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GLINT AND GLARE ASSESSMENT

Proposed Part 8 Residential Development

Kishoge, Lucan

Prepared by Macro Works Ltd.

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Registered Landscape Architect

macroworks APEM Group

1 INTRODUCTION

1.1.1 This Glint and Glare Assessment was carried out by Macro Works Ltd to determine the potential for solar reflectance effects upon aviation receptors in respect of proposed roof-mounted solar PV installations on the roof of a proposed residential development in Kilshoge, Co. Dublin. The proposed panels will be mounted at the roof level of the proposed development and will remain in a fixed position throughout the day and year (i.e. they will not rotate to track the movement of the sun). Figure 1 and Figure 2 refer. The aviation based glint and glare assessment will assess the proposed panels at four tilt angles; 0 degrees, 5 degrees, 10 degrees and 15 degrees on blocks A and B, whilst the tilt angle of the panels on the terraced buildings will mimic the proposed roof pitch of 13 degrees.

Figure 1: Aerial view indicating the approximate location of the proposed development (yellow pin).

Figure 2: Extract from drawing "SHB5-CSD-DR-MCORM-AR-P3-1002 Plan" showing the proposed roof layouts with the location of the proposed PV panels.

1.2 Project Description

1.2.1 The proposed development will comprise

i. 118 no. residential units in a mix of two storey houses, 3 storey duplex units and apartment blocks of 4 – 6 storeys comprising 26 no. 1 bed apartments; 42 no. 2 bed apartments; 21 no. 3 bed apartments; 23 no. 3 bed houses; and 6 no. 4 bed houses, with renewable energy design measures (which may be provided externally) for each housing unit;

ii. Landscaping works including provision of (a) communal open space areas (b) outdoor sports and play areas; (c) new pedestrian and cycle connections; and (d) civic plaza;

iii. Temporary on-site pumping station and water supply to the site pending delivery of the proposed Link Street and associated water services infrastructure adjoining the site to the north;

iv. Associated site and infrastructural works including provision for (a) ESB substations and switchrooms; (b) energy centre to the rear of 6 storey block; (c) photovoltaic panels; (e) car and bicycle parking; (f) public lighting; (g) bin storage; (h) temporary construction signage; (i) estate signage; and (j) varied site boundary treatment comprising walls and fencing; and

v. all associated site development works.

1.3 Statement of Authority

1.3.1 Macro Works' relevant experience includes twenty years of analysing the visual effects of a wide range of infrastructural and commercial development types. This experience includes numerous domestic and international wind and solar energy developments.

1.4 Guidance and Best Practice

1.4.1 Guidance has been prepared by the Federal Aviation Authority[1] to address the potential hazards that solar developments may pose to aviation activities, and this has been adopted for use by the Irish Aviation Authority. SGHAT was developed in conjunction with the FAA in harmony with this guidance and is commonly regarded as the accepted industry standard by aviation authorities internationally when considering the glint and glare effects upon aviation related receptors.

1.4.2 By virtue of their efficiency, the intensity of reflected light from modern PV solar panels is deliberately low and currently equates with that of the reflection from still water. Recent studies generally agree, however, that there still exists the potential for hazard or nuisance upon surrounding receptors. Macro Works' glint and glare analysis methods and determination of effects are based on a combination of available studies and established best practice. This methodology has been successfully implemented on numerous previous solar farm projects that met with the approval of both Planning Authorities and An Bord Pleanála.

Federal Aviation Authority

1.4.3 Within the FAA's interim policy, a 'Review of Solar Energy System Projects on Federally Obligated Airports'[2] it states:

> *"To obtain FAA approval to revise an airport layout plan to depict a solar installation and/or a ''no objection'' to a Notice of Proposed Construction Form 7460–1, the airport sponsor will be required to demonstrate that the proposed solar energy system meets the following standards:*
>
> *No potential for glint or glare in the existing or planned Airport Traffic Control Tower (ATCT) cab, and*
>
> *No potential for glare or ''low potential for after-image'' (shown in green in Figure 1 [Figure 3 refers]) along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glidepath."*

1.4.4 Furthermore, in November 2021 the FAA deprioritised runway approaches as critical aviation receptors, citing the following;

> *"Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT" (Federal Aviation Administration 05/11/2021).*

1.4.5 In summary, glare at an ATCT is not acceptable and while still relevant glare with a ''low potential for after-image'' is generally acceptable along final approach paths to runways in most instances.

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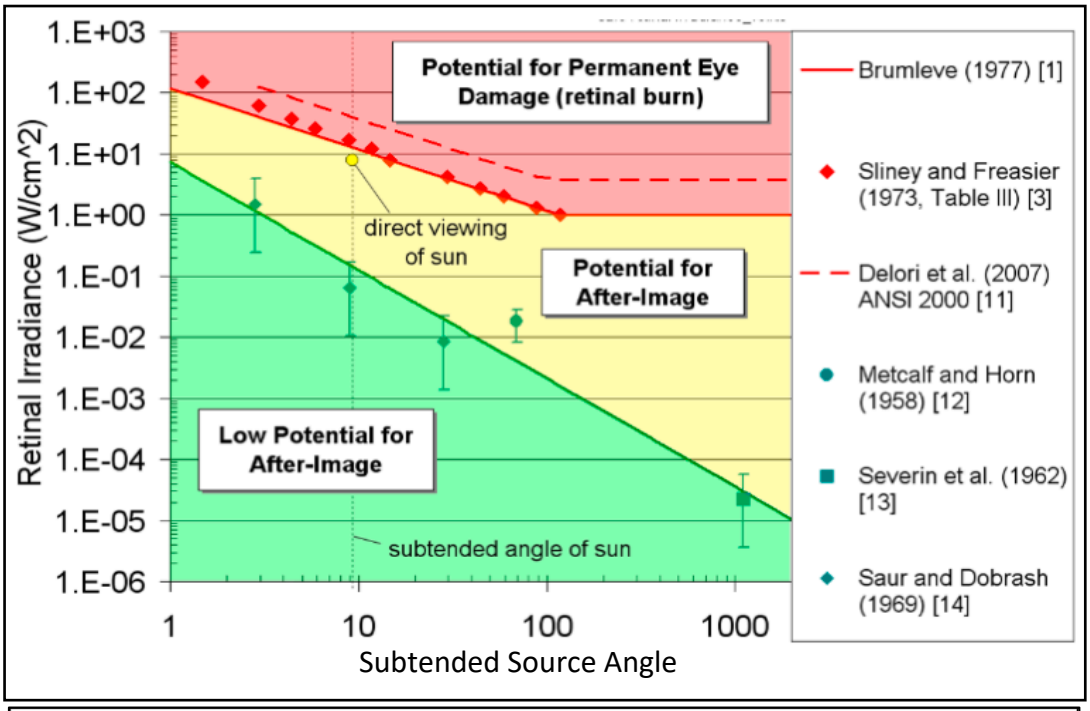
[1] Harris, Miller, Miller & Hanson Inc.. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. *Technical Guidance for Evaluating Selected Solar Technologies on Airports*. Available at: https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf

[2] Federal Aviation Administration (FAA). (2013). Department of Transportation - Federal Aviation Administration. *Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports*. Vol 78 (No 205), 63276-63279.

Solar Glare Hazard Analysis Tool

1.4.6 The SGHAT was designed to determine whether a proposed solar energy project would result in the potential for ocular impact as depicted on the Solar Glare Hazard Analysis Plot (Figure 3 refers). SGHAT analyses ocular impact over the entire calendar year in one minute intervals from when the sun rises above the horizon until the sun sets below the horizon. One of the principal outputs from the SGHAT report is a glare plot per receptor that indicates the time of day and days per year that glare has the potential to occur. SGHAT plot classifies the intensity of ocular impact as either Green Glare, Yellow Glare or Red Glare. These colour classifications are equivalent to the FAA's definitions regarding the level of ocular impact e.g. 'Green Glare' in the SGHAT is synonymous to the FAA's *"low potential for after-image','* and so forth. The various correlations are illustrated on the Solar Glare Hazard Analysis Plot.



Solar Glare Ocular Hazard Plot: The potential ocular hazard from solar glare is a function of retinal irradiance and the subtended angle (size/distance) of the glare source. It should be noted that the ratio of spectrally weighted solar illuminance to solar irradiance at the earth's surface yields a conversion factor of ~100 lumens/W. Plot adapted from Ho et al., 2011.

Chart References: Ho, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare Hazards from Concentrating Solar Power Plants: Analytical Models and Experimental Validation, J. Solar Energy Engineering, August 2011, Vol. 133, 031021-1 – 031021-9.

Figure 3: Figure 1 from the FAA Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports

2 METHODOLOGY

2.1.1 The process for dealing with aviation receptors is as follows:

1. The Federal Aviation Administration (FAA) approved Solar Glare Hazard Analysis Tool (SGHAT) is used to determine if any of these aviation receptors has the potential to theoretically experience glint or glare. This tool also calculates the intensity of such reflectance and whether it is acceptable by FAA standards.
2. SGHAT does not account for terrain screening or screening provided by surface elements such as existing vegetation or buildings, therefore the results of the SGHAT may need to be considered, in

conjunction with an assessment of existing intervening screening that may be present, to establish if reflectance can actually be experienced at the receptors.

3. Finally, if necessary, additional assessment is undertaken using Macro Works' bespoke model which would into account any screening provided by any proposed mitigation measures.

2.2 Identification of Relevant Receptors

2.2.1 The Planning and Development (Solar Safeguarding Zone) Regulations 2022 set out 43 Solar Safeguarding Zones (SSZs). A SSZ is an area around an airport, aerodrome or helipad in which there is a potential for glint or glare from solar panels to impact aviation safety.

Runways & Air Traffic Control Towers

2.2.2 This SGHAT analysis was produced to assess the potential for impacts upon aviation receptors, resulting from the proposed solar installation. Casement Aerodrome is located slightly under 3.5km to the southwest of the proposed development and comprises 2 active runways and an Air Traffic Control Tower.

Figure 4: Aerial view (Google Earth Pro) showing the approximate location of the proposed development (yellow pin) relative to the identified aviation receptor (red pin).

3 RESULTS

Runway Approaches

3.1.1 The SGHAT results are contained in Appendix A and show that only one of the four runway approaches analysed had potential for Green Glare to occur. None of the four runway approaches showed any potential for Yellow Glare as a result of the proposed solar panels. As a result, the 2-mile flight path approaches at Casement Aerodrome receive a 'pass' status as the flight path receptors do not receive yellow glare.

Air Traffic Control Towers

3.1.2 The SGHAT results contained in Appendix A also assess the potential for reflectance at Casement Aerodromes Air Traffic Control Towers (ATCT). The assessment identifies no potential for reflectance from all of the proposed panel tilt angles at the ATCT at Casement Aerodrome. Thus, the assessment results in a 'pass' states as the ATCT receptors do not experience glare episodes as a result of the proposed development.

4 OVERALL CONCLUSION

4.1.1 From the analysis and discussions contained herein, it is considered that there will not be any significant nuisance effects from glint and glare at the proposed development, as a result of the proposed roof-mounted solar PV panels.

APPENDIX A

SGHAT Results

FORGESOLAR GLARE ANALYSIS

Project: **SGHAT Dub W**
Site configuration: **Clonburris**
Analysis conducted by Luis Dominguez (luis@macroworks.ie) at 12:17 on 26 Mar, 2024.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 115396.12446
Methodology: V2

PV Array(s)

Name: Block A
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 185.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.334901	-6.428813	59.00	19.50	78.50
2	53.334848	-6.428822	59.00	19.50	78.50
3	53.334839	-6.428678	59.00	19.50	78.50
4	53.334850	-6.428676	59.00	19.50	78.50
5	53.334840	-6.428511	59.00	19.50	78.50
6	53.334894	-6.428502	59.00	19.50	78.50
7	53.334910	-6.428780	59.00	19.50	78.50
8	53.334899	-6.428781	59.00	19.50	78.50
9	53.334901	-6.428813	59.00	19.50	78.50

Name: Block B
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 230.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.334901	-6.428813	59.00	19.50	78.50
2	53.334848	-6.428822	59.00	19.50	78.50
3	53.334839	-6.428678	59.00	19.50	78.50
4	53.334850	-6.428676	59.00	19.50	78.50
5	53.334840	-6.428511	59.00	19.50	78.50
6	53.334894	-6.428502	59.00	19.50	78.50
7	53.334910	-6.428780	59.00	19.50	78.50
8	53.334899	-6.428781	59.00	19.50	78.50
9	53.334901	-6.428813	59.00	19.50	78.50

Name: Terrace 1
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 135.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.335120	-6.428560	59.00	11.00	70.00
2	53.335351	-6.428098	59.00	11.00	70.00
3	53.335303	-6.428031	59.00	10.00	69.00
4	53.335072	-6.428492	59.00	10.00	69.00
5	53.335120	-6.428560	59.00	11.00	70.00

Name: Terrace 2_1
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 230.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.335295	-6.427885	59.00	11.00	70.00
2	53.335148	-6.427680	59.00	11.00	70.00
3	53.335108	-6.427764	59.00	10.00	69.00
4	53.335254	-6.427966	59.00	10.00	69.00
5	53.335295	-6.427885	59.00	11.00	70.00

Name: Terrace 2_2
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 253.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.335041	-6.427661	59.00	10.00	69.00
2	53.335060	-6.427560	59.00	11.00	70.00
3	53.335038	-6.427548	59.00	11.00	70.00
4	53.335019	-6.427649	59.00	10.00	69.00
5	53.335041	-6.427661	59.00	10.00	69.00

Name: Terrace 2_3
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 275.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.334939	-6.427668	59.00	10.00	69.00
2	53.334933	-6.427564	59.00	11.00	70.00
3	53.334910	-6.427567	59.00	11.00	70.00
4	53.334916	-6.427672	59.00	10.00	69.00
5	53.334939	-6.427668	59.00	10.00	69.00

Name: Terrace 3
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.334896	-6.428391	59.00	10.00	69.00
2	53.334849	-6.427577	59.00	10.00	69.00
3	53.334786	-6.427587	59.00	11.00	70.00
4	53.334833	-6.428401	59.00	11.00	70.00
5	53.334896	-6.428391	59.00	10.00	69.00

Name: Terrace 4
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 185.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.335529	-6.426993	59.00	11.00	70.00
2	53.335515	-6.426737	59.00	11.00	70.00
3	53.335492	-6.426741	59.00	11.00	70.00
4	53.335481	-6.426577	59.00	11.00	70.00
5	53.335418	-6.426587	59.00	10.00	69.00
6	53.335427	-6.426726	59.00	10.00	69.00
7	53.335451	-6.426722	59.00	10.00	69.00
8	53.335467	-6.427003	59.00	10.00	69.00
9	53.335529	-6.426993	59.00	11.00	70.00

Name: Terrace 5
Axis tracking: Fixed (no rotation)
Tilt: 13.0°
Orientation: 185.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.335440	-6.426202	59.00	11.00	70.00
2	53.335434	-6.426085	59.00	11.00	70.00
3	53.335449	-6.426083	59.00	11.00	70.00
4	53.335441	-6.425944	59.00	11.00	70.00
5	53.335378	-6.425954	59.00	10.00	69.00
6	53.335385	-6.426071	59.00	10.00	69.00
7	53.335370	-6.426073	59.00	10.00	69.00
8	53.335377	-6.426212	59.00	10.00	69.00
9	53.335440	-6.426202	59.00	11.00	70.00

Flight Path Receptor(s)

Name: Casement 04 Runway
Description: None
Threshold height: 15 m
Direction: 41.3°
Glide slope: 4.72°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.293830	-6.453465	98.30	15.20	113.50
Two-mile	53.272113	-6.485435	154.40	127.80	282.20

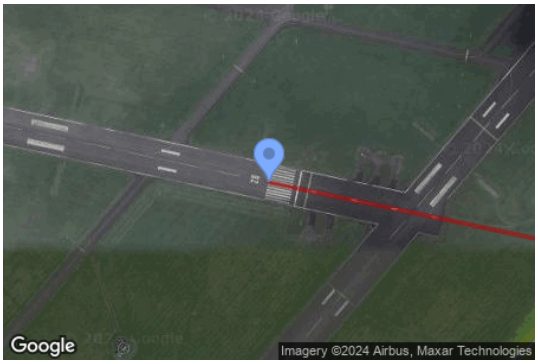
Name: Casement 10 Runway
Description: None
Threshold height: 15 m
Direction: 101.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.304622	-6.468287	86.30	15.30	101.60
Two-mile	53.310549	-6.515700	73.60	196.60	270.20

Name: Casement 22 Runway
Description: None
Threshold height: 15 m
Direction: 220.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.303267	-6.439788	93.40	15.20	108.60
Two-mile	53.325107	-6.408047	62.50	214.80	277.30

Name: Casement 28 Runway
Description: None
Threshold height: 15 m
Direction: 281.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.301696	-6.445153	96.10	15.20	111.30
Two-mile	53.295759	-6.397747	106.20	173.80	280.00

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	53.305525	-6.441821	90.00	9.00

Map image of 1-ATCT

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Block A	13.0	185.0	773	0	-
Block B	13.0	230.0	0	0	-
Terrace 1	13.0	135.0	560	0	-
Terrace 2_1	13.0	230.0	0	0	-
Terrace 2_2	13.0	253.0	0	0	-
Terrace 2_3	13.0	275.0	0	0	-
Terrace 3	13.0	5.0	0	0	-
Terrace 4	13.0	185.0	1,137	0	-
Terrace 5	13.0	185.0	1,103	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	3573	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Results for: Block A

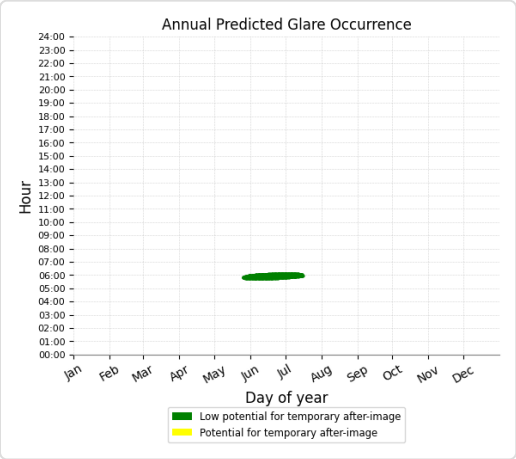
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	773	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

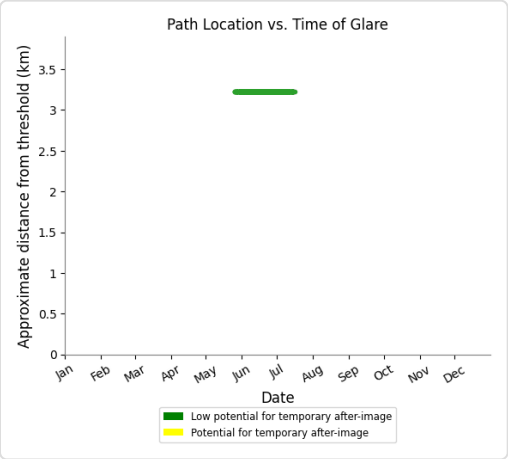
Flight Path: Casement 04 Runway

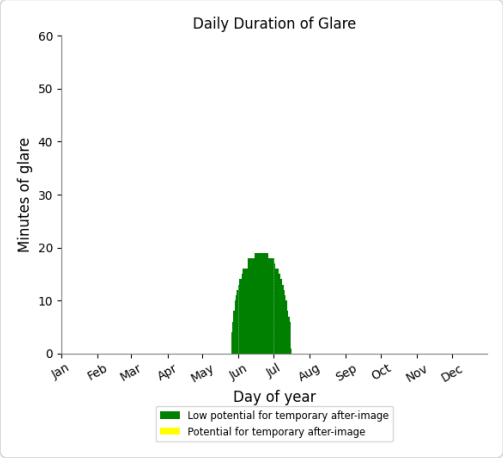
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
773 minutes of green glare







Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Block B

Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Flight Path: Casement 04 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Terrace 1

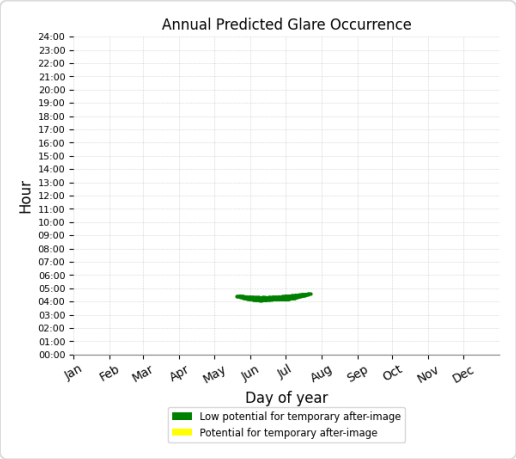
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	560	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

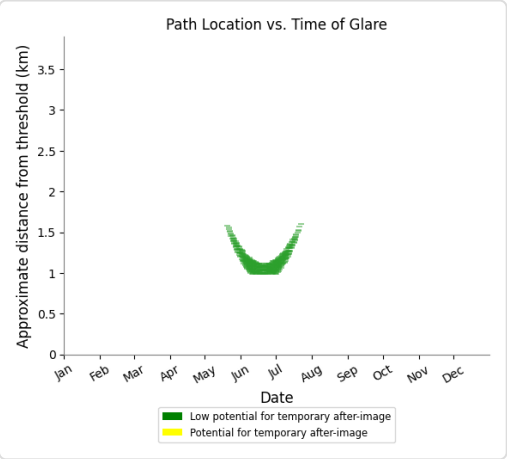
Flight Path: Casement 04 Runway

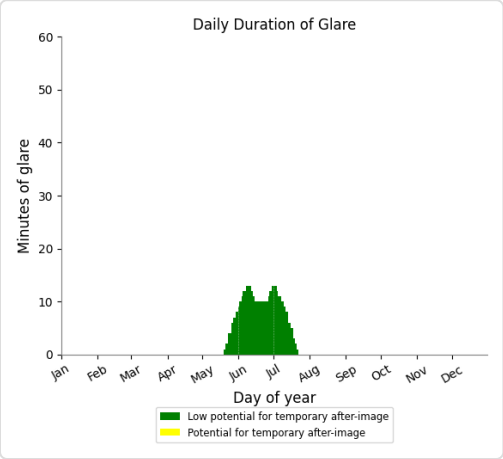
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
560 minutes of green glare







Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Terrace 2_1

Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Flight Path: Casement 04 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Terrace 2_2

Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Flight Path: Casement 04 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Terrace 2_3

Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Flight Path: Casement 04 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Terrace 3

Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Flight Path: Casement 04 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Terrace 4

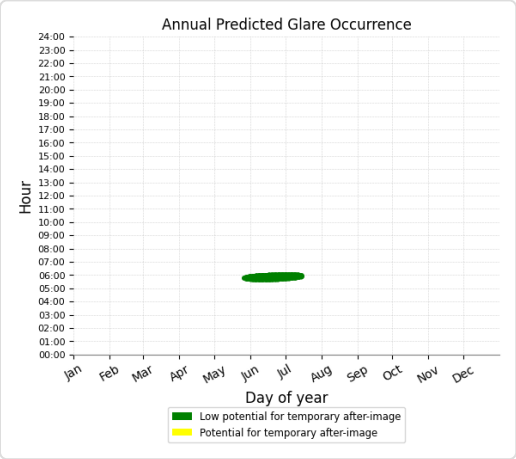
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	1137	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

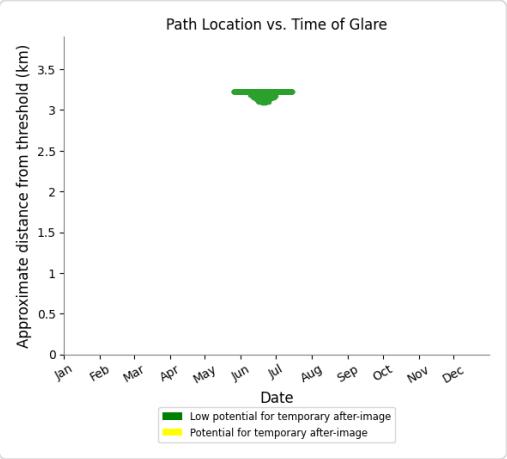
Flight Path: Casement 04 Runway

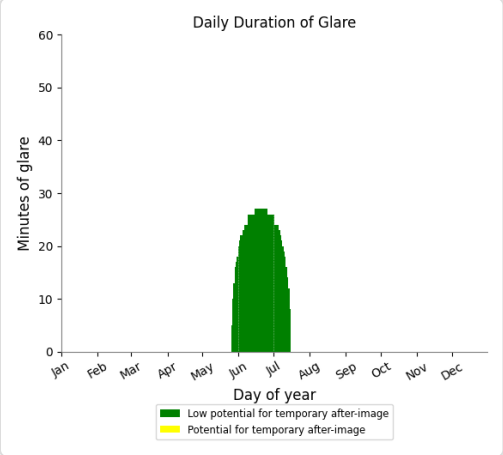
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
1137 minutes of green glare







Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Terrace 5

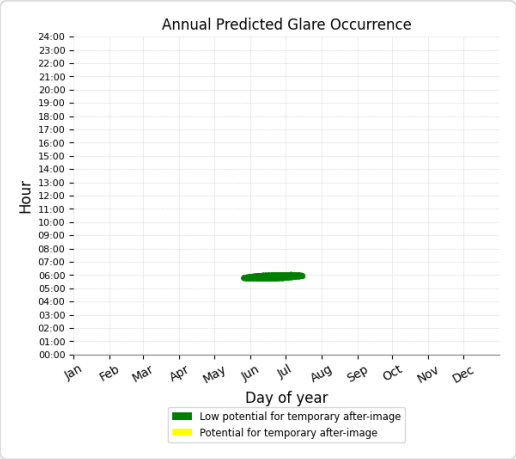
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	0	0
Casement 10 Runway	1103	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

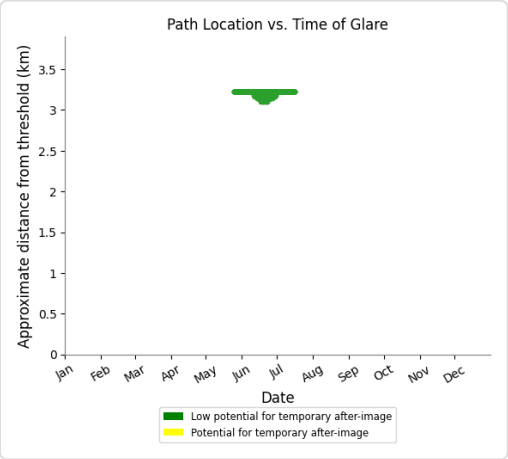
Flight Path: Casement 04 Runway

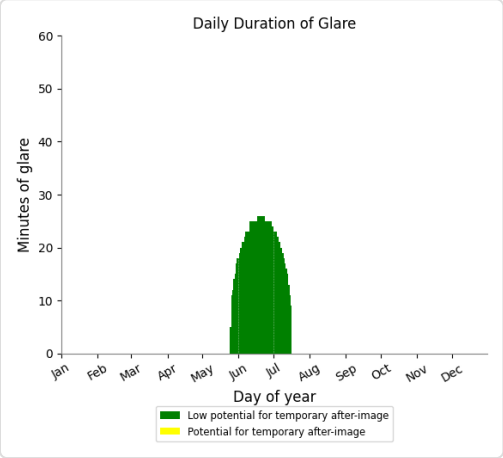
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 10 Runway

0 minutes of yellow glare
1103 minutes of green glare







Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to V1 algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

ForgeSolar

Optimization Results

Block A Optimization

PV configurations in optimization: 222
Orientation (deg) range: 95 to 275 in intervals of 5
Tilt angle (deg) range: 0 to 25 in intervals of 5
Created: March 26, 2024 8:21 a.m.
Completed: March 26, 2024 8:24 a.m.

Flight path receptors: 4
Route receptors: 0
Observation point receptors: 1
ATCT-specific OP receptors: 1

Note: OPs must be marked as "ATCT" to be included in FAA summary

FAA 2013 Policy Summary Table

Pass/fail results of each optimization case pertaining to FAA policy. Percentages denote system output relative to theoretical max.
Blue: adheres to FAA policy (no glare for ATCT, only green for flight paths).
Red: Fails FAA policy

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
95°	-	-	-	-	-	-
100°	-	-	-	-	-	-
105°	-	-	-	-	-	-
110°	-	-	-	-	-	-
115°	-	-	-	-	-	-
120°	-	-	-	-	-	-
125°	-	-	-	-	-	-
130°	-	-	-	-	-	-
135°	-	-	-	-	-	-
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-

170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-
215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-

Color-Coded Hazard Summary Table

Results of each optimization case colored by maximum hazard. Percentages denote system output relative to theoretical max.
Yellow: glare with potential for after-image found.
Green: glare with low potential for after-image.
Blue: no glare found.

Tilt → Orient ↓	**0°**	**5°**	**10°**	**15°**	**20°**	**25°**
95°	-	-	-	-	-	-
100°	-	-	-	-	-	-
105°	-	-	-	-	-	-
110°	-	-	-	-	-	-
115°	-	-	-	-	-	-
120°	-	-	-	-	-	-
125°	-	-	-	-	-	-
130°	-	-	-	-	-	-
135°	-	-	-	-	-	-
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-

165°	-	-	-	-	-	-
170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-
215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-

2-Mile Flight Path Glare

Case results summary for FP receptors only.

Tilt → Orient ↓	**0°**	**5°**	**10°**	**15°**	**20°**	**25°**
95°	-	-	-	-	-	-
100°	-	-	-	-	-	-
105°	-	-	-	-	-	-
110°	-	-	-	-	-	-
115°	-	-	-	-	-	-
120°	-	-	-	-	-	-
125°	-	-	-	-	-	-
130°	-	-	-	-	-	-
135°	-	-	-	-	-	-
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-

170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-
215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-

Observation Point Glare

Case results summary for OP receptors, including ATCTs.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
95°	-	-	-	-	-	-
100°	-	-	-	-	-	-
105°	-	-	-	-	-	-
110°	-	-	-	-	-	-
115°	-	-	-	-	-	-
120°	-	-	-	-	-	-
125°	-	-	-	-	-	-
130°	-	-	-	-	-	-
135°	-	-	-	-	-	-
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-
170°	-	-	-	-	-	-

175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-
215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-

ATCT Glare

Case results summary for ATCT receptor(s) only.

Tilt → Orient ↓	**0°**	**5°**	**10°**	**15°**	**20°**	**25°**
95°	-	-	-	-	-	-
100°	-	-	-	-	-	-
105°	-	-	-	-	-	-
110°	-	-	-	-	-	-
115°	-	-	-	-	-	-
120°	-	-	-	-	-	-
125°	-	-	-	-	-	-
130°	-	-	-	-	-	-
135°	-	-	-	-	-	-
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-
170°	-	-	-	-	-	-
175°	-	-	-	-	-	-

180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-
215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-

Glare & Energy Summary

Compilation of results for each PV configuration. Hazard, minutes of glare and energy produced.

Panel Orientation	Panel Tilt	"Green" Glare	"Yellow" Glare	"Red" Glare	Energy Produced	% Max Energy
deg	deg	min	min	min	kWh	% of max
135.0	15.0	364	0	0	-	-
140.0	0.0	3,312	0	0	-	-
135.0	25.0	0	0	0	-	-
140.0	20.0	989	0	0	-	-
140.0	10.0	1,595	0	0	-	-
140.0	25.0	880	0	0	-	-
145.0	5.0	2,763	0	0	-	-
145.0	0.0	3,312	0	0	-	-
140.0	15.0	1,183	0	0	-	-
140.0	5.0	2,429	0	0	-	-
145.0	15.0	1,749	0	0	-	-
145.0	20.0	1,520	0	0	-	-
145.0	25.0	1,398	0	0	-	-
150.0	0.0	3,312	0	0	-	-
150.0	5.0	2,904	0	0	-	-
145.0	10.0	2,171	0	0	-	-
150.0	15.0	2,180	0	0	-	-
150.0	10.0	2,478	0	0	-	-
150.0	20.0	1,952	0	0	-	-

150.0	25.0	1,829	0	0	-	-
155.0	0.0	3,312	0	0	-	-
155.0	10.0	2,563	0	0	-	-
155.0	5.0	2,919	0	0	-	-
155.0	15.0	2,354	0	0	-	-
155.0	20.0	2,226	0	0	-	-
160.0	0.0	3,312	0	0	-	-
160.0	5.0	2,858	0	0	-	-
155.0	25.0	2,164	0	0	-	-
160.0	10.0	2,456	0	0	-	-
160.0	20.0	2,107	0	0	-	-
160.0	25.0	2,075	0	0	-	-
165.0	0.0	3,312	0	0	-	-
165.0	5.0	2,739	0	0	-	-
165.0	10.0	2,272	0	0	-	-
160.0	15.0	2,222	0	0	-	-
165.0	15.0	2,006	0	0	-	-
165.0	25.0	1,849	0	0	-	-
170.0	15.0	1,750	0	0	-	-
170.0	10.0	2,073	0	0	-	-
170.0	5.0	2,624	0	0	-	-
170.0	25.0	1,576	0	0	-	-
170.0	20.0	1,600	0	0	-	-
165.0	20.0	1,869	0	0	-	-
175.0	5.0	2,507	0	0	-	-
175.0	0.0	3,312	0	0	-	-
170.0	0.0	3,312	0	0	-	-
175.0	15.0	1,443	0	0	-	-
175.0	10.0	1,844	0	0	-	-
175.0	20.0	1,255	0	0	-	-
180.0	0.0	3,312	0	0	-	-
180.0	5.0	2,384	0	0	-	-
180.0	10.0	1,583	0	0	-	-
175.0	25.0	1,226	0	0	-	-
180.0	20.0	723	0	0	-	-
185.0	0.0	3,312	0	0	-	-
180.0	25.0	678	0	0	-	-
185.0	5.0	2,245	0	0	-	-
185.0	15.0	520	0	0	-	-
180.0	15.0	1,024	0	0	-	-
185.0	20.0	17	0	0	-	-
185.0	25.0	0	0	0	-	-
190.0	0.0	3,312	0	0	-	-
185.0	10.0	1,238	0	0	-	-
190.0	10.0	865	0	0	-	-
190.0	5.0	2,114	0	0	-	-
190.0	20.0	0	0	0	-	-
190.0	15.0	0	0	0	-	-
195.0	0.0	3,312	0	0	-	-
190.0	25.0	0	0	0	-	-
195.0	5.0	1,981	0	0	-	-
195.0	15.0	0	0	0	-	-
195.0	10.0	499	0	0	-	-

195.0	20.0	0	0	0	-	-
200.0	0.0	3,312	0	0	-	-
195.0	25.0	0	0	0	-	-
200.0	5.0	1,809	0	0	-	-
200.0	10.0	140	0	0	-	-
200.0	25.0	0	0	0	-	-
205.0	0.0	3,312	0	0	-	-
205.0	5.0	1,637	0	0	-	-
200.0	15.0	0	0	0	-	-
200.0	20.0	0	0	0	-	-
205.0	15.0	0	0	0	-	-
205.0	25.0	0	0	0	-	-
205.0	10.0	0	0	0	-	-
205.0	20.0	0	0	0	-	-
210.0	5.0	1,473	0	0	-	-
210.0	0.0	3,312	0	0	-	-
210.0	15.0	0	0	0	-	-
210.0	10.0	0	0	0	-	-
210.0	20.0	0	0	0	-	-
215.0	0.0	3,312	0	0	-	-
210.0	25.0	0	0	0	-	-
215.0	5.0	1,306	0	0	-	-
215.0	20.0	0	0	0	-	-
215.0	25.0	0	0	0	-	-
220.0	0.0	3,312	0	0	-	-
220.0	5.0	1,162	0	0	-	-
215.0	15.0	0	0	0	-	-
220.0	10.0	0	0	0	-	-
215.0	10.0	0	0	0	-	-
220.0	20.0	0	0	0	-	-
220.0	15.0	0	0	0	-	-
225.0	0.0	3,312	0	0	-	-
220.0	25.0	0	0	0	-	-
225.0	10.0	0	0	0	-	-
225.0	15.0	0	0	0	-	-
225.0	20.0	0	0	0	-	-
230.0	5.0	922	0	0	-	-
230.0	0.0	3,312	0	0	-	-
225.0	5.0	1,037	0	0	-	-
225.0	25.0	0	0	0	-	-
230.0	20.0	0	0	0	-	-
230.0	10.0	0	0	0	-	-
230.0	25.0	0	0	0	-	-
230.0	15.0	0	0	0	-	-
235.0	0.0	3,312	0	0	-	-
235.0	5.0	832	0	0	-	-
235.0	20.0	0	0	0	-	-
235.0	10.0	0	0	0	-	-
235.0	25.0	0	0	0	-	-
240.0	0.0	3,312	0	0	-	-
235.0	15.0	0	0	0	-	-
240.0	10.0	0	0	0	-	-
240.0	5.0	766	0	0	-	-

240.0	20.0	0	0	0	-	-
240.0	15.0	0	0	0	-	-
245.0	10.0	0	0	0	-	-
245.0	5.0	726	0	0	-	-
245.0	15.0	0	0	0	-	-
240.0	25.0	0	0	0	-	-
245.0	20.0	0	0	0	-	-
245.0	25.0	0	0	0	-	-
250.0	0.0	3,312	0	0	-	-
250.0	15.0	0	0	0	-	-
250.0	10.0	0	0	0	-	-
250.0	20.0	0	0	0	-	-
250.0	5.0	707	0	0	-	-
255.0	0.0	3,312	0	0	-	-
250.0	25.0	0	0	0	-	-
245.0	0.0	3,312	0	0	-	-
255.0	10.0	0	0	0	-	-
255.0	5.0	714	0	0	-	-
255.0	20.0	0	0	0	-	-
100.0	5.0	0	0	0	-	-
95.0	25.0	0	0	0	-	-
255.0	25.0	0	0	0	-	-
95.0	15.0	0	0	0	-	-
260.0	0.0	3,312	0	0	-	-
95.0	10.0	0	0	0	-	-
255.0	15.0	0	0	0	-	-
95.0	0.0	3,312	0	0	-	-
260.0	10.0	0	0	0	-	-
260.0	15.0	0	0	0	-	-
100.0	0.0	3,312	0	0	-	-
95.0	5.0	0	0	0	-	-
260.0	5.0	768	0	0	-	-
95.0	20.0	0	0	0	-	-
260.0	25.0	0	0	0	-	-
100.0	15.0	0	0	0	-	-
265.0	0.0	3,312	0	0	-	-
100.0	10.0	0	0	0	-	-
265.0	5.0	845	0	0	-	-
100.0	20.0	0	0	0	-	-
260.0	20.0	0	0	0	-	-
105.0	5.0	0	0	0	-	-
265.0	20.0	0	0	0	-	-
100.0	25.0	0	0	0	-	-
265.0	15.0	0	0	0	-	-
105.0	0.0	3,312	0	0	-	-
265.0	25.0	0	0	0	-	-
105.0	15.0	0	0	0	-	-
270.0	0.0	3,312	0	0	-	-
105.0	10.0	0	0	0	-	-
270.0	5.0	958	0	0	-	-
105.0	25.0	0	0	0	-	-
270.0	10.0	0	0	0	-	-
110.0	0.0	3,312	0	0	-	-

265.0	10.0	0	0	0	-	-
105.0	20.0	0	0	0	-	-
270.0	15.0	0	0	0	-	-
110.0	20.0	0	0	0	-	-
270.0	25.0	0	0	0	-	-
110.0	10.0	0	0	0	-	-
270.0	20.0	0	0	0	-	-
110.0	25.0	0	0	0	-	-
275.0	25.0	0	0	0	-	-
110.0	5.0	0	0	0	-	-
275.0	20.0	0	0	0	-	-
115.0	0.0	3,312	0	0	-	-
275.0	5.0	1,089	0	0	-	-
110.0	15.0	0	0	0	-	-
275.0	0.0	3,312	0	0	-	-
115.0	5.0	0	0	0	-	-
275.0	10.0	0	0	0	-	-
115.0	10.0	0	0	0	-	-
275.0	15.0	0	0	0	-	-
115.0	15.0	0	0	0	-	-
115.0	25.0	0	0	0	-	-
120.0	0.0	3,312	0	0	-	-
115.0	20.0	0	0	0	-	-
120.0	20.0	0	0	0	-	-
120.0	5.0	283	0	0	-	-
120.0	25.0	0	0	0	-	-
125.0	0.0	3,312	0	0	-	-
120.0	15.0	0	0	0	-	-
125.0	5.0	786	0	0	-	-
120.0	10.0	0	0	0	-	-
125.0	15.0	0	0	0	-	-
130.0	0.0	3,312	0	0	-	-
125.0	20.0	0	0	0	-	-
125.0	10.0	0	0	0	-	-
125.0	25.0	0	0	0	-	-
130.0	25.0	0	0	0	-	-
130.0	10.0	158	0	0	-	-
130.0	15.0	0	0	0	-	-
130.0	5.0	1,398	0	0	-	-
135.0	0.0	3,312	0	0	-	-
130.0	20.0	0	0	0	-	-
135.0	5.0	1,995	0	0	-	-
135.0	10.0	853	0	0	-	-
135.0	20.0	60	0	0	-	-

Results Per Component

Predicted minutes of worst glare per receptor.

PV Orientation	Tilt	% Max Energy	caseme	caseme	caseme	caseme	1-ATCT

135.0	15.0	-	-	364 green	-	-	-
140.0	0.0	-	-	3,312 green	-	-	-
135.0	25.0	-	-	-	-	-	-
140.0	20.0	-	-	989 green	-	-	-
140.0	10.0	-	-	1,595 green	-	-	-
140.0	25.0	-	-	880 green	-	-	-
145.0	5.0	-	-	2,763 green	-	-	-
145.0	0.0	-	-	3,312 green	-	-	-
140.0	15.0	-	-	1,183 green	-	-	-
140.0	5.0	-	-	2,429 green	-	-	-
145.0	15.0	-	-	1,749 green	-	-	-
145.0	20.0	-	-	1,520 green	-	-	-
145.0	25.0	-	-	1,398 green	-	-	-
150.0	0.0	-	-	3,312 green	-	-	-
150.0	5.0	-	-	2,904 green	-	-	-
145.0	10.0	-	-	2,171 green	-	-	-
150.0	15.0	-	-	2,180 green	-	-	-
150.0	10.0	-	-	2,478 green	-	-	-
150.0	20.0	-	-	1,952 green	-	-	-
150.0	25.0	-	-	1,829 green	-	-	-
155.0	0.0	-	-	3,312 green	-	-	-
155.0	10.0	-	-	2,563 green	-	-	-
155.0	5.0	-	-	2,919 green	-	-	-
155.0	15.0	-	-	2,354 green	-	-	-
155.0	20.0	-	-	2,226 green	-	-	-
160.0	0.0	-	-	3,312 green	-	-	-
160.0	5.0	-	-	2,858 green	-	-	-
155.0	25.0	-	-	2,164 green	-	-	-
160.0	10.0	-	-	2,456 green	-	-	-
160.0	20.0	-	-	2,107 green	-	-	-
160.0	25.0	-	-	2,075 green	-	-	-
165.0	0.0	-	-	3,312 green	-	-	-
165.0	5.0	-	-	2,739 green	-	-	-
165.0	10.0	-	-	2,272 green	-	-	-
160.0	15.0	-	-	2,222 green	-	-	-
165.0	15.0	-	-	2,006 green	-	-	-
165.0	25.0	-	-	1,849 green	-	-	-
170.0	15.0	-	-	1,750 green	-	-	-
170.0	10.0	-	-	2,073 green	-	-	-
170.0	5.0	-	-	2,624 green	-	-	-
170.0	25.0	-	-	1,576 green	-	-	-
170.0	20.0	-	-	1,600 green	-	-	-
165.0	20.0	-	-	1,869 green	-	-	-
175.0	5.0	-	-	2,507 green	-	-	-
175.0	0.0	-	-	3,312 green	-	-	-
170.0	0.0	-	-	3,312 green	-	-	-
175.0	15.0	-	-	1,443 green	-	-	-
175.0	10.0	-	-	1,844 green	-	-	-
175.0	20.0	-	-	1,255 green	-	-	-
180.0	0.0	-	-	3,312 green	-	-	-
180.0	5.0	-	-	2,384 green	-	-	-
180.0	10.0	-	-	1,583 green	-	-	-
175.0	25.0	-	-	1,226 green	-	-	-

180.0	20.0	-	-	723 green	-	-	-
185.0	0.0	-	-	3,312 green	-	-	-
180.0	25.0	-	-	678 green	-	-	-
185.0	5.0	-	-	2,245 green	-	-	-
185.0	15.0	-	-	520 green	-	-	-
180.0	15.0	-	-	1,024 green	-	-	-
185.0	20.0	-	-	17 green	-	-	-
185.0	25.0	-	-	-	-	-	-
190.0	0.0	-	-	3,312 green	-	-	-
185.0	10.0	-	-	1,238 green	-	-	-
190.0	10.0	-	-	865 green	-	-	-
190.0	5.0	-	-	2,114 green	-	-	-
190.0	20.0	-	-	-	-	-	-
190.0	15.0	-	-	-	-	-	-
195.0	0.0	-	-	3,312 green	-	-	-
190.0	25.0	-	-	-	-	-	-
195.0	5.0	-	-	1,981 green	-	-	-
195.0	15.0	-	-	-	-	-	-
195.0	10.0	-	-	499 green	-	-	-
195.0	20.0	-	-	-	-	-	-
200.0	0.0	-	-	3,312 green	-	-	-
195.0	25.0	-	-	-	-	-	-
200.0	5.0	-	-	1,809 green	-	-	-
200.0	10.0	-	-	140 green	-	-	-
200.0	25.0	-	-	-	-	-	-
205.0	0.0	-	-	3,312 green	-	-	-
205.0	5.0	-	-	1,637 green	-	-	-
200.0	15.0	-	-	-	-	-	-
200.0	20.0	-	-	-	-	-	-
205.0	15.0	-	-	-	-	-	-
205.0	25.0	-	-	-	-	-	-
205.0	10.0	-	-	-	-	-	-
205.0	20.0	-	-	-	-	-	-
210.0	5.0	-	-	1,473 green	-	-	-
210.0	0.0	-	-	3,312 green	-	-	-
210.0	15.0	-	-	-	-	-	-
210.0	10.0	-	-	-	-	-	-
210.0	20.0	-	-	-	-	-	-
215.0	0.0	-	-	3,312 green	-	-	-
210.0	25.0	-	-	-	-	-	-
215.0	5.0	-	-	1,306 green	-	-	-
215.0	20.0	-	-	-	-	-	-
215.0	25.0	-	-	-	-	-	-
220.0	0.0	-	-	3,312 green	-	-	-
220.0	5.0	-	-	1,162 green	-	-	-
215.0	15.0	-	-	-	-	-	-
220.0	10.0	-	-	-	-	-	-
215.0	10.0	-	-	-	-	-	-
220.0	20.0	-	-	-	-	-	-
220.0	15.0	-	-	-	-	-	-
225.0	0.0	-	-	3,312 green	-	-	-
220.0	25.0	-	-	-	-	-	-
225.0	10.0	-	-	-	-	-	-

225.0	15.0	-	-	-	-	-	-
225.0	20.0	-	-	-	-	-	-
230.0	5.0	-	-	922 green	-	-	-
230.0	0.0	-	-	3,312 green	-	-	-
225.0	5.0	-	-	1,037 green	-	-	-
225.0	25.0	-	-	-	-	-	-
230.0	20.0	-	-	-	-	-	-
230.0	10.0	-	-	-	-	-	-
230.0	25.0	-	-	-	-	-	-
230.0	15.0	-	-	-	-	-	-
235.0	0.0	-	-	3,312 green	-	-	-
235.0	5.0	-	-	832 green	-	-	-
235.0	20.0	-	-	-	-	-	-
235.0	10.0	-	-	-	-	-	-
235.0	25.0	-	-	-	-	-	-
240.0	0.0	-	-	3,312 green	-	-	-
235.0	15.0	-	-	-	-	-	-
240.0	10.0	-	-	-	-	-	-
240.0	5.0	-	-	766 green	-	-	-
240.0	20.0	-	-	-	-	-	-
240.0	15.0	-	-	-	-	-	-
245.0	10.0	-	-	-	-	-	-
245.0	5.0	-	-	726 green	-	-	-
245.0	15.0	-	-	-	-	-	-
240.0	25.0	-	-	-	-	-	-
245.0	20.0	-	-	-	-	-	-
245.0	25.0	-	-	-	-	-	-
250.0	0.0	-	-	3,312 green	-	-	-
250.0	15.0	-	-	-	-	-	-
250.0	10.0	-	-	-	-	-	-
250.0	20.0	-	-	-	-	-	-
250.0	5.0	-	-	707 green	-	-	-
255.0	0.0	-	-	3,312 green	-	-	-
250.0	25.0	-	-	-	-	-	-
245.0	0.0	-	-	3,312 green	-	-	-
255.0	10.0	-	-	-	-	-	-
255.0	5.0	-	-	714 green	-	-	-
255.0	20.0	-	-	-	-	-	-
100.0	5.0	-	-	-	-	-	-
95.0	25.0	-	-	-	-	-	-
255.0	25.0	-	-	-	-	-	-
95.0	15.0	-	-	-	-	-	-
260.0	0.0	-	-	3,312 green	-	-	-
95.0	10.0	-	-	-	-	-	-
255.0	15.0	-	-	-	-	-	-
95.0	0.0	-	-	3,312 green	-	-	-
260.0	10.0	-	-	-	-	-	-
260.0	15.0	-	-	-	-	-	-
100.0	0.0	-	-	3,312 green	-	-	-
95.0	5.0	-	-	-	-	-	-
260.0	5.0	-	-	768 green	-	-	-
95.0	20.0	-	-	-	-	-	-
260.0	25.0	-	-	-	-	-	-

100.0	15.0	-	-	-	-	-	-
265.0	0.0	-	-	3,312 green	-	-	-
100.0	10.0	-	-	-	-	-	-
265.0	5.0	-	-	845 green	-	-	-
100.0	20.0	-	-	-	-	-	-
260.0	20.0	-	-	-	-	-	-
105.0	5.0	-	-	-	-	-	-
265.0	20.0	-	-	-	-	-	-
100.0	25.0	-	-	-	-	-	-
265.0	15.0	-	-	-	-	-	-
105.0	0.0	-	-	3,312 green	-	-	-
265.0	25.0	-	-	-	-	-	-
105.0	15.0	-	-	-	-	-	-
270.0	0.0	-	-	3,312 green	-	-	-
105.0	10.0	-	-	-	-	-	-
270.0	5.0	-	-	958 green	-	-	-
105.0	25.0	-	-	-	-	-	-
270.0	10.0	-	-	-	-	-	-
110.0	0.0	-	-	3,312 green	-	-	-
265.0	10.0	-	-	-	-	-	-
105.0	20.0	-	-	-	-	-	-
270.0	15.0	-	-	-	-	-	-
110.0	20.0	-	-	-	-	-	-
270.0	25.0	-	-	-	-	-	-
110.0	10.0	-	-	-	-	-	-
270.0	20.0	-	-	-	-	-	-
110.0	25.0	-	-	-	-	-	-
275.0	25.0	-	-	-	-	-	-
110.0	5.0	-	-	-	-	-	-
275.0	20.0	-	-	-	-	-	-
115.0	0.0	-	-	3,312 green	-	-	-
275.0	5.0	-	-	1,089 green	-	-	-
110.0	15.0	-	-	-	-	-	-
275.0	0.0	-	-	3,312 green	-	-	-
115.0	5.0	-	-	-	-	-	-
275.0	10.0	-	-	-	-	-	-
115.0	10.0	-	-	-	-	-	-
275.0	15.0	-	-	-	-	-	-
115.0	15.0	-	-	-	-	-	-
115.0	25.0	-	-	-	-	-	-
120.0	0.0	-	-	3,312 green	-	-	-
115.0	20.0	-	-	-	-	-	-
120.0	20.0	-	-	-	-	-	-
120.0	5.0	-	-	283 green	-	-	-
120.0	25.0	-	-	-	-	-	-
125.0	0.0	-	-	3,312 green	-	-	-
120.0	15.0	-	-	-	-	-	-
125.0	5.0	-	-	786 green	-	-	-
120.0	10.0	-	-	-	-	-	-
125.0	15.0	-	-	-	-	-	-
130.0	0.0	-	-	3,312 green	-	-	-
125.0	20.0	-	-	-	-	-	-
125.0	10.0	-	-	-	-	-	-

125.0	25.0	-	-	-	-	-	-
130.0	25.0	-	-	-	-	-	-
130.0	10.0	-	-	158 green	-	-	-
130.0	15.0	-	-	-	-	-	-
130.0	5.0	-	-	1,398 green	-	-	-
135.0	0.0	-	-	3,312 green	-	-	-
130.0	20.0	-	-	-	-	-	-
135.0	5.0	-	-	1,995 green	-	-	-
135.0	10.0	-	-	853 green	-	-	-
135.0	20.0	-	-	60 green	-	-	-

Other Settings

DNI: **varies (1,000.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

Analysis Methodology: **Version 2**
Enhanced subtended angle calculation: **On**

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
- Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
- The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
- Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
- Refer to the **Help page** for assumptions and limitations not listed here.

ForgeSolar

Optimization Results

Block B Optimization

PV configurations in optimization: 222
Orientation (deg) range: 140 to 320 in intervals of 5
Tilt angle (deg) range: 0 to 25 in intervals of 5
Created: March 26, 2024 8:23 a.m.
Completed: March 26, 2024 8:27 a.m.

Flight path receptors: 4
Route receptors: 0
Observation point receptors: 1
ATCT-specific OP receptors: 1

Note: OPs must be marked as "ATCT" to be included in FAA summary

FAA 2013 Policy Summary Table

Pass/fail results of each optimization case pertaining to FAA policy. Percentages denote system output relative to theoretical max.
Blue: adheres to FAA policy (no glare for ATCT, only green for flight paths).
Red: Fails FAA policy

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-
170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-

215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-
280°	-	-	-	-	-	-
285°	-	-	-	-	-	-
290°	-	-	-	-	-	-
295°	-	-	-	-	-	-
300°	-	-	-	-	-	-
305°	-	-	-	-	-	-
310°	-	-	-	-	-	-
315°	-	-	-	-	-	-
320°	-	-	-	-	-	-

Color-Coded Hazard Summary Table

Results of each optimization case colored by maximum hazard. Percentages denote system output relative to theoretical max.
Yellow: glare with potential for after-image found.
Green: glare with low potential for after-image.
Blue: no glare found.

Tilt → **Orient ↓**	**0°**	**5°**	**10°**	**15°**	**20°**	**25°**
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-
170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-

210°	-	-	-	-	-	-
215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-
280°	-	-	-	-	-	-
285°	-	-	-	-	-	-
290°	-	-	-	-	-	-
295°	-	-	-	-	-	-
300°	-	-	-	-	-	-
305°	-	-	-	-	-	-
310°	-	-	-	-	-	-
315°	-	-	-	-	-	-
320°	-	-	-	-	-	-

2-Mile Flight Path Glare

Case results summary for FP receptors only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-
170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-

215°	-	-	-	-	-	-
220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-
280°	-	-	-	-	-	-
285°	-	-	-	-	-	-
290°	-	-	-	-	-	-
295°	-	-	-	-	-	-
300°	-	-	-	-	-	-
305°	-	-	-	-	-	-
310°	-	-	-	-	-	-
315°	-	-	-	-	-	-
320°	-	-	-	-	-	-

Observation Point Glare

Case results summary for OP receptors, including ATCTs.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-
170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-
215°	-	-	-	-	-	-

220°	-	-	-	-	-	-
225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-
280°	-	-	-	-	-	-
285°	-	-	-	-	-	-
290°	-	-	-	-	-	-
295°	-	-	-	-	-	-
300°	-	-	-	-	-	-
305°	-	-	-	-	-	-
310°	-	-	-	-	-	-
315°	-	-	-	-	-	-
320°	-	-	-	-	-	-

ATCT Glare

Case results summary for ATCT receptor(s) only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
140°	-	-	-	-	-	-
145°	-	-	-	-	-	-
150°	-	-	-	-	-	-
155°	-	-	-	-	-	-
160°	-	-	-	-	-	-
165°	-	-	-	-	-	-
170°	-	-	-	-	-	-
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-
190°	-	-	-	-	-	-
195°	-	-	-	-	-	-
200°	-	-	-	-	-	-
205°	-	-	-	-	-	-
210°	-	-	-	-	-	-
215°	-	-	-	-	-	-
220°	-	-	-	-	-	-

225°	-	-	-	-	-	-
230°	-	-	-	-	-	-
235°	-	-	-	-	-	-
240°	-	-	-	-	-	-
245°	-	-	-	-	-	-
250°	-	-	-	-	-	-
255°	-	-	-	-	-	-
260°	-	-	-	-	-	-
265°	-	-	-	-	-	-
270°	-	-	-	-	-	-
275°	-	-	-	-	-	-
280°	-	-	-	-	-	-
285°	-	-	-	-	-	-
290°	-	-	-	-	-	-
295°	-	-	-	-	-	-
300°	-	-	-	-	-	-
305°	-	-	-	-	-	-
310°	-	-	-	-	-	-
315°	-	-	-	-	-	-
320°	-	-	-	-	-	-

Glare & Energy Summary

Compilation of results for each PV configuration. Hazard, minutes of glare and energy produced.

Panel Orientation	Panel Tilt	"Green" Glare	"Yellow" Glare	"Red" Glare	Energy Produced	% Max Energy
deg	deg	min	min	min	kWh	% of max
160.0	0.0	3,312	0	0	-	-
300.0	25.0	0	0	0	-	-
155.0	20.0	2,226	0	0	-	-
300.0	15.0	0	0	0	-	-
160.0	5.0	2,858	0	0	-	-
305.0	5.0	2,965	0	0	-	-
155.0	10.0	2,563	0	0	-	-
305.0	0.0	3,312	0	0	-	-
160.0	15.0	2,222	0	0	-	-
305.0	15.0	0	0	0	-	-
160.0	20.0	2,107	0	0	-	-
305.0	20.0	0	0	0	-	-
165.0	0.0	3,312	0	0	-	-
310.0	0.0	3,312	0	0	-	-
165.0	5.0	2,739	0	0	-	-
310.0	10.0	1,008	0	0	-	-
165.0	10.0	2,272	0	0	-	-
310.0	5.0	3,357	0	0	-	-
160.0	25.0	2,075	0	0	-	-

305.0	10.0	180	0	0	-	-
160.0	10.0	2,456	0	0	-	-
310.0	20.0	0	0	0	-	-
165.0	20.0	1,869	0	0	-	-
310.0	25.0	0	0	0	-	-
165.0	15.0	2,006	0	0	-	-
310.0	15.0	0	0	0	-	-
165.0	25.0	1,849	0	0	-	-
315.0	10.0	2,380	0	0	-	-
170.0	0.0	3,312	0	0	-	-
315.0	5.0	3,745	0	0	-	-
170.0	10.0	2,073	0	0	-	-
305.0	25.0	0	0	0	-	-
170.0	20.0	1,600	0	0	-	-
315.0	15.0	0	0	0	-	-
170.0	5.0	2,624	0	0	-	-
315.0	0.0	3,312	0	0	-	-
170.0	15.0	1,750	0	0	-	-
315.0	25.0	0	0	0	-	-
175.0	5.0	2,507	0	0	-	-
320.0	0.0	3,312	0	0	-	-
170.0	25.0	1,576	0	0	-	-
320.0	5.0	3,925	0	0	-	-
175.0	0.0	3,312	0	0	-	-
315.0	20.0	0	0	0	-	-
175.0	10.0	1,844	0	0	-	-
320.0	10.0	4,116	0	0	-	-
175.0	15.0	1,443	0	0	-	-
320.0	25.0	267	0	0	-	-
175.0	25.0	1,226	0	0	-	-
320.0	20.0	453	0	0	-	-
175.0	20.0	1,255	0	0	-	-
320.0	15.0	2,804	0	0	-	-
180.0	5.0	2,384	0	0	-	-
180.0	0.0	3,312	0	0	-	-
180.0	15.0	1,024	0	0	-	-
180.0	25.0	678	0	0	-	-
185.0	0.0	3,312	0	0	-	-
180.0	20.0	723	0	0	-	-
185.0	5.0	2,245	0	0	-	-
185.0	10.0	1,238	0	0	-	-
180.0	10.0	1,583	0	0	-	-
185.0	15.0	520	0	0	-	-
190.0	0.0	3,312	0	0	-	-
185.0	25.0	0	0	0	-	-
190.0	5.0	2,114	0	0	-	-
185.0	20.0	17	0	0	-	-
190.0	15.0	0	0	0	-	-
195.0	0.0	3,312	0	0	-	-
190.0	10.0	865	0	0	-	-
190.0	25.0	0	0	0	-	-
190.0	20.0	0	0	0	-	-
195.0	5.0	1,981	0	0	-	-

195.0	20.0	0	0	0	-	-
195.0	10.0	499	0	0	-	-
195.0	25.0	0	0	0	-	-
200.0	0.0	3,312	0	0	-	-
200.0	5.0	1,809	0	0	-	-
195.0	15.0	0	0	0	-	-
200.0	15.0	0	0	0	-	-
200.0	10.0	140	0	0	-	-
200.0	20.0	0	0	0	-	-
205.0	0.0	3,312	0	0	-	-
200.0	25.0	0	0	0	-	-
205.0	5.0	1,637	0	0	-	-
205.0	15.0	0	0	0	-	-
205.0	20.0	0	0	0	-	-
205.0	25.0	0	0	0	-	-
205.0	10.0	0	0	0	-	-
210.0	0.0	3,312	0	0	-	-
210.0	5.0	1,473	0	0	-	-
210.0	10.0	0	0	0	-	-
210.0	25.0	0	0	0	-	-
210.0	20.0	0	0	0	-	-
215.0	5.0	1,306	0	0	-	-
210.0	15.0	0	0	0	-	-
215.0	0.0	3,312	0	0	-	-
215.0	15.0	0	0	0	-	-
215.0	10.0	0	0	0	-	-
215.0	20.0	0	0	0	-	-
215.0	25.0	0	0	0	-	-
220.0	5.0	1,162	0	0	-	-
220.0	10.0	0	0	0	-	-
220.0	25.0	0	0	0	-	-
220.0	15.0	0	0	0	-	-
225.0	0.0	3,312	0	0	-	-
220.0	0.0	3,312	0	0	-	-
220.0	20.0	0	0	0	-	-
225.0	5.0	1,037	0	0	-	-
225.0	15.0	0	0	0	-	-
225.0	20.0	0	0	0	-	-
225.0	25.0	0	0	0	-	-
225.0	10.0	0	0	0	-	-
230.0	0.0	3,312	0	0	-	-
230.0	10.0	0	0	0	-	-
230.0	20.0	0	0	0	-	-
230.0	15.0	0	0	0	-	-
230.0	5.0	922	0	0	-	-
235.0	0.0	3,312	0	0	-	-
230.0	25.0	0	0	0	-	-
235.0	10.0	0	0	0	-	-
235.0	5.0	832	0	0	-	-
235.0	15.0	0	0	0	-	-
235.0	20.0	0	0	0	-	-
235.0	25.0	0	0	0	-	-
240.0	0.0	3,312	0	0	-	-

240.0	10.0	0	0	0	-	-
240.0	20.0	0	0	0	-	-
240.0	25.0	0	0	0	-	-
240.0	15.0	0	0	0	-	-
245.0	5.0	726	0	0	-	-
245.0	15.0	0	0	0	-	-
240.0	5.0	766	0	0	-	-
245.0	20.0	0	0	0	-	-
245.0	10.0	0	0	0	-	-
245.0	25.0	0	0	0	-	-
245.0	0.0	3,312	0	0	-	-
250.0	0.0	3,312	0	0	-	-
250.0	15.0	0	0	0	-	-
250.0	5.0	707	0	0	-	-
250.0	25.0	0	0	0	-	-
250.0	20.0	0	0	0	-	-
255.0	5.0	714	0	0	-	-
255.0	10.0	0	0	0	-	-
255.0	15.0	0	0	0	-	-
255.0	20.0	0	0	0	-	-
260.0	0.0	3,312	0	0	-	-
255.0	25.0	0	0	0	-	-
250.0	10.0	0	0	0	-	-
260.0	20.0	0	0	0	-	-
260.0	10.0	0	0	0	-	-
260.0	15.0	0	0	0	-	-
260.0	5.0	768	0	0	-	-
255.0	0.0	3,312	0	0	-	-
265.0	0.0	3,312	0	0	-	-
265.0	5.0	845	0	0	-	-
265.0	20.0	0	0	0	-	-
265.0	15.0	0	0	0	-	-
260.0	25.0	0	0	0	-	-
265.0	25.0	0	0	0	-	-
265.0	10.0	0	0	0	-	-
270.0	0.0	3,312	0	0	-	-
270.0	5.0	958	0	0	-	-
270.0	20.0	0	0	0	-	-
270.0	15.0	0	0	0	-	-
270.0	10.0	0	0	0	-	-
270.0	25.0	0	0	0	-	-
275.0	0.0	3,312	0	0	-	-
275.0	10.0	0	0	0	-	-
275.0	5.0	1,089	0	0	-	-
275.0	20.0	0	0	0	-	-
275.0	25.0	0	0	0	-	-
280.0	0.0	3,312	0	0	-	-
280.0	5.0	1,294	0	0	-	-
280.0	10.0	0	0	0	-	-
280.0	15.0	0	0	0	-	-
280.0	20.0	0	0	0	-	-
280.0	25.0	0	0	0	-	-
275.0	15.0	0	0	0	-	-

285.0	0.0	3,312	0	0	-	-
285.0	15.0	0	0	0	-	-
140.0	0.0	3,312	0	0	-	-
285.0	25.0	0	0	0	-	-
140.0	5.0	2,429	0	0	-	-
285.0	5.0	1,531	0	0	-	-
140.0	10.0	1,595	0	0	-	-
285.0	20.0	0	0	0	-	-
140.0	20.0	989	0	0	-	-
285.0	10.0	0	0	0	-	-
140.0	15.0	1,183	0	0	-	-
290.0	0.0	3,312	0	0	-	-
140.0	25.0	880	0	0	-	-
290.0	15.0	0	0	0	-	-
145.0	5.0	2,763	0	0	-	-
290.0	20.0	0	0	0	-	-
145.0	0.0	3,312	0	0	-	-
145.0	15.0	1,749	0	0	-	-
290.0	5.0	1,833	0	0	-	-
145.0	10.0	2,171	0	0	-	-
290.0	10.0	0	0	0	-	-
145.0	25.0	1,398	0	0	-	-
290.0	25.0	0	0	0	-	-
150.0	0.0	3,312	0	0	-	-
295.0	5.0	2,167	0	0	-	-
150.0	5.0	2,904	0	0	-	-
295.0	10.0	0	0	0	-	-
150.0	10.0	2,478	0	0	-	-
295.0	15.0	0	0	0	-	-
150.0	15.0	2,180	0	0	-	-
295.0	0.0	3,312	0	0	-	-
295.0	20.0	0	0	0	-	-
150.0	20.0	1,952	0	0	-	-
295.0	25.0	0	0	0	-	-
150.0	25.0	1,829	0	0	-	-
300.0	0.0	3,312	0	0	-	-
145.0	20.0	1,520	0	0	-	-
155.0	5.0	2,919	0	0	-	-
300.0	10.0	0	0	0	-	-
155.0	0.0	3,312	0	0	-	-
300.0	20.0	0	0	0	-	-
155.0	25.0	2,164	0	0	-	-
300.0	5.0	2,545	0	0	-	-
155.0	15.0	2,354	0	0	-	-

Results Per Component

Predicted minutes of worst glare per receptor.

PV Orientation	Tilt	% Max Energy	caseme	caseme	caseme	caseme	1-ATCT

160.0	0.0	-	-	3,312 green	-	-	-
300.0	25.0	-	-	-	-	-	-
155.0	20.0	-	-	2,226 green	-	-	-
300.0	15.0	-	-	-	-	-	-
160.0	5.0	-	-	2,858 green	-	-	-
305.0	5.0	-	-	2,965 green	-	-	-
155.0	10.0	-	-	2,563 green	-	-	-
305.0	0.0	-	-	3,312 green	-	-	-
160.0	15.0	-	-	2,222 green	-	-	-
305.0	15.0	-	-	-	-	-	-
160.0	20.0	-	-	2,107 green	-	-	-
305.0	20.0	-	-	-	-	-	-
165.0	0.0	-	-	3,312 green	-	-	-
310.0	0.0	-	-	3,312 green	-	-	-
165.0	5.0	-	-	2,739 green	-	-	-
310.0	10.0	-	-	1,008 green	-	-	-
165.0	10.0	-	-	2,272 green	-	-	-
310.0	5.0	-	-	3,357 green	-	-	-
160.0	25.0	-	-	2,075 green	-	-	-
305.0	10.0	-	-	180 green	-	-	-
160.0	10.0	-	-	2,456 green	-	-	-
310.0	20.0	-	-	-	-	-	-
165.0	20.0	-	-	1,869 green	-	-	-
310.0	25.0	-	-	-	-	-	-
165.0	15.0	-	-	2,006 green	-	-	-
310.0	15.0	-	-	-	-	-	-
165.0	25.0	-	-	1,849 green	-	-	-
315.0	10.0	-	-	2,380 green	-	-	-
170.0	0.0	-	-	3,312 green	-	-	-
315.0	5.0	-	-	3,745 green	-	-	-
170.0	10.0	-	-	2,073 green	-	-	-
305.0	25.0	-	-	-	-	-	-
170.0	20.0	-	-	1,600 green	-	-	-
315.0	15.0	-	-	-	-	-	-
170.0	5.0	-	-	2,624 green	-	-	-
315.0	0.0	-	-	3,312 green	-	-	-
170.0	15.0	-	-	1,750 green	-	-	-
315.0	25.0	-	-	-	-	-	-
175.0	5.0	-	-	2,507 green	-	-	-
320.0	0.0	-	-	3,312 green	-	-	-
170.0	25.0	-	-	1,576 green	-	-	-
320.0	5.0	-	-	3,925 green	-	-	-
175.0	0.0	-	-	3,312 green	-	-	-
315.0	20.0	-	-	-	-	-	-
175.0	10.0	-	-	1,844 green	-	-	-
320.0	10.0	-	-	4,116 green	-	-	-
175.0	15.0	-	-	1,443 green	-	-	-
320.0	25.0	-	-	267 green	-	-	-
175.0	25.0	-	-	1,226 green	-	-	-
320.0	20.0	-	-	453 green	-	-	-
175.0	20.0	-	-	1,255 green	-	-	-
320.0	15.0	-	-	2,804 green	-	-	-
180.0	5.0	-	-	2,384 green	-	-	-

180.0	0.0	-	-	3,312 green	-	-	-
180.0	15.0	-	-	1,024 green	-	-	-
180.0	25.0	-	-	678 green	-	-	-
185.0	0.0	-	-	3,312 green	-	-	-
180.0	20.0	-	-	723 green	-	-	-
185.0	5.0	-	-	2,245 green	-	-	-
185.0	10.0	-	-	1,238 green	-	-	-
180.0	10.0	-	-	1,583 green	-	-	-
185.0	15.0	-	-	520 green	-	-	-
190.0	0.0	-	-	3,312 green	-	-	-
185.0	25.0	-	-	-	-	-	-
190.0	5.0	-	-	2,114 green	-	-	-
185.0	20.0	-	-	17 green	-	-	-
190.0	15.0	-	-	-	-	-	-
195.0	0.0	-	-	3,312 green	-	-	-
190.0	10.0	-	-	865 green	-	-	-
190.0	25.0	-	-	-	-	-	-
190.0	20.0	-	-	-	-	-	-
195.0	5.0	-	-	1,981 green	-	-	-
195.0	20.0	-	-	-	-	-	-
195.0	10.0	-	-	499 green	-	-	-
195.0	25.0	-	-	-	-	-	-
200.0	0.0	-	-	3,312 green	-	-	-
200.0	5.0	-	-	1,809 green	-	-	-
195.0	15.0	-	-	-	-	-	-
200.0	15.0	-	-	-	-	-	-
200.0	10.0	-	-	140 green	-	-	-
200.0	20.0	-	-	-	-	-	-
205.0	0.0	-	-	3,312 green	-	-	-
200.0	25.0	-	-	-	-	-	-
205.0	5.0	-	-	1,637 green	-	-	-
205.0	15.0	-	-	-	-	-	-
205.0	20.0	-	-	-	-	-	-
205.0	25.0	-	-	-	-	-	-
205.0	10.0	-	-	-	-	-	-
210.0	0.0	-	-	3,312 green	-	-	-
210.0	5.0	-	-	1,473 green	-	-	-
210.0	10.0	-	-	-	-	-	-
210.0	25.0	-	-	-	-	-	-
210.0	20.0	-	-	-	-	-	-
215.0	5.0	-	-	1,306 green	-	-	-
210.0	15.0	-	-	-	-	-	-
215.0	0.0	-	-	3,312 green	-	-	-
215.0	15.0	-	-	-	-	-	-
215.0	10.0	-	-	-	-	-	-
215.0	20.0	-	-	-	-	-	-
215.0	25.0	-	-	-	-	-	-
220.0	5.0	-	-	1,162 green	-	-	-
220.0	10.0	-	-	-	-	-	-
220.0	25.0	-	-	-	-	-	-
220.0	15.0	-	-	-	-	-	-
225.0	0.0	-	-	3,312 green	-	-	-
220.0	0.0	-	-	3,312 green	-	-	-

220.0	20.0	-	-	-	-	-	-
225.0	5.0	-	-	1,037 green	-	-	-
225.0	15.0	-	-	-	-	-	-
225.0	20.0	-	-	-	-	-	-
225.0	25.0	-	-	-	-	-	-
225.0	10.0	-	-	-	-	-	-
230.0	0.0	-	-	3,312 green	-	-	-
230.0	10.0	-	-	-	-	-	-
230.0	20.0	-	-	-	-	-	-
230.0	15.0	-	-	-	-	-	-
230.0	5.0	-	-	922 green	-	-	-
235.0	0.0	-	-	3,312 green	-	-	-
230.0	25.0	-	-	-	-	-	-
235.0	10.0	-	-	-	-	-	-
235.0	5.0	-	-	832 green	-	-	-
235.0	15.0	-	-	-	-	-	-
235.0	20.0	-	-	-	-	-	-
235.0	25.0	-	-	-	-	-	-
240.0	0.0	-	-	3,312 green	-	-	-
240.0	10.0	-	-	-	-	-	-
240.0	20.0	-	-	-	-	-	-
240.0	25.0	-	-	-	-	-	-
240.0	15.0	-	-	-	-	-	-
245.0	5.0	-	-	726 green	-	-	-
245.0	15.0	-	-	-	-	-	-
240.0	5.0	-	-	766 green	-	-	-
245.0	20.0	-	-	-	-	-	-
245.0	10.0	-	-	-	-	-	-
245.0	25.0	-	-	-	-	-	-
245.0	0.0	-	-	3,312 green	-	-	-
250.0	0.0	-	-	3,312 green	-	-	-
250.0	15.0	-	-	-	-	-	-
250.0	5.0	-	-	707 green	-	-	-
250.0	25.0	-	-	-	-	-	-
250.0	20.0	-	-	-	-	-	-
255.0	5.0	-	-	714 green	-	-	-
255.0	10.0	-	-	-	-	-	-
255.0	15.0	-	-	-	-	-	-
255.0	20.0	-	-	-	-	-	-
260.0	0.0	-	-	3,312 green	-	-	-
255.0	25.0	-	-	-	-	-	-
250.0	10.0	-	-	-	-	-	-
260.0	20.0	-	-	-	-	-	-
260.0	10.0	-	-	-	-	-	-
260.0	15.0	-	-	-	-	-	-
260.0	5.0	-	-	768 green	-	-	-
255.0	0.0	-	-	3,312 green	-	-	-
265.0	0.0	-	-	3,312 green	-	-	-
265.0	5.0	-	-	845 green	-	-	-
265.0	20.0	-	-	-	-	-	-
265.0	15.0	-	-	-	-	-	-
260.0	25.0	-	-	-	-	-	-
265.0	25.0	-	-	-	-	-	-

265.0	10.0	-	-	-	-	-	-
270.0	0.0	-	-	3,312 green	-	-	-
270.0	5.0	-	-	958 green	-	-	-
270.0	20.0	-	-	-	-	-	-
270.0	15.0	-	-	-	-	-	-
270.0	10.0	-	-	-	-	-	-
270.0	25.0	-	-	-	-	-	-
275.0	0.0	-	-	3,312 green	-	-	-
275.0	10.0	-	-	-	-	-	-
275.0	5.0	-	-	1,089 green	-	-	-
275.0	20.0	-	-	-	-	-	-
275.0	25.0	-	-	-	-	-	-
280.0	0.0	-	-	3,312 green	-	-	-
280.0	5.0	-	-	1,294 green	-	-	-
280.0	10.0	-	-	-	-	-	-
280.0	15.0	-	-	-	-	-	-
280.0	20.0	-	-	-	-	-	-
280.0	25.0	-	-	-	-	-	-
275.0	15.0	-	-	-	-	-	-
285.0	0.0	-	-	3,312 green	-	-	-
285.0	15.0	-	-	-	-	-	-
140.0	0.0	-	-	3,312 green	-	-	-
285.0	25.0	-	-	-	-	-	-
140.0	5.0	-	-	2,429 green	-	-	-
285.0	5.0	-	-	1,531 green	-	-	-
140.0	10.0	-	-	1,595 green	-	-	-
285.0	20.0	-	-	-	-	-	-
140.0	20.0	-	-	989 green	-	-	-
285.0	10.0	-	-	-	-	-	-
140.0	15.0	-	-	1,183 green	-	-	-
290.0	0.0	-	-	3,312 green	-	-	-
140.0	25.0	-	-	880 green	-	-	-
290.0	15.0	-	-	-	-	-	-
145.0	5.0	-	-	2,763 green	-	-	-
290.0	20.0	-	-	-	-	-	-
145.0	0.0	-	-	3,312 green	-	-	-
145.0	15.0	-	-	1,749 green	-	-	-
290.0	5.0	-	-	1,833 green	-	-	-
145.0	10.0	-	-	2,171 green	-	-	-
290.0	10.0	-	-	-	-	-	-
145.0	25.0	-	-	1,398 green	-	-	-
290.0	25.0	-	-	-	-	-	-
150.0	0.0	-	-	3,312 green	-	-	-
295.0	5.0	-	-	2,167 green	-	-	-
150.0	5.0	-	-	2,904 green	-	-	-
295.0	10.0	-	-	-	-	-	-
150.0	10.0	-	-	2,478 green	-	-	-
295.0	15.0	-	-	-	-	-	-
150.0	15.0	-	-	2,180 green	-	-	-
295.0	0.0	-	-	3,312 green	-	-	-
295.0	20.0	-	-	-	-	-	-
150.0	20.0	-	-	1,952 green	-	-	-
295.0	25.0	-	-	-	-	-	-

150.0	25.0	-	-	1,829 green	-	-	-
300.0	0.0	-	-	3,312 green	-	-	-
145.0	20.0	-	-	1,520 green	-	-	-
155.0	5.0	-	-	2,919 green	-	-	-
300.0	10.0	-	-	-	-	-	-
155.0	0.0	-	-	3,312 green	-	-	-
300.0	20.0	-	-	-	-	-	-
155.0	25.0	-	-	2,164 green	-	-	-
300.0	5.0	-	-	2,545 green	-	-	-
155.0	15.0	-	-	2,354 green	-	-	-

Other Settings

DNI: **varies (1,000.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

Analysis Methodology: **Version 2**
Enhanced subtended angle calculation: **On**

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
- Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
- The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
- Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
- Refer to the **Help page** for assumptions and limitations not listed here.