grenzwert der Schattenwurfdauer wird am SR-02 um maximal 177:03 Stunden pro Jahr überschritten (der jährliche Grenzwert wird an den beiden untersuchten Immissionsorten seitens der Gesamtbelastung überschritten). Der tägliche Grenzwert wird um maximal 63 Minuten am SR-02 überschritten (der tägliche Grenzwert wird an beiden Immissionsorten seitens der Gesamtbelastung überschritten).

Eine Überprüfung der Schutzwürdigkeit der an der relevanten Fassadenseite liegenden Räume wurde nicht durchgeführt.

Die Untersuchung entspricht der Maximalbetrachtung (Worst Case) mit Immissionsrichtwerten von 30 Stunden pro Kalenderjahr und 30 Minuten pro Kalendertag.

Zur Einhaltung der Immissionsrichtwerte durch die Gesamtbelastung ist die Installation einer Abschaltvorrichtung bei Schattenschlag erforderlich.

Grundlage der Berechnung sind die in Kapitel 4.3 und 4.5 aufgeführten Anlagendaten.

Nachfolgender Bericht wurde nach bestem Wissen und Gewissen mit größter Sorgfalt erstellt. *

Rheine, 02.07.2024 RMR/BB

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2.) Situation und Aufgabenstellung

Die Windenergie Rüthen Wald GmbH & Co.KG plant die Errichtung von acht Windenergieanlagen (WEA) vom Typ Enercon E-175 EP5 TES mit einer Nabenhöhen von $h_N = 162$ m und einer elektrischen Leistung von $P_{el} = 6.000$ kW im Windpark Rüthen Wald am Standort 59602 Kallenhardt, Landkreis Soest in Nordrhein-Westfalen. Zum Erlangen der Genehmigung für die Errichtung der neuen Windenergieanlagen ist der Nachweis der Schattenwurfausbreitung notwendig. Für die Berechnungen werden die Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windkraftanlagen nach den Vorgaben der Bund/Länder-Arbeitsgemeinschaft Immissionsschutz (LAI) [1] angewendet.

In der Umgebung des Standortes befinden sich 41 Windenergieanlagen, die als Vorbelastung an den Immissionsorten zu berücksichtigen sind oder in Erwägung gezogen werden.

In der Umgebung des Standortes befinden sich 29 Windenergieanlagen, die jedoch nicht als Vorbelastung an den Immissionsorten zu berücksichtigen sind. Die Prüfung hat ergeben, dass sich keine Immissionsorte im Überschneidungsbereich der Schatteneinwirkung von WEA der Vor- und Zusatzbelastung befinden.

In der Prognose soll ermittelt werden, ob die Gesamtbelastung die Immissionsrichtwerte des kumulativen periodischen Schattenwurfes (Grenzwertüberschreitung der Gesamtbelastung mit Einfluss der Zusatzbelastung) an den umliegenden Immissionspunkten einhält.

In der Nachbarschaft des geplanten Standortes befinden sich mehrere immissionsrelevante Gehöfte und Wohnhäuser, welche um die geplanten WEA angeordnet sind. Eine Beurteilung der Schutzwürdigkeit der Fassaden hat nicht stattgefunden.

Die Ergebnisse der Untersuchung sind in Form eines Schattenwurfgutachtens vorzulegen.

3.) **Berechnungs- und Beurteilungsgrundlagen**

Für die Berechnung und Bearbeitung werden folgende Vorschriften und Unterlagen herangezogen:

- [1] Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windkraftanlagen (WKA-Schattenwurf-Hinweise), Bund/Länder-Arbeitsgemeinschaft Immissionsschutz (LAI), Aktualisierung 2019, 23.01.2020
- [2] Bundes-Immissionsschutzgesetz in der Fassung der Bekanntmachung vom 17. Mai 2013 (BGBl. S. 1274), das durch Artikel 1 des Gesetzes vom 20. November 2014 (BGBl. S. 1740) geändert worden ist
- [3] WindPRO 4.5.540, Herausgeber EMD International A/S (DK)
- [4] Ausschnitt aus OpenStreetMap® (UTM, Zone 32: untere linke Ecke: RW = 449.957, HW = 5.687.408; obere rechte Ecke: RW = 469.925, HW = 5.707.203). Herausgeber: OpenStreetMap® 2.0-Lizenz (CC BY-SA 2.0)
- [5] Ortstermin zur Besichtigung der Immissionspunkte am 13.06.2024 durch KÖTTER Consulting Engineers GmbH & Co. KG, Herrn Robert Müller-Rhein, M. Sc.

4.) **Berechnungsvoraussetzungen für optische Immissionen**

4.1. **Grundlagen**

Die optischen Immissionen von WEA beziehen sich auf den dynamischen Rotorschlag (periodischer Schattenwurf). Der statische, vom Turm erzeugte Schatten bildet keinen relevanten und zu berücksichtigenden Effekt, da primär die frequentierenden Lichtwechsel als Immissionen gelten und beim Menschen zu Belästigungswirkungen führen können [2].

Die Schattenlänge einer WEA hängt stark von der jeweiligen Jahreszeit ab. So sind die Einwirkbereiche in den Wintermonaten länger, da der Sonnenstand zu einem späteren Zeitpunkt morgens und zu einem früheren Zeitpunkt abends niedriger ist als in den Sommermonaten. Die Berechnung berücksichtigt einen Sonnenstand von mindestens 3° .

Eine Untersuchung der optischen Immissionen soll an Immissionsorten mit schutzwürdigen Räumen oder an Bereichen, die planungsrechtlich Potential für eine entsprechende Bebauung geben, stattfinden [1]. Die Schutzwürdigkeit besteht bei:

- Wohnräumen
- Schlafräumen
- Unterrichtsräumen
- Büroräumen, Praxisräumen, Arbeitsräumen etc.

An den einzelnen Immissionsorten wurde die Schutzwürdigkeit nicht untersucht. Für alle Fassadenseiten wird eine Worst Case-Betrachtung durchgeführt.

Eine Unterscheidung zwischen Kern- und Halbschatten findet in der Berechnung des Worst Case-Szenarios keine Anwendung.

4.2. Astronomisch maximal mögliche Beschattungsdauer

Auf Grundlage der Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windkraftanlagen der Bund/Länder-Arbeitsgemeinschaft Immissionsschutz (LAI), Arbeitskreis Lichtimmissionen [1], sind die Berechnungen für eine Maximalbetrachtung durch die astronomisch maximal möglichen Beschattungszeiten durchzuführen.

Sofern die Grenzwerte für die astronomisch maximal mögliche Beschattungsdauer

30 Stunden / Jahr und

30 Minuten / Tag

von allen WEA im Umkreis an den Immissionsorten überschritten werden, wird davon ebenfalls eine Überschreitung der realen Beschattungszeiten abgeleitet (8 Stunden / Jahr). In entsprechenden Fällen werden Abschaltvorrichtungen in den WEA installiert und zeitliche Strategien entwickelt.

Die folgenden Annahmen werden für eine Betrachtung der astronomisch maximal möglichen Beschattungsdauer vorausgesetzt:

- Die Sonne scheint durchgehend täglich von Sonnenauf- bis -untergang.
- Ausreichender Wind für eine dauerhafte Bewegung der Rotoren (100 % Verfügbarkeit).
- Die WEA sind immer in Betrieb und stehen mit der Rotorfläche immer senkrecht zur Sonneneinstrahlungsrichtung.
- Minimale relevante Sonnenhöhe über Horizont mit 3° .
- Es werden keine Hindernisse angenommen, die eine abschirmende Wirkung besitzen.
- An den Wohngebäuden werden die Schattenrezeptoren im Gewächshausmodus platziert, d. h. der Schatten wirkt von allen Seiten ein.

Die Berechnung der optischen Immissionen erfolgt mit Hilfe des Berechnungsprogramms WindPRO, Version 4.5.540 [3]. Als Immissionspunkt wird ein Schattenrezeptor (SR) an der kritischen Fensterseite der Gebäude angesetzt. Im Modell wird dieser mit einer Breite x Höhe von 0,1 m x 0,1 m in 2 m Höhe über Grund platziert.

Die Sonne wird als Punktquelle angesehen und die Rotorfläche als Kreisfläche im Zuge der Maximalbetrachtung betrachtet.

4.3. Prüfung von Windenergieanlagen der Vorbelastung

In der Nähe der geplanten Zusatzbelastung, bestehend aus acht Enercon E-175 EP5 TES, befinden sich 41 weitere bereits bestehende oder im Genehmigungsverfahren befindliche WEA, welche als Vorbelastung in Erwägung gezogen werden. Die im Anlage A aufgeführte Abbildung, zeigt die SHADOW-Karte mit Darstellung des Lageplans und der Schattenausbreitung der Gesamtbelastung unterteilt in Minuten / Tag und Stunden / Jahr (Grenzwerte). Die zu erwartende Schattenbelastung der unten aufgeführten WEA reicht hierbei nicht bis zu den maßgeblichen Schattenrezeptoren, wie in der Schattenkarte ersichtlich. Demzufolge werden diese in dem folgenden Kapitel 4.4 nicht weiter aufgeführt.

| WEA Bezeichnung | WEA Typ |
|-----------------|--|
| WEA_VB02 | Enercon E-40/5.40 500 40.3 NH: 50,0 m (ges: 70,2 m) |
| WEA_VB03 | Vestas V172-7.2 7200 172.0 NH: 175,0 m (ges: 261,0 m) |
| WEA_VB15 | GE Wind Energy 5.5-158 GT120 5500 158.0 NH: 161,0 m (ges: 240,0 m) |
| WEA_VB16 | GE Wind Energy 5.5-158 GT120 5500 158.0 NH: 161,0 m (ges: 240,0 m) |
| WEA_VB17 | GE Wind Energy 5.5-158 GT120 5500 158.0 NH: 161,0 m (ges: 240,0 m) |
| WEA_VB18 | GE Wind Energy 5.5-158 GT120 5500 158.0 NH: 161,0 m (ges: 240,0 m) |
| WEA_VB19 | Enercon E-160 EP5 E3 R1 5560 160.0 NH: 166,6 m (ges: 246,6 m) |
| WEA_VB20 | Enercon E-160 EP5 E3 R1 5560 160.0 NH: 166,6 m (ges: 246,6 m) |
| WEA_VB21 | Enercon E-160 EP5 E3 R1 5560 160.0 NH: 166,6 m (ges: 246,6 m) |
| WEA_VB22 | Enercon E-160 EP5 E3 R1 5560 160.0 NH: 166,6 m (ges: 246,6 m) |
| WEA_VB23 | Enercon E-160 EP5 E3 5560 160.0 NH: 166,6 m (ges: 246,6 m) |
| WEA_VB24 | Enercon E-160 EP5 E3 5560 160.0 NH: 166,6 m (ges: 246,6 m) |
| WEA_VB25 | Nordex N149/5.X 5700 149.0 NH: 164,0 m (ges: 238,5 m) |
| WEA_VB26 | Nordex N175/6.X 6800 175.0 NH: 179,0 m (ges: 266,5 m) |
| WEA_VB27 | Nordex N175/6.X 6800 175.0 NH: 179,0 m (ges: 266,5 m) |
| WEA_VB28 | Nordex N175/6.X 6800 175.0 NH: 179,0 m (ges: 266,5 m) |
| WEA_VB29 | Nordex N175/6.X 6800 175.0 NH: 179,0 m (ges: 266,5 m) |
| WEA_VB30 | Vestas V126-3.45 LTq 3450 126.0 NH: 149,0 m (ges: 212,0 m) |
| WEA_VB31 | Vestas V117-3.45 3450 117.0 NH: 116,5 m (ges: 175,0 m) |
| WEA_VB32 | Vestas V126-3.45 LTq 3450 126.0 NH: 149,0 m (ges: 212,0 m) |
| WEA_VB33 | Vestas V126-3.45 LTq 3450 126.0 NH: 149,0 m (ges: 212,0 m) |
| WEA_VB34 | Vestas V126-3.45 LTq 3450 126.0 NH: 149,0 m (ges: 212,0 m) |

| WEA Bezeichnung | WEA Typ |
|-----------------|---|
| WEA_VB35 | Vestas V126-3.45 LTq 3450 126.0 NH: 149,0 m (ges: 212,0 m) |
| WEA_VB36 | Enercon E-82 E2 TES 2300 82.0 NH: 138,4 m (ges: 179,4 m) |
| WEA_VB37 | Enercon E-82 E2 TES 2300 82.0 NH: 108,4 m (ges: 149,4 m) |
| WEA_VB38 | Enercon E-82 E2 TES 2300 82.0 NH: 138,4 m (ges: 179,4 m) |
| WEA_VB39 | Enercon E-160 EP5 E3 R1 5560 160.0 NH: 166,6 m (ges: 246,6 m) |
| WEA_VB40 | Enercon E-48 800 48.0 NH: 64,6 m (ges: 88,6 m) |
| WEA_VB41 | Enercon E-101 3000 101.0 NH: 135,4 m (ges: 185,9 m) |

Tabelle 1: Windenergieanlagen der Vorbelastung deren Schattenbelastung auf die maßgeblichen Schattenrezeptoren zu vernachlässigen sind. (Angaben zum WEA-Typ aus Programm WindPRO)

Damit liegen in Summe zwölf WEA als Vorbelastung vor (WEA_VB01, WEA_VB04 bis WEA_VB14), welche innerhalb der Schattenprognose betrachtet werden müssen.

4.4. Windenergieanlagen der Vorbelastung

In der nahen Umgebung des Standortes befinden sich 41 weitere Windenergieanlagen, wovon zwölf WEA als Vorbelastung zu berücksichtigen sind (siehe Kapitel 4.3). Die UTM/ETRS 89-Koordinaten (Zone 32) befinden sich im SHADOW-Hauptergebnis in Anlage A2.

| Typ | V-162 7.2 | V-162 6.2 |
|-------------------------|--------------------|-----------------------|
| Bezeichnung | WEA VB01, WEA VB04 | WEA VB05 bis WEA VB14 |
| Hersteller | Vestas | |
| Nabenhöhe h_N [m] | 169 | 169 |
| Rotordurchmesser [m] | 162 | 162 |
| Nennleistung [kW] | 7.200 | 6.200 |
| Maximale Blatttiefe [m] | 4,32 [3] | 4.32 [3] |
| Schattenbereich [m] | 2.041 [3] | 2.041 [3] |

Tabelle 2: Anlagendaten der vorhandenen Windenergieanlagen der Vorbelastung im Windpark Rüthen Wald

4.5. Windenergieanlagen der Zusatzbelastung

Die relevante Zusatzbelastung besteht im Windpark Rüthen Wald aus acht geplanten WEA vom Typ Enercon E-175 EP5 TES mit einer Nabenhöhe von $h_N = 162$ m und einem Rotordurchmesser von 175 m. Die Nabenhöhe ist vom Auftraggeber vorgegeben. Die UTM/ETRS 89-Koordinaten (Zone 32) befinden sich im SHADOW-Hauptergebnis in Anlage A2.

| | |
|-------------------------|-----------------------|
| Typ | Enercon E-175 EP5 TES |
| Bezeichnung | WEA ZB01 bis WEA ZB08 |
| Hersteller | Enercon |
| Nabenhöhe h_N [m] | 162 |
| Rotordurchmesser [m] | 175 |
| Nennleistung [kW] | 6.000 |
| Maximale Blatttiefe [m] | 4,01 [3] |
| Schattenbereich [m] | 1.737 [3] |

Tabelle 3: Anlagendaten der Windenergieanlage der Zusatzbelastung im Windpark Rüthen Wald

Der Schattenbereich berechnet sich aus den Abmaßen der WEA (Rotordurchmesser, Nabenhöhe und Blatttiefe) und dem variierenden Sonnenstand.

4.6. Immissionsorte

Die Aufnahme der relevanten Immissionsorte, die die Grenzwerte überschreiten, erfolgt auf Grundlage der Schattenausbreitungsdarstellung. Demnach werden alle Gebäude mit schutzwürdigen Räumen innerhalb der jährlichen und täglichen Grenzwerte der Gesamtbelastung, bei denen die Zusatzbelastung einen Einfluss hat, im Rahmen der weiteren Berechnung der einzelnen Schattenwurfzeiten untersucht. Innerhalb dieser Auflistung sind zwei maßgebliche Schattenrezeptoren aufgenommen worden, welche zusätzlich im Lageplan in Abbildung 1 abgebildet werden. Die Tabelle 4 zeigt die Schattenrezeptoren mit deren Adressen und den UTM/ETRS 89-Koordinaten (Zone 32) auf.

| Bezeichnung | Adresse | UTM-Koordinaten | |
|-------------|---|-----------------|-----------|
| | | Ost | Nord |
| SR-01 | Provinzialstraße 2, 59602 Rüthen | 461.385 | 5.697.535 |
| SR-02 | Forsthaus Antfelder Wald 1, 59939 Olsberg | 462.381 | 5.696.208 |

Tabelle 4: Immissionsorte am Standort Kallenhardt

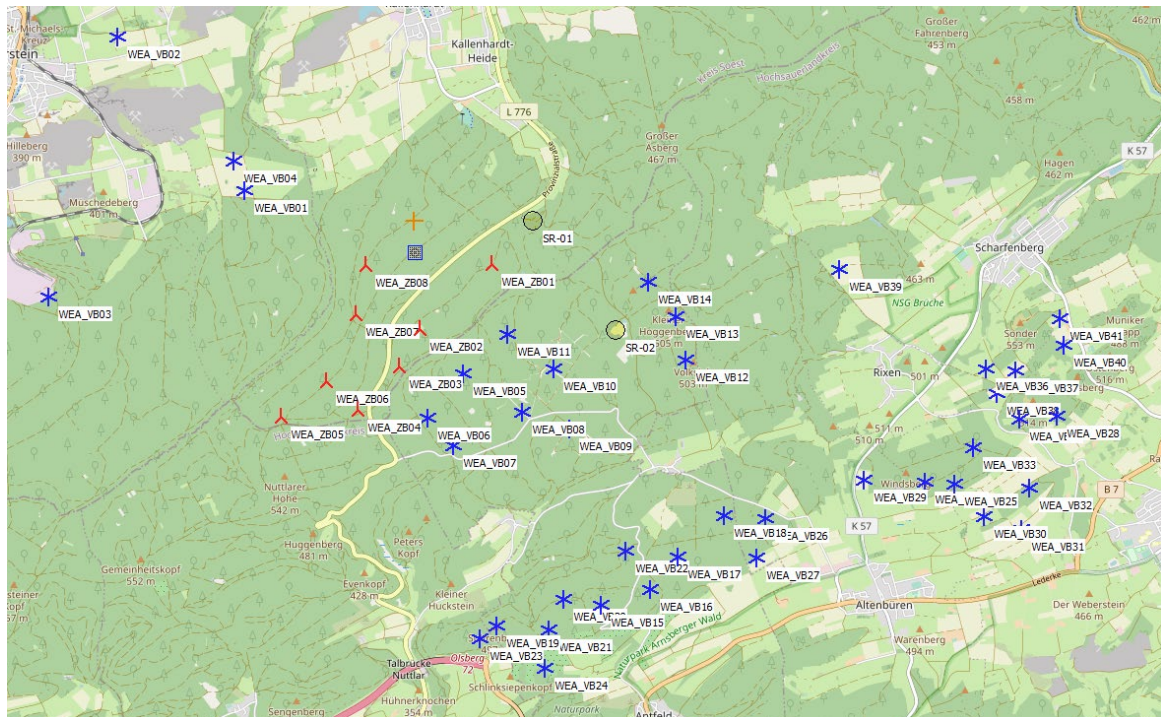


Abbildung 1: Lageplan der relevanten Schattenrezeptoren, sowie der in der Nähe befindlichen Vor- (blaue Symbole) und Zusatzbelastung (rote Symbole) im WP Rüthen Wald, EMD International A/S (DK) ©

Aus den Koordinaten der untersuchten Immissionsorte (IO) und der WEA der Zusatzbelastung, s. Anlage A, ergeben sich folgende horizontale Abstände:

| Bezeichnung | Abstand [m] | | | | | | | |
|-------------|-------------|----------|----------|----------|----------|----------|----------|----------|
| | WEA ZB01 | WEA ZB02 | WEA ZB03 | WEA ZB04 | WEA ZB05 | WEA ZB06 | WEA ZB07 | WEA ZB08 |
| SR-01 | 726 | 1.897 | 2.404 | 3.121 | 3.871 | 3.169 | 2.432 | 2.096 |
| SR-02 | 1.708 | 2.381 | 2.674 | 3.279 | 4.200 | 3.566 | 3.165 | 3.134 |

Tabelle 5: Horizontale Abstände der Zusatzbelastung im Windpark Rüthen Wald zu den untersuchten Immissionsorten (Angaben auf volle Meter gerundet)

5.) Berechnung der Schattenwurfimmissionen

Auf Grundlage des Kapitels 4.) wurden folgende Ergebnisse ermittelt. In den Berechnungen wurden keine vorhandenen Abschaltzeiten berücksichtigt, die Ergebnisse stellen somit das Worst Case-Szenario dar.

5.1. Astronomisch maximal mögliche Beschattungsdauer der Vorbelastung

Im Folgenden wird die maximal mögliche jährliche Schattenwurfdauer (Grenzwert 30 Stunden/Jahr) und maximal mögliche tägliche Schattendauer (30 Minuten/Tag) der Vorbelastung mit 41 WEA dargestellt:

| Immissionsorte | Maximal mögliche Schatten-dauer jährlich VB [hh:mm] | Grenzwertüber-schreitung 30 h/a VB [hh:mm] | Maximal mögliche Schatten-dauer täglich VB [hh:mm] | Grenzwertüber-schreitung 30 min/d VB [hh:mm] |
|----------------|---|--|--|--|
| SR-01 | 9:59 | -- | 0:23 | -- |
| SR-02 | 179:52 | 149:52 | 1:33 | 1:03 |

Tabelle 6: Schattenwurfzeiten der Vorbelastung im Windpark Rüthen Wald; Überschreitung der Grenzwerte an den Immissionsorten

Im Rahmen der Schattenwurfzeiten führen die WEA der Vorbelastung an einem Schattenrezeptor zu unzulässigen Überschreitungen mindestens eines Grenzwertes. Der jährliche Grenzwert der Schattenwurfdauer wird am SR-02 um maximal 149:52 Stunden pro Jahr überschritten. Der tägliche Grenzwert wird um maximal 63 Minuten am SR-02 überschritten.

5.2. Astronomisch maximal mögliche Beschattungsdauer der Zusatzbelastung

Im Folgenden wird die maximal mögliche jährliche Schattenwurfdauer (Grenzwert 30 Stunden/Jahr) und maximal mögliche tägliche Schattendauer (30 Minuten/Tag) der Zusatzbelastung mit acht Enercon E-175 EP5 TES dargestellt:

| Immissionsorte | Maximal mögliche Schattendauer jährlich ZB [hh:mm] | Grenzwertüberschreitung 30 h/a ZB [hh:mm] | Maximal mögliche Schattendauer täglich ZB [hh:mm] | Grenzwertüberschreitung 30 min/d ZB [hh:mm] |
|----------------|--|---|---|---|
| SR-01 | 51:39 | 21:39 | 0:54 | 0:24 |
| SR-02 | 27:11 | -- | 0:25 | -- |

Tabelle 7: Schattenwurfzeiten der Zusatzbelastung im Windpark Rüthen Wald; Überschreitung der Grenzwerte an den Immissionsorten

Im Rahmen der Schattenwurfzeiten führen die WEA der Zusatzbelastung an einem Schattenrezeptor zu unzulässigen Überschreitungen mindestens eines Grenzwertes. Der jährliche Grenzwert der Schattenwurfdauer wird am SR-01 um maximal 21:39 Stunden pro Jahr überschritten. Der tägliche Grenzwert wird um maximal 24 Minuten am SR-01 überschritten.

5.3. Astronomisch maximal mögliche Beschattungsdauer der Gesamtbelastung

Die Tabelle 8 zeigt die auf Basis der Schattenwurfzeiten von Vor- und Zusatzbelastung kumulativ überschrittenen Grenzwerte.

| Immissionsorte | Maximal mögliche Schattendauer jährlich GB [hh:mm] | Grenzwertüberschreitung 30 h/a GB [hh:mm] | Maximal mögliche Schattendauer täglich GB [hh:mm] | Grenzwertüberschreitung 30 min/d GB [hh:mm] |
|----------------|--|---|---|---|
| SR-01 | 61:38 | 31:38 | 1:14 | 0:44 |
| SR-02 | 207:03 | 177:03 | 1:33 | 1:03 |

Tabelle 8: Schattenwurfzeiten der Gesamtbelastung im Windpark Rüthen Wald; Überschreitung der Grenzwerte an den Immissionsorten

Die Berechnung zeigt an zwei untersuchten Schattenrezeptoren unzulässige Überschreitungen durch periodischen Schattenwurf der Gesamtbelastung bei mindestens einem zu berücksichtigenden Grenzwert auf.

Das Ergebnis stellt eine Maximalbetrachtung dar. Der jährliche Grenzwert der Schattenwurfdauer wird am SR-02 um maximal 177:03 Stunden pro Jahr überschritten. Der tägliche Grenzwert wird um maximal 63 Minuten am SR-02 überschritten.

6.) Bewertung

Im Zuge der Bewertung weist die Zusatzbelastung eine Relevanz auf, sofern die acht geplanten WEA zu einer Überschreitung der jährlichen Grenzwerte von 30 Stunden/Jahr oder die täglichen Grenzwerte von 30 Minuten/Tag führen. Weiterhin besteht für die Zusatzbelastung eine Relevanz, sofern zusätzliche Schattenwurfzeiten an den schon seitens der Vorbelastung überschrittenen Immissionsorten zu erwarten sind.

6.1. Maximal mögliche jährliche Schattendauer

Im Folgenden wird die maximal mögliche jährliche Schattenwurfdauer in Bezug auf die durch die Zusatzbelastung verursachten Überschreitungen bewertet:

| IO | Maximal mögliche Schattendauer jährlich VB [hh:mm] | Maximal mögliche Schattendauer jährlich GB [hh:mm] | Grenzwertüberschreitung 30 h/a GB [hh:mm] | Erhöhung durch ZB [hh:mm] | Relevanz |
|-------|--|--|---|---------------------------|----------|
| SR-01 | 9:59 | 61:38 | 31:38 | 51:39 | ja |
| SR-02 | 179:52 | 207:03 | 177:03 | 27:11 | ja |

Tabelle 9: Bewertung der maximal möglichen jährlichen Schattendauer der Vor- und Gesamtbelastung, Grenzwertüberschreitung der Gesamtbelastung, Darstellung der Erhöhung durch die Zusatzbelastung

An allen zwei Immissionsorten kommt es zu einer Überschreitung des Grenzwertes der Gesamtbelastung. Diese tritt an den Immissionsorten SR-02 durch die Vorbelastung auf und wird durch die Zusatzbelastung weiter erhöht. Die maximale Erhöhung der Zusatzbelastung tritt an SR-01 mit zusätzlichen 51:39 Stunden im Jahr auf.

6.2. Maximal mögliche tägliche Schattendauer

Im Folgenden wird die maximal mögliche tägliche Schattenwurfdauer in Bezug auf die durch die Zusatzbelastung verursachten Überschreitungen bewertet:

| IO | Maximal mögliche Schattendauer täglich VB [hh:mm] | Maximal mögliche Schattendauer täglich GB [hh:mm] | Grenzwertüberschreitung 30 min/d GB [hh:mm] | Erhöhung durch ZB [hh:mm] | Relevanz |
|-------|---|---|---|---------------------------|----------|
| SR-01 | 0:23 | 1:14 | 0:44 | 0:51 | ja |
| SR-02 | 1:33 | 1:33 | 1:03 | -- | nein |

Tabelle 10: Bewertung der maximal möglichen täglichen Schattendauer der Vor- und Gesamtbelastung, Grenzwertüberschreitung der Gesamtbelastung, Darstellung der Erhöhung durch die Zusatzbelastung

An allen zwei Immissionsorten führt die Gesamtbelastung zu einer Überschreitung der Schattenwurfdauer bzw. des Grenzwertes. Die maximale Erhöhung der Zusatzbelastung tritt am SR-01 mit zusätzlichen 51 Minuten am Tag auf.

7.) Anlagen

- Anlage A: Schattenausbreitung der Gesamtbelastung
- Anlage A1: SHADOW-Karte mit Darstellung des Lageplanes und der Schattenausbreitung der Gesamtbelastung unterteilt in Minuten / Tag und Stunden / Jahr (Grenzwerte)
- Anlage A2: SHADOW-Hauptergebnis mit Darstellung der Gesamtbelastung, Immissionsorte SR-01 bis SR-02, Berechnungsergebnisse Stunden / Jahr, Schattentage / Jahr und maximalen Stunden / Tag
- Anlage A3: SHADOW-Kalender mit Darstellung der Schattenzeiten je Immissionsort SR-01 bis SR-02 über das ganze Jahr
- Anlage A4: SHADOW-Grafischer Kalender mit Darstellung der Schattenzeiten je Immissionsort durch die einzelnen WEA über das ganze Jahr
- Anlage A5: SHADOW-Kalender pro WEA mit Darstellung der Beschattungszeiten je WEA über das ganze Jahr
- Anlage A6: SHADOW-Grafischer Kalender pro WEA mit Darstellung der Beschattungszeiten je WEA an den Immissionsorten über das ganze Jahr
- Anlage B: Schattenausbreitung der Vor- und Zusatzbelastung
- Anlage B1: SHADOW-Hauptergebnis mit Darstellung der Vorbelastung, Immissionsorte SR-01 bis SR-02, Berechnungsergebnisse Stunden / Jahr, Schattentage / Jahr und maximalen Stunden / Tag

Anlage B2: SHADOW-Karte mit Darstellung des Lageplanes und der Schattenausbreitung der Vorbelastung unterteilt in Minuten / Tag und Stunden / Jahr

Anlage B3: SHADOW-Hauptergebnis mit Darstellung der Zusatzbelastung, Immissionsorte SR-01 bis SR-02, Berechnungsergebnisse Stunden / Jahr, Schattentage / Jahr und maximalen Stunden / Tag

Anlage B4: SHADOW-Karte mit Darstellung des Lageplanes und der Schattenausbreitung der Zusatzbelastung unterteilt in Minuten / Tag und Stunden / Jahr

Anlage C: Bilder der untersuchten Immissionsorte

Anlage A: Schattenausbreitung der Gesamtbelastung

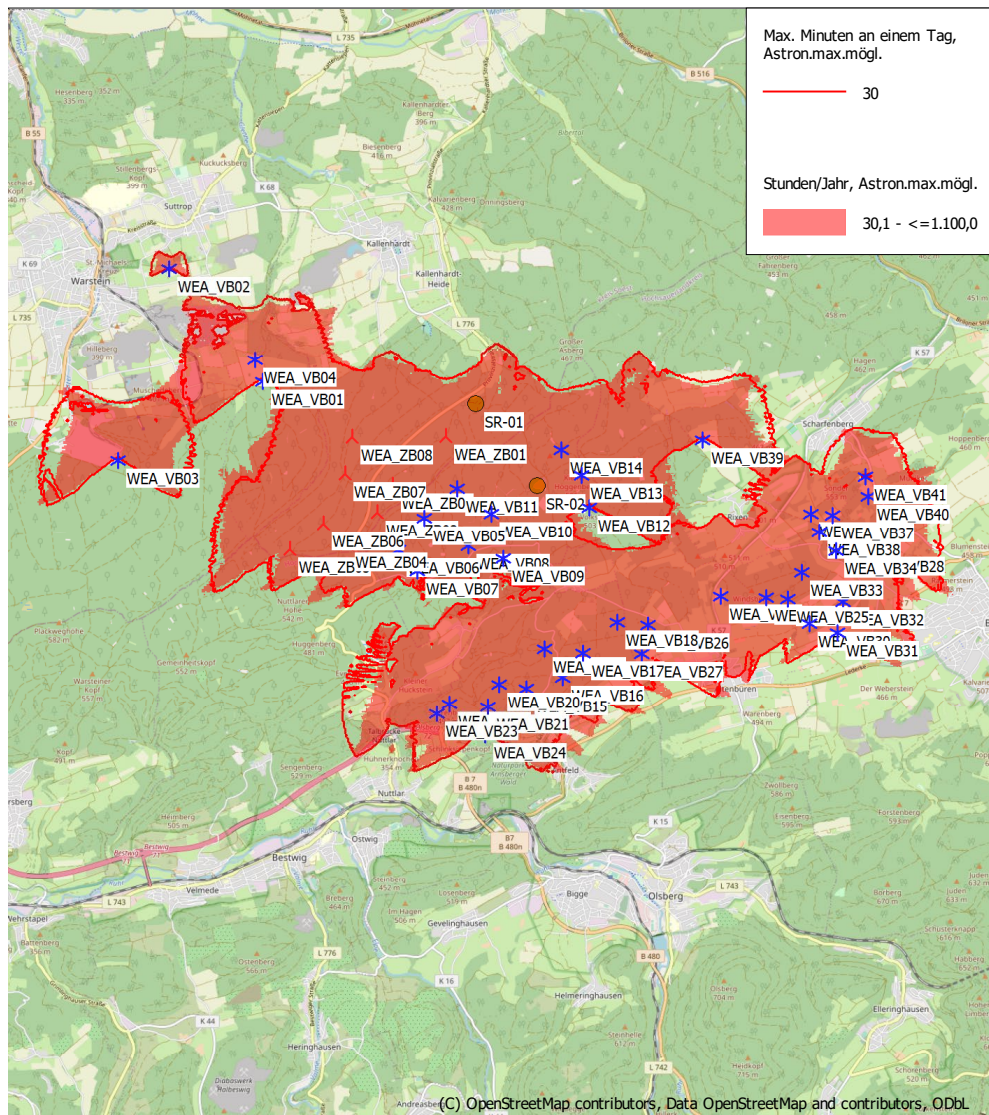
Anlage A1: SHADOW-Karte mit Darstellung des Lageplanes und der Schattenausbreitung der Gesamtbelastung unterteilt in Minuten / Tag und Stunden / Jahr (Grenzwerte)

Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Karte

Berechnung: Gesamtbelastung



Karte: EMD OpenStreetMap, Maßstab 1:90.000, Mitte: ETRS-TMzn Pan-European Transverse Mercator (UTM)-ETRS89 Zone: 32 Ost: 461.805 Nord: 5.695.012
 ▲ Neue WEA * Existierende WEA 📡 Schattenrezeptor
 Höhe der Schattenkarte: Höhenraster-Objekt: R-2-2023-0368_WP_Rüthen_EMDGrid_0.wpg (1)
 Zeitschritt: 3 Minuten, Schrittweite: 7 Tag(e), Kartenaufösung: 20 m, Sichtbarkeit Auflösung: 10 m, Augenhöhe: 1,5 m

Anlage A2: SHADOW-Hauptergebnis mit Darstellung der Gesamtbelastung, Immissionsorte SR-01 bis SR-zwei, Berechnungsergebnisse Stunden / Jahr, Schattentage / Jahr und maximalen Stunden / Tag

Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung
Annahmen für Schattenwurfberechnung

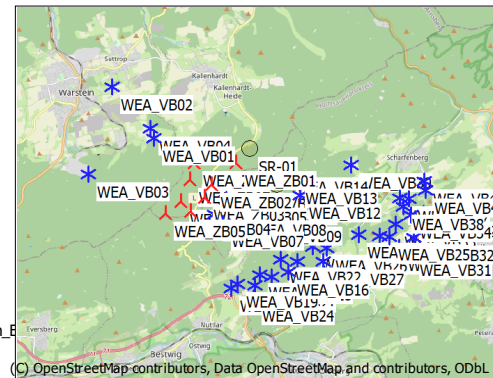
Beschattungsbereich der WEA
Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
Siehe WEA-Tabelle

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

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
Verwendete Höhenlinien: Höhenraster-Objekt: R-2-2023-0368_WP_Rüthen
Rasterauflösung: 1,0 m

Alle Koordinatenangaben in:
ETRS-TM21 Pan-European Transverse Mercator (UTM)-ETRS89 Zone: 32



© OpenStreetMap-contributors, Data OpenStreetMap and contributors, ODbL
Maßstab 1:200.000
* Neue WEA * Existierende WEA * Schattenrezeptor

| WEA | Ost | Nord | Z | WEA-Typ | | Typ | Nennleistung | Rotor-durchmesser | NH | Schattendaten | | |
|----------|---------|-----------|-------|---------------|---------|----------------|-----------------------|-------------------|-------|---------------|-------------------|-------|
| | | | | Beschreibung | Aktuell | | | | | Hersteller | Beschatt.-Bereich | U/min |
| WEA_VB01 | 457.890 | 5.697.928 | 391,3 | VESTAS V16... | Ja | VESTAS | V162-7.2-7.200 | 7.200 | 162,0 | 169,0 | 2.041 | 9,5 |
| WEA_VB02 | 456.367 | 5.699.796 | 383,0 | ENERCON E... | Nein | ENERCON | E-40/5.40-500 | 500 | 40,3 | 50,0 | 898 | 38,0 |
| WEA_VB03 | 455.501 | 5.696.658 | 398,1 | VESTAS V17... | Ja | VESTAS | V172-7.2-7.200 | 7.200 | 172,0 | 175,0 | 1.903 | - |
| WEA_VB04 | 457.762 | 5.698.286 | 386,8 | VESTAS V16... | Ja | VESTAS | V162-7.2-7.200 | 7.200 | 162,0 | 169,0 | 2.041 | 9,5 |
| WEA_VB05 | 460.521 | 5.695.694 | 473,2 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB06 | 460.083 | 5.695.167 | 508,2 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB07 | 460.400 | 5.694.830 | 540,3 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB08 | 461.236 | 5.695.224 | 507,9 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB09 | 461.805 | 5.695.012 | 503,1 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB10 | 461.620 | 5.695.750 | 514,1 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB11 | 461.065 | 5.696.170 | 486,7 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB12 | 463.220 | 5.695.835 | 500,7 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB13 | 463.100 | 5.696.360 | 494,8 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB14 | 462.774 | 5.696.786 | 485,3 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB15 | 462.177 | 5.692.883 | 511,6 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB16 | 462.772 | 5.693.064 | 504,8 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB17 | 463.110 | 5.693.456 | 539,4 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB18 | 463.675 | 5.693.961 | 555,0 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB19 | 460.909 | 5.692.642 | 497,3 | ENERCON E... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB20 | 461.717 | 5.692.956 | 494,7 | ENERCON E... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB21 | 461.541 | 5.692.583 | 475,5 | ENERCON E... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB22 | 462.478 | 5.693.533 | 494,4 | ENERCON E... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB23 | 460.695 | 5.692.494 | 492,6 | ENERCON E... | Nein | ENERCON | E-160 EP5 E3-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB24 | 461.487 | 5.692.126 | 413,3 | ENERCON E... | Nein | ENERCON | E-160 EP5 E3-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB25 | 466.472 | 5.694.313 | 499,5 | NORDEX N1... | Ja | NORDEX | N149/5.X-5.700 | 5.700 | 149,0 | 164,0 | 1.805 | 10,7 |
| WEA_VB26 | 464.178 | 5.693.918 | 530,1 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB27 | 464.067 | 5.693.436 | 501,8 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB28 | 467.717 | 5.695.131 | 484,5 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB29 | 465.368 | 5.694.375 | 515,1 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB30 | 466.829 | 5.693.916 | 446,3 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB31 | 467.275 | 5.693.760 | 467,3 | VESTAS V11... | Ja | VESTAS | V117-3.45-3.450 | 3.450 | 117,0 | 116,5 | 1.734 | 13,8 |
| WEA_VB32 | 467.371 | 5.694.267 | 432,3 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB33 | 466.700 | 5.694.760 | 525,8 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB34 | 467.265 | 5.695.093 | 471,9 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB35 | 466.114 | 5.694.340 | 543,9 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB36 | 466.863 | 5.695.705 | 500,5 | ENERCON E... | Ja | ENERCON | E-82 E2 TES-2.300 | 2.300 | 82,0 | 138,4 | 1.599 | 18,0 |
| WEA_VB37 | 467.213 | 5.695.685 | 504,4 | ENERCON E... | Ja | ENERCON | E-82 E2 TES-2.300 | 2.300 | 82,0 | 138,4 | 1.599 | 18,0 |
| WEA_VB38 | 466.992 | 5.695.406 | 498,4 | ENERCON E... | Ja | ENERCON | E-82 E2 TES-2.300 | 2.300 | 82,0 | 138,4 | 1.599 | 18,0 |

(Fortsetzung nächste Seite)...

Projekt:
R-2-2023-0368_WP_Rüthen

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Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung

...(Fortsetzung von vorheriger Seite)

| | Ost | Nord | Z | WEA-Typ | | Typ | Nennleistung [kW] | Rotor-durchmesser [m] | NH [m] | Schattendaten | | |
|----------|---------|-----------|-------|---------------|---------|---------|-----------------------|-----------------------|--------|---------------|-----------------------|-------|
| | | | | Beschreibung | Aktuell | | | | | Hersteller | Beschatt.-Bereich [m] | U/min |
| WEA_VB39 | 465.090 | 5.696.919 | 468,5 | ENERCON E-... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB40 | 467.811 | 5.695.993 | 510,8 | ENERCON E-... | Nein | ENERCON | E-48-800 | 800 | 48,0 | 64,6 | 1.047 | 30,0 |
| WEA_VB41 | 467.760 | 5.696.309 | 518,8 | ENERCON E-... | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 135,4 | 2.214 | 14,5 |
| WEA_ZB01 | 460.877 | 5.697.017 | 446,9 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |
| WEA_ZB02 | 460.000 | 5.696.239 | 480,7 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |
| WEA_ZB03 | 459.741 | 5.695.781 | 461,6 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |
| WEA_ZB04 | 459.240 | 5.695.268 | 483,1 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |
| WEA_ZB05 | 458.307 | 5.695.188 | 515,7 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |
| WEA_ZB06 | 458.865 | 5.695.613 | 524,6 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |
| WEA_ZB07 | 459.223 | 5.696.422 | 464,1 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |
| WEA_ZB08 | 459.354 | 5.697.018 | 489,7 | ENERCON E-... | Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite | Höhe | Höhe ü.Gr. | Neigung des Fensters | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. [m] |
|-------|--|---------|-----------|-------|--------|------|------------|----------------------|---------------------|---------------------------|
| SR-01 | SR-01, Provinzialstraße 2, 59602 Rüthen | 461.385 | 5.697.535 | 380,0 | 0,1 | 0,1 | 2,0 | 90,0 | "Gewächshaus-Modus" | 2,1 |
| SR-02 | SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg | 462.381 | 5.696.208 | 429,2 | 0,1 | 0,1 | 2,0 | 90,0 | "Gewächshaus-Modus" | 2,1 |

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | |
|-------|--|--------------------------------------|-------------------------|-----------------------------|
| | | Stunden/Jahr [h/a] | Schattentage/Jahr [d/a] | Max.Schattendauer/Tag [h/d] |
| SR-01 | SR-01, Provinzialstraße 2, 59602 Rüthen | 61:38 | 82 | 1:14 |
| SR-02 | SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg | 207:03 | 294 | 1:33 |

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal [h/a] |
|----------|---|---------------|
| WEA_VB01 | VESTAS V162-7.2 7200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (188) | 0:00 |
| WEA_VB02 | ENERCON E-40/5.40 500 40.3 !O! NH: 50,0 m (Ges:70,2 m) (228) | 0:00 |
| WEA_VB03 | VESTAS V172-7.2 7200 172.0 !O! NH: 175,0 m (Ges:261,0 m) (189) | 0:00 |
| WEA_VB04 | VESTAS V162-7.2 7200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (190) | 0:00 |
| WEA_VB05 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (191) | 6:12 |
| WEA_VB06 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (192) | 0:00 |
| WEA_VB07 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (193) | 0:00 |
| WEA_VB08 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (194) | 13:35 |
| WEA_VB09 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (195) | 19:05 |
| WEA_VB10 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (196) | 26:51 |
| WEA_VB11 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (197) | 13:43 |
| WEA_VB12 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (198) | 24:57 |
| WEA_VB13 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (199) | 75:55 |
| WEA_VB14 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (200) | 9:33 |
| WEA_VB15 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (201) | 0:00 |
| WEA_VB16 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (202) | 0:00 |
| WEA_VB17 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (203) | 0:00 |
| WEA_VB18 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (204) | 0:00 |
| WEA_VB19 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (205) | 0:00 |
| WEA_VB20 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (206) | 0:00 |
| WEA_VB21 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (207) | 0:00 |
| WEA_VB22 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (208) | 0:00 |
| WEA_VB23 | ENERCON E-160 EP5 E3 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (209) | 0:00 |
| WEA_VB24 | ENERCON E-160 EP5 E3 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (210) | 0:00 |
| WEA_VB25 | NORDEX N149/5.X 5700 149.0 !O! NH: 164,0 m (Ges:238,5 m) (211) | 0:00 |
| WEA_VB26 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (212) | 0:00 |
| WEA_VB27 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (213) | 0:00 |
| WEA_VB28 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (214) | 0:00 |

(Fortsetzung nächste Seite)...

Projekt:
R-2-2023-0368_WP_Rüthen

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 Berechnet:
 24.06.2024 10:06/4.0.540

SHADOW - Hauptergebnis

Berechnung: Gesamtbelastung

...(Fortsetzung von vorheriger Seite)

| Nr. | Name | Maximal [h/a] |
|----------|--|------------------|
| WEA_VB29 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (215) | 0:00 |
| WEA_VB30 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (216) | 0:00 |
| WEA_VB31 | VESTAS V117-3.45 3450 117.0 !O! NH: 116,5 m (Ges:175,0 m) (217) | 0:00 |
| WEA_VB32 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (218) | 0:00 |
| WEA_VB33 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (219) | 0:00 |
| WEA_VB34 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (220) | 0:00 |
| WEA_VB35 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (221) | 0:00 |
| WEA_VB36 | ENERCON E-82 E2 TES 2300 82.0 !O! NH: 138,4 m (Ges:179,4 m) (222) | 0:00 |
| WEA_VB37 | ENERCON E-82 E2 TES 2300 82.0 !O! NH: 108,4 m (Ges:149,4 m) (223) | 0:00 |
| WEA_VB38 | ENERCON E-82 E2 TES 2300 82.0 !O! NH: 138,4 m (Ges:179,4 m) (224) | 0:00 |
| WEA_VB39 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (225) | 0:00 |
| WEA_VB40 | ENERCON E-48 800 48.0 !O! NH: 64,6 m (Ges:88,6 m) (226) | 0:00 |
| WEA_VB41 | ENERCON E-101 3000 101.0 !-! NH: 135,4 m (Ges:185,9 m) (227) | 0:00 |
| WEA_ZB01 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (17) | 78:50 |
| WEA_ZB02 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (10) | 0:00 |
| WEA_ZB03 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (11) | 0:00 |
| WEA_ZB04 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (12) | 0:00 |
| WEA_ZB05 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (13) | 0:00 |
| WEA_ZB06 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (15) | 0:00 |
| WEA_ZB07 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (14) | 0:00 |
| WEA_ZB08 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges:249,5 m) (16) | 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.

Anlage A3: SHADOW-Kalender mit Darstellung der Schattenzeiten je Immissionsort
SR-01 bis SR-zwei über das ganze Jahr

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
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Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender

Berechnung: Gesamtbelastung **Schattenrezeptor:**SR-01 - SR-01, Provinzialstraße 2, 59602 Rüthen
Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni |
|---------------------------|--------|------------------|--------------------------|--------------------------|-------|-------|
| 1 | 08:32 | 08:06 | 15:17 (WEA_ZB01) 07:14 | 08:21 (WEA_VB14) 07:04 | 06:01 | 05:16 |
| 2 | 16:28 | 17:15 | 15:40 (WEA_ZB01) 18:06 | 15:51 (WEA_ZB01) 19:59 | 20:48 | 21:33 |
| 3 | 08:32 | 08:05 | 15:15 (WEA_ZB01) 07:12 | 08:22 (WEA_VB14) 07:02 | 05:59 | 05:16 |
| 4 | 16:29 | 17:17 | 15:42 (WEA_ZB01) 18:07 | 15:50 (WEA_ZB01) 20:00 | 20:50 | 21:34 |
| 5 | 08:32 | 08:03 | 15:14 (WEA_ZB01) 07:10 | 08:23 (WEA_VB14) 07:00 | 05:57 | 05:15 |
| 6 | 16:30 | 17:19 | 15:45 (WEA_ZB01) 18:09 | 15:49 (WEA_ZB01) 20:02 | 20:52 | 21:35 |
| 7 | 08:32 | 08:02 | 15:12 (WEA_ZB01) 07:07 | 08:24 (WEA_VB14) 06:58 | 05:55 | 05:14 |
| 8 | 16:31 | 17:20 | 15:47 (WEA_ZB01) 18:11 | 15:46 (WEA_ZB01) 20:04 | 20:53 | 21:36 |
| 9 | 08:32 | 08:00 | 15:10 (WEA_ZB01) 07:05 | 08:28 (WEA_VB14) 06:55 | 05:53 | 05:13 |
| 10 | 16:32 | 17:22 | 15:48 (WEA_ZB01) 18:13 | 15:44 (WEA_ZB01) 20:05 | 20:55 | 21:37 |
| 11 | 08:31 | 07:58 | 15:09 (WEA_ZB01) 07:03 | 15:18 (WEA_ZB01) 06:53 | 05:51 | 05:13 |
| 12 | 16:34 | 17:24 | 15:49 (WEA_ZB01) 18:14 | 15:41 (WEA_ZB01) 20:07 | 20:56 | 21:38 |
| 13 | 08:31 | 07:57 | 15:09 (WEA_ZB01) 07:01 | 15:22 (WEA_ZB01) 06:51 | 05:50 | 05:12 |
| 14 | 16:35 | 17:26 | 15:51 (WEA_ZB01) 18:16 | 15:38 (WEA_ZB01) 20:09 | 20:58 | 21:39 |
| 15 | 08:31 | 07:55 | 15:08 (WEA_ZB01) 06:59 | 15:08 (WEA_ZB01) 06:49 | 05:48 | 05:12 |
| 16 | 16:36 | 17:28 | 15:52 (WEA_ZB01) 18:18 | 15:20 (WEA_ZB01) 20:10 | 21:00 | 21:40 |
| 17 | 08:30 | 07:53 | 15:07 (WEA_ZB01) 06:56 | 15:07 (WEA_ZB01) 06:46 | 05:46 | 05:11 |
| 18 | 16:38 | 17:30 | 15:53 (WEA_ZB01) 18:20 | 15:22 (WEA_ZB01) 20:12 | 21:01 | 21:41 |
| 19 | 08:30 | 07:51 | 15:06 (WEA_ZB01) 06:54 | 15:06 (WEA_ZB01) 06:44 | 05:45 | 05:11 |
| 20 | 16:39 | 17:31 | 15:53 (WEA_ZB01) 18:21 | 15:23 (WEA_ZB01) 20:14 | 21:02 | 21:42 |
| 21 | 08:29 | 07:50 | 15:05 (WEA_ZB01) 06:52 | 15:05 (WEA_ZB01) 06:42 | 05:43 | 05:10 |
| 22 | 16:40 | 17:33 | 15:54 (WEA_ZB01) 18:23 | 15:24 (WEA_ZB01) 20:15 | 21:04 | 21:42 |
| 23 | 08:28 | 07:48 | 15:05 (WEA_ZB01) 06:50 | 15:04 (WEA_ZB01) 06:40 | 05:41 | 05:10 |
| 24 | 16:42 | 17:35 | 15:54 (WEA_ZB01) 18:25 | 15:25 (WEA_ZB01) 20:17 | 21:06 | 21:43 |
| 25 | 08:28 | 07:46 | 15:04 (WEA_ZB01) 06:47 | 15:04 (WEA_ZB01) 06:37 | 05:40 | 05:10 |
| 26 | 16:43 | 17:37 | 15:55 (WEA_ZB01) 18:27 | 15:26 (WEA_ZB01) 20:19 | 21:07 | 21:44 |
| 27 | 08:27 | 07:44 | 15:04 (WEA_ZB01) 06:45 | 15:04 (WEA_ZB01) 06:35 | 05:38 | 05:10 |
| 28 | 16:45 | 17:39 | 15:55 (WEA_ZB01) 18:28 | 15:27 (WEA_ZB01) 20:20 | 21:09 | 21:44 |
| 29 | 08:26 | 07:42 | 15:03 (WEA_ZB01) 06:43 | 15:03 (WEA_ZB01) 06:33 | 05:37 | 05:09 |
| 30 | 16:46 | 17:41 | 15:56 (WEA_ZB01) 18:30 | 15:28 (WEA_ZB01) 20:22 | 21:11 | 21:45 |
| 31 | 08:25 | 07:40 | 15:03 (WEA_ZB01) 06:41 | 15:03 (WEA_ZB01) 06:31 | 05:35 | 05:09 |
| 1 | 16:48 | 17:42 | 15:56 (WEA_ZB01) 18:32 | 15:29 (WEA_ZB01) 20:24 | 21:12 | 21:45 |
| 2 | 08:24 | 07:38 | 15:03 (WEA_ZB01) 06:38 | 15:03 (WEA_ZB01) 06:29 | 05:34 | 05:09 |
| 3 | 16:49 | 17:44 | 15:56 (WEA_ZB01) 18:33 | 15:30 (WEA_ZB01) 20:25 | 21:14 | 21:46 |
| 4 | 08:24 | 07:36 | 15:02 (WEA_ZB01) 06:36 | 15:02 (WEA_ZB01) 06:27 | 05:32 | 05:09 |
| 5 | 16:51 | 17:46 | 15:56 (WEA_ZB01) 18:35 | 15:31 (WEA_ZB01) 20:27 | 21:15 | 21:46 |
| 6 | 08:23 | 07:34 | 15:02 (WEA_ZB01) 06:34 | 15:02 (WEA_ZB01) 06:25 | 05:31 | 05:09 |
| 7 | 16:53 | 17:48 | 15:56 (WEA_ZB01) 18:37 | 15:32 (WEA_ZB01) 20:29 | 21:16 | 21:47 |
| 8 | 08:22 | 07:32 | 15:02 (WEA_ZB01) 06:32 | 15:02 (WEA_ZB01) 06:23 | 05:29 | 05:09 |
| 9 | 16:54 | 17:50 | 15:56 (WEA_ZB01) 18:38 | 15:33 (WEA_ZB01) 20:30 | 21:18 | 21:47 |
| 10 | 08:21 | 07:30 | 15:02 (WEA_ZB01) 06:29 | 15:02 (WEA_ZB01) 06:21 | 05:28 | 05:10 |
| 11 | 16:56 | 17:51 | 15:56 (WEA_ZB01) 18:40 | 15:34 (WEA_ZB01) 20:32 | 21:19 | 21:47 |
| 12 | 08:19 | 07:28 | 15:02 (WEA_ZB01) 06:27 | 15:02 (WEA_ZB01) 06:18 | 05:27 | 05:10 |
| 13 | 16:58 | 17:53 | 15:56 (WEA_ZB01) 18:42 | 15:35 (WEA_ZB01) 20:34 | 21:21 | 21:47 |
| 14 | 08:18 | 07:26 | 15:02 (WEA_ZB01) 06:25 | 15:02 (WEA_ZB01) 06:16 | 05:26 | 05:10 |
| 15 | 16:59 | 17:55 | 15:56 (WEA_ZB01) 18:43 | 15:35 (WEA_ZB01) 20:35 | 21:22 | 21:48 |
| 16 | 08:17 | 07:24 | 15:02 (WEA_ZB01) 06:23 | 15:02 (WEA_ZB01) 06:14 | 05:24 | 05:10 |
| 17 | 17:01 | 17:57 | 15:55 (WEA_ZB01) 18:45 | 15:36 (WEA_ZB01) 20:37 | 21:23 | 21:48 |
| 18 | 08:16 | 07:22 | 15:02 (WEA_ZB01) 06:20 | 15:02 (WEA_ZB01) 06:12 | 05:23 | 05:11 |
| 19 | 17:03 | 17:59 | 15:55 (WEA_ZB01) 18:47 | 15:36 (WEA_ZB01) 20:38 | 21:25 | 21:48 |
| 20 | 08:15 | 07:20 | 15:02 (WEA_ZB01) 06:18 | 15:02 (WEA_ZB01) 06:10 | 05:22 | 05:11 |
| 21 | 17:04 | 18:00 | 15:54 (WEA_ZB01) 18:48 | 15:37 (WEA_ZB01) 20:40 | 21:26 | 21:48 |
| 22 | 08:13 | 07:18 | 15:02 (WEA_ZB01) 06:16 | 15:02 (WEA_ZB01) 06:08 | 05:21 | 05:11 |
| 23 | 17:06 | 18:02 | 15:53 (WEA_ZB01) 18:50 | 15:38 (WEA_ZB01) 20:42 | 21:27 | 21:48 |
| 24 | 08:12 | 07:16 | 15:02 (WEA_ZB01) 06:13 | 15:02 (WEA_ZB01) 06:06 | 05:20 | 05:12 |
| 25 | 17:08 | 18:04 | 15:52 (WEA_ZB01) 18:52 | 15:39 (WEA_ZB01) 20:43 | 21:28 | 21:48 |
| 26 | 08:11 | 18:04 | 15:52 (WEA_ZB01) 18:52 | 15:39 (WEA_ZB01) 20:43 | 21:28 | 21:48 |
| 27 | 17:10 | 18:04 | 15:52 (WEA_ZB01) 18:52 | 15:39 (WEA_ZB01) 20:43 | 21:28 | 21:48 |
| 28 | 08:09 | 15:24 (WEA_ZB01) | 15:09 (WEA_ZB01) 07:09 | 15:09 (WEA_ZB01) 06:03 | 05:18 | 05:13 |
| 29 | 17:11 | 15:32 (WEA_ZB01) | 15:10 (WEA_ZB01) 07:10 | 15:10 (WEA_ZB01) 06:04 | 05:19 | 05:14 |
| 30 | 08:08 | 15:20 (WEA_ZB01) | 15:08 (WEA_ZB01) 07:07 | 15:08 (WEA_ZB01) 06:01 | 05:17 | 05:13 |
| 31 | 17:13 | 15:38 (WEA_ZB01) | 15:11 (WEA_ZB01) 07:11 | 15:11 (WEA_ZB01) 06:05 | 05:21 | 05:16 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 |
| astr.max.mögl.Beschattung | 26 | 1503 | 295 | | | |

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

| Tag im Monat | Sonnenaufgang (SS:MM) | Sonnenuntergang (SS:MM) | Minuten mit Schatten | Zeitpunkt (SS:MM) Schattenanfang | Zeitpunkt (SS:MM) Schattende | Schattenanfang (WEA mit erstem Schatten) | Schattende (WEA mit letztem Schatten) |
|--------------|-----------------------|-------------------------|----------------------|----------------------------------|------------------------------|--|---------------------------------------|
|--------------|-----------------------|-------------------------|----------------------|----------------------------------|------------------------------|--|---------------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender

Berechnung: Gesamtbelastung **Schattenrezeptor:**SR-01 - SR-01, Provinzialstraße 2, 59602 Rüthen
Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Jul | August | September | Oktober | | November | | Dezember |
|---------------------------|-------|--------|-----------|---------|----|--------------------------|----|--------------------------|
| 1 | 05:14 | 05:49 | 06:38 | 07:26 | | 07:18 | | 14:36 (WEA_ZB01) 08:09 |
| | 21:47 | 21:16 | 20:15 | 19:07 | | 17:02 | 47 | 15:23 (WEA_ZB01) 16:22 |
| 2 | 05:14 | 05:51 | 06:39 | 07:27 | | 07:20 | | 14:37 (WEA_ZB01) 08:10 |
| | 21:47 | 21:14 | 20:13 | 19:04 | | 17:00 | 45 | 15:22 (WEA_ZB01) 16:22 |
| 3 | 05:15 | 05:52 | 06:41 | 07:29 | | 07:22 | | 14:37 (WEA_ZB01) 08:11 |
| | 21:46 | 21:13 | 20:11 | 19:02 | | 16:58 | 44 | 15:21 (WEA_ZB01) 16:21 |
| 4 | 05:16 | 05:54 | 06:43 | 07:31 | | 07:24 | | 14:39 (WEA_ZB01) 08:13 |
| | 21:46 | 21:11 | 20:08 | 19:00 | | 16:56 | 41 | 15:20 (WEA_ZB01) 16:20 |
| 5 | 05:16 | 05:55 | 06:44 | 07:32 | | 07:26 | | 14:40 (WEA_ZB01) 08:14 |
| | 21:45 | 21:09 | 20:06 | 18:58 | | 16:54 | 39 | 15:19 (WEA_ZB01) 16:20 |
| 6 | 05:17 | 05:57 | 06:46 | 07:34 | | 16:02 (WEA_ZB01) 07:27 | | 14:40 (WEA_ZB01) 08:15 |
| | 21:45 | 21:08 | 20:04 | 18:55 | 8 | 16:10 (WEA_ZB01) 16:53 | 37 | 15:17 (WEA_ZB01) 16:19 |
| 7 | 05:18 | 05:58 | 06:47 | 07:36 | | 15:56 (WEA_ZB01) 07:29 | | 14:42 (WEA_ZB01) 08:16 |
| | 21:44 | 21:06 | 20:02 | 18:53 | 20 | 16:16 (WEA_ZB01) 16:51 | 34 | 15:16 (WEA_ZB01) 16:19 |
| 8 | 05:19 | 06:00 | 06:49 | 07:37 | | 15:51 (WEA_ZB01) 07:31 | | 14:44 (WEA_ZB01) 08:18 |
| | 21:44 | 21:04 | 19:59 | 18:51 | 27 | 16:18 (WEA_ZB01) 16:49 | 31 | 15:15 (WEA_ZB01) 16:19 |
| 9 | 05:20 | 06:01 | 06:51 | 07:39 | | 09:01 (WEA_VB14) 07:33 | | 14:46 (WEA_ZB01) 08:19 |
| | 21:43 | 21:02 | 19:57 | 18:49 | 40 | 16:20 (WEA_ZB01) 16:48 | 27 | 15:13 (WEA_ZB01) 16:18 |
| 10 | 05:21 | 06:03 | 06:52 | 07:41 | | 08:58 (WEA_VB14) 07:34 | | 14:48 (WEA_ZB01) 08:20 |
| | 21:42 | 21:00 | 19:55 | 18:46 | 50 | 16:22 (WEA_ZB01) 16:46 | 23 | 15:11 (WEA_ZB01) 16:18 |
| 11 | 05:22 | 06:05 | 06:54 | 07:42 | | 08:57 (WEA_VB14) 07:36 | | 14:51 (WEA_ZB01) 08:21 |
| | 21:42 | 20:58 | 19:52 | 18:44 | 55 | 16:23 (WEA_ZB01) 16:45 | 17 | 15:08 (WEA_ZB01) 16:18 |
| 12 | 05:23 | 06:06 | 06:55 | 07:44 | | 08:54 (WEA_VB14) 07:38 | | 14:56 (WEA_ZB01) 08:22 |
| | 21:41 | 20:57 | 19:50 | 18:42 | 62 | 16:24 (WEA_ZB01) 16:43 | 8 | 15:04 (WEA_ZB01) 16:18 |
| 13 | 05:24 | 06:08 | 06:57 | 07:46 | | 08:54 (WEA_VB14) 07:40 | | 14:56 (WEA_ZB01) 08:23 |
| | 21:40 | 20:55 | 19:48 | 18:40 | 65 | 16:25 (WEA_ZB01) 16:42 | | 15:04 (WEA_ZB01) 16:18 |
| 14 | 05:25 | 06:09 | 06:59 | 07:47 | | 08:53 (WEA_VB14) 07:41 | | 14:56 (WEA_ZB01) 08:24 |
| | 21:39 | 20:53 | 19:46 | 18:38 | 69 | 16:26 (WEA_ZB01) 16:40 | | 15:04 (WEA_ZB01) 16:18 |
| 15 | 05:26 | 06:11 | 07:00 | 07:49 | | 08:53 (WEA_VB14) 07:43 | | 14:56 (WEA_ZB01) 08:25 |
| | 21:38 | 20:51 | 19:43 | 18:36 | 70 | 16:26 (WEA_ZB01) 16:39 | | 15:04 (WEA_ZB01) 16:18 |
| 16 | 05:28 | 06:12 | 07:02 | 07:51 | | 08:52 (WEA_VB14) 07:45 | | 14:56 (WEA_ZB01) 08:26 |
| | 21:37 | 20:49 | 19:41 | 18:33 | 72 | 16:26 (WEA_ZB01) 16:38 | | 15:04 (WEA_ZB01) 16:18 |
| 17 | 05:29 | 06:14 | 07:03 | 07:52 | | 08:52 (WEA_VB14) 07:46 | | 14:56 (WEA_ZB01) 08:26 |
| | 21:36 | 20:47 | 19:39 | 18:31 | 73 | 16:26 (WEA_ZB01) 16:36 | | 15:04 (WEA_ZB01) 16:18 |
| 18 | 05:30 | 06:16 | 07:05 | 07:54 | | 08:52 (WEA_VB14) 07:48 | | 14:56 (WEA_ZB01) 08:27 |
| | 21:35 | 20:45 | 19:36 | 18:29 | 74 | 16:27 (WEA_ZB01) 16:35 | | 15:04 (WEA_ZB01) 16:19 |
| 19 | 05:31 | 06:17 | 07:06 | 07:56 | | 08:53 (WEA_VB14) 07:50 | | 14:56 (WEA_ZB01) 08:28 |
| | 21:34 | 20:43 | 19:34 | 18:27 | 73 | 16:27 (WEA_ZB01) 16:34 | | 15:04 (WEA_ZB01) 16:19 |
| 20 | 05:32 | 06:19 | 07:08 | 07:58 | | 08:53 (WEA_VB14) 07:51 | | 14:56 (WEA_ZB01) 08:29 |
| | 21:33 | 20:41 | 19:32 | 18:25 | 73 | 16:27 (WEA_ZB01) 16:32 | | 15:04 (WEA_ZB01) 16:19 |
| 21 | 05:34 | 06:20 | 07:10 | 07:59 | | 08:53 (WEA_VB14) 07:53 | | 14:56 (WEA_ZB01) 08:29 |
| | 21:32 | 20:39 | 19:30 | 18:23 | 73 | 16:27 (WEA_ZB01) 16:31 | | 15:04 (WEA_ZB01) 16:20 |
| 22 | 05:35 | 06:22 | 07:11 | 08:01 | | 08:55 (WEA_VB14) 07:55 | | 14:56 (WEA_ZB01) 08:30 |
| | 21:30 | 20:37 | 19:27 | 18:21 | 69 | 16:27 (WEA_ZB01) 16:30 | | 15:04 (WEA_ZB01) 16:20 |
| 23 | 05:36 | 06:24 | 07:13 | 08:03 | | 08:57 (WEA_VB14) 07:56 | | 14:56 (WEA_ZB01) 08:30 |
| | 21:29 | 20:34 | 19:25 | 18:19 | 66 | 16:27 (WEA_ZB01) 16:29 | | 15:04 (WEA_ZB01) 16:21 |
| 24 | 05:38 | 06:25 | 07:14 | 08:04 | | 09:01 (WEA_VB14) 07:58 | | 14:56 (WEA_ZB01) 08:31 |
| | 21:28 | 20:32 | 19:23 | 18:17 | 58 | 16:27 (WEA_ZB01) 16:28 | | 15:04 (WEA_ZB01) 16:21 |
| 25 | 05:39 | 06:27 | 07:16 | 08:06 | | 14:33 (WEA_ZB01) 08:00 | | 13:21 (WEA_VB11) 08:31 |
| | 21:26 | 20:30 | 19:20 | 17:15 | 54 | 15:27 (WEA_ZB01) 16:27 | | 14:56 (WEA_ZB01) 16:22 |
| 26 | 05:41 | 06:28 | 07:18 | 08:08 | | 14:34 (WEA_ZB01) 08:01 | | 13:22 (WEA_VB11) 08:31 |
| | 21:25 | 20:28 | 19:18 | 17:13 | 52 | 15:26 (WEA_ZB01) 16:26 | | 14:56 (WEA_ZB01) 16:23 |
| 27 | 05:42 | 06:30 | 07:19 | 08:10 | | 14:33 (WEA_ZB01) 08:03 | | 13:22 (WEA_VB11) 08:32 |
| | 21:24 | 20:26 | 19:16 | 17:11 | 52 | 15:25 (WEA_ZB01) 16:25 | | 14:56 (WEA_ZB01) 16:23 |
| 28 | 05:43 | 06:32 | 07:21 | 08:11 | | 14:33 (WEA_ZB01) 08:04 | | 13:22 (WEA_VB11) 08:32 |
| | 21:22 | 20:24 | 19:13 | 17:09 | 52 | 15:25 (WEA_ZB01) 16:24 | | 14:56 (WEA_ZB01) 16:24 |
| 29 | 05:45 | 06:33 | 07:23 | 08:13 | | 14:34 (WEA_ZB01) 08:06 | | 13:22 (WEA_VB11) 08:32 |
| | 21:21 | 20:22 | 19:11 | 17:07 | 50 | 15:24 (WEA_ZB01) 16:24 | | 14:56 (WEA_ZB01) 16:25 |
| 30 | 05:46 | 06:35 | 07:24 | 08:15 | | 14:34 (WEA_ZB01) 08:07 | | 13:22 (WEA_VB11) 08:32 |
| | 21:19 | 20:19 | 19:09 | 17:05 | 50 | 15:24 (WEA_ZB01) 16:23 | | 14:56 (WEA_ZB01) 16:26 |
| 31 | 05:48 | 06:36 | | 07:17 | | 14:35 (WEA_ZB01) | | 13:22 (WEA_VB11) 08:32 |
| | 21:18 | 20:17 | | 17:03 | 48 | 15:23 (WEA_ZB01) | | 14:56 (WEA_ZB01) 16:27 |
| Sonnenscheinstunden | 499 | 452 | 381 | 332 | | 268 | | 246 |
| astr.max.mögl.Beschattung | | | | 1455 | | 393 | | 26 |

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

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

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender

Berechnung: Gesamtbelastung **Schattenrezeptor:**SR-02 - SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg
Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| Januar | | Februar | | März | | April | | Mai | | Juni | |
|--------------------------|-------|------------------|-------|------------------|-------|------------------|-------|------------------|-------|------------------|------------------|
| 1 | 08:32 | 14:55 (WEA_V009) | 08:06 | 15:50 (WEA_V008) | 07:14 | 16:02 (WEA_V010) | 07:04 | 18:48 (WEA_V011) | 06:01 | 05:16 | 07:04 (WEA_V013) |
| 1 | 16:28 | 14:32 (WEA_V009) | 17:15 | 16:14 (WEA_V008) | 18:06 | 16:39 (WEA_V010) | 15:58 | 19:12 (WEA_V011) | 10:48 | 21:33 | 07:04 (WEA_V013) |
| 2 | 08:32 | 14:56 (WEA_V009) | 08:05 | 15:49 (WEA_V008) | 07:02 | 16:23 (WEA_V012) | 07:02 | 18:46 (WEA_V011) | 06:59 | 07:27 (WEA_V013) | 05:16 |
| 3 | 16:29 | 14:33 (WEA_V009) | 17:17 | 16:14 (WEA_V008) | 18:07 | 17:35 (WEA_V005) | 20:00 | 19:11 (WEA_V011) | 20:50 | 21:34 | 05:16 |
| 4 | 08:32 | 14:52 (WEA_V009) | 08:01 | 15:50 (WEA_V008) | 07:07 | 17:39 (WEA_V005) | 20:03 | 18:45 (WEA_V011) | 06:57 | 07:05 (WEA_V013) | 05:16 |
| 5 | 16:31 | 14:31 (WEA_V009) | 17:20 | 16:15 (WEA_V008) | 18:11 | 17:39 (WEA_V005) | 20:03 | 19:12 (WEA_V011) | 20:53 | 21:36 | 05:16 |
| 6 | 08:31 | 14:59 (WEA_V009) | 08:00 | 15:50 (WEA_V008) | 07:05 | 16:14 (WEA_V012) | 06:55 | 18:45 (WEA_V011) | 06:53 | 07:17 (WEA_V013) | 05:13 |
| 7 | 16:32 | 14:33 (WEA_V009) | 17:22 | 16:15 (WEA_V008) | 18:13 | 17:41 (WEA_V005) | 20:05 | 19:12 (WEA_V011) | 20:55 | 21:37 | 05:13 |
| 8 | 08:31 | 14:59 (WEA_V009) | 07:58 | 15:50 (WEA_V008) | 07:03 | 16:12 (WEA_V012) | 06:53 | 18:43 (WEA_V011) | 06:51 | 07:04 (WEA_V013) | 05:13 |
| 9 | 16:34 | 14:33 (WEA_V009) | 17:24 | 16:15 (WEA_V008) | 18:14 | 17:41 (WEA_V005) | 20:07 | 19:11 (WEA_V011) | 20:56 | 21:38 | 05:13 |
| 10 | 08:31 | 14:10 (WEA_V009) | 07:57 | 15:51 (WEA_V008) | 07:01 | 16:11 (WEA_V012) | 06:51 | 18:44 (WEA_V011) | 06:50 | 07:12 (WEA_V013) | 05:12 |
| 11 | 16:35 | 14:33 (WEA_V009) | 17:26 | 16:15 (WEA_V008) | 18:16 | 17:40 (WEA_V005) | 20:08 | 19:11 (WEA_V011) | 20:58 | 21:39 | 05:12 |
| 12 | 08:30 | 14:11 (WEA_V009) | 07:55 | 15:52 (WEA_V008) | 06:59 | 16:09 (WEA_V012) | 06:49 | 18:44 (WEA_V011) | 06:48 | 07:12 (WEA_V013) | 05:12 |
| 13 | 16:36 | 14:33 (WEA_V009) | 17:28 | 16:15 (WEA_V008) | 18:18 | 17:41 (WEA_V005) | 20:10 | 19:11 (WEA_V011) | 21:00 | 21:40 | 05:12 |
| 14 | 08:30 | 14:11 (WEA_V009) | 07:53 | 15:52 (WEA_V008) | 06:56 | 16:09 (WEA_V012) | 06:46 | 18:44 (WEA_V011) | 06:46 | 07:10 (WEA_V013) | 05:11 |
| 15 | 16:38 | 14:32 (WEA_V009) | 17:30 | 16:14 (WEA_V008) | 18:20 | 17:41 (WEA_V005) | 20:12 | 19:10 (WEA_V011) | 21:01 | 21:41 | 05:12 |
| 16 | 08:29 | 14:13 (WEA_V009) | 07:51 | 15:53 (WEA_V008) | 06:54 | 16:08 (WEA_V012) | 06:44 | 18:45 (WEA_V011) | 06:45 | 07:10 (WEA_V013) | 05:11 |
| 17 | 16:39 | 14:33 (WEA_V009) | 17:31 | 16:13 (WEA_V008) | 18:21 | 17:41 (WEA_V005) | 20:13 | 19:09 (WEA_V011) | 21:03 | 21:41 | 05:12 |
| 18 | 08:29 | 14:14 (WEA_V009) | 07:50 | 15:54 (WEA_V008) | 06:52 | 16:07 (WEA_V012) | 06:42 | 18:45 (WEA_V011) | 06:43 | 07:08 (WEA_V013) | 05:10 |
| 19 | 16:40 | 14:12 (WEA_V009) | 17:33 | 16:11 (WEA_V008) | 18:23 | 17:40 (WEA_V005) | 20:15 | 19:07 (WEA_V011) | 21:04 | 21:42 | 05:12 |
| 20 | 08:28 | 14:15 (WEA_V009) | 07:48 | 15:56 (WEA_V008) | 06:50 | 16:06 (WEA_V012) | 06:40 | 18:46 (WEA_V011) | 06:41 | 07:07 (WEA_V013) | 05:10 |
| 21 | 16:42 | 14:31 (WEA_V009) | 17:35 | 16:14 (WEA_V008) | 18:25 | 17:38 (WEA_V005) | 20:17 | 19:06 (WEA_V011) | 21:06 | 21:43 | 05:12 |
| 22 | 08:28 | 14:17 (WEA_V009) | 07:46 | 15:59 (WEA_V008) | 06:47 | 16:06 (WEA_V012) | 06:38 | 18:46 (WEA_V011) | 06:40 | 07:07 (WEA_V013) | 05:10 |
| 23 | 16:43 | 14:30 (WEA_V009) | 17:37 | 16:16 (WEA_V008) | 18:26 | 17:36 (WEA_V005) | 20:18 | 19:04 (WEA_V011) | 21:07 | 21:44 | 05:12 |
| 24 | 08:27 | 14:20 (WEA_V009) | 07:44 | 15:59 (WEA_V008) | 06:46 | 16:06 (WEA_V012) | 06:35 | 18:46 (WEA_V011) | 06:38 | 07:07 (WEA_V013) | 05:10 |
| 25 | 16:45 | 14:28 (WEA_V009) | 17:39 | 16:17 (WEA_V008) | 18:28 | 17:33 (WEA_V005) | 20:20 | 19:02 (WEA_V011) | 21:09 | 21:44 | 05:12 |
| 26 | 08:26 | 14:21 (WEA_V009) | 07:42 | 15:59 (WEA_V008) | 06:43 | 16:05 (WEA_V012) | 06:33 | 18:47 (WEA_V011) | 06:37 | 07:05 (WEA_V013) | 05:09 |
| 27 | 16:46 | 14:26 (WEA_V009) | 17:40 | 16:18 (WEA_V008) | 18:30 | 16:31 (WEA_V010) | 20:22 | 19:03 (WEA_V011) | 21:10 | 21:46 | 05:12 |
| 28 | 08:25 | 14:23 (WEA_V009) | 07:40 | 15:59 (WEA_V008) | 06:41 | 16:05 (WEA_V012) | 06:31 | 18:47 (WEA_V011) | 06:35 | 07:05 (WEA_V013) | 05:09 |
| 29 | 16:48 | 14:22 (WEA_V009) | 17:42 | 16:18 (WEA_V008) | 18:32 | 16:29 (WEA_V010) | 20:23 | 19:02 (WEA_V011) | 21:10 | 21:46 | 05:12 |
| 30 | 08:24 | 14:23 (WEA_V009) | 07:38 | 15:59 (WEA_V008) | 06:38 | 16:05 (WEA_V012) | 06:29 | 18:47 (WEA_V011) | 06:34 | 07:05 (WEA_V013) | 05:09 |
| 31 | 16:49 | 14:24 (WEA_V009) | 17:44 | 16:19 (WEA_V008) | 18:33 | 16:26 (WEA_V010) | 20:25 | 19:01 (WEA_V011) | 21:13 | 21:46 | 05:12 |
| 1 | 08:23 | 14:25 (WEA_V009) | 07:36 | 15:59 (WEA_V008) | 06:36 | 16:06 (WEA_V012) | 06:27 | 18:47 (WEA_V011) | 06:32 | 07:04 (WEA_V013) | 05:09 |
| 2 | 16:51 | 14:24 (WEA_V009) | 17:46 | 16:19 (WEA_V008) | 18:35 | 16:21 (WEA_V010) | 20:27 | 19:00 (WEA_V011) | 21:15 | 21:46 | 05:12 |
| 3 | 08:22 | 14:26 (WEA_V009) | 07:34 | 15:59 (WEA_V008) | 06:34 | 16:05 (WEA_V012) | 06:25 | 18:47 (WEA_V011) | 06:31 | 07:04 (WEA_V013) | 05:09 |
| 4 | 16:53 | 14:23 (WEA_V009) | 17:48 | 16:19 (WEA_V008) | 18:37 | 16:21 (WEA_V010) | 20:28 | 19:00 (WEA_V011) | 21:16 | 21:46 | 05:12 |
| 5 | 08:21 | 14:27 (WEA_V009) | 07:32 | 15:59 (WEA_V008) | 06:32 | 16:06 (WEA_V012) | 06:23 | 18:47 (WEA_V011) | 06:29 | 07:04 (WEA_V013) | 05:09 |
| 6 | 16:54 | 14:22 (WEA_V009) | 17:50 | 16:19 (WEA_V008) | 18:38 | 16:23 (WEA_V010) | 20:30 | 19:00 (WEA_V011) | 21:18 | 21:47 | 05:12 |
| 7 | 08:20 | 14:29 (WEA_V009) | 07:30 | 15:59 (WEA_V008) | 06:29 | 16:07 (WEA_V012) | 06:21 | 18:47 (WEA_V011) | 06:28 | 07:04 (WEA_V013) | 05:10 |
| 8 | 16:56 | 14:21 (WEA_V009) | 17:51 | 16:20 (WEA_V008) | 18:40 | 16:23 (WEA_V010) | 20:32 | 19:00 (WEA_V011) | 21:19 | 21:47 | 05:12 |
| 9 | 08:19 | 14:30 (WEA_V009) | 07:28 | 15:59 (WEA_V008) | 06:27 | 16:07 (WEA_V012) | 06:18 | 18:47 (WEA_V011) | 06:27 | 07:04 (WEA_V013) | 05:10 |
| 10 | 16:57 | 14:21 (WEA_V009) | 17:53 | 16:20 (WEA_V008) | 18:42 | 16:23 (WEA_V010) | 20:33 | 19:00 (WEA_V011) | 21:21 | 21:47 | 05:12 |
| 11 | 08:18 | 14:31 (WEA_V009) | 07:26 | 15:59 (WEA_V008) | 06:25 | 16:06 (WEA_V012) | 06:16 | 18:47 (WEA_V011) | 06:26 | 07:04 (WEA_V013) | 05:10 |
| 12 | 16:59 | 14:22 (WEA_V009) | 17:55 | 16:21 (WEA_V008) | 18:43 | 16:24 (WEA_V010) | 20:35 | 19:00 (WEA_V011) | 21:22 | 21:47 | 05:12 |
| 13 | 08:17 | 14:32 (WEA_V009) | 07:24 | 15:59 (WEA_V008) | 06:22 | 16:06 (WEA_V012) | 06:14 | 18:47 (WEA_V011) | 06:25 | 07:04 (WEA_V013) | 05:10 |
| 14 | 17:01 | 14:21 (WEA_V009) | 17:57 | 16:22 (WEA_V008) | 18:45 | 16:24 (WEA_V010) | 20:37 | 19:00 (WEA_V011) | 21:23 | 21:47 | 05:12 |
| 15 | 08:16 | 14:33 (WEA_V009) | 07:22 | 15:59 (WEA_V008) | 06:20 | 16:06 (WEA_V012) | 06:12 | 18:47 (WEA_V011) | 06:23 | 07:03 (WEA_V013) | 05:11 |
| 16 | 17:03 | 14:20 (WEA_V009) | 17:59 | 16:23 (WEA_V008) | 18:47 | 16:25 (WEA_V010) | 20:38 | 19:00 (WEA_V011) | 21:25 | 21:47 | 05:12 |
| 17 | 08:15 | 14:34 (WEA_V009) | 07:20 | 15:59 (WEA_V008) | 06:18 | 16:06 (WEA_V012) | 06:10 | 18:47 (WEA_V011) | 06:22 | 07:03 (WEA_V013) | 05:11 |
| 18 | 17:04 | 14:21 (WEA_V009) | 18:00 | 16:23 (WEA_V008) | 18:48 | 16:26 (WEA_V010) | 20:40 | 19:00 (WEA_V011) | 21:26 | 21:48 | 05:12 |
| 19 | 08:13 | 14:35 (WEA_V009) | 07:18 | 15:59 (WEA_V008) | 06:16 | 16:06 (WEA_V012) | 06:08 | 18:47 (WEA_V011) | 06:21 | 07:04 (WEA_V013) | 05:11 |
| 20 | 17:06 | 14:20 (WEA_V009) | 18:02 | 16:24 (WEA_V008) | 18:50 | 16:27 (WEA_V010) | 20:42 | 19:00 (WEA_V011) | 21:27 | 21:48 | 05:12 |
| 21 | 08:12 | 14:36 (WEA_V009) | 07:16 | 15:59 (WEA_V008) | 06:13 | 16:06 (WEA_V012) | 06:06 | 18:47 (WEA_V011) | 06:20 | 07:04 (WEA_V013) | 05:12 |
| 22 | 17:08 | 14:21 (WEA_V009) | 18:04 | 16:24 (WEA_V008) | 18:52 | 16:28 (WEA_V010) | 20:43 | 19:00 (WEA_V011) | 21:28 | 21:47 | 05:12 |
| 23 | 08:10 | 14:37 (WEA_V009) | 07:11 | 15:59 (WEA_V008) | 06:11 | 16:06 (WEA_V012) | 06:04 | 18:47 (WEA_V011) | 06:19 | 07:04 (WEA_V013) | 05:12 |
| 24 | 17:10 | 14:22 (WEA_V009) | 18:06 | 16:25 (WEA_V008) | 18:53 | 16:28 (WEA_V010) | 20:45 | 19:00 (WEA_V011) | 21:30 | 21:47 | 05:12 |
| 25 | 08:09 | 14:38 (WEA_V009) | 07:08 | 15:59 (WEA_V008) | 06:09 | 16:06 (WEA_V012) | 06:03 | 18:47 (WEA_V011) | 06:18 | 07:04 (WEA_V013) | 05:13 |
| 26 | 17:11 | 14:21 (WEA_V009) | 18:08 | 16:25 (WEA_V008) | 18:54 | 16:29 (WEA_V010) | 20:47 | 19:00 (WEA_V011) | 21:31 | 21:47 | 05:12 |
| 27 | 08:08 | 14:39 (WEA_V009) | 07:07 | 15:59 (WEA_V008) | 06:07 | 16:06 (WEA_V012) | 06:01 | 18:47 (WEA_V011) | 06:17 | 07:04 (WEA_V013) | 05:13 |
| 28 | 17:13 | 14:24 (WEA_V009) | 18:09 | 16:26 (WEA_V008) | 18:57 | 16:30 (WEA_V010) | 20:49 | 19:00 (WEA_V011) | 21:32 | 21:47 | 05:12 |
| 29 | 08:07 | 14:40 (WEA_V009) | 07:06 | 15:59 (WEA_V008) | 06:05 | 16:06 (WEA_V012) | 05:59 | 18:47 (WEA_V011) | 06:16 | 07:04 (WEA_V013) | 05:13 |
| 30 | 17:14 | 14:25 (WEA_V009) | 18:10 | 16:27 (WEA_V008) | 18:59 | 16:31 (WEA_V010) | 20:51 | 19:00 (WEA_V011) | 21:33 | 21:47 | 05:12 |
| 31 | 08:06 | 14:41 (WEA_V009) | 07:05 | 15:59 (WEA_V008) | 06:04 | 16:06 (WEA_V012) | 05:58 | 18:47 (WEA_V011) | 06:15 | 07:04 (WEA_V013) | 05:13 |
| 1 | 17:15 | 14:26 (WEA_V009) | 18:12 | 16:28 (WEA_V008) | 19:00 | 16:32 (WEA_V010) | 20:53 | 19:00 (WEA_V011) | 21:34 | 21:47 | 05:12 |
| Sonnenscheinstunden | 261 | | 279 | | 367 | | 415 | | 483 | | 496 |
| astronomisch Beschattung | 425 | | 486 | | 589 | | 731 | | 819 | | 910 |

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

| Tag im Monat | Sonnenaufgang (SS:MM) | | Minuten mit Schatten | Zeitpunkt (SS:MM) | | Schattenanfang (WEA mit erstem Schatten) | | Schattendecke (WEA mit letztem Schatten) | |
|--------------|-------------------------|--|----------------------|-------------------|---------------|--|--|--|--|
| | Sonnenuntergang (SS:MM) | | | Zeitpunkt (SS:MM) | Schattendecke | | | | |

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
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DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender

Berechnung: Gesamtbelastung **Schattenrezeptor:**SR-02 - SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg
Annahmen für Schattenwurfberechnung

- Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| Juli | | August | | September | | Oktober | | November | | Dezember | | | | | | | | |
|------|-------|--------|-----------------|-----------|----|-----------------|-------|----------|-----------------|----------|----|-----------------|-------|----|-----------------|-------|----|-----------------|
| 1 | 05:14 | 71 | 07:12 (WEA_VB1) | 05:49 | 42 | 07:19 (WEA_VB1) | 06:38 | 22 | 18:45 (WEA_VB1) | 07:26 | 84 | 08:46 (WEA_VB2) | 07:18 | 20 | 15:23 (WEA_VB6) | 08:08 | 17 | 13:57 (WEA_VB9) |
| 2 | 05:17 | | 20:56 (WEA_VB3) | 21:16 | | 08:01 (WEA_VB3) | 20:15 | | 19:07 (WEA_VB1) | 19:07 | | 18:57 (WEA_VB2) | 17:02 | | 15:43 (WEA_VB6) | 16:22 | | 14:14 (WEA_VB9) |
| 3 | 05:14 | | 07:11 (WEA_VB1) | 05:51 | | 07:19 (WEA_VB1) | 06:39 | | 18:43 (WEA_VB1) | 07:27 | | 08:45 (WEA_VB2) | 07:20 | | 15:22 (WEA_VB6) | 08:10 | | 13:55 (WEA_VB9) |
| 4 | 05:16 | | 20:55 (WEA_VB3) | 21:14 | | 08:00 (WEA_VB3) | 20:13 | | 19:07 (WEA_VB1) | 19:04 | | 18:17 (WEA_VB2) | 17:00 | | 15:44 (WEA_VB6) | 16:22 | | 14:15 (WEA_VB9) |
| 5 | 05:15 | | 07:12 (WEA_VB1) | 05:52 | | 07:19 (WEA_VB1) | 06:41 | | 18:40 (WEA_VB1) | 07:29 | | 08:46 (WEA_VB2) | 07:22 | | 15:23 (WEA_VB6) | 08:11 | | 13:56 (WEA_VB9) |
| 6 | 05:16 | | 20:56 (WEA_VB3) | 21:13 | | 08:00 (WEA_VB3) | 20:10 | | 19:08 (WEA_VB1) | 19:02 | | 18:18 (WEA_VB2) | 16:58 | | 15:44 (WEA_VB6) | 16:21 | | 14:16 (WEA_VB9) |
| 7 | 05:18 | | 07:12 (WEA_VB1) | 05:54 | | 07:21 (WEA_VB1) | 06:43 | | 18:41 (WEA_VB1) | 07:31 | | 08:46 (WEA_VB2) | 07:24 | | 15:23 (WEA_VB6) | 08:13 | | 13:55 (WEA_VB9) |
| 8 | 05:17 | | 20:57 (WEA_VB3) | 21:11 | | 07:58 (WEA_VB3) | 20:08 | | 19:08 (WEA_VB1) | 19:00 | | 18:59 (WEA_VB2) | 16:56 | | 15:45 (WEA_VB6) | 16:20 | | 14:17 (WEA_VB9) |
| 9 | 05:16 | | 07:12 (WEA_VB1) | 05:55 | | 07:22 (WEA_VB1) | 06:44 | | 18:41 (WEA_VB1) | 07:32 | | 08:46 (WEA_VB2) | 07:25 | | 15:20 (WEA_VB6) | 08:14 | | 13:55 (WEA_VB9) |
| 10 | 05:18 | | 20:57 (WEA_VB3) | 21:09 | | 07:57 (WEA_VB3) | 20:06 | | 19:08 (WEA_VB1) | 18:58 | | 18:18 (WEA_VB2) | 16:54 | | 15:44 (WEA_VB6) | 16:20 | | 14:18 (WEA_VB9) |
| 11 | 05:17 | | 07:12 (WEA_VB1) | 05:57 | | 07:23 (WEA_VB1) | 06:46 | | 18:40 (WEA_VB1) | 07:34 | | 08:47 (WEA_VB2) | 07:27 | | 15:20 (WEA_VB6) | 08:15 | | 13:55 (WEA_VB9) |
| 12 | 05:18 | | 20:57 (WEA_VB3) | 21:07 | | 07:56 (WEA_VB3) | 20:04 | | 19:07 (WEA_VB1) | 18:55 | | 18:18 (WEA_VB2) | 16:53 | | 15:45 (WEA_VB6) | 16:19 | | 14:19 (WEA_VB9) |
| 13 | 05:18 | | 07:12 (WEA_VB1) | 05:58 | | 07:24 (WEA_VB1) | 06:47 | | 18:40 (WEA_VB1) | 07:36 | | 08:48 (WEA_VB2) | 07:29 | | 15:20 (WEA_VB6) | 08:16 | | 13:55 (WEA_VB9) |
| 14 | 05:19 | | 20:57 (WEA_VB3) | 21:06 | | 07:54 (WEA_VB3) | 20:02 | | 19:07 (WEA_VB1) | 18:53 | | 18:18 (WEA_VB2) | 16:51 | | 15:45 (WEA_VB6) | 16:19 | | 14:19 (WEA_VB9) |
| 15 | 05:19 | | 07:12 (WEA_VB1) | 06:00 | | 07:27 (WEA_VB1) | 06:49 | | 18:39 (WEA_VB1) | 07:37 | | 08:48 (WEA_VB2) | 07:31 | | 15:20 (WEA_VB6) | 08:18 | | 13:56 (WEA_VB9) |
| 16 | 05:19 | | 20:58 (WEA_VB3) | 21:04 | | 07:53 (WEA_VB3) | 19:59 | | 19:06 (WEA_VB1) | 18:51 | | 18:16 (WEA_VB2) | 16:49 | | 15:45 (WEA_VB6) | 16:19 | | 14:21 (WEA_VB9) |
| 17 | 05:20 | | 07:12 (WEA_VB1) | 06:01 | | 07:28 (WEA_VB1) | 06:51 | | 18:39 (WEA_VB1) | 07:39 | | 08:50 (WEA_VB2) | 07:32 | | 15:20 (WEA_VB6) | 08:19 | | 13:55 (WEA_VB9) |
| 18 | 05:20 | | 20:58 (WEA_VB3) | 21:02 | | 07:50 (WEA_VB3) | 19:57 | | 19:06 (WEA_VB1) | 18:49 | | 18:15 (WEA_VB2) | 16:48 | | 15:45 (WEA_VB6) | 16:18 | | 14:21 (WEA_VB9) |
| 19 | 05:21 | | 07:13 (WEA_VB1) | 06:03 | | 07:31 (WEA_VB1) | 06:52 | | 18:39 (WEA_VB1) | 07:41 | | 08:51 (WEA_VB2) | 07:34 | | 15:21 (WEA_VB6) | 08:20 | | 13:55 (WEA_VB9) |
| 20 | 05:22 | | 20:58 (WEA_VB3) | 21:00 | | 07:47 (WEA_VB3) | 19:55 | | 19:05 (WEA_VB1) | 18:46 | | 18:14 (WEA_VB2) | 16:46 | | 15:45 (WEA_VB6) | 16:18 | | 14:22 (WEA_VB9) |
| 21 | 05:22 | | 07:13 (WEA_VB1) | 06:05 | | 07:32 (WEA_VB1) | 06:54 | | 18:40 (WEA_VB1) | 07:42 | | 08:54 (WEA_VB2) | 07:36 | | 15:21 (WEA_VB6) | 08:21 | | 13:56 (WEA_VB9) |
| 22 | 05:21 | | 20:59 (WEA_VB3) | 20:58 | | 07:52 (WEA_VB3) | 19:52 | | 19:04 (WEA_VB1) | 18:44 | | 18:11 (WEA_VB2) | 16:45 | | 15:45 (WEA_VB6) | 16:18 | | 14:22 (WEA_VB9) |
| 23 | 05:23 | | 07:13 (WEA_VB1) | 06:06 | | 07:33 (WEA_VB1) | 06:56 | | 18:40 (WEA_VB1) | 07:44 | | 08:59 (WEA_VB2) | 07:38 | | 15:22 (WEA_VB6) | 08:22 | | 13:56 (WEA_VB9) |
| 24 | 05:23 | | 20:59 (WEA_VB3) | 20:56 | | 07:53 (WEA_VB3) | 19:50 | | 19:02 (WEA_VB1) | 18:42 | | 18:13 (WEA_VB2) | 16:43 | | 15:44 (WEA_VB6) | 16:18 | | 14:23 (WEA_VB9) |
| 25 | 05:24 | | 07:13 (WEA_VB1) | 06:08 | | 07:34 (WEA_VB1) | 06:57 | | 18:41 (WEA_VB1) | 07:46 | | 08:55 (WEA_VB2) | 07:39 | | 15:23 (WEA_VB6) | 08:23 | | 13:56 (WEA_VB9) |
| 26 | 05:24 | | 20:59 (WEA_VB3) | 20:55 | | 07:54 (WEA_VB3) | 19:48 | | 19:01 (WEA_VB1) | 18:40 | | 18:12 (WEA_VB2) | 16:42 | | 15:44 (WEA_VB6) | 16:18 | | 14:23 (WEA_VB9) |
| 27 | 05:25 | | 07:13 (WEA_VB1) | 06:09 | | 07:35 (WEA_VB1) | 06:58 | | 18:43 (WEA_VB1) | 07:47 | | 08:56 (WEA_VB2) | 07:41 | | 15:24 (WEA_VB6) | 08:24 | | 13:56 (WEA_VB9) |
| 28 | 05:25 | | 20:59 (WEA_VB3) | 20:53 | | 07:54 (WEA_VB3) | 19:46 | | 18:59 (WEA_VB1) | 18:38 | | 18:11 (WEA_VB2) | 16:40 | | 15:43 (WEA_VB6) | 16:18 | | 14:24 (WEA_VB9) |
| 29 | 05:26 | | 07:13 (WEA_VB1) | 06:11 | | 07:36 (WEA_VB1) | 07:00 | | 18:45 (WEA_VB1) | 07:49 | | 08:56 (WEA_VB2) | 07:43 | | 15:25 (WEA_VB6) | 08:25 | | 13:57 (WEA_VB9) |
| 30 | 05:26 | | 20:59 (WEA_VB3) | 20:51 | | 07:54 (WEA_VB3) | 19:43 | | 19:00 (WEA_VB1) | 18:36 | | 18:10 (WEA_VB2) | 16:39 | | 15:44 (WEA_VB6) | 16:18 | | 14:25 (WEA_VB9) |
| 31 | 05:28 | | 07:13 (WEA_VB1) | 06:12 | | 07:37 (WEA_VB1) | 07:02 | | 18:55 (WEA_VB1) | 07:51 | | 08:57 (WEA_VB2) | 07:45 | | 15:26 (WEA_VB6) | 08:26 | | 13:57 (WEA_VB9) |
| 1 | 05:27 | | 20:59 (WEA_VB3) | 20:49 | | 07:54 (WEA_VB3) | 19:41 | | 19:01 (WEA_VB1) | 18:33 | | 18:08 (WEA_VB2) | 16:38 | | 15:40 (WEA_VB6) | 16:18 | | 14:25 (WEA_VB9) |
| 2 | 05:29 | | 07:13 (WEA_VB1) | 06:14 | | 07:39 (WEA_VB1) | 07:03 | | 18:52 (WEA_VB1) | 07:52 | | 08:58 (WEA_VB2) | 07:46 | | 15:29 (WEA_VB6) | 08:26 | | 13:58 (WEA_VB9) |
| 3 | 05:26 | | 20:59 (WEA_VB3) | 20:47 | | 07:54 (WEA_VB3) | 19:39 | | 19:01 (WEA_VB1) | 18:31 | | 18:07 (WEA_VB2) | 16:36 | | 15:39 (WEA_VB6) | 16:18 | | 14:26 (WEA_VB9) |
| 4 | 05:30 | | 07:13 (WEA_VB1) | 06:16 | | 07:40 (WEA_VB1) | 07:05 | | 09:02 (WEA_VB2) | 07:54 | | 08:58 (WEA_VB2) | 07:48 | | 15:33 (WEA_VB6) | 08:27 | | 13:58 (WEA_VB9) |
| 5 | 05:25 | | 20:58 (WEA_VB3) | 20:45 | | 07:53 (WEA_VB3) | 19:36 | | 19:05 (WEA_VB1) | 18:29 | | 18:06 (WEA_VB2) | 16:35 | | 15:38 (WEA_VB6) | 16:19 | | 14:26 (WEA_VB9) |
| 6 | 05:31 | | 07:14 (WEA_VB1) | 06:17 | | 07:40 (WEA_VB1) | 07:06 | | 08:58 (WEA_VB2) | 07:56 | | 08:52 (WEA_VB2) | 07:50 | | 15:30 (WEA_VB6) | 08:28 | | 13:58 (WEA_VB9) |
| 7 | 05:31 | | 20:59 (WEA_VB3) | 20:43 | | 07:54 (WEA_VB3) | 19:30 | | 19:04 (WEA_VB1) | 18:27 | | 18:03 (WEA_VB2) | 16:34 | | 15:34 (WEA_VB6) | 16:19 | | 14:27 (WEA_VB9) |
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| 9 | 05:31 | | 20:59 (WEA_VB3) | 20:41 | | 07:54 (WEA_VB3) | 19:24 | | 19:02 (WEA_VB1) | 18:25 | | 18:00 (WEA_VB2) | 16:32 | | 15:30 (WEA_VB6) | 16:19 | | 14:27 (WEA_VB9) |
| 10 | 05:34 | | 07:14 (WEA_VB1) | 06:20 | | 07:42 (WEA_VB1) | 07:10 | | 08:53 (WEA_VB2) | 07:59 | | 08:50 (WEA_VB2) | 07:53 | | 15:30 (WEA_VB6) | 08:29 | | 13:59 (WEA_VB9) |
| 11 | 05:32 | | 20:58 (WEA_VB3) | 20:39 | | 07:54 (WEA_VB3) | 19:29 | | 19:01 (WEA_VB1) | 18:23 | | 18:04 (WEA_VB2) | 16:31 | | 15:30 (WEA_VB6) | 16:20 | | 14:28 (WEA_VB9) |
| 12 | 05:35 | | 07:14 (WEA_VB1) | 06:22 | | 07:43 (WEA_VB1) | 07:11 | | 08:52 (WEA_VB2) | 08:01 | | 08:51 (WEA_VB2) | 07:55 | | 15:31 (WEA_VB6) | 08:30 | | 13:59 (WEA_VB9) |
| 13 | 05:30 | | 20:58 (WEA_VB3) | 20:36 | | 07:54 (WEA_VB3) | 19:27 | | 19:02 (WEA_VB1) | 18:21 | | 18:01 (WEA_VB2) | 16:29 | | 15:30 (WEA_VB6) | 16:20 | | 14:28 (WEA_VB9) |
| 14 | 05:36 | | 07:15 (WEA_VB1) | 06:24 | | 07:43 (WEA_VB1) | 07:13 | | 08:51 (WEA_VB2) | 08:03 | | 08:52 (WEA_VB2) | 07:56 | | 15:32 (WEA_VB6) | 08:30 | | 14:00 (WEA_VB9) |
| 15 | 05:39 | | 20:58 (WEA_VB3) | 20:34 | | 07:54 (WEA_VB3) | 19:25 | | 19:03 (WEA_VB1) | 18:19 | | 18:02 (WEA_VB2) | 16:29 | | 15:32 (WEA_VB6) | 16:21 | | 14:29 (WEA_VB9) |
| 16 | 05:38 | | 07:15 (WEA_VB1) | 06:25 | | 07:44 (WEA_VB1) | 07:14 | | 08:49 (WEA_VB2) | 08:04 | | 08:53 (WEA_VB2) | 07:58 | | 15:32 (WEA_VB6) | 08:31 | | 14:01 (WEA_VB9) |
| 17 | 05:41 | | 20:57 (WEA_VB3) | 20:32 | | 07:53 (WEA_VB3) | 19:23 | | 19:03 (WEA_VB1) | 18:17 | | 18:01 (WEA_VB2) | 16:28 | | 15:32 (WEA_VB6) | 16:20 | | 14:29 (WEA_VB9) |
| 18 | 05:39 | | 07:15 (WEA_VB1) | 06:27 | | 07:45 (WEA_VB1) | 07:16 | | 08:49 (WEA_VB2) | 07:06 | | 08:54 (WEA_VB2) | 07:59 | | 15:33 (WEA_VB6) | 08:31 | | 14:02 (WEA_VB9) |
| 19 | 05:36 | | 20:56 (WEA_VB3) | 20:30 | | 07:54 (WEA_VB3) | 19:20 | | 19:02 (WEA_VB1) | 17:15 | | 18:02 (WEA_VB2) | 16:27 | | 15:32 (WEA_VB6) | 16:20 | | 14:30 (WEA_VB9) |
| 20 | 05:41 | | 07:15 (WEA_VB1) | 06:28 | | 07:46 (WEA_VB1) | 07:18 | | 08:47 (WEA_VB2) | 07:08 | | 08:51 (WEA_VB2) | 07:58 | | 15:33 (WEA_VB6) | 08:31 | | 14:02 (WEA_VB9) |
| 21 | 05:42 | | 20:54 (WEA_VB3) | 20:28 | | 07:54 (WEA_VB3) | 19:18 | | 19:01 (WEA_VB1) | 17:13 | | 18:00 (WEA_VB2) | 16:26 | | 15:32 (WEA_VB6) | 16:20 | | 14:31 (WEA_VB9) |
| 22 | 05:42 | | 07:15 (WEA_VB1) | 06:30 | | 07:47 (WEA_VB1) | 07:19 | | 08:47 (WEA_VB2) | 07:10 | | 08:52 (WEA_VB2) | 07:58 | | 15:33 (WEA_VB6) | 08:32 | | 14:02 (WEA_VB9) |
| 23 | 05:43 | | 20:54 (WEA_VB3) | 20:26 | | 07:54 (WEA_VB3) | 19:16 | | 19:00 (WEA_VB1) | 17:11 | | 18:00 (WEA_VB2) | 16:25 | | 15:32 (WEA_VB6) | 16:20 | | 14:30 (WEA_VB9) |
| 24 | 05:43 | | 07:16 (WEA_VB1) | 06:31 | | 07:47 (WEA_VB1) | 07:21 | | 08:47 (WEA_VB2) | 07:11 | | 08:54 (WEA_VB2) | 07:58 | | 15:34 (WEA_VB6) | 08:32 | | 14:03 (WEA_VB9) |
| 25 | 05:42 | | 20:54 (WEA_VB3) | 20:24 | | 07:54 (WEA_VB3) | 19:14 | | 19:01 (WEA_VB1) | 17:09 | | 18:00 (WEA_VB2) | 16:24 | | 15:33 (WEA_VB6) | 16:24 | | 14:31 (WEA_VB9) |
| 26 | 05:45 | | 07:16 (WEA_VB1) | 06:33 | | 07:48 (WEA_VB1) | 07:22 | | 08:46 (WEA_VB2) | 07:13 | | 08:55 (WEA_VB2) | 07:59 | | 15:34 (WEA_VB6) | 08:32 | | 14:03 (WEA_VB9) |
| 27 | 05:43 | | 20:54 (WEA_VB3) | 20:22 | | 07:54 (WEA_VB3) | 19:11 | | 19:02 (WEA_VB1) | 17:07 | | 18:00 (WEA_VB2) | 16:24 | | 15:33 (WEA_VB6) | 16:25 | | 14:31 (WEA_VB9) |
| 28 | 05:46 | | 07:17 (WEA_VB1) | 06:35 | | 07:49 (WEA_VB1) | 07:24 | | 08:46 (WEA_VB2) | 07:15 | | 08:57 (WEA_VB2) | 07:59 | | 15:37 (WEA_VB6) | 08:32 | | 14:04 (WEA_VB9) |
| 29 | 05:49 | | 20:54 (WEA_VB3) | 20:19 | | 07:54 (WEA_VB3) | 19:09 | | 19:00 (WEA_VB1) | 17:05 | | 18:00 (WEA_VB2) | 16:23 | | 15:34 (WEA_VB6) | 16:26 | | 14:31 (WEA_VB9) |
| 30 | 05:48 | | 07:17 (WEA_VB1) | 06:36 | | 07:50 (WEA_VB1) | 07:25 | | 18:46 (WEA_VB1) | 07:17 | | 08:54 (WEA_VB2) | 07 | | | | | |

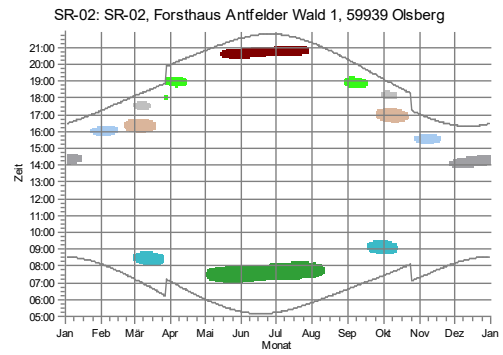
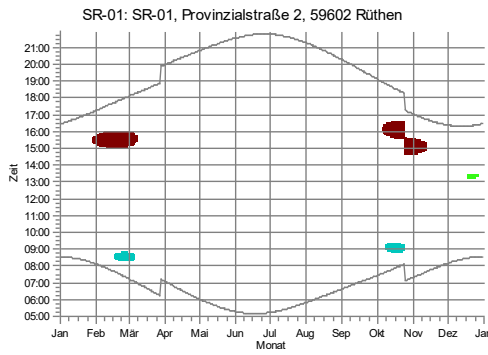
Anlage A4: SHADOW-Grafischer Kalender mit Darstellung der Schattenzeiten je Immissionsort durch die einzelnen WEA über das ganze Jahr

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
 Bonifatiusstr. 400
 DE-48432 Rheine
 +49 5971 9710-31
 Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
 Berechnet:
 24.06.2024 10:06/4.0.540

SHADOW - Grafischer Kalender

Berechnung: Gesamtbelastung



| | | |
|--|--|--|
| <p>WEA</p> <p>WEA_Z801: ENERCON E-175 EPS 6000 175.0 IOI NH: 162.0 m (Gau249.5 m) [17]</p> <p>WEA_V805: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [191]</p> <p>WEA_V808: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [194]</p> | <p>WEA_V809: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [195]</p> <p>WEA_V810: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [196]</p> <p>WEA_V811: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [197]</p> | <p>WEA_V812: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [198]</p> <p>WEA_V813: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [199]</p> <p>WEA_V814: VESTAS V162-6.2 6200 162.0 IOI NH: 169.0 m (Gau250.0 m) [200]</p> |
|--|--|--|

Anlage A5: SHADOW-Kalender pro WEA mit Darstellung der Beschattungszeiten je WEA über das ganze Jahr

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB01 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (17)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni |
|-----------------------------|----------------------|----------------------|----------------------|-------|----------------------|----------------------|
| 1 | 08:32 | 08:06 15:17-15:40/23 | 07:14 15:08-15:51/43 | 07:04 | 06:01 | 05:16 20:25-20:50/25 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 |
| 2 | 08:32 | 08:05 15:15-15:42/27 | 07:12 15:10-15:50/40 | 07:02 | 05:59 | 05:16 20:26-20:51/25 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 |
| 3 | 08:32 | 08:03 15:14-15:45/31 | 07:10 15:11-15:49/38 | 07:00 | 05:57 | 05:15 20:26-20:51/25 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 |
| 4 | 08:32 | 08:02 15:12-15:47/35 | 07:07 15:12-15:46/34 | 06:58 | 05:55 | 05:14 20:27-20:51/24 |
| | 16:31 | 17:20 | 18:11 | 20:04 | 20:53 | 21:36 |
| 5 | 08:32 | 08:00 15:10-15:48/38 | 07:05 15:15-15:44/29 | 06:55 | 05:53 | 05:13 20:27-20:51/24 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 |
| 6 | 08:31 | 07:58 15:09-15:49/40 | 07:03 15:18-15:41/23 | 06:53 | 05:51 | 05:13 20:26-20:50/24 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 |
| 7 | 08:31 | 07:57 15:09-15:51/42 | 07:01 15:22-15:38/16 | 06:51 | 05:50 | 05:12 20:27-20:51/24 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 |
| 8 | 08:31 | 07:55 15:08-15:52/44 | 06:59 | 06:49 | 05:48 | 05:12 20:28-20:51/23 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 |
| 9 | 08:30 | 07:53 15:07-15:53/46 | 06:56 | 06:46 | 05:46 | 05:11 20:28-20:51/23 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 |
| 10 | 08:30 | 07:51 15:06-15:53/47 | 06:54 | 06:44 | 05:45 | 05:11 20:28-20:51/23 |
| | 16:39 | 17:31 | 18:21 | 20:14 | 21:03 | 21:42 |
| 11 | 08:29 | 07:50 15:05-15:54/49 | 06:52 | 06:42 | 05:43 | 05:10 20:29-20:51/22 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 |
| 12 | 08:28 | 07:48 15:05-15:54/49 | 06:50 | 06:40 | 05:41 | 05:10 20:29-20:51/22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 |
| 13 | 08:28 | 07:46 15:04-15:55/51 | 06:47 | 06:38 | 05:40 | 05:10 20:29-20:51/22 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:07 | 21:44 |
| 14 | 08:27 | 07:44 15:04-15:55/51 | 06:45 | 06:35 | 05:38 | 05:10 20:30-20:51/21 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 |
| 15 | 08:26 | 07:42 15:03-15:56/53 | 06:43 | 06:33 | 05:37 20:35-20:38/3 | 05:10 20:30-20:51/21 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 |
| 16 | 08:25 | 07:40 15:03-15:56/53 | 06:41 | 06:31 | 05:35 20:32-20:42/10 | 05:09 20:30-20:52/22 |
| | 16:48 | 17:42 | 18:32 | 20:24 | 21:12 | 21:45 |
| 17 | 08:24 | 07:38 15:03-15:56/53 | 06:38 | 06:29 | 05:34 20:30-20:44/14 | 05:09 20:31-20:52/21 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:14 | 21:46 |
| 18 | 08:24 | 07:36 15:03-15:56/53 | 06:36 | 06:27 | 05:32 20:28-20:44/16 | 05:09 20:31-20:52/21 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 |
| 19 | 08:23 | 07:34 15:03-15:56/53 | 06:34 | 06:25 | 05:31 20:28-20:46/18 | 05:09 20:31-20:52/21 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:16 | 21:47 |
| 20 | 08:22 | 07:33 15:03-15:56/53 | 06:32 | 06:23 | 05:30 20:27-20:47/20 | 05:09 20:31-20:52/21 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 |
| 21 | 08:21 | 07:30 15:03-15:56/53 | 06:29 | 06:21 | 05:28 20:27-20:48/21 | 05:10 20:31-20:52/21 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 |
| 22 | 08:19 | 07:28 15:03-15:56/53 | 06:27 | 06:19 | 05:27 20:26-20:48/22 | 05:10 20:32-20:53/21 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:47 |
| 23 | 08:18 | 07:26 15:04-15:56/52 | 06:25 | 06:16 | 05:26 20:26-20:49/23 | 05:10 20:32-20:53/21 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:48 |
| 24 | 08:17 | 07:24 15:04-15:55/51 | 06:23 | 06:14 | 05:24 20:25-20:48/23 | 05:10 20:32-20:53/21 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 |
| 25 | 08:16 | 07:22 15:05-15:55/50 | 06:20 | 06:12 | 05:23 20:25-20:49/24 | 05:11 20:33-20:54/21 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:25 | 21:48 |
| 26 | 08:15 | 07:20 15:06-15:54/48 | 06:18 | 06:10 | 05:22 20:25-20:49/24 | 05:11 20:33-20:54/21 |
| | 17:04 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 |
| 27 | 08:13 | 07:18 15:06-15:53/47 | 06:16 | 06:08 | 05:21 20:26-20:50/24 | 05:11 20:33-20:54/21 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 |
| 28 | 08:12 | 07:16 15:07-15:52/45 | 06:13 | 06:06 | 05:20 20:25-20:50/25 | 05:12 20:33-20:54/21 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:48 |
| 29 | 08:11 | | 07:11 | 06:04 | 05:19 20:25-20:50/25 | 05:12 20:33-20:55/22 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 |
| 30 | 08:09 15:24-15:32/8 | | 07:09 | 06:03 | 05:18 20:25-20:50/25 | 05:13 20:33-20:55/22 |
| | 17:11 | | 19:55 | 20:47 | 21:31 | 21:47 |
| 31 | 08:08 15:20-15:38/18 | | 07:07 | | 05:17 20:25-20:50/25 | |
| | 17:13 | | 19:57 | | 21:32 | |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 |
| Anzahl Minuten mit Schatten | 26 | 1290 | 223 | 0 | 342 | 666 |

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:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB01 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (17)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Juli | | August | | September | | Oktober | | November | | Dezember | |
|-----------------------------|-------|----------------|--------|-------|-----------|----------------|---------|--|----------|----------------|----------|--|
| 1 | 05:14 | 20:33-20:56/23 | 05:49 | 06:38 | 07:26 | | | | 07:18 | 14:36-15:23/47 | 08:09 | |
| | 21:47 | | 21:16 | 20:15 | 19:07 | | | | 17:02 | | 16:22 | |
| 2 | 05:14 | 20:33-20:55/22 | 05:51 | 06:40 | 07:27 | | | | 07:20 | 14:37-15:22/45 | 08:10 | |
| | 21:47 | | 21:14 | 20:13 | 19:04 | | | | 17:00 | | 16:22 | |
| 3 | 05:15 | 20:33-20:56/23 | 05:52 | 06:41 | 07:29 | | | | 07:22 | 14:37-15:21/44 | 08:11 | |
| | 21:46 | | 21:13 | 20:11 | 19:02 | | | | 16:58 | | 16:21 | |
| 4 | 05:16 | 20:33-20:57/24 | 05:54 | 06:43 | 07:31 | | | | 07:24 | 14:39-15:20/41 | 08:13 | |
| | 21:46 | | 21:11 | 20:08 | 19:00 | | | | 16:56 | | 16:20 | |
| 5 | 05:17 | 20:34-20:57/23 | 05:55 | 06:44 | 07:32 | | | | 07:26 | 14:40-15:19/39 | 08:14 | |
| | 21:45 | | 21:09 | 20:06 | 18:58 | | | | 16:55 | | 16:20 | |
| 6 | 05:17 | 20:33-20:57/24 | 05:57 | 06:46 | 07:34 | 16:02-16:10/8 | | | 07:27 | 14:40-15:17/37 | 08:15 | |
| | 21:45 | | 21:08 | 20:04 | 18:55 | | | | 16:53 | | 16:20 | |
| 7 | 05:18 | 20:33-20:57/24 | 05:58 | 06:47 | 07:36 | 15:56-16:16/20 | | | 07:29 | 14:42-15:16/34 | 08:16 | |
| | 21:44 | | 21:06 | 20:02 | 18:53 | | | | 16:51 | | 16:19 | |
| 8 | 05:19 | 20:33-20:58/25 | 06:00 | 06:49 | 07:37 | 15:51-16:18/27 | | | 07:31 | 14:44-15:15/31 | 08:18 | |
| | 21:44 | | 21:04 | 19:59 | 18:51 | | | | 16:50 | | 16:19 | |
| 9 | 05:20 | 20:33-20:58/25 | 06:02 | 06:51 | 07:39 | 15:49-16:20/31 | | | 07:33 | 14:46-15:13/27 | 08:19 | |
| | 21:43 | | 21:02 | 19:57 | 18:49 | | | | 16:48 | | 16:19 | |
| 10 | 05:21 | 20:33-20:58/25 | 06:03 | 06:52 | 07:41 | 15:46-16:22/36 | | | 07:34 | 14:48-15:11/23 | 08:20 | |
| | 21:42 | | 21:00 | 19:55 | 18:46 | | | | 16:46 | | 16:18 | |
| 11 | 05:22 | 20:34-20:59/25 | 06:05 | 06:54 | 07:42 | 15:45-16:23/38 | | | 07:36 | 14:51-15:08/17 | 08:21 | |
| | 21:42 | | 20:58 | 19:53 | 18:44 | | | | 16:45 | | 16:18 | |
| 12 | 05:23 | 20:34-20:59/25 | 06:06 | 06:55 | 07:44 | 15:42-16:24/42 | | | 07:38 | 14:56-15:04/8 | 08:22 | |
| | 21:41 | | 20:57 | 19:50 | 18:42 | | | | 16:43 | | 16:18 | |
| 13 | 05:24 | 20:34-20:59/25 | 06:08 | 06:57 | 07:46 | 15:41-16:25/44 | | | 07:40 | | 08:23 | |
| | 21:40 | | 20:55 | 19:48 | 18:40 | | | | 16:42 | | 16:18 | |
| 14 | 05:25 | 20:34-20:59/25 | 06:09 | 06:59 | 07:47 | 15:40-16:26/46 | | | 07:41 | | 08:24 | |
| | 21:39 | | 20:53 | 19:46 | 18:38 | | | | 16:40 | | 16:18 | |
| 15 | 05:26 | 20:34-20:59/25 | 06:11 | 07:00 | 07:49 | 15:39-16:26/47 | | | 07:43 | | 08:25 | |
| | 21:38 | | 20:51 | 19:43 | 18:36 | | | | 16:39 | | 16:18 | |
| 16 | 05:28 | 20:34-20:59/25 | 06:13 | 07:02 | 07:51 | 15:37-16:26/49 | | | 07:45 | | 08:26 | |
| | 21:37 | | 20:49 | 19:41 | 18:33 | | | | 16:38 | | 16:18 | |
| 17 | 05:29 | 20:34-20:59/25 | 06:14 | 07:03 | 07:52 | 15:36-16:26/50 | | | 07:46 | | 08:26 | |
| | 21:36 | | 20:47 | 19:39 | 18:31 | | | | 16:36 | | 16:18 | |
| 18 | 05:30 | 20:34-20:58/24 | 06:16 | 07:05 | 07:54 | 15:36-16:27/51 | | | 07:48 | | 08:27 | |
| | 21:35 | | 20:45 | 19:36 | 18:29 | | | | 16:35 | | 16:19 | |
| 19 | 05:31 | 20:35-20:59/24 | 06:17 | 07:07 | 07:56 | 15:35-16:27/52 | | | 07:50 | | 08:28 | |
| | 21:34 | | 20:43 | 19:34 | 18:27 | | | | 16:34 | | 16:19 | |
| 20 | 05:33 | 20:35-20:59/24 | 06:19 | 07:08 | 07:58 | 15:35-16:27/52 | | | 07:51 | | 08:29 | |
| | 21:33 | | 20:41 | 19:32 | 18:25 | | | | 16:33 | | 16:19 | |
| 21 | 05:34 | 20:36-20:58/22 | 06:20 | 07:10 | 07:59 | 15:33-16:27/54 | | | 07:53 | | 08:29 | |
| | 21:32 | | 20:39 | 19:30 | 18:23 | | | | 16:31 | | 16:20 | |
| 22 | 05:35 | 20:36-20:58/22 | 06:22 | 07:11 | 08:01 | 15:33-16:27/54 | | | 07:55 | | 08:30 | |
| | 21:30 | | 20:37 | 19:27 | 18:21 | | | | 16:30 | | 16:20 | |
| 23 | 05:36 | 20:37-20:58/21 | 06:24 | 07:13 | 08:03 | 15:33-16:27/54 | | | 07:56 | | 08:30 | |
| | 21:29 | | 20:34 | 19:25 | 18:19 | | | | 16:29 | | 16:21 | |
| 24 | 05:38 | 20:38-20:57/19 | 06:25 | 07:15 | 08:04 | 15:33-16:27/54 | | | 07:58 | | 08:31 | |
| | 21:28 | | 20:32 | 19:23 | 18:17 | | | | 16:28 | | 16:21 | |
| 25 | 05:39 | 20:38-20:56/18 | 06:27 | 07:16 | 07:06 | 14:33-15:27/54 | | | 08:00 | | 08:31 | |
| | 21:26 | | 20:30 | 19:20 | 17:15 | | | | 16:27 | | 16:22 | |
| 26 | 05:41 | 20:39-20:54/15 | 06:28 | 07:18 | 07:08 | 14:34-15:26/52 | | | 08:01 | | 08:31 | |
| | 21:25 | | 20:28 | 19:18 | 17:13 | | | | 16:26 | | 16:23 | |
| 27 | 05:42 | 20:41-20:54/13 | 06:30 | 07:19 | 07:10 | 14:33-15:25/52 | | | 08:03 | | 08:32 | |
| | 21:24 | | 20:26 | 19:16 | 17:11 | | | | 16:25 | | 16:23 | |
| 28 | 05:43 | 20:43-20:51/8 | 06:32 | 07:21 | 07:11 | 14:33-15:25/52 | | | 08:04 | | 08:32 | |
| | 21:22 | | 20:24 | 19:13 | 17:09 | | | | 16:24 | | 16:24 | |
| 29 | 05:45 | | 06:33 | 07:23 | 07:13 | 14:34-15:24/50 | | | 08:06 | | 08:32 | |
| | 21:21 | | 20:22 | 19:11 | 17:07 | | | | 16:24 | | 16:25 | |
| 30 | 05:46 | | 06:35 | 07:24 | 07:15 | 14:34-15:24/50 | | | 08:07 | | 08:32 | |
| | 21:19 | | 20:19 | 19:09 | 17:05 | | | | 16:23 | | 16:26 | |
| 31 | 05:48 | | 06:36 | | 07:17 | 14:35-15:23/48 | | | | | 08:32 | |
| | 21:18 | | 20:17 | | 17:03 | | | | | | 16:27 | |
| Sonnenscheinstunden | 499 | | 452 | 381 | 332 | 268 | | | | 246 | | |
| Anzahl Minuten mit Schatten | 623 | | 0 | 0 | 1167 | 393 | | | 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:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB02 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (10)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:16 | 05:14 | 05:49 | 06:38 | 07:26 | 07:19 | 08:09 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:28 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:31 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:15 | 20:07 | 20:57 | 21:38 | 21:45 | 21:08 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:18 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:30 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| | 16:39 | 17:32 | 18:21 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:47 | 16:46 | 16:18 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:42 | 20:58 | 19:53 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:08 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:09 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:42 | 18:32 | 20:24 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 17 | 08:25 | 07:38 | 06:39 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:27 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:14 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:24 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:16 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:29 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:21 | 07:31 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:44 | 20:35 | 21:22 | 21:48 | 21:29 | 20:35 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:05 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 17:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 07:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 17:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 07:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 17:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 17:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 17:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 17:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
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Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB03 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (11)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:19 | 08:09 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:28 | 07:20 | 08:10 |
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| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
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| 5 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
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| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
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| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:16 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:29 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
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| | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
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| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 24 | 08:17 | 07:24 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:05 | 07:58 | 08:31 |
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| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
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| 27 | 08:13 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 08:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:48 | 21:22 | 20:24 | 19:14 | 18:09 | 16:25 | 16:24 |
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| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB04 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (12)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:32 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:56 | 06:44 | 07:32 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
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| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
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| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
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| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:43 | 18:32 | 20:24 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
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| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:29 |
| | 16:54 | 17:50 | 18:39 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:20 |
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| | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
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| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 25 | 08:16 | 07:22 | 06:20 | 06:13 | 05:24 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 17:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:11 | 05:22 | 05:11 | 05:41 | 06:29 | 07:18 | 07:08 | 08:01 | 08:31 |
| | 17:05 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 17:13 | 16:26 | 16:23 |
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| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 17:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:06 | 08:32 |
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| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 17:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB05 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (13)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:05 | 06:01 | 05:17 | 05:14 | 05:50 | 06:38 | 07:26 | 07:19 | 08:09 |
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| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
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| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| 12 | 16:34 | 17:24 | 18:15 | 20:07 | 20:57 | 21:38 | 21:45 | 21:08 | 20:04 | 18:55 | 16:53 | 16:20 |
| 13 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:13 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:17 |
| 14 | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 15 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:18 |
| 16 | 16:37 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 17 | 08:30 | 07:53 | 06:57 | 06:47 | 05:47 | 05:12 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
| 18 | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 19 | 08:30 | 07:52 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| 20 | 16:39 | 17:32 | 18:22 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:47 | 16:47 | 16:19 |
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| 24 | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| 26 | 16:43 | 17:37 | 18:27 | 20:19 | 21:08 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 27 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:26 | 06:10 | 06:59 | 07:47 | 07:41 | 08:24 |
| 28 | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:41 | 16:18 |
| 29 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
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| 32 | 16:48 | 17:43 | 18:32 | 20:24 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
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| 35 | 08:24 | 07:37 | 06:36 | 06:27 | 05:33 | 05:10 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| 36 | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:37 | 18:29 | 16:35 | 16:19 |
| 37 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:10 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| 38 | 16:53 | 17:48 | 18:37 | 20:29 | 21:17 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 39 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:52 | 08:29 |
| 40 | 16:54 | 17:50 | 18:39 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:20 |
| 41 | 08:21 | 07:31 | 06:30 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| 42 | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:32 | 16:20 |
| 43 | 08:20 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| 44 | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
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| 48 | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:22 |
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| 50 | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
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| 52 | 17:05 | 18:01 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 53 | 08:13 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:03 | 08:32 |
| 54 | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 18:11 | 16:26 | 16:24 |
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| 56 | 17:08 | 18:04 | 18:52 | 20:44 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 18:09 | 16:25 | 16:24 |
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| 59 | 08:09 | 07:09 | 06:03 | 05:18 | 05:13 | 05:47 | 06:35 | 07:24 | 08:15 | 09:06 | 08:32 | 08:32 |
| 60 | 17:12 | 18:08 | 18:56 | 20:47 | 21:31 | 21:47 | 21:19 | 20:20 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:08 | 07:07 | 06:01 | 05:17 | 05:12 | 05:48 | 06:37 | 07:27 | 08:18 | 09:09 | 08:32 | 08:32 |
| 62 | 17:13 | 18:09 | 18:57 | 20:48 | 21:32 | 21:48 | 21:18 | 20:17 | 19:08 | 18:04 | 16:23 | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB06 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (15)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| 4 | 16:29 | 17:17 | 18:08 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 5 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
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| 8 | 16:32 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 9 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:56 | 06:44 | 07:32 | 07:26 | 08:14 |
| 10 | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
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| 15 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:18 |
| 16 | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 17 | 08:30 | 07:53 | 06:57 | 06:47 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
| 18 | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 19 | 08:30 | 07:52 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| 20 | 16:39 | 17:32 | 18:22 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:47 | 16:46 | 16:19 |
| 21 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
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| 27 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:10 | 06:59 | 07:47 | 07:41 | 08:24 |
| 28 | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:41 | 16:18 |
| 29 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
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| 39 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:29 |
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| 45 | 08:18 | 07:27 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 48 | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:22 |
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| 50 | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
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| 58 | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
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| 62 | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB07 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (14)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| | 16:29 | 17:17 | 18:08 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
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| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
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| 10 | 08:30 | 07:52 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| | 16:39 | 17:32 | 18:21 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:47 | 16:46 | 16:18 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:42 | 20:59 | 19:53 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:08 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:42 | 18:32 | 20:24 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 17 | 08:25 | 07:38 | 06:39 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:53 | 07:46 | 08:27 |
| | 16:50 | 17:44 | 18:33 | 20:25 | 21:14 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:24 | 07:37 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:37 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:16 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:52 | 08:29 |
| | 16:54 | 17:50 | 18:39 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:21 | 07:31 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:20 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:27 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:44 | 20:35 | 21:22 | 21:48 | 21:29 | 20:35 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:05 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:13 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:11 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 07:08 | 08:01 | 08:31 |
| | 17:05 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 07:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:44 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 18:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:20 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_ZB08 - ENERCON E-175 EP5 6000 175.0 IO!NH: 162,0 m (Ges:249,5 m) (16)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:28 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:08 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:31 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:46 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:15 | 20:07 | 20:57 | 21:38 | 21:45 | 21:08 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:17 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:18 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:57 | 06:47 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:30 | 07:52 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| | 16:39 | 17:32 | 18:21 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:47 | 16:46 | 16:18 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:42 | 20:59 | 19:53 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:08 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:09 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:42 | 18:32 | 20:24 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 17 | 08:25 | 07:38 | 06:39 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:53 | 07:46 | 08:27 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:14 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:24 | 07:37 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:37 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:17 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:52 | 08:29 |
| | 16:54 | 17:50 | 18:39 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:21 | 07:31 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:20 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:27 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:44 | 20:35 | 21:22 | 21:48 | 21:29 | 20:35 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:05 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 07:08 | 08:01 | 08:31 |
| | 17:05 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
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| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:44 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 18:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:20 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB01 - VESTAS V 162-7.2 7200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (188)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:05 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:19 | 08:09 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:49 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:28 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:08 | 20:00 | 20:50 | 21:34 | 21:47 | 21:15 | 20:13 | 19:05 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:36 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:08 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:32 | 17:21 | 18:11 | 20:04 | 20:53 | 21:37 | 21:46 | 21:11 | 20:09 | 19:00 | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:05 | 06:56 | 05:53 | 05:14 | 05:17 | 05:56 | 06:44 | 07:33 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:38 | 21:46 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:59 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:28 | 08:15 |
| | 16:34 | 17:24 | 18:15 | 20:07 | 20:57 | 21:38 | 21:45 | 21:08 | 20:04 | 18:56 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:17 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:45 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:38 | 07:31 | 08:18 |
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| 9 | 08:30 | 07:53 | 06:57 | 06:47 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
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| 10 | 08:30 | 07:52 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:35 | 08:20 |
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| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:43 | 07:36 | 08:21 |
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| 12 | 08:29 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:56 | 07:44 | 07:38 | 08:22 |
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| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:10 | 06:59 | 07:48 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:45 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:44 | 18:36 | 16:39 | 16:18 |
| 16 | 08:26 | 07:41 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:43 | 18:32 | 20:24 | 21:12 | 21:46 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 17 | 08:25 | 07:39 | 06:39 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:04 | 07:53 | 07:47 | 08:27 |
| | 16:50 | 17:44 | 18:34 | 20:25 | 21:14 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:24 | 07:37 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:37 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:17 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:52 | 08:29 |
| | 16:54 | 17:50 | 18:39 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:21 | 07:31 | 06:30 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:20 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:48 | 21:31 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:19 | 07:27 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:57 | 08:30 |
| | 16:59 | 17:55 | 18:44 | 20:35 | 21:22 | 21:48 | 21:29 | 20:35 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:25 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:05 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:24 | 21:48 | 21:28 | 20:33 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:13 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:27 | 20:30 | 19:21 | 17:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:11 | 05:22 | 05:11 | 05:41 | 06:29 | 07:18 | 07:08 | 08:01 | 08:32 |
| | 17:05 | 18:01 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 17:13 | 16:26 | 16:23 |
| 27 | 08:14 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:20 | 07:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 17:11 | 16:25 | 16:24 |
| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:44 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 17:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:48 | 21:21 | 20:22 | 19:11 | 17:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:20 | 19:09 | 17:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB02 - ENERCON E-40/5.40 500 40.3 IO! NH: 50,0 m (Ges:70,2 m) (228)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:33 | 08:07 | 07:14 | 07:05 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:19 | 08:09 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:49 | 21:34 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:33 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:28 | 07:21 | 08:10 |
| | 16:29 | 17:17 | 18:08 | 20:00 | 20:50 | 21:35 | 21:47 | 21:15 | 20:13 | 19:05 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:12 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:36 | 21:47 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:08 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:32 | 17:21 | 18:11 | 20:04 | 20:54 | 21:37 | 21:46 | 21:11 | 20:09 | 19:00 | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:06 | 06:56 | 05:53 | 05:14 | 05:17 | 05:56 | 06:45 | 07:33 | 07:26 | 08:14 |
| | 16:33 | 17:23 | 18:13 | 20:06 | 20:55 | 21:38 | 21:46 | 21:10 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:32 | 07:59 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:28 | 08:16 |
| | 16:34 | 17:24 | 18:15 | 20:07 | 20:57 | 21:39 | 21:45 | 21:08 | 20:04 | 18:56 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:17 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:40 | 21:45 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:38 | 07:31 | 08:18 |
| | 16:36 | 17:28 | 18:18 | 20:11 | 21:00 | 21:40 | 21:44 | 21:04 | 20:00 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:54 | 06:57 | 06:47 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:02 | 21:41 | 21:43 | 21:03 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:30 | 07:52 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:35 | 08:20 |
| | 16:39 | 17:32 | 18:22 | 20:14 | 21:03 | 21:42 | 21:43 | 21:01 | 19:55 | 18:47 | 16:47 | 16:18 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:43 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:16 | 21:05 | 21:43 | 21:42 | 20:59 | 19:53 | 18:44 | 16:45 | 16:18 |
| 12 | 08:29 | 07:48 | 06:50 | 06:40 | 05:42 | 05:10 | 05:23 | 06:06 | 06:56 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:51 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:08 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:46 | 06:36 | 05:38 | 05:10 | 05:25 | 06:10 | 06:59 | 07:48 | 07:42 | 08:24 |
| | 16:45 | 17:39 | 18:29 | 20:21 | 21:09 | 21:45 | 21:39 | 20:53 | 19:46 | 18:38 | 16:41 | 16:18 |
| 15 | 08:27 | 07:43 | 06:43 | 06:34 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:39 | 20:51 | 19:44 | 18:36 | 16:39 | 16:18 |
| 16 | 08:26 | 07:41 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:43 | 18:32 | 20:24 | 21:12 | 21:46 | 21:38 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 17 | 08:25 | 07:39 | 06:39 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:04 | 07:53 | 07:47 | 08:27 |
| | 16:50 | 17:44 | 18:34 | 20:26 | 21:14 | 21:46 | 21:36 | 20:47 | 19:39 | 18:32 | 16:36 | 16:19 |
| 18 | 08:24 | 07:37 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:28 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:47 | 21:35 | 20:45 | 19:37 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:17 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:52 | 08:29 |
| | 16:54 | 17:50 | 18:39 | 20:31 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:21 | 07:31 | 06:30 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 08:00 | 07:53 | 08:30 |
| | 16:56 | 17:52 | 18:40 | 20:32 | 21:20 | 21:48 | 21:32 | 20:39 | 19:30 | 18:23 | 16:32 | 16:20 |
| 22 | 08:20 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:12 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:48 | 21:31 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:19 | 07:27 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:57 | 08:31 |
| | 16:59 | 17:55 | 18:44 | 20:35 | 21:22 | 21:48 | 21:29 | 20:35 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:25 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:05 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:24 | 21:48 | 21:28 | 20:33 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:23 | 06:21 | 06:13 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:07 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:27 | 20:31 | 19:21 | 18:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:21 | 06:18 | 06:11 | 05:22 | 05:11 | 05:41 | 06:29 | 07:18 | 07:08 | 08:01 | 08:32 |
| | 17:05 | 18:01 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:14 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:20 | 07:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:28 | 21:48 | 21:24 | 20:26 | 19:16 | 18:11 | 16:25 | 16:24 |
| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:44 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 18:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:14 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:48 | 21:21 | 20:22 | 19:11 | 18:06 | 16:24 | 16:25 |
| 30 | 08:10 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:47 | 06:35 | 07:24 | 07:15 | 08:07 | 08:33 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:48 | 21:19 | 20:20 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:37 | | 07:17 | | 08:33 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:18 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 500 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB03 - VESTAS V172-7.2 7200 172.0 !D! NH: 175,0 m (Ges:261,0 m) (189)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:33 | 08:07 | 07:14 | 07:05 | 06:01 | 05:17 | 05:14 | 05:50 | 06:38 | 07:26 | 07:19 | 08:09 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:49 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:23 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:15 | 05:51 | 06:40 | 07:28 | 07:21 | 08:10 |
| | 16:29 | 17:17 | 18:08 | 20:01 | 20:50 | 21:35 | 21:47 | 21:15 | 20:13 | 19:05 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:53 | 06:41 | 07:29 | 07:22 | 08:12 |
| | 16:31 | 17:19 | 18:10 | 20:02 | 20:52 | 21:36 | 21:47 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:08 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:32 | 17:21 | 18:11 | 20:04 | 20:54 | 21:37 | 21:46 | 21:11 | 20:09 | 19:00 | 16:57 | 16:21 |
| 5 | 08:32 | 08:00 | 07:06 | 06:56 | 05:54 | 05:14 | 05:17 | 05:56 | 06:45 | 07:33 | 07:26 | 08:14 |
| | 16:33 | 17:23 | 18:13 | 20:06 | 20:55 | 21:38 | 21:46 | 21:10 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:32 | 07:59 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:28 | 08:16 |
| | 16:34 | 17:24 | 18:15 | 20:07 | 20:57 | 21:39 | 21:45 | 21:08 | 20:04 | 18:56 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:13 | 05:19 | 05:59 | 06:48 | 07:36 | 07:29 | 08:17 |
| | 16:35 | 17:26 | 18:17 | 20:09 | 20:58 | 21:39 | 21:45 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:38 | 07:31 | 08:18 |
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| 9 | 08:30 | 07:53 | 06:57 | 06:47 | 05:47 | 05:12 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
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| 10 | 08:30 | 07:52 | 06:55 | 06:45 | 05:45 | 05:11 | 05:21 | 06:03 | 06:53 | 07:41 | 07:35 | 08:20 |
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| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:43 | 07:36 | 08:21 |
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| 12 | 08:29 | 07:48 | 06:50 | 06:40 | 05:42 | 05:10 | 05:23 | 06:07 | 06:56 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:51 | 18:42 | 16:44 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:25 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
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| 14 | 08:27 | 07:44 | 06:46 | 06:36 | 05:39 | 05:10 | 05:26 | 06:10 | 06:59 | 07:48 | 07:42 | 08:24 |
| | 16:45 | 17:39 | 18:29 | 20:21 | 21:09 | 21:45 | 21:39 | 20:53 | 19:46 | 18:38 | 16:41 | 16:18 |
| 15 | 08:26 | 07:43 | 06:43 | 06:34 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:47 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:44 | 18:36 | 16:39 | 16:18 |
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| 18 | 08:24 | 07:37 | 06:37 | 06:27 | 05:33 | 05:10 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:28 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:47 | 21:35 | 20:45 | 19:37 | 18:30 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:10 | 05:32 | 06:18 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:17 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:52 | 08:29 |
| | 16:55 | 17:50 | 18:39 | 20:31 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:20 |
| 21 | 08:21 | 07:31 | 06:30 | 06:21 | 05:29 | 05:10 | 05:34 | 06:21 | 07:10 | 08:00 | 07:53 | 08:29 |
| | 16:56 | 17:52 | 18:40 | 20:32 | 21:20 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:32 | 16:20 |
| 22 | 08:20 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:12 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:54 | 18:42 | 20:34 | 21:21 | 21:48 | 21:31 | 20:37 | 19:28 | 18:21 | 16:31 | 16:21 |
| 23 | 08:19 | 07:27 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:57 | 08:31 |
| | 17:00 | 17:55 | 18:44 | 20:35 | 21:22 | 21:48 | 21:29 | 20:35 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:25 | 06:23 | 06:15 | 05:25 | 05:11 | 05:38 | 06:26 | 07:15 | 08:05 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:24 | 21:48 | 21:28 | 20:33 | 19:23 | 18:17 | 16:28 | 16:22 |
| 25 | 08:16 | 07:23 | 06:21 | 06:13 | 05:24 | 05:11 | 05:40 | 06:27 | 07:16 | 07:07 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:27 | 20:31 | 19:21 | 18:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:21 | 06:18 | 06:11 | 05:23 | 05:11 | 05:41 | 06:29 | 07:18 | 07:08 | 08:01 | 08:32 |
| | 17:05 | 18:01 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:27 | 16:23 |
| 27 | 08:14 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:20 | 07:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:28 | 21:48 | 21:24 | 20:26 | 19:16 | 18:11 | 16:26 | 16:24 |
| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:44 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 18:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:14 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:48 | 21:21 | 20:22 | 19:11 | 18:06 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:47 | 06:35 | 07:25 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:56 | 20:47 | 21:31 | 21:47 | 21:19 | 20:20 | 19:09 | 18:00 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:18 | | 05:48 | 06:37 | | 07:17 | | 08:32 |
| | 17:14 | | 19:57 | | 21:32 | | 21:18 | 20:18 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB04 - VESTAS V 162-7.2 7200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (190)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:05 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:19 | 08:09 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:49 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:28 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:08 | 20:00 | 20:50 | 21:34 | 21:47 | 21:15 | 20:13 | 19:05 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:12 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:36 | 21:47 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:08 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:31 | 17:21 | 18:11 | 20:04 | 20:53 | 21:37 | 21:46 | 21:11 | 20:09 | 19:00 | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:05 | 06:56 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:33 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:38 | 21:46 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:32 | 07:59 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:28 | 08:15 |
| | 16:34 | 17:24 | 18:15 | 20:07 | 20:57 | 21:38 | 21:45 | 21:08 | 20:04 | 18:56 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:17 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:45 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:31 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:38 | 07:31 | 08:18 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 20:00 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:57 | 06:47 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:30 | 07:52 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:35 | 08:20 |
| | 16:39 | 17:32 | 18:22 | 20:14 | 21:03 | 21:42 | 21:43 | 21:01 | 19:55 | 18:47 | 16:46 | 16:18 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:43 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:15 | 21:05 | 21:43 | 21:42 | 20:59 | 19:53 | 18:44 | 16:45 | 16:18 |
| 12 | 08:29 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:56 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:08 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:10 | 06:59 | 07:48 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:45 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:44 | 18:36 | 16:39 | 16:18 |
| 16 | 08:26 | 07:41 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:43 | 18:32 | 20:24 | 21:12 | 21:46 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 17 | 08:25 | 07:39 | 06:39 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:04 | 07:53 | 07:47 | 08:27 |
| | 16:50 | 17:44 | 18:34 | 20:25 | 21:14 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:24 | 07:37 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:37 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:17 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:52 | 08:29 |
| | 16:54 | 17:50 | 18:39 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:21 | 07:31 | 06:30 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:20 | 07:29 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:48 | 21:31 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:19 | 07:27 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:57 | 08:30 |
| | 16:59 | 17:55 | 18:44 | 20:35 | 21:22 | 21:48 | 21:29 | 20:35 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:25 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:05 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:24 | 21:48 | 21:28 | 20:33 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:13 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 08:00 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:39 | 21:25 | 21:48 | 21:27 | 20:30 | 19:21 | 17:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:11 | 05:22 | 05:11 | 05:41 | 06:29 | 07:18 | 07:08 | 08:01 | 08:32 |
| | 17:05 | 18:01 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 17:13 | 16:26 | 16:23 |
| 27 | 08:14 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:20 | 07:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 17:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:14 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:12 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:44 | 21:29 | 21:48 | 21:22 | 20:24 | 19:14 | 17:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:48 | 21:21 | 20:22 | 19:11 | 17:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:20 | 19:09 | 17:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 500 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB05 - VESTAS V 162-6.2 6200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (191)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember | |
|----|-----------------------------|---------|-------|-------|-------|-------|-------|--------|-----------|---------------|----------------|----------|-------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:16 | 05:14 | 05:49 | 06:38 | 07:26 | 18:04-18:17/13 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:27 | 18:01-18:17/16 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 18:01-18:18/17 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 18:00-18:19/19 | 07:24 | 08:13 |
| | 16:31 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 17:59-18:18/19 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 17:59-18:18/19 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:08 | 20:04 | 18:55 | | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:36 | 17:59-18:18/19 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 17:59-18:16/17 | 07:31 | 08:18 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 18:00-18:15/15 | 07:33 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | | 16:48 | 16:19 |
| 10 | 08:30 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 18:01-18:14/13 | 07:34 | 08:20 |
| | 16:39 | 17:31 | 18:21 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:46 | | 16:46 | 16:18 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 18:02-18:11/9 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:42 | 20:58 | 19:53 | 18:44 | | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | | 07:40 | 08:23 |
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| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | | 16:36 | 16:16 |
| 18 | 08:24 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | | 16:35 | 16:19 |
| 19 | 08:23 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | | 07:50 | 08:28 |
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| 21 | 08:21 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:04 | | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 17:15 | | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 17:13 | | 16:26 | 16:21 |
| 27 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 07:10 | | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 17:11 | | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:11 | | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 17:09 | | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 17:07 | | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 18:06-18:15/9 | | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 17:05 | | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 17:07 | | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:03 | | | 16:27 |
| | Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 452 | 381 | 332 | 176 | 268 | 246 |
| | Anzahl Minuten mit Schatten | 0 | 0 | 187 | 0 | 0 | 0 | 0 | 9 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB06 - VESTAS V 162-6.2 6200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (192)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:28 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:08 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| | 16:31 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:26 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:15 | 20:07 | 20:56 | 21:38 | 21:45 | 21:08 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:18 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:47 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:30 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| | 16:39 | 17:32 | 18:21 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:47 | 16:46 | 16:18 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:42 | 20:58 | 19:53 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:07 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:11 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:26 |
| | 16:48 | 17:42 | 18:32 | 20:24 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 17 | 08:24 | 07:38 | 06:39 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:50 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:24 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:35 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:29 | 21:16 | 21:47 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:33 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:29 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:21 | 07:31 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:34 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:44 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:04 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 17:15 | 16:27 | 16:22 |
| 26 | 08:15 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 07:08 | 08:01 | 08:31 |
| | 17:05 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 17:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 07:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 17:11 | 16:25 | 16:24 |
| 28 | 08:12 | 07:16 | 06:13 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:14 | 17:09 | 16:25 | 16:24 |
| 29 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:06 | 08:32 |
| | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 17:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 17:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:18 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB07 - VESTAS V 162-6.2 6200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (193)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| 2 | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 3 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:27 | 07:20 | 08:10 |
| 4 | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 5 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 7 | 08:32 | 08:02 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:13 |
| 8 | 16:31 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 9 | 08:32 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:26 | 08:14 |
| 10 | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
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| 13 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:16 |
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| 18 | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
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| 20 | 16:39 | 17:32 | 18:21 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:47 | 16:46 | 16:18 |
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| 23 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| 24 | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:57 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:28 | 07:46 | 06:48 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:40 | 08:23 |
| 26 | 16:43 | 17:37 | 18:27 | 20:19 | 21:07 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
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| 34 | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 35 | 08:24 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| 36 | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 37 | 08:23 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| 38 | 16:53 | 17:48 | 18:37 | 20:29 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 39 | 08:22 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:29 |
| 40 | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
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| 42 | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:32 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 43 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| 44 | 16:58 | 17:53 | 18:42 | 20:33 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
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| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 47 | 08:17 | 07:24 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:04 | 07:58 | 08:31 |
| 48 | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
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| 50 | 17:03 | 17:59 | 18:47 | 20:38 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:15 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| 52 | 17:05 | 18:00 | 18:49 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 53 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:03 | 08:32 |
| 54 | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:24 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 55 | 08:12 | 07:16 | 06:13 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 08:11 | 08:04 | 08:32 |
| 56 | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:25 | 16:24 |
| 57 | 08:11 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 08:13 | 08:06 | 08:32 |
| 58 | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB08 - VESTAS V 162-6.2 6200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (194)

Annahmen für Schattenwurfberechnung

- Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Winderganlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|----------------------|----------------------|-------|-------|-------|-------|-------|--------|-----------|----------------------|----------------------|----------|
| 1 | 08:32 | 08:06 15:50-16:14/24 | 07:14 | 07:04 | 06:01 | 05:16 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 15:23-15:43/20 | 08:08 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 15:49-16:14/25 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:27 | 07:20 15:22-15:44/22 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:47 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 15:50-16:15/25 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 15:21-15:44/23 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:02 15:50-16:15/25 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 15:21-15:45/24 | 08:13 |
| | 16:31 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 15:50-16:15/25 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 15:20-15:44/24 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 15:50-16:15/25 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 15:20-15:45/25 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 15:51-16:15/24 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:36 | 07:29 15:20-15:45/25 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 15:52-16:15/23 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 15:20-15:45/25 | 08:18 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 15:52-16:14/22 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:33 15:20-15:45/25 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:29 | 07:51 15:53-16:13/20 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 15:21-15:45/24 | 08:20 |
| | 16:39 | 17:31 | 18:21 | 20:14 | 21:03 | 21:42 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:50 15:54-16:11/17 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 15:21-15:45/24 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:42 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 15:56-16:10/14 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 15:22-15:44/22 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 15:59-16:07/8 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 15:23-15:44/21 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:19 | 21:07 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 15:24-15:43/19 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 15:25-15:41/16 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:09 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 15:26-15:40/14 | 08:26 |
| | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 15:29-15:39/10 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 15:33-15:36/3 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:23 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:22 | 07:32 | 06:32 | 06:23 | 05:30 | 05:09 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:28 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:33 | 21:21 | 21:47 | 21:30 | 20:37 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 15:59-16:02/3 | 07:24 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:31 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:48 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 15:56-16:06/10 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:15 15:53-16:08/15 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:13 15:53-16:10/17 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:03 | 08:32 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:48 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 15:51-16:10/19 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 08:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:11 15:51-16:12/21 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 08:13 15:28-15:37/9 | 08:06 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 15:50-16:12/22 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 15:25-15:40/15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 15:50-16:14/24 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 15:24-15:41/17 | 08:03 | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | 16:27 | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 131 | 277 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |

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:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA : WEA_VB09 - VESTAS V 162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (195)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember | |
|----|-------------------------------|--|----------------------------|--|--|--|--|--|--|--|--|--|-------------------------------|
| 1 | 08:32 14:05-14:32/27 16:28 | 08:06 07:14 07:04 17:15 18:06 19:58 | 07:04 07:04 18:06 19:58 | 06:01 05:16 05:14 20:48 21:33 21:47 | 05:16 05:14 05:14 21:16 20:15 19:07 | 05:14 05:14 05:14 21:16 20:15 19:07 | 05:14 05:14 05:14 21:16 20:15 19:07 | 05:14 05:14 05:14 21:16 20:15 19:07 | 05:14 05:14 05:14 21:16 20:15 19:07 | 05:14 05:14 05:14 21:16 20:15 19:07 | 05:14 05:14 05:14 21:16 20:15 19:07 | 05:14 05:14 05:14 21:16 20:15 19:07 | 08:08 13:57-14:14/17 16:22 |
| 2 | 08:32 14:06-14:33/27 16:29 | 08:05 07:12 07:02 17:17 18:07 20:00 | 07:12 07:02 18:07 20:00 | 05:59 05:16 05:14 20:50 21:34 21:46 | 05:16 05:14 05:14 21:14 20:13 19:04 | 05:14 05:14 05:14 21:14 20:13 19:04 | 05:14 05:14 05:14 21:14 20:13 19:04 | 05:14 05:14 05:14 21:14 20:13 19:04 | 05:14 05:14 05:14 21:14 20:13 19:04 | 05:14 05:14 05:14 21:14 20:13 19:04 | 05:14 05:14 05:14 21:14 20:13 19:04 | 05:14 05:14 05:14 21:14 20:13 19:04 | 08:10 13:55-14:15/20 16:22 |
| 3 | 08:32 14:06-14:32/26 16:30 | 08:03 07:09 07:00 17:19 18:09 20:02 | 07:09 07:00 18:09 20:02 | 05:57 05:15 05:15 20:52 21:35 21:46 | 05:15 05:15 05:15 21:13 20:11 19:02 | 05:15 05:15 05:15 21:13 20:11 19:02 | 05:15 05:15 05:15 21:13 20:11 19:02 | 05:15 05:15 05:15 21:13 20:11 19:02 | 05:15 05:15 05:15 21:13 20:11 19:02 | 05:15 05:15 05:15 21:13 20:11 19:02 | 05:15 05:15 05:15 21:13 20:11 19:02 | 05:15 05:15 05:15 21:13 20:11 19:02 | 08:11 13:56-14:16/20 16:21 |
| 4 | 08:32 14:07-14:33/26 16:31 | 08:01 07:07 06:58 17:20 18:11 20:03 | 07:07 06:58 18:11 20:03 | 05:55 05:14 05:16 20:53 21:36 21:46 | 05:14 05:16 05:16 21:11 20:08 19:00 | 05:14 05:16 05:16 21:11 20:08 19:00 | 05:14 05:16 05:16 21:11 20:08 19:00 | 05:14 05:16 05:16 21:11 20:08 19:00 | 05:14 05:16 05:16 21:11 20:08 19:00 | 05:14 05:16 05:16 21:11 20:08 19:00 | 05:14 05:16 05:16 21:11 20:08 19:00 | 05:14 05:16 05:16 21:11 20:08 19:00 | 08:12 13:55-14:17/22 16:20 |
| 5 | 08:31 14:09-14:33/24 16:33 | 08:00 07:05 06:55 17:22 18:13 20:05 | 07:05 06:55 18:13 20:05 | 05:53 05:13 05:17 20:55 21:37 21:45 | 05:13 05:17 05:17 21:09 20:06 18:58 | 05:13 05:17 05:17 21:09 20:06 18:58 | 05:13 05:17 05:17 21:09 20:06 18:58 | 05:13 05:17 05:17 21:09 20:06 18:58 | 05:13 05:17 05:17 21:09 20:06 18:58 | 05:13 05:17 05:17 21:09 20:06 18:58 | 05:13 05:17 05:17 21:09 20:06 18:58 | 05:13 05:17 05:17 21:09 20:06 18:58 | 08:14 13:55-14:18/23 16:20 |
| 6 | 08:31 14:09-14:33/24 16:34 | 07:58 07:03 06:53 17:24 18:14 20:07 | 07:03 06:53 18:14 20:07 | 05:52 05:13 05:17 20:56 21:38 21:45 | 05:13 05:17 05:17 21:07 20:04 18:55 | 05:13 05:17 05:17 21:07 20:04 18:55 | 05:13 05:17 05:17 21:07 20:04 18:55 | 05:13 05:17 05:17 21:07 20:04 18:55 | 05:13 05:17 05:17 21:07 20:04 18:55 | 05:13 05:17 05:17 21:07 20:04 18:55 | 05:13 05:17 05:17 21:07 20:04 18:55 | 05:13 05:17 05:17 21:07 20:04 18:55 | 08:15 13:55-14:19/24 16:20 |
| 7 | 08:31 14:10-14:33/23 16:35 | 07:57 07:01 06:51 17:26 18:16 20:08 | 07:01 06:51 18:16 20:08 | 05:50 05:12 05:18 20:58 21:39 21:44 | 05:12 05:18 05:18 21:06 20:02 18:53 | 05:12 05:18 05:18 21:06 20:02 18:53 | 05:12 05:18 05:18 21:06 20:02 18:53 | 05:12 05:18 05:18 21:06 20:02 18:53 | 05:12 05:18 05:18 21:06 20:02 18:53 | 05:12 05:18 05:18 21:06 20:02 18:53 | 05:12 05:18 05:18 21:06 20:02 18:53 | 05:12 05:18 05:18 21:06 20:02 18:53 | 08:16 13:55-14:19/24 16:19 |
| 8 | 08:30 14:11-14:33/22 16:36 | 07:55 06:59 06:49 17:28 18:18 20:10 | 06:59 06:49 18:18 20:10 | 05:48 05:12 05:19 21:00 21:40 21:44 | 05:12 05:19 05:19 21:04 19:59 18:51 | 05:12 05:19 05:19 21:04 19:59 18:51 | 05:12 05:19 05:19 21:04 19:59 18:51 | 05:12 05:19 05:19 21:04 19:59 18:51 | 05:12 05:19 05:19 21:04 19:59 18:51 | 05:12 05:19 05:19 21:04 19:59 18:51 | 05:12 05:19 05:19 21:04 19:59 18:51 | 05:12 05:19 05:19 21:04 19:59 18:51 | 08:18 13:56-14:21/25 16:19 |
| 9 | 08:30 14:11-14:32/21 16:38 | 07:53 06:56 06:46 17:30 18:20 20:12 | 06:56 06:46 18:20 20:12 | 05:46 05:11 05:20 21:01 21:41 21:43 | 05:11 05:20 05:20 21:02 19:57 18:49 | 05:11 05:20 05:20 21:02 19:57 18:49 | 05:11 05:20 05:20 21:02 19:57 18:49 | 05:11 05:20 05:20 21:02 19:57 18:49 | 05:11 05:20 05:20 21:02 19:57 18:49 | 05:11 05:20 05:20 21:02 19:57 18:49 | 05:11 05:20 05:20 21:02 19:57 18:49 | 05:11 05:20 05:20 21:02 19:57 18:49 | 08:19 13:55-14:21/26 16:19 |
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| 13 | 08:28 14:17-14:30/13 16:43 | 07:46 06:47 06:38 17:37 18:26 20:18 | 06:47 06:38 18:26 20:18 | 05:40 05:10 05:24 21:07 21:44 21:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 05:10 05:24 05:24 20:55 19:48 18:40 | 08:23 13:56-14:23/27 16:18 |
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| 16 | 08:25 16:48 | 07:40 06:41 06:31 17:42 18:32 20:23 | 06:41 06:31 18:32 20:23 | 05:35 05:09 05:28 21:12 21:45 21:37 | 05:09 05:28 05:28 20:49 19:41 18:33 | 05:09 05:28 05:28 20:49 19:41 18:33 | 05:09 05:28 05:28 20:49 19:41 18:33 | 05:09 05:28 05:28 20:49 19:41 18:33 | 05:09 05:28 05:28 20:49 19:41 18:33 | 05:09 05:28 05:28 20:49 19:41 18:33 | 05:09 05:28 05:28 20:49 19:41 18:33 | 05:09 05:28 05:28 20:49 19:41 18:33 | 08:26 13:57-14:25/28 16:18 |
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Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
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Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA**: WEA_VB10 - VESTAS V162-6.2 6200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (196)

Annahmen für Schattenwurfberechnung

- Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember | |
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| 21 | 08:29 | 07:50 | 06:52 16:01-16:37/36 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 16:34-17:13/39 | 07:36 | 08:21 | |
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| 23 | 08:28 | 07:48 | 06:50 16:01-16:36/35 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 16:35-17:13/38 | 07:38 | 08:22 | |
| 24 | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 | |
| 25 | 08:28 | 07:46 | 06:47 16:03-16:35/32 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 16:35-17:12/37 | 07:39 | 08:23 | |
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| 27 | 08:27 | 07:44 | 06:45 16:04-16:34/30 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 16:36-17:11/35 | 07:41 | 08:24 | |
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| 30 | 16:46 | 17:41 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 | |
| 31 | 08:25 | 07:40 | 06:41 16:07-16:29/22 | 06:31 | 05:35 | 05:09 | 05:28 | 06:12 | 07:02 | 07:51 16:37-17:08/31 | 07:45 | 08:26 | |
| 32 | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 | |
| 33 | 08:24 | 07:38 | 06:38 16:10-16:26/16 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 16:38-17:07/29 | 07:46 | 08:26 | |
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| 36 | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 | |
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| 38 | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 | |
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| 42 | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:29 | 18:23 | 16:31 | 16:20 | |
| 43 | 08:19 | 07:28 16:13-16:30/17 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 | |
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| 45 | 08:18 | 07:26 16:10-16:33/23 | 06:25 | 06:16 | 05:26 | 05:10 | 05:36 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 | |
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| 47 | 08:17 | 07:24 16:08-16:35/27 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:31 | |
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| 49 | 08:16 | 07:22 16:07-16:36/29 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 07:59 | 08:31 | |
| 50 | 17:03 | 17:59 | 18:47 | 20:38 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 17:15 | 16:27 | 16:22 | |
| 51 | 08:15 | 07:20 16:04-16:37/33 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 16:53-17:07/14 | 07:08 | 08:01 | 08:31 | |
| 52 | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 17:13 | 16:26 | 16:23 | |
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| 55 | 08:12 | 07:16 16:03-16:39/36 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:32 | 07:21 16:47-17:12/25 | 07:11 | 08:04 | 08:32 | |
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| 58 | 17:10 | | 19:53 | 20:45 | 21:30 | 21:47 | 21:21 | 20:22 | 19:11 | 17:07 | 16:24 | 16:25 | |
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| 61 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 | |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 | |
| 63 | Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| 64 | Anzahl Minuten mit Schatten | 0 | 209 | 591 | 0 | 0 | 0 | 0 | 0 | 119 | 692 | 0 | 0 |

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:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
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+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA**: WEA_VB11 - VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (197)

Annahmen für Schattenwurfberechnung

- Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|----|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| 88 | 17:43 | 18:39 | 19:28 | 20:44 | 21:33 | 22:17 | 21:40 | | | | | |

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
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Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB12 - VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (198)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember | | | | |
|----|-----------------------------|---------|-------|----------------|-------|-------|-------|--------|-----------|----------------|----------------|----------------|-------|-------|-----|---|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:16 | 05:14 | 05:49 | 06:38 | 07:26 | 08:46-09:24/38 | 07:18 | 08:08 | | | |
| | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 | 17:01 | | | |
| 2 | 08:32 | 08:05 | 07:12 | 08:23-08:34/11 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:39 | 07:27 | 08:45-09:23/38 | 07:20 | 08:10 | | |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:21 | 17:00 | | | |
| 3 | 08:32 | 08:03 | 07:09 | 08:19-08:38/19 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 08:46-09:23/37 | 07:22 | 08:11 | | |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 | 17:02 | | | |
| 4 | 08:32 | 08:01 | 07:07 | 08:16-08:39/23 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 08:46-09:22/36 | 07:24 | 08:12 | | |
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| 5 | 08:31 | 08:00 | 07:05 | 08:14-08:41/27 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 08:46-09:21/35 | 07:25 | 08:14 | | |
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| 8 | 08:30 | 07:55 | 06:58 | 08:09-08:44/35 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 08:48-09:17/29 | 07:31 | 08:17 | | |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 | 17:00 | | | |
| 9 | 08:30 | 07:53 | 06:56 | 08:09-08:44/35 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:51 | 07:39 | 08:50-09:15/25 | 07:32 | 08:19 | | |
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| 10 | 08:29 | 07:51 | 06:54 | 08:08-08:45/37 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 08:52-09:13/21 | 07:34 | 08:20 | | |
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| 25 | 08:16 | 07:22 | 06:20 | 08:14-08:29/15 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:49-09:25/36 | 07:06 | 07:59 | 08:31 | | |
| | 17:03 | 17:58 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 | 17:00 | | | |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:47-09:24/37 | 07:08 | 08:01 | 08:31 | 09:18 | | |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 | 17:00 | | | |
| 27 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:47-09:25/38 | 07:10 | 08:02 | 08:31 | 09:18 | | |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 | 17:00 | | | |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:47-09:25/38 | 07:11 | 08:04 | 08:32 | 09:19 | | |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 | 17:00 | | | |
| 29 | 08:10 | 07:11 | 06:09 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:46-09:24/38 | 07:13 | 08:05 | 08:32 | 09:20 | | |
| | 17:10 | 18:01 | 18:53 | 20:45 | 21:30 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 | 17:00 | | | |
| 30 | 08:09 | 07:09 | 06:07 | 06:02 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:46-09:25/39 | 07:15 | 08:07 | 08:32 | 09:21 | | |
| | 17:11 | 18:00 | 18:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 | 17:00 | | | |
| 31 | 08:08 | 07:07 | 06:05 | 06:01 | 05:17 | 05:14 | 05:48 | 06:36 | 07:25 | 08:46-09:25/39 | 07:17 | 08:07 | 08:32 | 09:22 | | |
| | 17:13 | 18:01 | 18:57 | 20:49 | 21:32 | 21:47 | 21:17 | 20:17 | 19:07 | 18:03 | 16:23 | 16:27 | 17:00 | | | |
| | Sonnenscheinstunden | 261 | 279 | 367 | 745 | 415 | 483 | 496 | 452 | 381 | 332 | 343 | 268 | 0 | 246 | 0 |
| | Anzahl Minuten mit Schatten | 0 | 0 | 367 | 745 | 415 | 483 | 496 | 452 | 381 | 332 | 343 | 268 | 0 | 246 | 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 |

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB13 - VESTAS V162-6.2 6200 162.0 !D! NH: 169,0 m (Ges:250,0 m) (199)

Annahmen für Schattenwurfberechnung

- Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|----------------|----------------------|----------------------|----------------------|----------------------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:16:07:04-07:54/50 | 05:14:07:12-08:00/48 | 05:49 07:19-08:01/42 | 06:38 | 07:26 | 07:18 | 08:08 |
| 2 | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 3 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 07:27-07:33/6 | 05:16:07:05-07:55/50 | 05:14:07:11-07:59/48 | 05:51 07:19-08:00/41 | 06:39 | 07:27 | 08:10 |
| 4 | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:21 |
| 5 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 07:21-07:38/17 | 05:15:07:05-07:55/50 | 05:15:07:12-08:00/48 | 05:52 07:19-07:59/40 | 06:41 | 07:29 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:13 | 20:10 | 19:02 | 16:58 | 16:21 |
| 7 | 08:32 | 08:01 | 07:07 | 06:57 | 05:55 | 07:18-07:41/23 | 05:14:07:06-07:55/49 | 05:19:07:12-08:01/49 | 05:54 07:21-07:58/37 | 06:43 | 07:31 | 08:12 |
| 8 | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 9 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 07:17-07:44/27 | 05:13:07:06-07:55/49 | 05:16:07:12-08:01/49 | 05:55 07:22-07:57/35 | 06:44 | 07:32 | 08:14 |
| 10 | 16:32 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 07:14-07:45/31 | 05:13:07:05-07:55/50 | 05:17:07:12-08:01/49 | 05:57 07:23-07:56/33 | 06:46 | 07:34 | 08:15 |
| 12 | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:19 |
| 13 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 07:12-07:46/34 | 05:12:07:06-07:55/49 | 05:18:07:12-08:01/49 | 05:58 07:24-07:54/30 | 06:47 | 07:36 | 08:16 |
| 14 | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:01 | 18:53 | 16:51 | 16:19 |
| 15 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 07:12-07:48/36 | 05:12:07:07-07:55/48 | 05:19:07:12-08:02/50 | 06:00 07:27-07:53/26 | 06:49 | 07:37 | 08:17 |
| 16 | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 17 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 07:10-07:48/38 | 05:11:07:06-07:55/49 | 05:20:07:12-08:02/50 | 06:01 07:28-07:50/22 | 06:51 | 07:39 | 08:19 |
| 18 | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:18 |
| 19 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 07:10-07:50/40 | 05:11:07:07-07:55/48 | 05:21:07:13-08:02/49 | 06:03 07:32-07:47/15 | 06:52 | 07:41 | 08:20 |
| 20 | 16:39 | 17:31 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:18 |
| 21 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 07:08-07:50/42 | 05:10:07:08-07:56/48 | 05:22:07:13-08:03/50 | 06:05 | 06:54 | 07:42 | 08:21 |
| 22 | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 23 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 07:08-07:51/43 | 05:10:07:07-07:55/48 | 05:23:07:13-08:03/50 | 06:06 | 06:55 | 07:44 | 08:22 |
| 24 | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:28 | 07:46 | 06:47 | 06:38 | 05:40 | 07:07-07:51/44 | 05:10:07:08-07:55/47 | 05:24:07:13-08:03/50 | 06:08 | 06:57 | 07:46 | 08:23 |
| 26 | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:44 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 27 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 07:07-07:52/45 | 05:10:07:08-07:55/47 | 05:25:07:13-08:03/50 | 06:09 | 06:58 | 07:47 | 08:24 |
| 28 | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 29 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 07:05-07:52/47 | 05:09:07:08-07:56/48 | 05:26:07:13-08:04/51 | 06:11 | 07:00 | 07:49 | 08:25 |
| 30 | 16:46 | 17:40 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:35 | 16:39 | 16:18 |
| 31 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 07:05-07:53/48 | 05:09:07:09-07:56/47 | 05:28:07:13-08:04/51 | 06:12 | 07:02 | 07:51 | 08:26 |
| 32 | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:37 | 16:18 |
| 33 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 07:05-07:53/48 | 05:09:07:09-07:56/47 | 05:29:07:13-08:04/51 | 06:14 | 07:03 | 07:52 | 08:26 |
| 34 | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:18 |
| 35 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 07:04-07:53/49 | 05:09:07:09-07:56/47 | 05:30:07:13-08:04/51 | 06:16 | 07:05 | 07:54 | 08:27 |
| 36 | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 37 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 07:04-07:53/49 | 05:09:07:09-07:56/47 | 05:31:07:14-08:05/51 | 06:17 | 07:06 | 07:56 | 08:28 |
| 38 | 16:52 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 39 | 08:21 | 07:32 | 06:32 | 06:23 | 05:29 | 07:04-07:54/50 | 05:09:07:09-07:56/47 | 05:32:07:14-08:04/50 | 06:19 | 07:08 | 07:57 | 08:28 |
| 40 | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:32 | 16:19 |
| 41 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 07:04-07:54/50 | 05:09:07:09-07:56/47 | 05:34:07:14-08:04/50 | 06:20 | 07:10 | 07:59 | 08:29 |
| 42 | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:29 | 18:23 | 16:31 | 16:20 |
| 43 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 07:04-07:55/51 | 05:10:07:10-07:57/47 | 05:35:07:14-08:04/50 | 06:22 | 07:11 | 08:01 | 08:30 |
| 44 | 16:57 | 17:52 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 45 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 07:04-07:55/51 | 05:10:07:10-07:57/47 | 05:36:07:15-08:05/50 | 06:23 | 07:13 | 08:03 | 08:30 |
| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 47 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 07:03-07:54/51 | 05:10:07:10-07:57/47 | 05:38:07:15-08:04/49 | 06:25 | 07:14 | 08:04 | 08:31 |
| 48 | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 49 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 07:03-07:54/51 | 05:11:07:11-07:58/47 | 05:39:07:15-08:04/49 | 06:27 | 07:16 | 08:06 | 08:31 |
| 50 | 17:03 | 17:58 | 18:47 | 20:38 | 21:25 | 21:48 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 07:03-07:54/51 | 05:11:07:11-07:58/47 | 05:41:07:15-08:03/48 | 06:28 | 07:18 | 08:08 | 08:31 |
| 52 | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:48 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 53 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 07:04-07:55/51 | 05:11:07:12-07:59/47 | 05:42:07:16-08:04/48 | 06:30 | 07:19 | 08:10 | 08:31 |
| 54 | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 55 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 07:04-07:55/51 | 05:12:07:11-07:59/48 | 05:43:07:16-08:03/47 | 06:31 | 07:21 | 08:11 | 08:32 |
| 56 | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 57 | 08:10 | 07:11 | 06:04 | 05:19 | 07:04-07:55/51 | 05:12:07:12-07:59/47 | 05:45:07:16-08:02/46 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| 58 | 17:10 | 18:06 | 18:54 | 20:45 | 21:30 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 59 | 08:09 | 07:09 | 06:02 | 05:18 | 07:04-07:55/51 | 05:13:07:11-07:59/48 | 05:46:07:17-08:02/45 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:11 | 18:07 | 18:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:08 | 07:07 | 06:00 | 05:17 | 07:04-07:55/51 | 05:14:07:17-08:01/44 | 05:48:07:17-08:01/44 | 06:36 | 07:25 | 08:16 | 08:08 | 08:32 |
| 62 | 17:13 | 18:09 | 18:57 | 20:49 | 21:32 | 21:47 | 21:17 | 20:17 | 19:08 | 18:03 | 16:22 | 16:27 |
| Sonnenscheiteltunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 267 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 1277 | 1437 | 1520 | 321 | 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) | | Zeitpunkt (SS:MM) | | Schattenanfang-Zeitpunkt (SS:MM) | | Schattenende/Minuten mit Schatten | |
|--------------|-----------------------|-------|-------------------|-------|----------------------------------|-------|-----------------------------------|--|
| | SS:MM | SS:MM | SS:MM | SS:MM | SS:MM | SS:MM | Minuten mit Schatten | |

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB14 - VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (200)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|----|-----------------------------|----------------|----------------|-------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 1 | 08:32 16:28 | 08:06 17:15 | 07:14 18:06 | 08:21-08:42/21 19:58 | 07:04 20:48 | 06:01 21:33 | 05:16 21:47 | 05:14 21:16 | 05:49 20:15 | 06:38 19:07 | 07:26 17:01 | 08:08 16:22 |
| 2 | 08:32 16:29 | 08:05 17:17 | 07:12 18:07 | 08:22-08:41/19 19:07 | 07:02 20:00 | 05:59 20:50 | 05:16 21:34 | 05:14 21:47 | 05:51 21:14 | 06:39 20:13 | 07:27 19:04 | 08:10 17:00 |
| 3 | 08:32 16:30 | 08:03 17:19 | 07:09 18:09 | 08:23-08:39/16 17:00 | 07:00 20:02 | 05:57 20:52 | 05:15 21:35 | 05:15 21:46 | 05:52 21:13 | 06:41 20:10 | 07:29 19:02 | 08:11 16:21 |
| 4 | 08:32 16:31 | 08:01 17:20 | 07:07 18:11 | 08:24-08:36/12 19:11 | 06:57 20:03 | 05:55 20:53 | 05:14 21:36 | 05:16 21:46 | 05:54 21:11 | 06:43 20:08 | 07:31 19:00 | 08:13 16:56 |
| 5 | 08:31 16:32 | 08:00 17:22 | 07:05 18:13 | 08:28-08:32/4 19:13 | 06:55 20:05 | 05:53 20:55 | 05:13 21:37 | 05:16 21:45 | 05:55 21:09 | 06:44 20:06 | 07:32 18:57 | 08:14 16:54 |
| 6 | 08:31 16:34 | 07:58 17:24 | 07:03 18:14 | 07:03 19:14 | 06:53 20:07 | 05:51 20:56 | 05:13 21:38 | 05:17 21:45 | 05:57 21:07 | 06:46 20:04 | 07:34 18:55 | 08:15 16:53 |
| 7 | 08:31 16:35 | 07:57 17:26 | 07:01 18:16 | 07:01 19:16 | 06:51 20:08 | 05:50 20:58 | 05:12 21:39 | 05:18 21:44 | 05:58 21:06 | 06:47 20:01 | 07:36 18:53 | 08:16 16:51 |
| 8 | 08:30 16:36 | 07:55 17:28 | 06:59 18:18 | 06:59 19:18 | 06:49 20:10 | 05:48 21:00 | 05:12 21:40 | 05:19 21:44 | 06:00 21:04 | 06:49 19:59 | 07:37 18:51 | 08:18 16:49 |
| 9 | 08:30 16:38 | 07:53 17:30 | 06:56 18:20 | 06:56 19:20 | 06:46 20:12 | 05:46 21:01 | 05:11 21:41 | 05:20 21:43 | 06:01 21:02 | 06:51 19:57 | 07:39 18:49 | 08:19 16:48 |
| 10 | 08:29 16:39 | 07:51 17:31 | 06:54 18:21 | 06:54 19:21 | 06:44 20:13 | 05:45 21:03 | 05:11 21:41 | 05:21 21:42 | 06:03 21:00 | 06:52 19:55 | 07:41 18:46 | 08:20 16:46 |
| 11 | 08:29 16:40 | 07:50 17:33 | 06:52 18:23 | 06:52 19:23 | 06:42 20:15 | 05:43 21:04 | 05:10 21:42 | 05:22 21:42 | 06:05 20:58 | 06:54 19:52 | 07:42 18:44 | 08:21 16:45 |
| 12 | 08:28 16:42 | 07:48 17:35 | 06:50 18:25 | 06:50 19:25 | 06:40 20:17 | 05:41 21:06 | 05:10 21:43 | 05:23 21:41 | 06:06 20:56 | 06:55 19:50 | 07:44 18:42 | 08:22 16:43 |
| 13 | 08:28 16:43 | 07:46 17:37 | 06:47 18:26 | 06:47 19:26 | 06:38 20:18 | 05:40 21:07 | 05:10 21:44 | 05:24 21:40 | 06:08 20:55 | 06:57 19:48 | 07:46 18:40 | 08:23 16:42 |
| 14 | 08:27 16:45 | 07:44 17:39 | 06:45 18:28 | 06:45 19:28 | 06:35 20:20 | 05:38 21:09 | 05:10 21:44 | 05:25 21:39 | 06:09 20:53 | 06:58 19:46 | 07:47 18:38 | 08:24 16:40 |
| 15 | 08:26 16:46 | 07:42 17:40 | 06:43 18:30 | 06:43 19:30 | 06:33 20:22 | 05:37 21:10 | 05:09 21:45 | 05:26 21:38 | 06:11 20:51 | 07:00 19:43 | 07:49 18:35 | 08:25 16:39 |
| 16 | 08:25 16:48 | 07:40 17:42 | 06:41 18:32 | 06:41 19:32 | 06:31 20:23 | 05:35 21:12 | 05:09 21:45 | 05:28 21:37 | 06:12 20:49 | 07:02 19:41 | 07:51 18:33 | 08:26 16:37 |
| 17 | 08:24 16:49 | 07:38 17:44 | 06:38 18:33 | 06:38 19:33 | 06:29 20:25 | 05:34 21:13 | 05:09 21:46 | 05:29 21:36 | 06:14 20:47 | 07:03 19:39 | 07:52 18:31 | 08:26 16:36 |
| 18 | 08:23 16:51 | 07:36 17:46 | 06:36 18:35 | 06:36 19:35 | 06:27 20:27 | 05:32 21:15 | 05:09 21:46 | 05:30 21:35 | 06:16 20:45 | 07:05 19:36 | 07:54 18:29 | 08:27 16:35 |
| 19 | 08:22 16:52 | 07:34 17:48 | 06:34 18:37 | 06:34 19:37 | 06:25 20:28 | 05:31 21:16 | 05:09 21:46 | 05:31 21:34 | 06:17 20:43 | 07:06 19:34 | 07:56 18:27 | 08:28 16:34 |
| 20 | 08:21 16:54 | 07:32 17:50 | 06:32 18:38 | 06:32 19:38 | 06:23 20:30 | 05:29 21:18 | 05:09 21:47 | 05:32 21:33 | 06:19 20:41 | 07:08 19:32 | 07:57 18:25 | 08:28 16:32 |
| 21 | 08:20 16:56 | 07:30 17:51 | 06:29 18:40 | 06:29 19:40 | 06:20 20:32 | 05:28 21:19 | 05:09 21:47 | 05:34 21:31 | 06:20 20:39 | 07:10 19:29 | 07:59 18:23 | 08:29 16:31 |
| 22 | 08:19 16:57 | 07:28 17:53 | 06:27 18:42 | 06:27 19:42 | 06:18 20:33 | 05:27 21:21 | 05:10 21:47 | 05:35 21:30 | 06:22 20:36 | 07:11 19:27 | 08:01 18:21 | 08:30 16:30 |
| 23 | 08:18 16:59 | 07:26 17:55 | 06:25 18:43 | 06:25 19:43 | 06:16 20:35 | 05:26 21:22 | 05:10 21:47 | 05:36 21:29 | 06:24 20:34 | 07:13 19:25 | 08:03 18:19 | 08:30 16:29 |
| 24 | 08:17 17:01 | 07:24 17:57 | 06:22 18:45 | 06:22 19:45 | 06:14 20:37 | 05:24 21:23 | 05:10 21:48 | 05:38 21:28 | 06:25 20:32 | 07:14 19:23 | 08:04 18:17 | 08:31 16:28 |
| 25 | 08:16 17:03 | 07:22 17:58 | 06:20 18:47 | 06:20 19:47 | 06:12 20:38 | 05:23 21:25 | 05:11 21:48 | 05:39 21:26 | 06:27 20:30 | 07:16 19:20 | 07:06 18:15 | 08:32 16:27 |
| 26 | 08:15 17:04 | 07:20 18:00 | 06:18 18:48 | 06:18 19:48 | 06:10 20:40 | 05:22 21:26 | 05:11 21:48 | 05:41 21:25 | 06:28 20:28 | 07:18 19:18 | 07:08 18:13 | 08:31 16:26 |
| 27 | 08:13 17:06 | 07:18 18:02 | 06:16 18:50 | 06:16 19:50 | 06:08 20:42 | 05:21 21:27 | 05:11 21:48 | 05:42 21:23 | 06:30 20:26 | 07:19 19:11 | 07:10 18:11 | 08:32 16:25 |
| 28 | 08:12 17:08 | 07:16 18:04 | 06:13 18:52 | 06:13 19:52 | 06:06 20:43 | 05:20 21:28 | 05:12 21:47 | 05:43 21:22 | 06:31 20:24 | 07:21 19:13 | 07:11 18:09 | 08:32 16:24 |
| 29 | 08:10 17:10 | 19:53 | 19:53 | 19:53 | 06:04 20:45 | 05:19 21:30 | 05:12 21:47 | 05:45 21:20 | 06:33 20:22 | 07:22 19:11 | 07:13 18:07 | 08:32 16:25 |
| 30 | 08:09 17:11 | 19:55 | 19:55 | 19:55 | 06:02 20:47 | 05:18 21:31 | 05:13 21:47 | 05:46 21:19 | 06:35 20:19 | 07:24 19:09 | 07:15 18:05 | 08:32 16:23 |
| 31 | 08:08 17:13 | 19:57 | 19:57 | 19:57 | 06:00 20:45 | 05:17 21:32 | 05:11 21:47 | 05:48 21:17 | 06:36 20:17 | 07:17 19:03 | 07:17 18:03 | 08:32 16:27 |
| | Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 288 |
| | Anzahl Minuten mit Schatten | 0 | 213 | 72 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: WEA_VB15 - GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (201)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| 3 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:27 | 07:20 | 08:10 |
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| 5 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 7 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| 8 | 16:31 | 17:21 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
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| 10 | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
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| 13 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:36 | 07:29 | 08:16 |
| 14 | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:01 | 18:53 | 16:51 | 16:19 |
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| 16 | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 17 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:32 | 08:19 |
| 18 | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 19 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| 20 | 16:39 | 17:31 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:18 |
| 21 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| 22 | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 23 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| 24 | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:27 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
| 26 | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 27 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| 28 | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
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| 32 | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 |
| 33 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| 34 | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 35 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
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| 37 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:50 | 08:28 |
| 38 | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 39 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| 40 | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 41 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| 42 | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 43 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| 44 | 16:58 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 45 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 47 | 08:17 | 07:24 | 06:22 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| 48 | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:27 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 49 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| 50 | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| 52 | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 53 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:02 | 08:31 |
| 54 | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 55 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 08:11 | 08:04 | 08:32 |
| 56 | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:25 | 16:24 |
| 57 | 08:10 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| 58 | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: WEA_VB16 - GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (202)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:16 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| 2 | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 3 | 08:32 | 08:04 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| 4 | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 5 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 7 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| 8 | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 9 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| 10 | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:55 | 16:20 |
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| 13 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:36 | 07:29 | 08:16 |
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| 39 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
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| 49 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| 50 | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| 52 | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 53 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:02 | 08:31 |
| 54 | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 55 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:32 | 07:21 | 08:11 | 08:04 | 08:32 |
| 56 | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 57 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:13 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| 58 | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:11 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:07 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB17 - GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (203)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| 3 | 08:32 | 08:04 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| 4 | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 5 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 7 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| 8 | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 9 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| 10 | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| 12 | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:20 |
| 13 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:36 | 07:29 | 08:16 |
| 14 | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:01 | 18:53 | 16:51 | 16:19 |
| 15 | 08:30 | 07:55 | 06:58 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
| 16 | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 17 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:32 | 08:19 |
| 18 | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 19 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:20 |
| 20 | 16:39 | 17:31 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:18 |
| 21 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
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| 24 | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:27 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
| 26 | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 27 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
| 28 | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:38 | 16:40 | 16:18 |
| 29 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| 30 | 16:46 | 17:41 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:35 | 16:39 | 16:18 |
| 31 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:09 | 05:28 | 06:12 | 07:02 | 07:51 | 07:44 | 08:25 |
| 32 | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 |
| 33 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| 34 | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:18 |
| 35 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| 36 | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 37 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:50 | 08:28 |
| 38 | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 39 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:09 | 05:33 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| 40 | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:32 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 41 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| 42 | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 43 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| 44 | 16:58 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 45 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:36 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 47 | 08:17 | 07:24 | 06:22 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| 48 | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 49 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| 50 | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| 52 | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 53 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:10 | 08:02 | 08:31 |
| 54 | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 55 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:32 |
| 56 | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 57 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| 58 | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:11 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:07 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: WEA_VB18 - GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (204)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| 4 | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 5 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 7 | 08:32 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| 8 | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 9 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| 10 | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
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| 13 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| 14 | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:01 | 18:53 | 16:51 | 16:19 |
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| 17 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:51 | 07:39 | 07:32 | 08:19 |
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| 38 | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 39 | 08:21 | 07:32 | 06:32 | 06:23 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
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| 41 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
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| 44 | 16:58 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 45 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:36 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
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| 57 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| 58 | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:11 | | 19:55 | 20:46 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung Gesamtbelastung **WEA**: WEA_VB19 - ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (205
Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:15 | 05:51 | 06:40 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| | 16:32 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:32 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| | 16:39 | 17:32 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:19 |
| 11 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:28 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:18 | 21:07 | 21:43 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:25 |
| | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:10 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:50 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:10 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:10 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:28 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:20 |
| 21 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:30 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| | 16:58 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:23 | 06:15 | 05:25 | 05:10 | 05:38 | 06:25 | 07:15 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:22 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:24 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 07:08 | 08:01 | 08:31 |
| | 17:05 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 07:10 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:24 |
| 28 | 08:12 | 07:16 | 06:13 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:25 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:30 | 21:47 | 21:20 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:47 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 247 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung Gesamtbelastung WEA: WEA_VB20 - ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges: 246,6 m) (206

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| | 16:31 | 17:21 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:47 | 07:36 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
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| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:32 | 08:19 |
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| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
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| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
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| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
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| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 24 | 08:17 | 07:24 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:24 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 08:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:25 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 08:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung Gesamtbelastung **WEA**: WEA_VB21 - ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (207

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
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| | 16:32 | 17:21 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:47 | 07:36 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:32 | 08:19 |
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| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| | 16:39 | 17:32 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
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| 13 | 08:27 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
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| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:25 |
| | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:10 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:50 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:10 | 05:31 | 06:17 | 07:06 | 07:56 | 07:50 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:20 |
| 21 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:29 |
| | 16:58 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 24 | 08:17 | 07:24 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| | 17:05 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:24 |
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| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:25 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 08:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 247 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
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+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung Gesamtbelastung **WEA**: WEA_VB22 - ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (208

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| 4 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
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| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:36 | 07:29 | 08:16 |
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| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
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| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
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| 13 | 08:27 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
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| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:09 | 05:28 | 06:13 | 07:02 | 07:51 | 07:44 | 08:25 |
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| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:50 | 08:28 |
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| 20 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
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| | 16:58 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
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| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:32 | 07:21 | 08:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:13 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung Gesamtbelastung **WEA**:WEA_VB23 - ENERCON E-160 EP5 E3 5560 160.0 IO! NH: 166,6 m (Ges:246,6 m) (209)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| 2 | 16:28 | 17:15 | 18:06 | 19:59 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 3 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:15 | 05:51 | 06:40 | 07:27 | 07:20 | 08:10 |
| 4 | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 5 | 08:32 | 08:03 | 07:10 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:19 | 18:09 | 20:02 | 20:52 | 21:35 | 21:46 | 21:13 | 20:11 | 19:02 | 16:58 | 16:21 |
| 7 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| 8 | 16:32 | 17:21 | 18:11 | 20:04 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 9 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:56 | 06:44 | 07:32 | 07:25 | 08:14 |
| 10 | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| 12 | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:20 |
| 13 | 08:31 | 07:57 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:48 | 07:36 | 07:29 | 08:16 |
| 14 | 16:35 | 17:26 | 18:16 | 20:09 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 15 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
| 16 | 16:36 | 17:28 | 18:18 | 20:10 | 21:00 | 21:40 | 21:44 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 17 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:12 | 05:20 | 06:02 | 06:51 | 07:39 | 07:32 | 08:19 |
| 18 | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 19 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
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| 21 | 08:29 | 07:50 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| 22 | 16:41 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 23 | 08:28 | 07:48 | 06:50 | 06:40 | 05:42 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| 24 | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:28 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
| 26 | 16:43 | 17:37 | 18:27 | 20:18 | 21:07 | 21:43 | 21:40 | 20:55 | 19:48 | 18:40 | 16:42 | 16:18 |
| 27 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:26 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| 28 | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:41 | 16:18 |
| 29 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
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| 31 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:25 |
| 32 | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:34 | 16:38 | 16:18 |
| 33 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:10 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| 34 | 16:50 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 35 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:10 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| 36 | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 37 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:10 | 05:31 | 06:17 | 07:07 | 07:56 | 07:50 | 08:28 |
| 38 | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:34 | 16:19 |
| 39 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:58 | 07:51 | 08:28 |
| 40 | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:20 |
| 41 | 08:20 | 07:30 | 06:29 | 06:21 | 05:28 | 05:10 | 05:34 | 06:21 | 07:10 | 07:59 | 07:53 | 08:29 |
| 42 | 16:56 | 17:52 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:30 | 18:23 | 16:32 | 16:20 |
| 43 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:30 |
| 44 | 16:58 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 45 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 47 | 08:17 | 07:24 | 06:23 | 06:15 | 05:25 | 05:11 | 05:38 | 06:25 | 07:15 | 08:04 | 07:58 | 08:30 |
| 48 | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:22 |
| 49 | 08:16 | 07:22 | 06:20 | 06:13 | 05:24 | 05:11 | 05:39 | 06:27 | 07:16 | 07:06 | 07:59 | 08:31 |
| 50 | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:14 | 07:20 | 06:18 | 06:11 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 07:08 | 08:01 | 08:31 |
| 52 | 17:05 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 53 | 08:13 | 07:18 | 06:16 | 06:09 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 07:10 | 08:02 | 08:31 |
| 54 | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:24 |
| 55 | 08:12 | 07:16 | 06:13 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 07:11 | 08:04 | 08:32 |
| 56 | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:25 | 16:24 |
| 57 | 08:10 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 07:13 | 08:05 | 08:32 |
| 58 | 17:10 | | 19:54 | 20:45 | 21:30 | 21:47 | 21:20 | 20:22 | 19:11 | 18:07 | 16:24 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:47 | 06:35 | 07:24 | 07:15 | 08:07 | 08:32 |
| 60 | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 247 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung Gesamtbelastung **WEA**:WEA_VB24 - ENERCON E-160 EP5 E3 5560 160.0 !O!NH: 166,6 m (Ges:246,6 m) (210)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:01 | 05:17 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:07 | 17:02 | 16:22 |
| 2 | 08:32 | 08:05 | 07:12 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:40 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:01 | 07:07 | 06:58 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| | 16:32 | 17:21 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:21 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:14 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:58 | 16:55 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:52 | 05:13 | 05:18 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:20 |
| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:59 | 06:47 | 07:36 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:02 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:59 | 06:49 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:50 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:02 | 06:51 | 07:39 | 07:32 | 08:19 |
| | 16:38 | 17:30 | 18:20 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:49 | 16:48 | 16:19 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:41 | 07:34 | 08:20 |
| | 16:39 | 17:32 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:19 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:11 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:41 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:46 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:27 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:36 | 05:38 | 05:10 | 05:25 | 06:09 | 06:59 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:53 | 19:46 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:10 | 05:27 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:41 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:36 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:10 | 05:28 | 06:13 | 07:02 | 07:51 | 07:45 | 08:25 |
| | 16:48 | 17:42 | 18:32 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:10 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:50 | 17:44 | 18:33 | 20:25 | 21:13 | 21:46 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:19 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:10 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
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| 20 | 08:21 | 07:32 | 06:32 | 06:23 | 05:30 | 05:10 | 05:33 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:50 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:41 | 19:32 | 18:25 | 16:33 | 16:20 |
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| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:39 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:19 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:55 | 08:29 |
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| 23 | 08:18 | 07:26 | 06:25 | 06:17 | 05:26 | 05:10 | 05:37 | 06:24 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 24 | 08:17 | 07:24 | 06:23 | 06:14 | 05:25 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:28 | 20:32 | 19:23 | 18:17 | 16:28 | 16:22 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:24 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:59 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| | 17:05 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:12 | 05:42 | 06:30 | 07:19 | 08:10 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:24 |
| 28 | 08:12 | 07:16 | 06:13 | 06:07 | 05:20 | 05:12 | 05:44 | 06:32 | 07:21 | 08:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:25 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:05 | 05:19 | 05:13 | 05:45 | 06:33 | 07:23 | 08:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:03 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:12 | | 19:55 | 20:47 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:08 | | 07:07 | | 05:17 | | 05:48 | 06:36 | | 07:17 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:04 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 247 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB25 - NORDEX N149/5.X 5700 149.0 !O! NH: 164,0 m (Ges:238,5 m) (211)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 17:00 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 7 | 08:30 | 07:56 | 07:01 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:12 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:02 | 21:41 | 21:42 | 21:00 | 19:54 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:47 | 06:49 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:38 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| | 16:46 | 17:40 | 18:30 | 20:22 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:28 |
| | 16:52 | 17:48 | 18:36 | 20:28 | 21:16 | 21:46 | 21:33 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:32 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
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| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB26 - NORDEX N175/6.X 6800 175.0 H NH: 179,0 m (Ges:266,5 m) (212)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:19 |
| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:38 | 17:30 | 18:19 | 20:12 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:45 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:20 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:05 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:40 | 18:30 | 20:22 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:09 | 05:28 | 06:12 | 07:02 | 07:51 | 07:44 | 08:25 |
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| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:49 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:42 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:23 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:18 | 21:47 | 21:32 | 20:40 | 19:32 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:36 | 06:23 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:58 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
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| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
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| | 17:11 | | 19:55 | 20:46 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB27 - NORDEX N175/6.X 6800 175.0 H NH: 179,0 m (Ges:266,5 m) (213)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| | 16:28 | 17:15 | 18:06 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:02 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:16 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:22 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:19 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:43 | 07:31 | 07:24 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:17 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:33 | 17:22 | 18:13 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
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| 12 | 08:28 | 07:48 | 06:50 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:38 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:38 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:37 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:40 | 18:30 | 20:22 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:41 | 06:31 | 05:35 | 05:09 | 05:28 | 06:12 | 07:02 | 07:51 | 07:44 | 08:25 |
| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:38 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:47 | 19:39 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:16 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:49 | 08:28 |
| | 16:53 | 17:48 | 18:37 | 20:28 | 21:16 | 21:46 | 21:34 | 20:42 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:23 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:18 | 21:47 | 21:32 | 20:40 | 19:32 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:10 | 05:34 | 06:20 | 07:10 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:36 | 06:23 | 07:13 | 08:03 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:11 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:58 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:41 | 06:28 | 07:18 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:23 |
| 27 | 08:13 | 07:18 | 06:16 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:24 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_V B28 - NORDEX N175/6.X 6800 175.0 H NH: 179,0 m (Ges:266,5 m) (214)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:13 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:15 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:50 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 06:59 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:01 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:15 | 05:53 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:13 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:33 | 17:24 | 18:14 | 20:06 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:52 | 16:19 |
| 7 | 08:30 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:54 | 06:58 | 06:48 | 05:48 | 05:11 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:11 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:02 | 21:41 | 21:42 | 21:00 | 19:54 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:44 | 16:18 |
| 12 | 08:28 | 07:47 | 06:49 | 06:39 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:41 | 17:35 | 18:24 | 20:16 | 21:05 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:39 | 05:10 | 05:24 | 06:07 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:39 | 20:54 | 19:48 | 18:40 | 16:41 | 16:18 |
| 14 | 08:26 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:23 |
| | 16:44 | 17:38 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| | 16:46 | 17:40 | 18:30 | 20:21 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
| | 16:47 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:28 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:26 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:27 |
| | 16:52 | 17:47 | 18:36 | 20:28 | 21:16 | 21:46 | 21:33 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:18 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:31 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:19 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:09 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:20 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:57 | 08:30 |
| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:56 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB29 - NORDEX N175/6.X 6800 175.0 H NH: 179,0 m (Ges:266,5 m) (215)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:00 | 05:16 | 05:14 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:19 |
| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
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| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
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| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:54 | 07:42 | 07:36 | 08:21 |
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| 12 | 08:28 | 07:48 | 06:49 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:45 | 07:39 | 08:23 |
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| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:38 | 16:40 | 16:18 |
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| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:34 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:19 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:49 | 08:28 |
| | 16:52 | 17:48 | 18:36 | 20:28 | 21:16 | 21:46 | 21:34 | 20:42 | 19:34 | 18:27 | 16:34 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:32 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:03 | 17:58 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:10 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: WEA_VB30 - VESTAS V126-3.45 LTq 3450 126.0 !O!NH: 149,0 m (Ges: 212,0 m) (216)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:15 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 17:00 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:13 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 7 | 08:30 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:12 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:02 | 21:41 | 21:42 | 21:00 | 19:54 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:47 | 06:49 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:42 | 17:35 | 18:24 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:39 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:26 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:23 |
| | 16:45 | 17:38 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| | 16:46 | 17:40 | 18:30 | 20:21 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:26 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:27 |
| | 16:52 | 17:48 | 18:36 | 20:28 | 21:16 | 21:46 | 21:33 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:31 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:57 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
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| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB31 - VESTAS V117-3.45 3450 117.0 IO!NH: 116,5 m (Ges:175,0 m) (217)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:

- Die Sonne scheint täglich von Sonnenauf- bis -untergang
- Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
- Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:13 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:15 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 17:00 | 16:21 |
| 3 | 08:31 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:01 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 5 | 08:31 | 07:59 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:13 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:06 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 7 | 08:30 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:54 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:39 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
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| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
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| 11 | 08:28 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:20 |
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| 12 | 08:28 | 07:47 | 06:49 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
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| 14 | 08:26 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:23 |
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| | 16:46 | 17:40 | 18:30 | 20:21 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
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| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:57 | 08:30 |
| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:25 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:56 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA**: WEA_VB32 - VESTAS V 126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges: 212,0 m) (218)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
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| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:15 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 06:59 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:01 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:13 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:33 | 17:24 | 18:14 | 20:06 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 7 | 08:30 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:54 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:11 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:02 | 21:41 | 21:42 | 21:00 | 19:54 | 18:46 | 16:46 | 16:18 |
| 11 | 08:28 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:20 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:44 | 16:18 |
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| | 16:42 | 17:35 | 18:24 | 20:16 | 21:05 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:39 | 05:10 | 05:24 | 06:07 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:39 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:26 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:23 |
| | 16:44 | 17:38 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| | 16:46 | 17:40 | 18:30 | 20:21 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:26 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:27 |
| | 16:52 | 17:47 | 18:36 | 20:28 | 21:16 | 21:46 | 21:33 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:31 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:20 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:57 | 08:30 |
| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:25 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:56 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: WEA_VB33 - VESTAS V 126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges: 212,0 m) (219)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 17:00 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 7 | 08:30 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
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| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
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| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
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| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
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| 12 | 08:28 | 07:47 | 06:49 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:42 | 17:35 | 18:24 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
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| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
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| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:28 |
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| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
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| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA : WEA_VB34 - VESTAS V 126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges: 212,0 m) (220)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:13 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 06:59 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:01 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:15 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:13 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:33 | 17:24 | 18:14 | 20:06 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 7 | 08:30 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:11 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:11 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:02 | 21:41 | 21:42 | 21:00 | 19:54 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:44 | 16:18 |
| 12 | 08:28 | 07:47 | 06:49 | 06:39 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:42 | 17:35 | 18:24 | 20:16 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:39 | 05:10 | 05:24 | 06:07 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:41 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:23 |
| | 16:44 | 17:38 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| | 16:46 | 17:40 | 18:30 | 20:21 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:26 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:27 |
| | 16:52 | 17:47 | 18:36 | 20:28 | 21:16 | 21:46 | 21:33 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:31 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:19 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:09 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:20 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:57 | 08:30 |
| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:56 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung WEA: WEA_VB35 - VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges: 212,0 m) (221)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 17:00 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:44 | 21:07 | 20:04 | 18:55 | 16:53 | 16:19 |
| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:50 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
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| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
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| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:54 | 07:42 | 07:36 | 08:21 |
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| 12 | 08:28 | 07:47 | 06:49 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:45 | 07:39 | 08:23 |
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| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:10 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
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| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:49 | 08:28 |
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| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:32 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:26 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:21 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
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| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
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| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
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| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB36 - ENERCON E-82 E2 TES 2300 82.0 !O! NH: 138,4 m (Ges:179,4 m) (222)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:15 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:33 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 7 | 08:31 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:11 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:12 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:20 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:02 | 21:41 | 21:42 | 21:00 | 19:54 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:44 | 16:18 |
| 12 | 08:28 | 07:47 | 06:49 | 06:39 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:42 | 17:35 | 18:24 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:39 | 05:10 | 05:24 | 06:07 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:41 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
| | 16:44 | 17:38 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| | 16:46 | 17:40 | 18:30 | 20:22 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:28 |
| | 16:52 | 17:47 | 18:36 | 20:28 | 21:16 | 21:46 | 21:34 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:31 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:19 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:09 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:20 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB37 - ENERCON E-82 E2 TES 2300 82.0 !O! NH: 108,4 m (Ges:149,4 m) (223)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:13 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:50 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 06:59 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:15 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:33 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:52 | 16:19 |
| 7 | 08:31 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:11 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:12 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
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| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:44 | 16:18 |
| 12 | 08:28 | 07:47 | 06:49 | 06:39 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| | 16:41 | 17:35 | 18:24 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:39 | 05:10 | 05:24 | 06:07 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:41 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
| | 16:44 | 17:38 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| | 16:46 | 17:40 | 18:30 | 20:21 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
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| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 17 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:28 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:26 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:28 |
| | 16:52 | 17:47 | 18:36 | 20:28 | 21:16 | 21:46 | 21:34 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:31 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:19 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:09 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
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| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:20 |
| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:56 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA:** WEA_VB38 - ENERCON E-82 E2 TES 2300 82.0 !O! NH: 138,4 m (Ges:179,4 m) (224)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:13 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| 2 | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 3 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:09 |
| 4 | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 5 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 7 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:15 | 05:54 | 06:42 | 07:30 | 07:23 | 08:12 |
| 8 | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 9 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| 10 | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| 12 | 16:33 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:53 | 16:19 |
| 13 | 08:31 | 07:56 | 07:00 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| 14 | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
| 15 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:11 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| 16 | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 17 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| 18 | 16:37 | 17:29 | 18:19 | 20:12 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 19 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
| 20 | 16:39 | 17:31 | 18:21 | 20:13 | 21:02 | 21:41 | 21:42 | 21:00 | 19:54 | 18:46 | 16:46 | 16:18 |
| 21 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
| 22 | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:44 | 16:18 |
| 23 | 08:28 | 07:47 | 06:49 | 06:39 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| 24 | 16:42 | 17:35 | 18:24 | 20:17 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:27 | 07:46 | 06:47 | 06:37 | 05:39 | 05:10 | 05:24 | 06:07 | 06:57 | 07:45 | 07:39 | 08:23 |
| 26 | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:41 | 16:18 |
| 27 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
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| 29 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:24 |
| 30 | 16:46 | 17:40 | 18:30 | 20:22 | 21:10 | 21:44 | 21:38 | 20:50 | 19:43 | 18:35 | 16:39 | 16:18 |
| 31 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:01 | 07:50 | 07:44 | 08:25 |
| 32 | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:48 | 19:41 | 18:33 | 16:37 | 16:18 |
| 33 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:29 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| 34 | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 35 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| 36 | 16:51 | 17:46 | 18:35 | 20:26 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 37 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:28 |
| 38 | 16:52 | 17:47 | 18:36 | 20:28 | 21:16 | 21:46 | 21:34 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 39 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| 40 | 16:54 | 17:49 | 18:38 | 20:30 | 21:17 | 21:46 | 21:32 | 20:40 | 19:31 | 18:25 | 16:32 | 16:19 |
| 41 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| 42 | 16:56 | 17:51 | 18:40 | 20:31 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:19 |
| 43 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:09 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| 44 | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
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| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:20 |
| 47 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| 48 | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 49 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| 50 | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| 52 | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 53 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| 54 | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 55 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| 56 | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 57 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| 58 | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| 62 | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung Gesamtbelastung **WEA**: WEA_VB39 - ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (225
Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:14 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:26 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:59 | 05:15 | 05:14 | 05:51 | 06:39 | 07:27 | 07:20 | 08:10 |
| | 16:29 | 17:17 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:13 | 19:04 | 17:00 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 07:00 | 05:57 | 05:15 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:02 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:32 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:16 | 05:54 | 06:42 | 07:30 | 07:24 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:46 | 21:11 | 20:08 | 19:00 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:55 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
| 6 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:13 | 05:17 | 05:57 | 06:46 | 07:34 | 07:27 | 08:15 |
| | 16:34 | 17:24 | 18:14 | 20:07 | 20:56 | 21:38 | 21:45 | 21:07 | 20:04 | 18:55 | 16:53 | 16:19 |
| 7 | 08:31 | 07:56 | 07:01 | 06:51 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:06 | 20:01 | 18:53 | 16:51 | 16:19 |
| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:12 | 05:19 | 06:00 | 06:49 | 07:37 | 07:31 | 08:17 |
| | 16:36 | 17:28 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:51 | 16:49 | 16:19 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:19 |
| | 16:37 | 17:29 | 18:19 | 20:12 | 21:01 | 21:41 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:20 |
| | 16:39 | 17:31 | 18:21 | 20:13 | 21:03 | 21:41 | 21:42 | 21:00 | 19:55 | 18:46 | 16:46 | 16:18 |
| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:54 | 07:42 | 07:36 | 08:21 |
| | 16:40 | 17:33 | 18:23 | 20:15 | 21:04 | 21:42 | 21:41 | 20:58 | 19:52 | 18:44 | 16:45 | 16:18 |
| 12 | 08:28 | 07:48 | 06:49 | 06:40 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:38 | 08:22 |
| | 16:42 | 17:35 | 18:25 | 20:17 | 21:06 | 21:43 | 21:41 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 13 | 08:27 | 07:46 | 06:47 | 06:37 | 05:40 | 05:10 | 05:24 | 06:08 | 06:57 | 07:45 | 07:39 | 08:23 |
| | 16:43 | 17:37 | 18:26 | 20:18 | 21:07 | 21:43 | 21:40 | 20:54 | 19:48 | 18:40 | 16:42 | 16:18 |
| 14 | 08:27 | 07:44 | 06:45 | 06:35 | 05:38 | 05:09 | 05:25 | 06:09 | 06:58 | 07:47 | 07:41 | 08:24 |
| | 16:45 | 17:39 | 18:28 | 20:20 | 21:09 | 21:44 | 21:39 | 20:52 | 19:45 | 18:37 | 16:40 | 16:18 |
| 15 | 08:26 | 07:42 | 06:43 | 06:33 | 05:36 | 05:09 | 05:26 | 06:11 | 07:00 | 07:49 | 07:43 | 08:25 |
| | 16:46 | 17:40 | 18:30 | 20:22 | 21:10 | 21:45 | 21:38 | 20:51 | 19:43 | 18:35 | 16:39 | 16:18 |
| 16 | 08:25 | 07:40 | 06:40 | 06:31 | 05:35 | 05:09 | 05:27 | 06:12 | 07:02 | 07:51 | 07:44 | 08:25 |
| | 16:48 | 17:42 | 18:31 | 20:23 | 21:12 | 21:45 | 21:37 | 20:49 | 19:41 | 18:33 | 16:37 | 16:18 |
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| 18 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:27 | 21:15 | 21:46 | 21:35 | 20:45 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:25 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:56 | 07:50 | 08:28 |
| | 16:52 | 17:48 | 18:36 | 20:28 | 21:16 | 21:46 | 21:34 | 20:43 | 19:34 | 18:27 | 16:33 | 16:19 |
| 20 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:19 | 07:08 | 07:57 | 07:51 | 08:28 |
| | 16:54 | 17:49 | 18:38 | 20:30 | 21:18 | 21:47 | 21:33 | 20:40 | 19:32 | 18:25 | 16:32 | 16:19 |
| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:34 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
| | 16:56 | 17:51 | 18:40 | 20:32 | 21:19 | 21:47 | 21:31 | 20:38 | 19:29 | 18:23 | 16:31 | 16:20 |
| 22 | 08:19 | 07:28 | 06:27 | 06:18 | 05:27 | 05:10 | 05:35 | 06:22 | 07:11 | 08:01 | 07:54 | 08:29 |
| | 16:57 | 17:53 | 18:42 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 23 | 08:18 | 07:26 | 06:25 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:03 | 07:56 | 08:30 |
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| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:38 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:57 | 18:45 | 20:37 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:16 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:27 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:47 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 27 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| | 17:06 | 18:02 | 18:50 | 20:42 | 21:27 | 21:47 | 21:23 | 20:26 | 19:16 | 18:11 | 16:25 | 16:23 |
| 28 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:32 |
| | 17:08 | 18:04 | 18:52 | 20:43 | 21:28 | 21:47 | 21:22 | 20:24 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 30 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:35 | 07:24 | 08:15 | 08:07 | 08:32 |
| | 17:11 | | 19:55 | 20:46 | 21:31 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:48 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:57 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:27 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB40 - ENERCON E-48 800 48.0 IO! NH: 64,6 m (Ges:88,6 m) (226)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:13 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| 2 | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:46 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 3 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:50 | 06:39 | 07:27 | 07:20 | 08:09 |
| 4 | 16:29 | 17:16 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 5 | 08:32 | 08:03 | 07:09 | 06:59 | 05:57 | 05:14 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| 6 | 16:30 | 17:18 | 18:09 | 20:01 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 7 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:15 | 05:53 | 06:42 | 07:30 | 07:23 | 08:12 |
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| 11 | 08:31 | 07:58 | 07:03 | 06:53 | 05:51 | 05:12 | 05:17 | 05:57 | 06:45 | 07:34 | 07:27 | 08:15 |
| 12 | 16:33 | 17:24 | 18:14 | 20:06 | 20:56 | 21:38 | 21:44 | 21:07 | 20:03 | 18:55 | 16:52 | 16:19 |
| 13 | 08:30 | 07:56 | 07:00 | 06:50 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
| 14 | 16:35 | 17:26 | 18:16 | 20:08 | 20:58 | 21:39 | 21:44 | 21:05 | 20:01 | 18:53 | 16:51 | 16:19 |
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| 16 | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:50 | 16:49 | 16:18 |
| 17 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| 18 | 16:37 | 17:29 | 18:19 | 20:11 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 19 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:11 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
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| 23 | 08:28 | 07:47 | 06:49 | 06:39 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
| 24 | 16:41 | 17:35 | 18:24 | 20:16 | 21:06 | 21:43 | 21:40 | 20:56 | 19:50 | 18:42 | 16:43 | 16:18 |
| 25 | 08:27 | 07:46 | 06:47 | 06:37 | 05:39 | 05:10 | 05:24 | 06:07 | 06:57 | 07:45 | 07:39 | 08:23 |
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| 33 | 08:24 | 07:38 | 06:38 | 06:29 | 05:33 | 05:09 | 05:28 | 06:14 | 07:03 | 07:52 | 07:46 | 08:26 |
| 34 | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 35 | 08:23 | 07:36 | 06:36 | 06:27 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
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| 38 | 16:52 | 17:47 | 18:36 | 20:28 | 21:16 | 21:46 | 21:33 | 20:42 | 19:34 | 18:27 | 16:33 | 16:19 |
| 39 | 08:21 | 07:32 | 06:31 | 06:22 | 05:29 | 05:09 | 05:32 | 06:18 | 07:08 | 07:57 | 07:51 | 08:28 |
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| 44 | 16:57 | 17:53 | 18:41 | 20:33 | 21:20 | 21:47 | 21:30 | 20:36 | 19:27 | 18:21 | 16:30 | 16:20 |
| 45 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
| 46 | 16:59 | 17:55 | 18:43 | 20:35 | 21:22 | 21:47 | 21:29 | 20:34 | 19:25 | 18:19 | 16:29 | 16:20 |
| 47 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:37 | 06:25 | 07:14 | 08:04 | 07:57 | 08:30 |
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| 50 | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 51 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| 52 | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
| 53 | 08:13 | 07:18 | 06:15 | 06:08 | 05:21 | 05:11 | 05:42 | 06:30 | 07:19 | 08:09 | 08:02 | 08:31 |
| 54 | 17:06 | 18:02 | 18:50 | 20:41 | 21:27 | 21:47 | 21:23 | 20:26 | 19:15 | 18:11 | 16:25 | 16:23 |
| 55 | 08:12 | 07:16 | 06:13 | 06:06 | 05:20 | 05:12 | 05:43 | 06:31 | 07:21 | 08:11 | 08:04 | 08:31 |
| 56 | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 57 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
| 58 | 17:09 | | 19:53 | 20:45 | 21:29 | 21:47 | 21:20 | 20:21 | 19:11 | 18:07 | 16:23 | 16:25 |
| 59 | 08:09 | | 07:09 | 06:02 | 05:18 | 05:13 | 05:46 | 06:34 | 07:24 | 08:15 | 08:07 | 08:32 |
| 60 | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 61 | 08:07 | | 07:06 | | 05:17 | | 05:47 | 06:36 | | 07:16 | | 08:32 |
| 62 | 17:13 | | 19:56 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:26 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

SHADOW - Kalender pro WEA

Berechnung: Gesamtbelastung **WEA** : WEA_VB41 - ENERCON E-101 3000 101.0 H-NH: 135,4 m (Ges:185,9 m) (227)

Annahmen für Schattenwurfberechnung

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

| | Januar | Februar | März | April | Mai | Juni | Juli | August | September | Oktober | November | Dezember |
|-----------------------------|--------|---------|-------|-------|-------|-------|-------|--------|-----------|---------|----------|----------|
| 1 | 08:32 | 08:06 | 07:13 | 07:04 | 06:00 | 05:16 | 05:13 | 05:49 | 06:38 | 07:25 | 07:18 | 08:08 |
| | 16:28 | 17:15 | 18:05 | 19:58 | 20:48 | 21:33 | 21:47 | 21:16 | 20:15 | 19:06 | 17:01 | 16:22 |
| 2 | 08:32 | 08:04 | 07:11 | 07:02 | 05:58 | 05:15 | 05:14 | 05:50 | 06:39 | 07:27 | 07:20 | 08:09 |
| | 16:29 | 17:16 | 18:07 | 20:00 | 20:50 | 21:34 | 21:46 | 21:14 | 20:12 | 19:04 | 16:59 | 16:21 |
| 3 | 08:32 | 08:03 | 07:09 | 06:59 | 05:57 | 05:14 | 05:15 | 05:52 | 06:41 | 07:29 | 07:22 | 08:11 |
| | 16:30 | 17:18 | 18:09 | 20:01 | 20:51 | 21:35 | 21:46 | 21:12 | 20:10 | 19:02 | 16:58 | 16:21 |
| 4 | 08:31 | 08:01 | 07:07 | 06:57 | 05:55 | 05:14 | 05:15 | 05:53 | 06:42 | 07:30 | 07:23 | 08:12 |
| | 16:31 | 17:20 | 18:11 | 20:03 | 20:53 | 21:36 | 21:45 | 21:11 | 20:08 | 18:59 | 16:56 | 16:20 |
| 5 | 08:31 | 08:00 | 07:05 | 06:55 | 05:53 | 05:13 | 05:16 | 05:55 | 06:44 | 07:32 | 07:25 | 08:14 |
| | 16:32 | 17:22 | 18:12 | 20:05 | 20:54 | 21:37 | 21:45 | 21:09 | 20:06 | 18:57 | 16:54 | 16:20 |
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| 7 | 08:31 | 07:56 | 07:00 | 06:50 | 05:49 | 05:12 | 05:18 | 05:58 | 06:47 | 07:35 | 07:29 | 08:16 |
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| 8 | 08:30 | 07:55 | 06:58 | 06:48 | 05:48 | 05:11 | 05:19 | 06:00 | 06:49 | 07:37 | 07:30 | 08:17 |
| | 16:36 | 17:27 | 18:18 | 20:10 | 20:59 | 21:40 | 21:43 | 21:04 | 19:59 | 18:50 | 16:49 | 16:18 |
| 9 | 08:30 | 07:53 | 06:56 | 06:46 | 05:46 | 05:11 | 05:20 | 06:01 | 06:50 | 07:39 | 07:32 | 08:18 |
| | 16:37 | 17:29 | 18:19 | 20:11 | 21:01 | 21:40 | 21:43 | 21:02 | 19:57 | 18:48 | 16:48 | 16:18 |
| 10 | 08:29 | 07:51 | 06:54 | 06:44 | 05:44 | 05:10 | 05:21 | 06:03 | 06:52 | 07:40 | 07:34 | 08:19 |
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| 11 | 08:29 | 07:49 | 06:52 | 06:42 | 05:43 | 05:10 | 05:22 | 06:04 | 06:53 | 07:42 | 07:36 | 08:21 |
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| 12 | 08:28 | 07:47 | 06:49 | 06:39 | 05:41 | 05:10 | 05:23 | 06:06 | 06:55 | 07:44 | 07:37 | 08:22 |
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| | 16:49 | 17:44 | 18:33 | 20:25 | 21:13 | 21:45 | 21:36 | 20:46 | 19:38 | 18:31 | 16:36 | 16:18 |
| 18 | 08:23 | 07:36 | 06:36 | 06:26 | 05:32 | 05:09 | 05:30 | 06:15 | 07:05 | 07:54 | 07:48 | 08:27 |
| | 16:51 | 17:46 | 18:35 | 20:26 | 21:15 | 21:46 | 21:35 | 20:44 | 19:36 | 18:29 | 16:35 | 16:18 |
| 19 | 08:22 | 07:34 | 06:34 | 06:24 | 05:31 | 05:09 | 05:31 | 06:17 | 07:06 | 07:55 | 07:49 | 08:28 |
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| 21 | 08:20 | 07:30 | 06:29 | 06:20 | 05:28 | 05:09 | 05:33 | 06:20 | 07:09 | 07:59 | 07:53 | 08:29 |
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| 23 | 08:18 | 07:26 | 06:24 | 06:16 | 05:25 | 05:10 | 05:36 | 06:23 | 07:13 | 08:02 | 07:56 | 08:30 |
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| 24 | 08:17 | 07:24 | 06:22 | 06:14 | 05:24 | 05:10 | 05:37 | 06:25 | 07:14 | 08:04 | 07:58 | 08:30 |
| | 17:01 | 17:56 | 18:45 | 20:36 | 21:23 | 21:47 | 21:27 | 20:32 | 19:22 | 18:17 | 16:28 | 16:21 |
| 25 | 08:15 | 07:22 | 06:20 | 06:12 | 05:23 | 05:10 | 05:39 | 06:26 | 07:16 | 08:06 | 07:59 | 08:31 |
| | 17:02 | 17:58 | 18:46 | 20:38 | 21:24 | 21:47 | 21:26 | 20:30 | 19:20 | 18:15 | 16:27 | 16:22 |
| 26 | 08:14 | 07:20 | 06:18 | 06:10 | 05:22 | 05:11 | 05:40 | 06:28 | 07:17 | 08:08 | 08:01 | 08:31 |
| | 17:04 | 18:00 | 18:48 | 20:40 | 21:26 | 21:47 | 21:25 | 20:28 | 19:18 | 18:13 | 16:26 | 16:22 |
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| | 17:08 | 18:04 | 18:51 | 20:43 | 21:28 | 21:47 | 21:22 | 20:23 | 19:13 | 18:09 | 16:24 | 16:24 |
| 29 | 08:10 | | 07:11 | 06:04 | 05:19 | 05:12 | 05:45 | 06:33 | 07:22 | 08:13 | 08:05 | 08:32 |
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| | 17:11 | | 19:55 | 20:46 | 21:30 | 21:47 | 21:19 | 20:19 | 19:09 | 18:05 | 16:23 | 16:26 |
| 31 | 08:07 | | 07:06 | | 05:17 | | 05:47 | 06:36 | | 07:16 | | 08:32 |
| | 17:13 | | 19:56 | | 21:32 | | 21:17 | 20:17 | | 17:03 | | 16:26 |
| Sonnenscheinstunden | 261 | 279 | 367 | 415 | 483 | 496 | 499 | 452 | 381 | 332 | 268 | 246 |
| Anzahl Minuten mit Schatten | 0 | 0 | 0 | 0 | 0 | 0 | 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 |
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|
|--------------|-----------------------|-------------------------|-------------------|----------------------------------|-----------------------------------|

Anlage A6: SHADOW-Grafischer Kalender pro WEA mit Darstellung der Beschattungszeiten je WEA an den Immissionsorten über das ganze Jahr

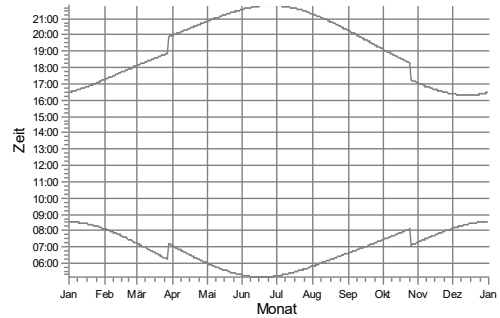
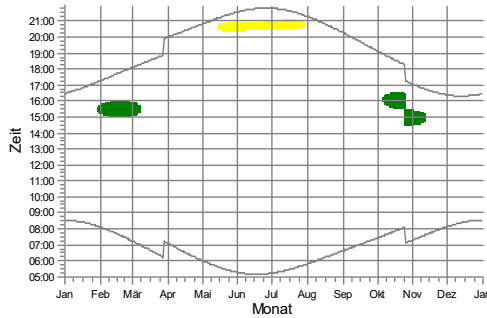
Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
KÖTTER Consulting Engineers GmbH & Co. KG
Bonifatiusstr. 400
DE-48432 Rheine
+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

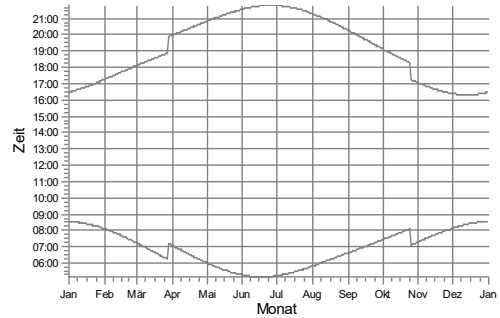
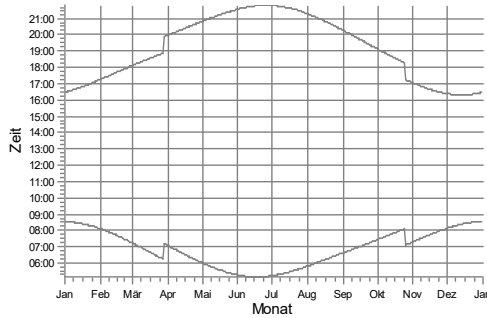
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

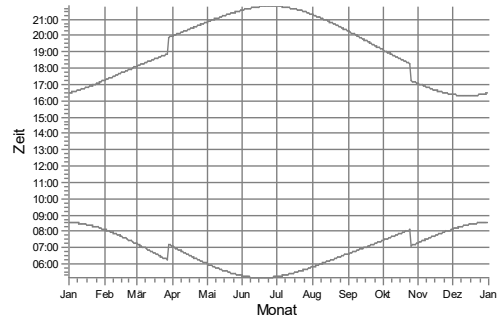
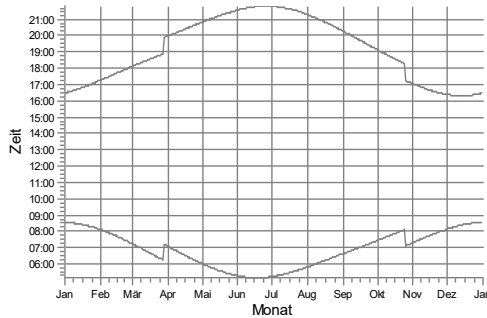
WEA_ZB01: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) WEA_ZB02: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) (10)



WEA_ZB03: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) WEA_ZB04: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) (12)



WEA_ZB05: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) WEA_ZB06: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) (15)



Schattenrezeptoren

- SR-01: SR-01, Provinzialstraße 2, 59602 Rüthen
- SR-02: SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg

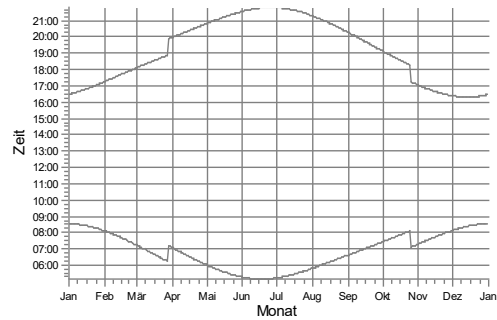
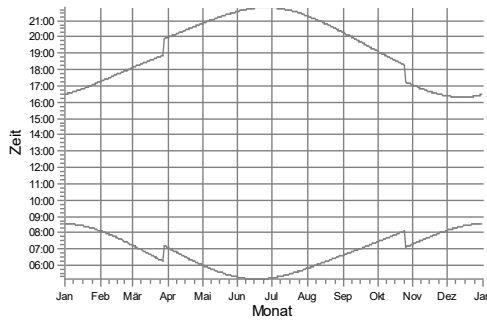
Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
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+49 5971 9710-31
Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
Berechnet:
24.06.2024 10:06/4.0.540

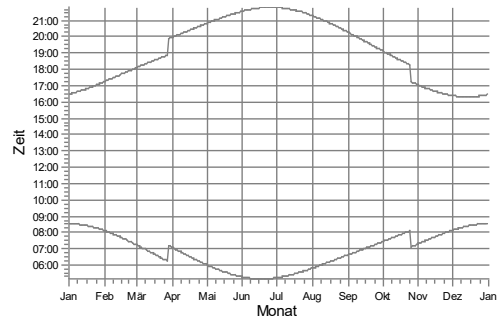
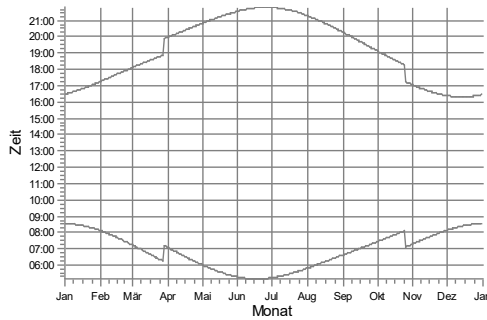
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

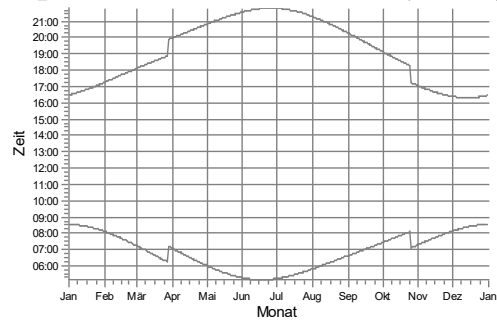
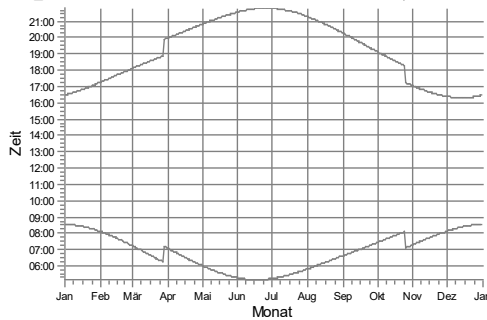
WEA_ZB07: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) WEA_ZB08: ENERCON E-175 EP5 6000 175.0 IO! NH: 162,0 m (Ges.:249,5 m) (16)



WEA_VB01: VESTAS V162-7.2 7200 162.0 IO! NH: 169,0 m (Ges.:250,0 m) WEA_VB02: ENERCON E-40/5.40 500 40.3 IO! NH: 50,0 m (Ges.:70,2 m) (228)



WEA_VB03: VESTAS V172-7.2 7200 172.0 IO! NH: 175,0 m (Ges.:261,0 m) WEA_VB04: VESTAS V162-7.2 7200 162.0 IO! NH: 169,0 m (Ges.:250,0 m) (190)



Schattenrezeptoren

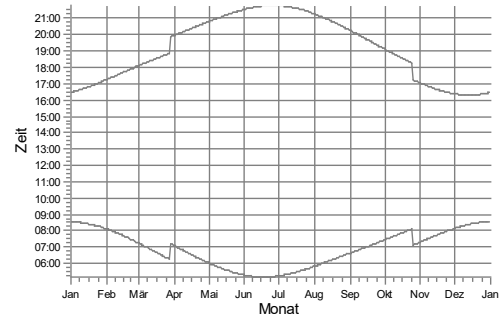
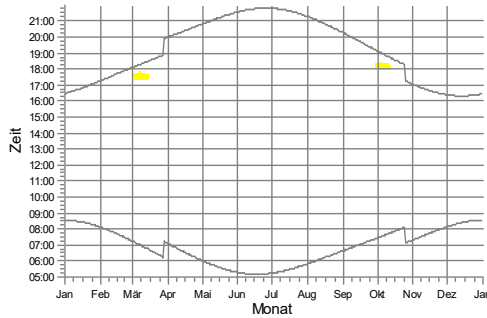
Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 10:06/4.0.540

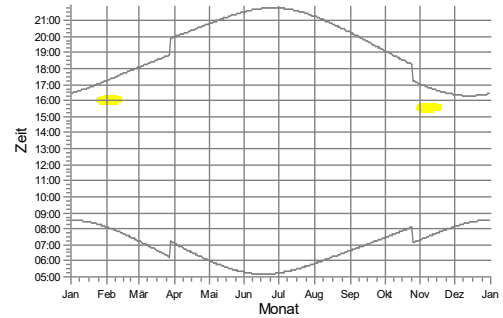
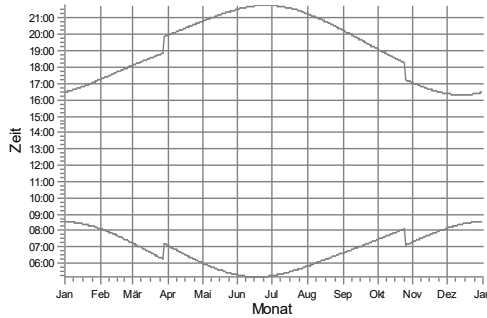
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

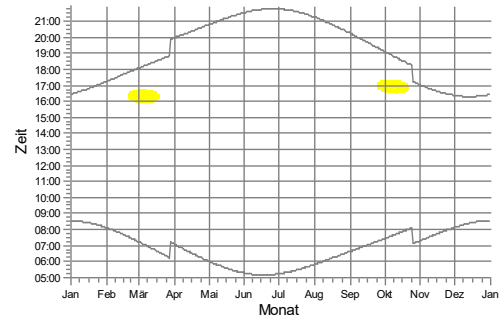
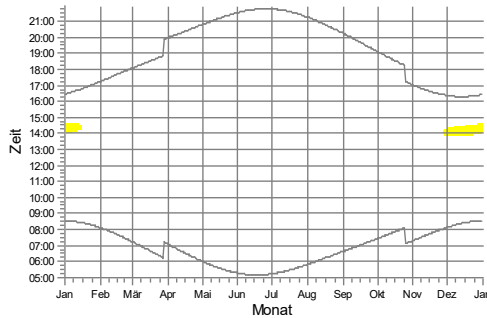
WEA_VB05: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges:250,0 m) WEA_VB06: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges:250,0 m) (192)



WEA_VB07: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges:250,0 m) WEA_VB08: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges:250,0 m) (194)



WEA_VB09: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges:250,0 m) WEA_VB10: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges:250,0 m) (196)



Schattenrezeptoren

 SR-02: SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg

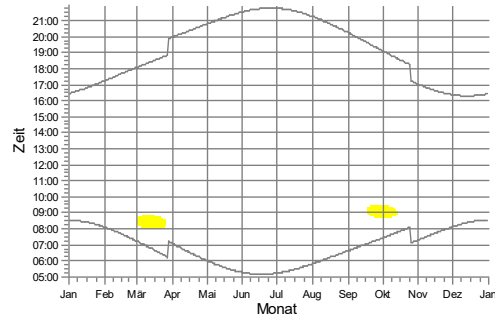
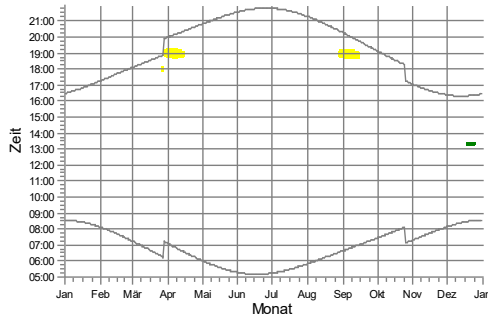
Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 10:06/4.0.540

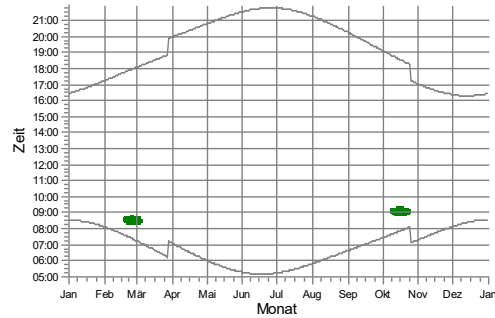
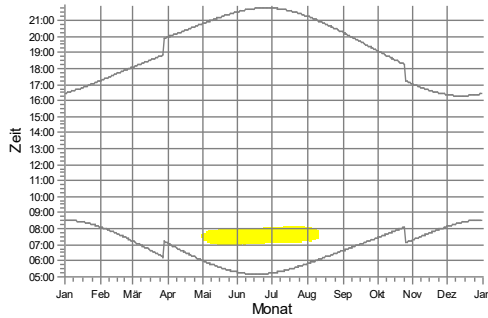
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

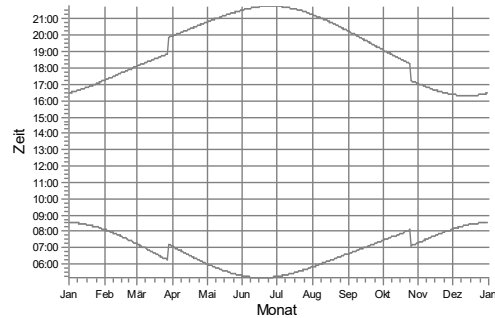
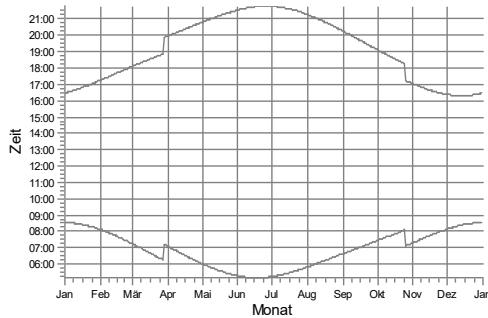
WEA_VB11: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges.:250,0 m) WEA_VB12: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges.:250,0 m) (198)



WEA_VB13: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges.:250,0 m) WEA_VB14: VESTAS V162-6.2 6200 162.0 IO! NH: 169,0 m (Ges.:250,0 m) (200)



WEA_VB15: GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (WEA_VB16: GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges.:24



Schattenrezeptoren

- SR-01: SR-01, Provinzialstraße 2, 59602 Rüthen
- SR-02: SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg

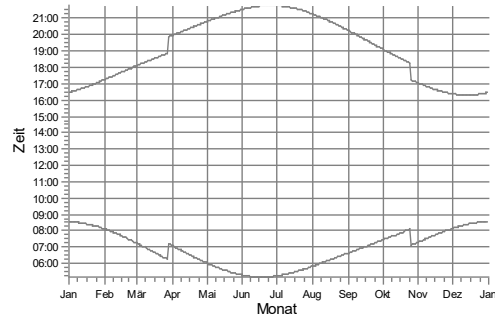
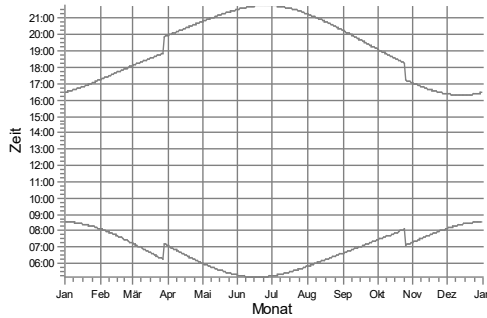
Projekt:
R-2-2023-0368_WP_Rüthen

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24.06.2024 10:06/4.0.540

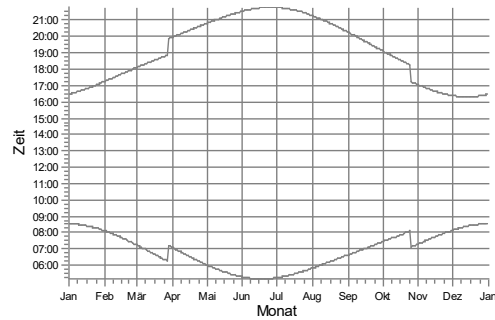
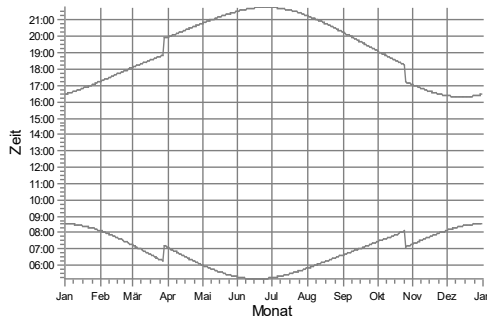
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

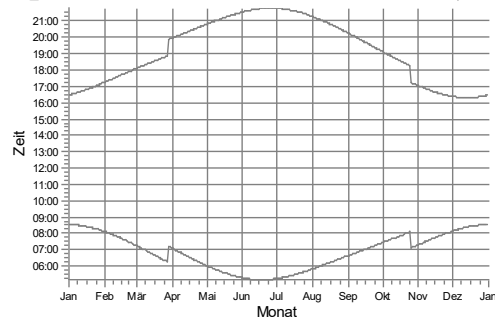
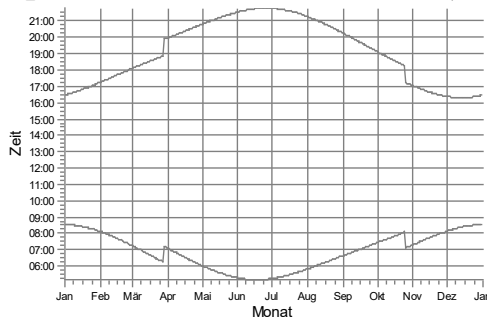
WEA_VB17: GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (WEA_VB18: GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:24C



WEA_VB19: ENERCON E-160 EP5 E3 R1 5560 160.0 IO! NH: 166,6 m (Ges:24C WEA_VB20: ENERCON E-160 EP5 E3 R1 5560 160.0 IO! NH: 166,6 m (Ges:246,6 m)



WEA_VB21: ENERCON E-160 EP5 E3 R1 5560 160.0 IO! NH: 166,6 m (Ges:24C WEA_VB22: ENERCON E-160 EP5 E3 R1 5560 160.0 IO! NH: 166,6 m (Ges:246,6 m)



Schattenrezeptoren

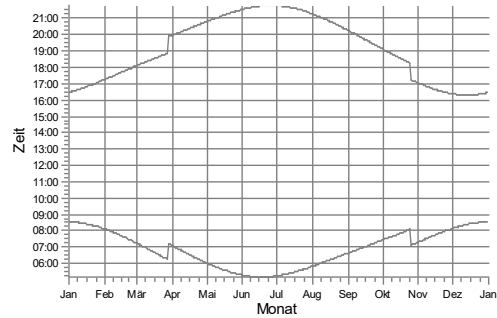
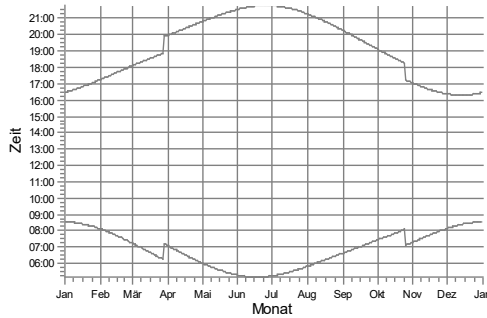
Projekt:
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 Berechnet:
 24.06.2024 10:06/4.0.540

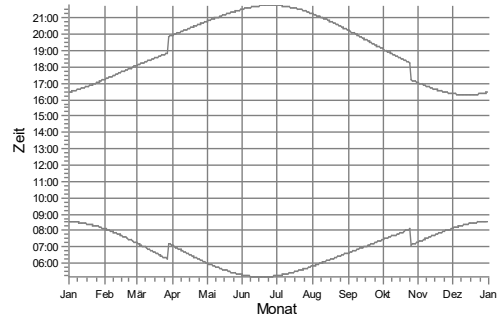
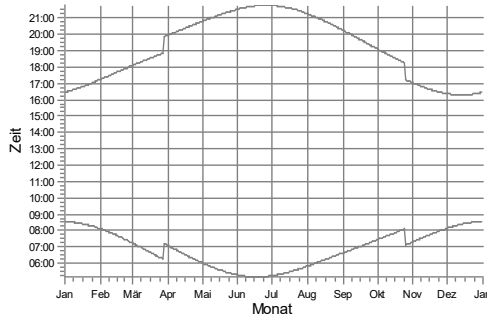
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

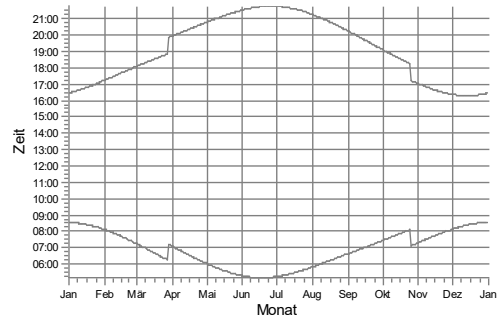
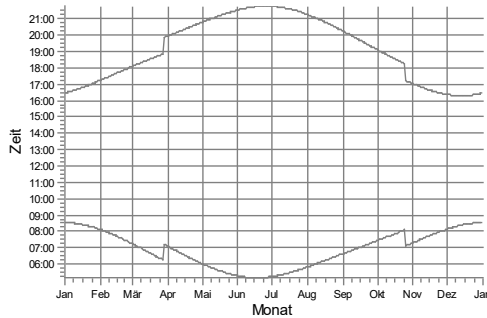
WEA_VB23: ENERCON E-160 EP5 E3 5560 160.0 IO! NH: 166,6 m (Ges.:246,6m) WEA_VB24: ENERCON E-160 EP5 E3 5560 160.0 IO! NH: 166,6 m (Ges.:246,6 m) (21)



WEA_VB25: NORDEX N149/5.X 5700 149.0 IO! NH: 164,0 m (Ges.:238,5 m) WEA_VB26: NORDEX N175/6.X 6800 175.0 IO! NH: 179,0 m (Ges.:266,5 m) (212)



WEA_VB27: NORDEX N175/6.X 6800 175.0 IO! NH: 179,0 m (Ges.:266,5 m) WEA_VB28: NORDEX N175/6.X 6800 175.0 IO! NH: 179,0 m (Ges.:266,5 m) (214)



Schattenrezeptoren

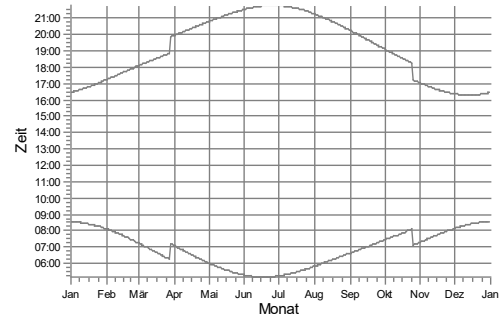
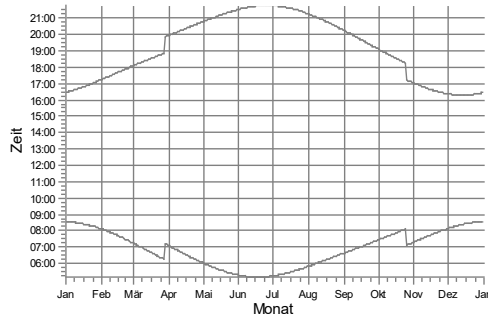
Projekt:
R-2-2023-0368_WP_Rüthen

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 +49 5971 9710-31
 Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
 Berechnet:
 24.06.2024 10:06/4.0.540

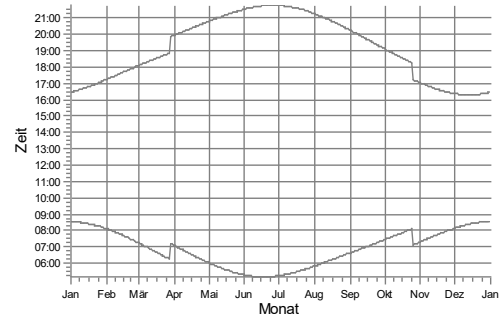
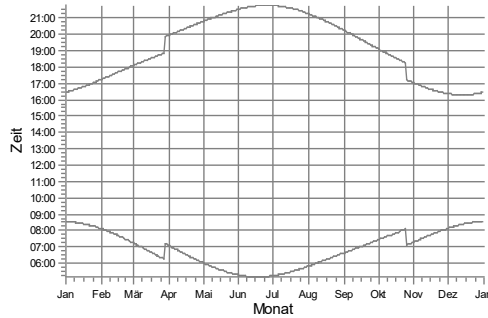
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

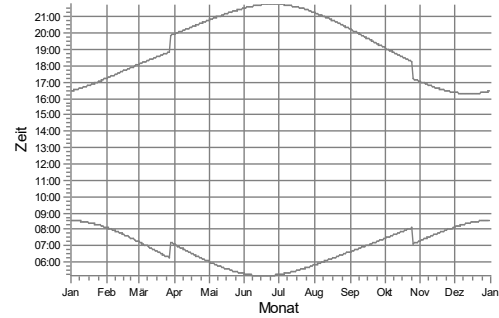
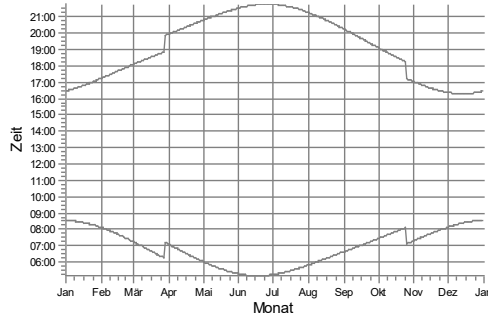
WEA_VB29: NORDEX N175/6.X 6800 175.0 !NH: 179,0 m (Ges:266,5 m) (; WEA_VB30: VESTAS V 126-3.45 LTq 3450 126.0 !NH: 149,0 m (Ges:212,0 m) (2



WEA_VB31: VESTAS V117-3.45 3450 117.0 !NH: 116,5 m (Ges:175,0 m) WEA_VB32: VESTAS V 126-3.45 LTq 3450 126.0 !NH: 149,0 m (Ges:212,0 m) (2



WEA_VB33: VESTAS V 126-3.45 LTq 3450 126.0 !NH: 149,0 m (Ges:212,0 m) WEA_VB34: VESTAS V 126-3.45 LTq 3450 126.0 !NH: 149,0 m (Ges:212,0 m) (2



Schattenrezeptoren

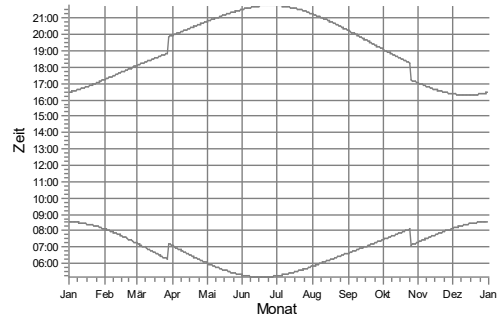
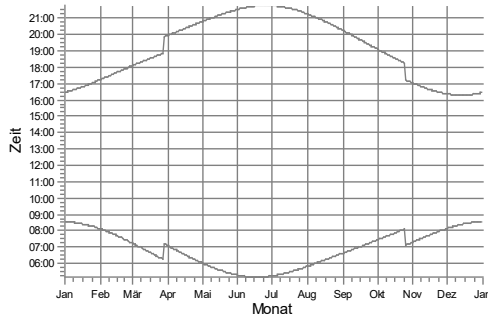
Projekt:
R-2-2023-0368_WP_Rüthen

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 24.06.2024 10:06/4.0.540

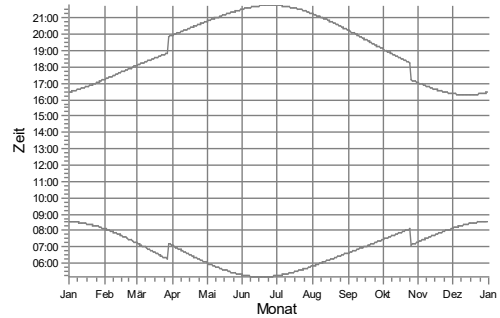
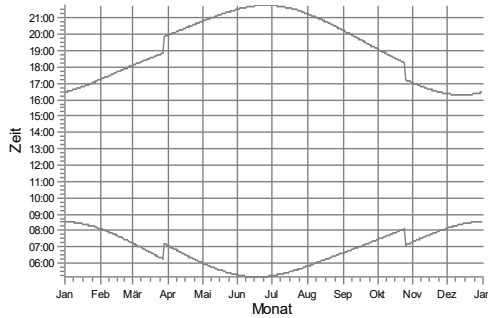
SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

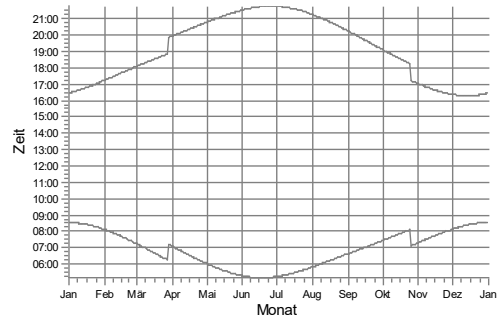
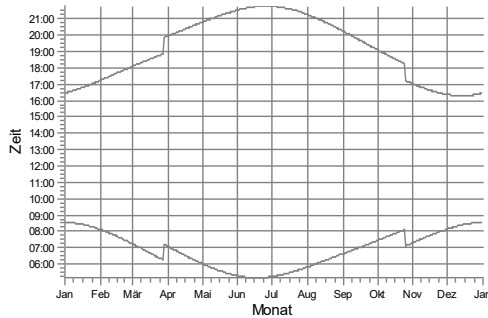
WEA_VB35: VESTAS V126-3.45 LTq 3450 126.0 IO! NH: 149,0 m (Ges:212) WEA_VB36: ENERCON E-82 E2 TES 2300 82.0 IO! NH: 138,4 m (Ges:179,4 m) (222)



WEA_VB37: ENERCON E-82 E2 TES 2300 82.0 IO! NH: 108,4 m (Ges:149,4) WEA_VB38: ENERCON E-82 E2 TES 2300 82.0 IO! NH: 138,4 m (Ges:179,4 m) (224)



WEA_VB39: ENERCON E-160 EP5 E3 R1 5560 160.0 IO! NH: 166,6 m (Ges:247) WEA_VB40: ENERCON E-48 800 48.0 IO! NH: 64,6 m (Ges:88,6 m) (226)



Schattenrezeptoren

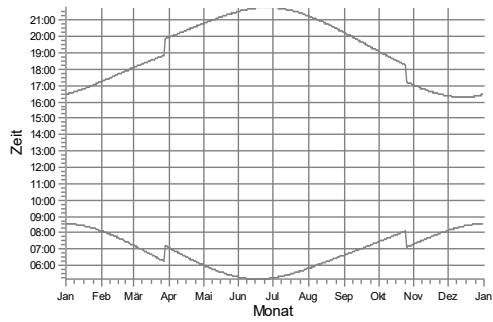
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SHADOW - Grafischer Kalender pro WEA

Berechnung: Gesamtbelastung

WEA_VB41: ENERCON E-101 3000 101.0 !NH: 135,4 m (Ges:185,9 m) (227)



Schattenrezeptoren

Anlage B: Schattenausbreitung der Vor- und Zusatzbelastung

Anlage B1: SHADOW-Hauptergebnis mit Darstellung der Vorbelastung, Immissionssorte SR-01 bis SR-zwei, Berechnungsergebnisse Stunden / Jahr, Schattentage / Jahr und maximalen Stunden / Tag

Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 09:54/4.0.540

SHADOW - Hauptergebnis

Berechnung: Vorbelastung
Annahmen für Schattenwurfberechnung

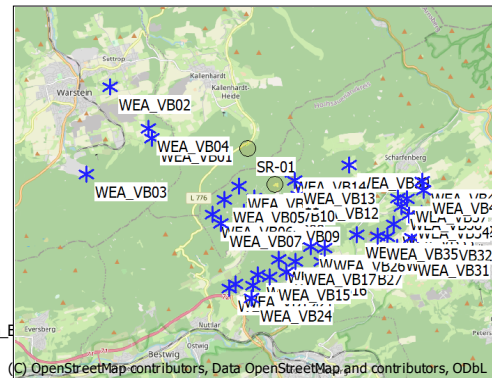
Beschattungsbereich der WEA
Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
Siehe WEA-Tabelle

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

Die dargestellten Zeiten sind die astronomisch maximale mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
Verwendete Höhenlinien: Höhenraster-Objekt: R-2-2023-0368_WP_Rüthen_E
Rasterauflösung: 1,0 m

Alle Koordinatenangaben in:
ETRS-TMz n Pan-European Transverse Mercator (UTM)-ETRS89 Zone: 32
WEA



| WEA | Ost | Nord | Z | Beschreibung | WEA-Typ | Hersteller | Typ | Nennleistung | Rotor-durchmesser | NH | Schattendaten | |
|----------|---------|-----------|-------|---------------|---------|----------------|-----------------------|--------------|-------------------|-------|-------------------|-------|
| | | | | | | | | | | | Beschatt.-Bereich | U/min |
| WEA_VB01 | 457.890 | 5.697.928 | 391,3 | VESTAS V16... | Ja | VESTAS | V162-7.2-7.200 | 7.200 | 162,0 | 169,0 | 2.041 | 9,5 |
| WEA_VB02 | 456.367 | 5.699.796 | 383,0 | ENERCON E-... | Nein | ENERCON | E-40/5.40-500 | 500 | 40,3 | 50,0 | 898 | 38,0 |
| WEA_VB03 | 455.501 | 5.696.658 | 398,1 | VESTAS V17... | Ja | VESTAS | V172-7.2-7.200 | 7.200 | 172,0 | 175,0 | 1.903 | - |
| WEA_VB04 | 457.762 | 5.698.286 | 386,8 | VESTAS V16... | Ja | VESTAS | V162-7.2-7.200 | 7.200 | 162,0 | 169,0 | 2.041 | 9,5 |
| WEA_VB05 | 460.521 | 5.695.694 | 473,2 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB06 | 460.083 | 5.695.167 | 508,2 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB07 | 460.400 | 5.694.830 | 540,3 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB08 | 461.236 | 5.695.224 | 507,9 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB09 | 461.805 | 5.695.012 | 503,1 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB10 | 461.620 | 5.695.750 | 514,1 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB11 | 461.065 | 5.696.170 | 486,7 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB12 | 463.220 | 5.695.835 | 500,7 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB13 | 463.100 | 5.696.360 | 494,8 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB14 | 462.774 | 5.696.786 | 485,3 | VESTAS V16... | Ja | VESTAS | V162-6.2-6.200 | 6.200 | 162,0 | 169,0 | 2.041 | - |
| WEA_VB15 | 462.177 | 5.692.883 | 511,6 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB16 | 462.772 | 5.693.064 | 504,8 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB17 | 463.110 | 5.693.456 | 539,4 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB18 | 463.675 | 5.693.961 | 555,0 | GE WIND EN... | Ja | GE WIND ENERGY | 5.5-158 GT120-5.500 | 5.500 | 158,0 | 161,0 | 1.816 | - |
| WEA_VB19 | 460.909 | 5.692.642 | 497,3 | ENERCON E-... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB20 | 461.717 | 5.692.956 | 494,7 | ENERCON E-... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB21 | 461.541 | 5.692.583 | 475,5 | ENERCON E-... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB22 | 462.478 | 5.693.533 | 494,4 | ENERCON E-... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB23 | 460.695 | 5.692.494 | 492,6 | ENERCON E-... | Nein | ENERCON | E-160 EP5 E3-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB24 | 461.487 | 5.692.126 | 413,3 | ENERCON E-... | Nein | ENERCON | E-160 EP5 E3-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |
| WEA_VB25 | 466.472 | 5.694.313 | 499,5 | NORDEX N1... | Ja | NORDEX | N149/5.X-5.700 | 5.700 | 149,0 | 164,0 | 1.805 | 10,7 |
| WEA_VB26 | 464.178 | 5.693.918 | 530,1 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB27 | 464.067 | 5.693.436 | 501,8 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB28 | 467.717 | 5.695.131 | 484,5 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB29 | 465.368 | 5.694.375 | 515,1 | NORDEX N1... | Ja | NORDEX | N175/6.X-6.800 | 6.800 | 175,0 | 179,0 | 1.893 | 10,8 |
| WEA_VB30 | 466.829 | 5.693.916 | 446,3 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB31 | 467.275 | 5.693.760 | 467,3 | VESTAS V11... | Ja | VESTAS | V117-3.45-3.450 | 3.450 | 117,0 | 116,5 | 1.734 | 13,8 |
| WEA_VB32 | 467.371 | 5.694.267 | 432,3 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB33 | 466.700 | 5.694.760 | 525,8 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB34 | 467.265 | 5.695.093 | 471,9 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB35 | 466.114 | 5.694.340 | 543,9 | VESTAS V12... | Ja | VESTAS | V126-3.45 LTq-3.450 | 3.450 | 126,0 | 149,0 | 1.717 | 13,4 |
| WEA_VB36 | 466.863 | 5.695.705 | 500,5 | ENERCON E-... | Ja | ENERCON | E-82 E2 TES-2.300 | 2.300 | 82,0 | 138,4 | 1.599 | 18,0 |
| WEA_VB37 | 467.213 | 5.695.685 | 504,4 | ENERCON E-... | Ja | ENERCON | E-82 E2 TES-2.300 | 2.300 | 82,0 | 108,4 | 1.601 | 18,0 |
| WEA_VB38 | 466.992 | 5.695.406 | 498,4 | ENERCON E-... | Ja | ENERCON | E-82 E2 TES-2.300 | 2.300 | 82,0 | 138,4 | 1.599 | 18,0 |
| WEA_VB39 | 465.090 | 5.696.919 | 468,5 | ENERCON E-... | Ja | ENERCON | E-160 EP5 E3 R1-5.560 | 5.560 | 160,0 | 166,6 | 1.781 | 9,6 |

(Fortsetzung nächste Seite)...

Projekt:
R-2-2023-0368_WP_Rüthen

Lizenzierter Anwender:
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Berechnet:
24.06.2024 09:54/4.0.540

SHADOW - Hauptergebnis

Berechnung: V orbelastung

...(Fortsetzung von vorheriger Seite)

| | Ost | Nord | Z | Beschreibung | WEA-Typ | | Typ | Nennleistung [kW] | Rotor-durchmesser [m] | NH [m] | Schattendaten | |
|----------|---------|-----------|-------|---------------|---------|------------|-------------|-------------------|-----------------------|--------|-----------------------|-------|
| | | | | | Aktuell | Hersteller | | | | | Beschatt.-Bereich [m] | U/min |
| WEA_VB40 | 467.811 | 5.695.993 | 510,8 | ENERCON E-... | Nein | ENERCON | E-48-800 | 800 | 48,0 | 64,6 | 1.047 | 30,0 |
| WEA_VB41 | 467.760 | 5.696.309 | 518,8 | ENERCON E-... | Nein | ENERCON | E-101-3.000 | 3.000 | 101,0 | 135,4 | 2.214 | 14,5 |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite [m] | Höhe [m] | Höhe ü.Gr. [m] | Neigung des Fensters [°] | Ausrichtungsmodus | Augenhöhe (ZVI) |
|-------|--|---------|-----------|-------|------------|----------|----------------|--------------------------|---------------------|-----------------|
| | | | | | | | | | | ü.Gr. [m] |
| SR-01 | SR-01, Provinzialstraße 2, 59602 Rüthen | 461.385 | 5.697.535 | 380,0 | 0,1 | 0,1 | 2,0 | 90,0 | "Gewächshaus-Modus" | 2,1 |
| SR-02 | SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg | 462.381 | 5.696.208 | 429,2 | 0,1 | 0,1 | 2,0 | 90,0 | "Gewächshaus-Modus" | 2,1 |

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | |
|-------|--|--------------------------------------|-------------------------|-----------------------------|
| | | Stunden/Jahr [h/a] | Schattentage/Jahr [d/a] | Max.Schattendauer/Tag [h/d] |
| SR-01 | SR-01, Provinzialstraße 2, 59602 Rüthen | 9:59 | 39 | 0:23 |
| SR-02 | SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg | 179:52 | 294 | 1:33 |

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal [h/a] |
|----------|---|---------------|
| WEA_VB01 | VESTAS V162-7.2 7200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (188) | 0:00 |
| WEA_VB02 | ENERCON E-40/5.40 500 40.3 !O! NH: 50,0 m (Ges:70,2 m) (228) | 0:00 |
| WEA_VB03 | VESTAS V172-7.2 7200 172.0 !O! NH: 175,0 m (Ges:261,0 m) (189) | 0:00 |
| WEA_VB04 | VESTAS V162-7.2 7200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (190) | 0:00 |
| WEA_VB05 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (191) | 6:12 |
| WEA_VB06 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (192) | 0:00 |
| WEA_VB07 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (193) | 0:00 |
| WEA_VB08 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (194) | 13:35 |
| WEA_VB09 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (195) | 19:05 |
| WEA_VB10 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (196) | 26:51 |
| WEA_VB11 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (197) | 13:43 |
| WEA_VB12 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (198) | 24:57 |
| WEA_VB13 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (199) | 75:55 |
| WEA_VB14 | VESTAS V162-6.2 6200 162.0 !O! NH: 169,0 m (Ges:250,0 m) (200) | 9:33 |
| WEA_VB15 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (201) | 0:00 |
| WEA_VB16 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (202) | 0:00 |
| WEA_VB17 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (203) | 0:00 |
| WEA_VB18 | GE WIND ENERGY 5.5-158 GT120 5500 158.0 !-! NH: 161,0 m (Ges:240,0 m) (204) | 0:00 |
| WEA_VB19 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (205) | 0:00 |
| WEA_VB20 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (206) | 0:00 |
| WEA_VB21 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (207) | 0:00 |
| WEA_VB22 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (208) | 0:00 |
| WEA_VB23 | ENERCON E-160 EP5 E3 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (209) | 0:00 |
| WEA_VB24 | ENERCON E-160 EP5 E3 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (210) | 0:00 |
| WEA_VB25 | NORDEX N149/5.X 5700 149.0 !O! NH: 164,0 m (Ges:238,5 m) (211) | 0:00 |
| WEA_VB26 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (212) | 0:00 |
| WEA_VB27 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (213) | 0:00 |
| WEA_VB28 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (214) | 0:00 |
| WEA_VB29 | NORDEX N175/6.X 6800 175.0 !-! NH: 179,0 m (Ges:266,5 m) (215) | 0:00 |
| WEA_VB30 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (216) | 0:00 |
| WEA_VB31 | VESTAS V117-3.45 3450 117.0 !O! NH: 116,5 m (Ges:175,0 m) (217) | 0:00 |
| WEA_VB32 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (218) | 0:00 |
| WEA_VB33 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (219) | 0:00 |
| WEA_VB34 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (220) | 0:00 |
| WEA_VB35 | VESTAS V126-3.45 LTq 3450 126.0 !O! NH: 149,0 m (Ges:212,0 m) (221) | 0:00 |
| WEA_VB36 | ENERCON E-82 E2 TES 2300 82.0 !O! NH: 138,4 m (Ges:179,4 m) (222) | 0:00 |
| WEA_VB37 | ENERCON E-82 E2 TES 2300 82.0 !O! NH: 108,4 m (Ges:149,4 m) (223) | 0:00 |

(Fortsetzung nächste Seite)...

Projekt:
R-2-2023-0368_WP_Rüthen

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 Robert Müller-Rhein / r.mueller-rhein@koetter-consulting.com
 Berechnet:
 24.06.2024 09:54/4.0.540

SHADOW - Hauptergebnis

Berechnung: Vorbelastung

...(Fortsetzung von vorheriger Seite)

| Nr. | Name | Maximal [h/a] |
|----------|--|------------------|
| WEA_VB38 | ENERCON E-82 E2 TES 2300 82.0 !O! NH: 138,4 m (Ges:179,4 m) (224) | 0:00 |
| WEA_VB39 | ENERCON E-160 EP5 E3 R1 5560 160.0 !O! NH: 166,6 m (Ges:246,6 m) (225) | 0:00 |
| WEA_VB40 | ENERCON E-48 800 48.0 !O! NH: 64,6 m (Ges:88,6 m) (226) | 0:00 |
| WEA_VB41 | ENERCON E-101 3000 101.0 !-! NH: 135,4 m (Ges:185,9 m) (227) | 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.

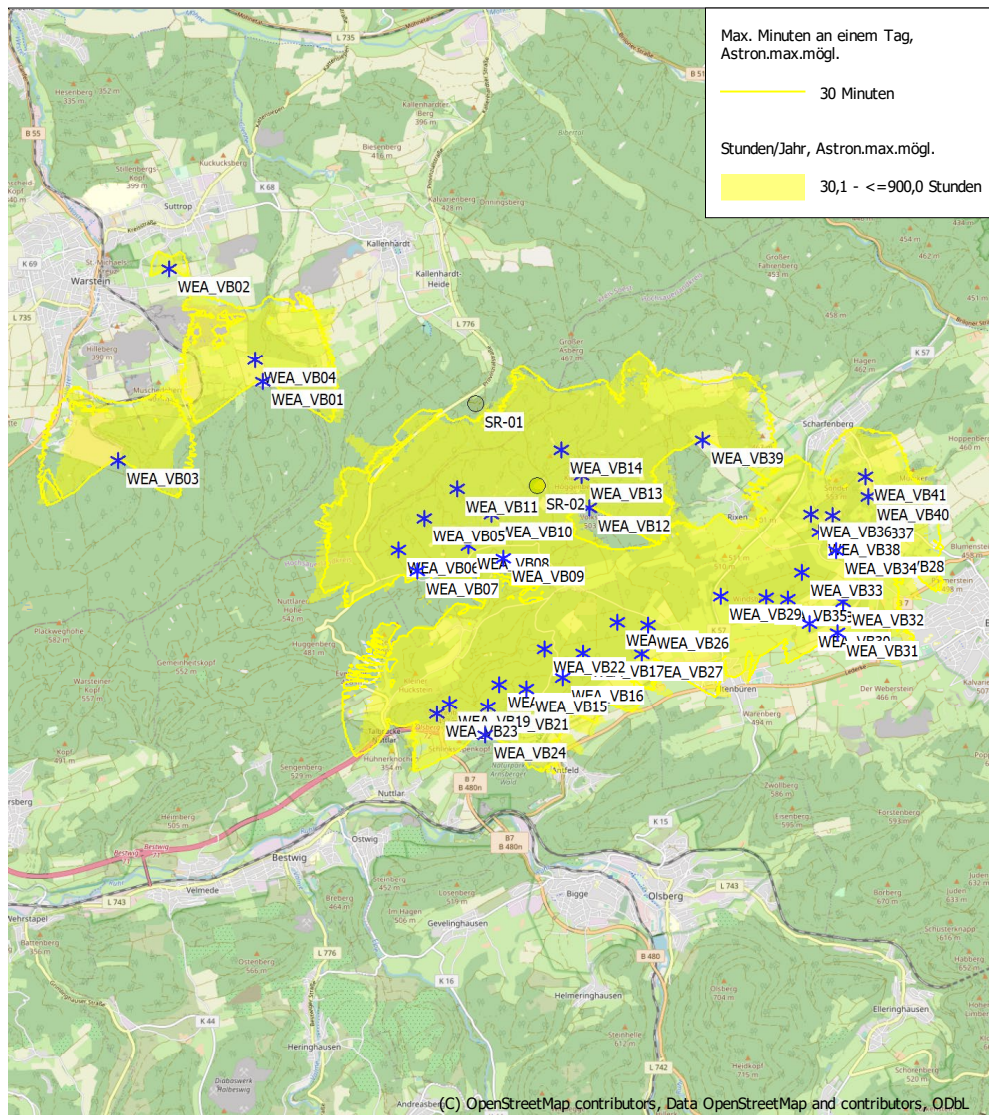
Anlage B2: SHADOW-Karte mit Darstellung des Lageplanes und der Schattenausbreitung der Vorbelastung unterteilt in Minuten / Tag und Stunden / Jahr

Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 09:54/4.0.540

SHADOW - Karte

Berechnung: Vorbelastung



Karte: EMD OpenStreetMap, Maßstab 1:90.000, Mitte: ETRS-TMzn Pan-European Transverse Mercator (UTM)-ETRS89 Zone: 32 Ost: 461.805 Nord: 5.695.012
 * Existierende WEA ☼ Schattenrezeptor
 Höhe der Schattenkarte: Höhenraster-Objekt: R-2-2023-0368_WP_Rüthen_EMDGrid_0.wpg (1)
 Zeitschritt: 3 Minuten, Schrittweite: 7 Tag(e), Kartenaufösung: 20 m, Sichtbarkeit Auflösung: 10 m, Augenhöhe: 1,5 m

Anlage B3: SHADOW-Hauptergebnis mit Darstellung der Zusatzbelastung, Immissionsorte SR-01 bis SR-zwei, Berechnungsergebnisse Stunden / Jahr, Schattentage / Jahr und maximalen Stunden / Tag

Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 10:10/4.0.540

SHADOW - Hauptergebnis

Berechnung: Zusatzbelastung
Annahmen für Schattenwurfberechnung

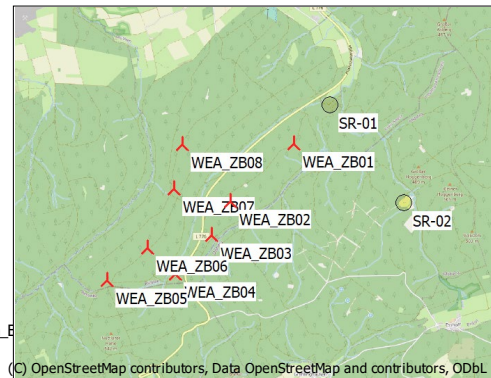
Beschattungsbereich der WEA
Schatten nur relevant, wo Rotorblatt mind. 20% der Sonne verdeckt
Siehe WEA-Tabelle

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

Die dargestellten Zeiten sind die astronomisch maximal mögliche Beschattungsdauer, berechnet unter folgenden Annahmen:
Die Sonne scheint täglich von Sonnenauf- bis -untergang
Die Rotorfläche steht immer senkrecht zur Sonneneinstrahlung
Die Windenergieanlage/n ist/sind immer in Betrieb

Eine WEA wird nicht berücksichtigt, wenn sie von keinem Teil der Rezeptorfläche aus sichtbar ist. Die Sichtbarkeitsberechnung basiert auf den folgenden Annahmen:
Verwendete Höhenlinien: Höhenraster-Objekt: R-2-2023-0368_WP_Rüthen_E
Rasterauflösung: 1,0 m

Alle Koordinatenangaben in:
ETRS-TMzn Pan-European Transverse Mercator (UTM)-ETRS89 Zone: 32



WEA

| | Ost | Nord | Z | Beschreibung | Ak-tu-ell | Hersteller | Typ | Nenn-leistung | Rotor-durch-messer | NH | Schattendaten | |
|----------|---------|-----------|-------|-----------------------------|-----------|-----------------|-------|---------------|--------------------|-------|-------------------|---------|
| | | | | | | | | | | | Beschatt.-Bereich | U/min |
| | | | [m] | | | | | [kW] | [m] | [m] | [m] | [U/min] |
| WEA_ZB01 | 460.877 | 5.697.017 | 446,9 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |
| WEA_ZB02 | 460.000 | 5.696.239 | 480,7 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |
| WEA_ZB03 | 459.741 | 5.695.781 | 461,6 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |
| WEA_ZB04 | 459.240 | 5.695.268 | 483,1 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |
| WEA_ZB05 | 458.307 | 5.695.188 | 515,7 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |
| WEA_ZB06 | 458.865 | 5.695.613 | 524,6 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |
| WEA_ZB07 | 459.223 | 5.696.422 | 464,1 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |
| WEA_ZB08 | 459.354 | 5.697.018 | 489,7 | ENERCON E-175 EP5 600... Ja | ENERCON | E-175 EP5-6.000 | 6.000 | 175,0 | 162,0 | 1.737 | - | |

Schattenrezeptor-Eingabe

| Nr. | Name | Ost | Nord | Z | Breite | Höhe | Höhe ü.Gr. | Neigung des Fensters | Ausrichtungsmodus | Augenhöhe (ZVI) ü.Gr. |
|-------|--|---------|-----------|-------|--------|------|------------|----------------------|---------------------|-----------------------|
| SR-01 | SR-01, Provinzialstraße 2, 59602 Rüthen | 461.385 | 5.697.535 | 380,0 | 0,1 | 0,1 | 2,0 | 90,0 | "Gewächshaus-Modus" | 2,1 |
| SR-02 | SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg | 462.381 | 5.696.208 | 429,2 | 0,1 | 0,1 | 2,0 | 90,0 | "Gewächshaus-Modus" | 2,1 |

Berechnungsergebnisse

Schattenrezeptor

| Nr. | Name | astron. max. mögl. Beschattungsdauer | | |
|-------|--|--------------------------------------|-------------------------|-----------------------------|
| | | Stunden/Jahr [h/a] | Schattentage/Jahr [d/a] | Max.Schattendauer/Tag [h/d] |
| SR-01 | SR-01, Provinzialstraße 2, 59602 Rüthen | 51:39 | 75 | 0:54 |
| SR-02 | SR-02, Forsthaus Antfelder Wald 1, 59939 Olsberg | 27:11 | 75 | 0:25 |

Gesamtdauer Beschattung an Rezeptoren pro WEA

| Nr. | Name | Maximal [h/a] |
|----------|--|---------------|
| WEA_ZB01 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (17) | 78:50 |
| WEA_ZB02 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (10) | 0:00 |
| WEA_ZB03 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (11) | 0:00 |
| WEA_ZB04 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (12) | 0:00 |
| WEA_ZB05 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (13) | 0:00 |
| WEA_ZB06 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (15) | 0:00 |
| WEA_ZB07 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (14) | 0:00 |
| WEA_ZB08 | ENERCON E-175 EP5 6000 175.0 !O! NH: 162,0 m (Ges.:249,5 m) (16) | 0:00 |

Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 10:10/4.0.540

SHADOW - Hauptergebnis

Berechnung: Zusatzbelastung

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.

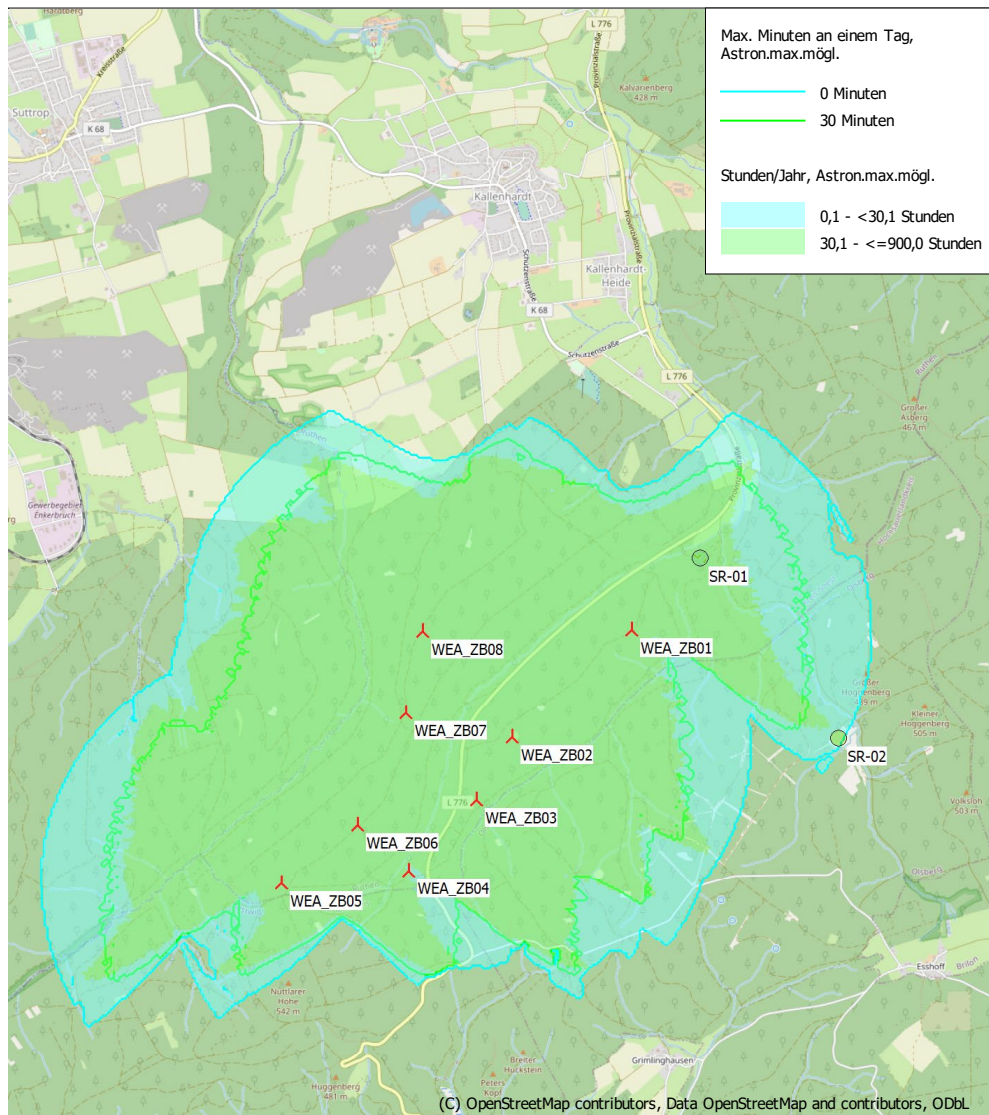
Anlage B4: SHADOW-Karte mit Darstellung des Lageplanes und der Schattenausbreitung der Zusatzbelastung unterteilt in Minuten / Tag und Stunden / Jahr

Projekt:
R-2-2023-0368_WP_Rüthen

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Berechnet:
24.06.2024 10:10/4.0.540

SHADOW - Karte

Berechnung: Zusatzbelastung



0 500 1000 1500 2000 m

Karte: EMD OpenStreetMap, Maßstab 1:40.000, Mitte: ETRS-TMzn Pan-European Transverse Mercator (UTM)-ETRS89 Zone: 32 Ost: 459.938 Nord: 5.697.548
 Neue WEA Schattenrezeptor
 Höhe der Schattenkarte: Höhenraster-Objekt: R-2-2023-0368_WP_Rüthen_EMDGrid_0.wpg (1)
 Zeitschritt: 3 Minuten, Schrittweite: 7 Tag(e), Kartenaufösung: 20 m, Sichtbarkeit Auflösung: 10 m, Augenhöhe: 1,5 m

Anlage C: Bilder der untersuchten Immissionsorte



Bild 1:

Schattenrezeptor SR-01



Bild 2: Schattenrezeptor SR-02 (tim-online.nrw.de)