

RELAZIONE DI COMPATIBILITA' AEREONAUTICA

Studio aeronautico di compatibilità e dei possibili effetti di abbagliamento generati dalla installazione di pannelli fotovoltaici.



Oggetto: Relazione tecnica a corredo delle verifiche per l'installazione di un impianto Fotovoltaico su carport, da ubicare in un'area a parcheggio, della società O.M.A. S.P.A., nel Comune di Foligno (PE), Via Cagliari, n° 20, nei pressi dell'Aeroporto di Foligno (ICAO: LIAF).

Ditta richiedente - Proprietaria: O.M.A. S.P.A. - Officine Meccaniche Aeronautiche -, con sede in Foligno (Pg), Via Cagliari, n°20. Partita I.V.A.: 00147650543.

Presidente e legale rappresentante: **Sig. Umberto Nazzareno Tonti**, nato a **Foligno** il 05/11/1958, residente in Via degli Eroi n°3 – 06034 - Foligno (Pg). Codice Fiscale **TNT MRT 58S05 D653A**.

Riferimenti: 1) Report Analisi Pre-Utility.

- **Premesso che:**

(Introduzione generale)

- la presente relazione, è parte integrante dell'analisi dei possibili effetti di abbagliamento generati dalla installazione di pannelli fotovoltaici, per la richiesta e il rilascio dell'autorizzazione, da parte dell'ENAC per l'installazione di un impianto fotovoltaico così come indicato in oggetto;
- a completezza della richiesta di autorizzazione, è stata eseguita l'analisi Pre-Utility, per la verifica di possibili interferenze con i sistemi di comunicazione e navigazione aerea eseguito come da procedura indicata dal portale ENAV, da cui si evince l'assenza di interferenze per gli aeroporti e i sistemi di comunicazione/navigazione/RADAR di ENAV S.p.A. (vedere report allegato).

(Collocazione, descrizione dell'intervento e dati Fotovoltaico)

- l'impianto sarà installato su carport, a copertura di un'area da adibire a parcheggio di proprietà della società **O.M.A. S.P.A. - Officine Meccaniche Aeronautiche**;
- il nuovo impianto sarà collocato ad una distanza dall'ARP (42°56'00" N e 12°42'44"E) di circa 950 m ed una distanza dalla pista 17 di circa m 250;
- l'altezza max delle pensiline (AGL), considerata ai fini dell'analisi di potenziale abbagliamento, è di m 3,00, mentre l'altezza s.l.m. dello stesso è di m 225,50, di conseguenza AGL+s.l.m. = AMSL= m 228,50;
- l'impianto, di potenza complessiva di **circa 7,27 Mwp**, sarà costituito da **1359** pannelli di dimensioni mm **1134 x 2278** e potenza nominale **535w** ciascuno.
- I pannelli saranno posti su carport e formeranno 14 pensiline (PV array) rispettivamente delle seguenti dimensioni e potenze:

PV array 1 (m 94,00 x 5,00)	Kwp 62,60 (117 pannelli – 330°);
PV array 2 (m 93,00 x 5,00)	Kwp 60,99 (114 pannelli – 150°);
PV array 3 (m 89,00 x 5,00)	Kwp 57,78 (108 pannelli – 330°);
PV array 4 (m 88,00 x 5,00)	Kwp 56,18 (105 pannelli – 150°);
PV array 5 (m 87,00 x 5,00)	Kwp 56,18 (105 pannelli – 330°);
PV array 6 (m 84,00 x 5,00)	Kwp 54,57 (102 pannelli – 150°);
PV array 7 (m 82,00 x 5,00)	Kwp 52,97 (99 pannelli – 330°);
PV array 8 (m 80,00 x 5,00)	Kwp 51,36 (96 pannelli– 150°););



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PV array 9 (m 79,00 x 5,00) **Kwp 51,36** (96 pannelli – 330°);
PV array 10 (m 78,00 x 5,00) **Kwp 48,15** (90 pannelli – 150°);
PV array 11 (m 75,00 x 5,00) **Kwp 46,55** (87 pannelli – 330°);
PV array 12 (m 72,00 x 5,00) **Kwp 44,94** (84 pannelli – 150°);
PV array 13 (m 70,00 x 5,00) **Kwp 43,34** (81 pannelli – 330°);
PV array 14 (m 68,00 x 5,00) **Kwp 41,73** (78 pannelli – 150°);

- la tipologia del pannello utilizzata per la presente analisi di compatibilità, è monocristallino con vetro strutturato con antiriflettanza certificata emessa da ente accreditato della ditta Ja-Solar;

(orientamento ed inclinazione FV)

- l'orientamento dei pannelli è di 330° NO e 150° SE con un'inclinazione rispetto al piano orizzontale (Tilt) di 5°;

(descrizione dell'aeroporto)

- l'aeroporto di riferimento per l'analisi da sviluppare è l'Aeroporto di Foligno dotato di una pista Codice ICAO 3C;
- le piste sono orientate per direzione magnetica 170° - 350° denominate pista 17 e pista 35;
- l'elevazione media sul livello del mare è di ft 730= m 222,504;
- non sono state individuate unità di controllo (TWR) per le quali devono essere svolte verifiche di compatibilità dell'impianto FV.

Tutto ciò premesso, si relazione quanto segue al fine *dell'analisi di compatibilità e dei possibili effetti di abbagliamento generati dalla installazione del nuovo impianto fotovoltaico.*

Principali criteri e metodologia utilizzata ai fini dello studio dell'abbagliamento:

- "Il potenziale fenomeno di abbagliamento del pilota/osservatore investito dai raggi riflessi deve essere valutato attraverso una sequenza di fasi logico-analitiche che preveda i seguenti passi:
- "il reperimento del diagramma solare relativo alla località in oggetto (involuppo della posizione del sole per ogni giorno dell'anno)";
- "la costruzione del diagramma solare dei raggi riflessi, tramite applicazione della legge di Fresnel";
- "la determinazione dei punti rappresentativi delle varie fasi di volo (FAF, intersezione delle traiettorie di discesa con MDH, DH, etc.)";
- "la collocazione di tali punti nel diagramma solare dei raggi riflessi";
- "la valutazione relativa al tipo di visione interessata";

- il calcolo per la verifica, proprio per quanto sopra esposto, è stato effettuato tramite software, riconosciuto dall'Autorità degli U.S.A: FAA, Glare Gauge/Forge Solar versione "Basic" per impianti compresi tra 5 e 10 Mwp, basato sull'algoritmo SGHAT v.3.

Infatti il software è in grado di restituire quanto necessario ad una analisi conforme a quanto dettato dalle linee guida:

- Ora del giorno in cui si verifica l'abbagliamento;
- Durata giornaliera dell'abbagliamento;
- Variazione stagionale dell'abbagliamento;
- Posizione dell'abbagliamento sul diagramma di irraggiamento retinale.

"Ai fini delle valutazioni in ambito aeronautico è necessario che ogni fenomeno di abbagliamento nelle direzioni di interesse (traiettorie di avvicinamento e personale in torre di controllo) abbia un basso potenziale di causare un'immagine residua e che, quindi, l'irraggiamento retinale si mantenga nella zona verde del diagramma".

La verifica è stata effettuata per le direzioni che caratterizzano l'avvicinamento alla pista 17 ed alla pista 35, con inclinazione di 3°, da cui risulta che:

- 1) I moduli FV non producono abbagliamento, "yellow glare";
- 2) nella direzione FP1 (pista 17) è presente un "Green Glare" che si azzerà nei mesi di giugno e luglio;
- 3) la direzione FP2 (pista 35) è esente da qualsiasi tipo di bagliore.

In conclusione dall'analisi effettuata emerge che il nuovo impianto FV è compatibile all'inserimento nel contesto di riferimento.

Per quanto non espressamente detto è per maggior dettaglio consultare anche l'elaborato restituito dal software di verifica, allegato a completezza della presente relazione.

Pescara lì, 26/07/2024

Il Tecnico





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PROJECTS

ForgeSolar

OMA s.p.a.

OMA spa

Created Jul 16, 2024
Updated Jul 17, 2024
Time-step 1 minute
Timezone offset UTC1
Minimum sun altitude 0.0 deg
Site ID 124328.21324

Project type Advanced
Project status: active
Category 5 MW to 10 MW



Misc. Analysis Settings

DNI: varies (1,000.0 W/m² peak)
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad

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

Summary of Results

Glare with low potential for temporary after-image predicted

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 1	5.0	150.0	18,622	0	116,600.0
PV array 10	5.0	330.0	13,310	0	79,560.0
PV array 11	5.0	150.0	5,678	0	86,750.0
PV array 12	5.0	330.0	11,544	0	74,250.0
PV array 13	5.0	150.0	4,287	0	80,750.0
PV array 14	5.0	330.0	10,551	0	68,940.0
PV array 2	5.0	330.0	23,923	0	100,700.0
PV array 3	5.0	150.0	15,616	0	107,700.0
PV array 4	5.0	330.0	20,867	0	92,780.0
PV array 5	5.0	150.0	12,339	0	104,700.0
PV array 6	5.0	330.0	17,384	0	90,210.0
PV array 7	5.0	150.0	9,418	0	98,670.0
PV array 8	5.0	330.0	14,611	0	84,860.0
PV array 9	5.0	150.0	7,407	0	95,710.0

Component Data

PV Array(s)

Total PV footprint area: 3,955 m^2

Name: PV array 1
Footprint area: 326 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 150.0 deg
Rated power: 3300 Wp
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.943148	12.710646	225.50	3.00	228.50
2	42.943429	12.711295	225.50	3.00	228.50
3	42.943390	12.711326	225.50	3.00	228.50
4	42.943106	12.710683	225.50	3.00	228.50



Name: PV array 10
Footprint area: 266 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 330.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942600	12.711240	225.50	3.00	228.50
2	42.942834	12.711791	225.50	3.00	228.50
3	42.942794	12.711824	225.50	3.00	228.50
4	42.942563	12.711274	225.50	3.00	228.50



Name: PV array 11
Footprint area: 256 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 150.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942521	12.711359	225.50	3.00	228.50
2	42.942736	12.711865	225.50	3.00	228.50
3	42.942697	12.711898	225.50	3.00	228.50
4	42.942480	12.711399	225.50	3.00	228.50



Name: PV array 12
Footprint area: 250 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 330.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942479	12.711422	225.50	3.00	228.50
2	42.942688	12.711903	225.50	3.00	228.50
3	42.942647	12.711940	225.50	3.00	228.50
4	42.942436	12.711457	225.50	3.00	228.50



Name: PV array 13
Footprint area: 240 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 150.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942398	12.711517	225.50	3.00	228.50
2	42.942602	12.711979	225.50	3.00	228.50
3	42.942562	12.712015	225.50	3.00	228.50
4	42.942355	12.711551	225.50	3.00	228.50



Name: PV array 14
Footprint area: 237 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 330.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942356	12.711576	225.50	3.00	228.50
2	42.942555	12.712021	225.50	3.00	228.50
3	42.942513	12.712058	225.50	3.00	228.50
4	42.942314	12.711614	225.50	3.00	228.50



Name: PV array 2
Footprint area: 321 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 330.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.943108	12.710707	225.50	3.00	228.50
2	42.943384	12.711331	225.50	3.00	228.50
3	42.943340	12.711364	225.50	3.00	228.50
4	42.943068	12.710742	225.50	3.00	228.50



Name: PV array 3
Footprint area: 305 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 150.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.943021	12.710785	225.50	3.00	228.50
2	42.943293	12.711407	225.50	3.00	228.50
3	42.943254	12.711442	225.50	3.00	228.50
4	42.942982	12.710817	225.50	3.00	228.50



Name: PV array 4
Footprint area: 302 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 330.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942983	12.710837	225.50	3.00	228.50
2	42.943246	12.711449	225.50	3.00	228.50
3	42.943206	12.711482	225.50	3.00	228.50
4	42.942944	12.710872	225.50	3.00	228.50



Name: PV array 5
Footprint area: 303 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 150.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942898	12.710912	225.50	3.00	228.50
2	42.943164	12.711519	225.50	3.00	228.50
3	42.943125	12.711553	225.50	3.00	228.50
4	42.942856	12.710947	225.50	3.00	228.50



Name: PV array 6
Footprint area: 292 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 330.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942856	12.710971	225.50	3.00	228.50
2	42.943118	12.711561	225.50	3.00	228.50
3	42.943078	12.711594	225.50	3.00	228.50
4	42.942817	12.711006	225.50	3.00	228.50



Name: PV array 7
Footprint area: 290 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 150.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942770	12.711055	225.50	3.00	228.50
2	42.943022	12.711631	225.50	3.00	228.50
3	42.942982	12.711661	225.50	3.00	228.50
4	42.942728	12.711093	225.50	3.00	228.50



Name: PV array 8
Footprint area: 285 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 330.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942733	12.711123	225.50	3.00	228.50
2	42.942975	12.711666	225.50	3.00	228.50
3	42.942933	12.711704	225.50	3.00	228.50
4	42.942693	12.711160	225.50	3.00	228.50



Name: PV array 9
Footprint area: 284 m^2
Axis tracking: Fixed (no rotation)
Tilt: 5.0 deg
Orientation: 150.0 deg
Rated power:
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	42.942645	12.711200	225.50	3.00	228.50
2	42.942887	12.711746	225.50	3.00	228.50
3	42.942842	12.711784	225.50	3.00	228.50
4	42.942607	12.711234	225.50	3.00	228.50



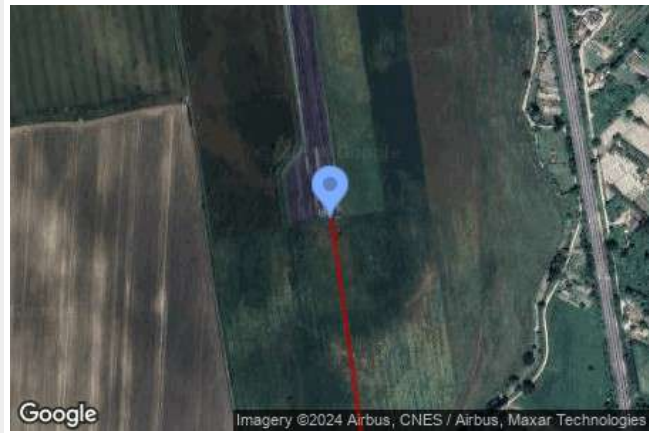
2-Mile Flight Path Receptor(s)

Name: FP 1
Description:
Threshold height : 15 m
Direction: 172.1 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg



Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	42.939664	12.711045	221.69	15.24	236.93
2-mile point	42.968305	12.705631	240.08	165.53	405.61

Name: FP 2
Description:
Threshold height : 15 m
Direction: 352.1 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg



Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	42.927178	12.713466	210.77	15.24	226.01
2-mile point	42.898543	12.718927	208.48	186.22	394.69

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced	Data File
	deg	deg	min	min	kWh	
PV array 1	5.0	150.0	18,622	0	116,600.0	-
PV array 10	5.0	330.0	13,310	0	79,560.0	-
PV array 11	5.0	150.0	5,678	0	86,750.0	-
PV array 12	5.0	330.0	11,544	0	74,250.0	-
PV array 13	5.0	150.0	4,287	0	80,750.0	-
PV array 14	5.0	330.0	10,551	0	68,940.0	-
PV array 2	5.0	330.0	23,923	0	100,700.0	-
PV array 3	5.0	150.0	15,616	0	107,700.0	-
PV array 4	5.0	330.0	20,867	0	92,780.0	-
PV array 5	5.0	150.0	12,339	0	104,700.0	-
PV array 6	5.0	330.0	17,384	0	90,210.0	-
PV array 7	5.0	150.0	9,418	0	98,670.0	-
PV array 8	5.0	330.0	14,611	0	84,860.0	-
PV array 9	5.0	150.0	7,407	0	95,710.0	-

Distinct glare per month

Excludes overlapping glare from PV array for multiple receptors at matching time(s)

PV	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pv-array-1 (green)	4177	3171	487	0	0	0	0	0	94	2521	4088	4084
pv-array-1 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-10 (green)	2219	2177	1451	7	0	0	0	0	753	2332	2171	2200
pv-array-10 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-11 (green)	1799	351	0	0	0	0	0	0	0	118	1510	1900
pv-array-11 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-12 (green)	2081	1960	966	0	0	0	0	0	392	2032	2021	2092
pv-array-12 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-13 (green)	1423	164	0	0	0	0	0	0	0	24	1141	1535
pv-array-13 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-14 (green)	2006	1841	691	0	0	0	0	0	217	1834	1929	2033
pv-array-14 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-2 (green)	2748	3066	3642	1571	4	0	0	823	3255	3467	2766	2581
pv-array-2 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-3 (green)	3519	2552	487	0	0	0	0	0	94	2122	3381	3461
pv-array-3 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-4 (green)	2593	2792	2999	1139	4	0	0	639	2497	3135	2593	2476
pv-array-4 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-5 (green)	3047	1832	197	0	0	0	0	0	13	1369	2857	3024
pv-array-5 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-6 (green)	2450	2548	2417	429	0	0	0	136	1799	2825	2423	2357
pv-array-6 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-7 (green)	2576	1178	8	0	0	0	0	0	0	701	2343	2612
pv-array-7 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-8 (green)	2285	2294	1830	87	0	0	0	0	1130	2504	2243	2238
pv-array-8 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-9 (green)	2191	679	0	0	0	0	0	0	0	325	1915	2297
pv-array-9 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 low potential for temporary after-image

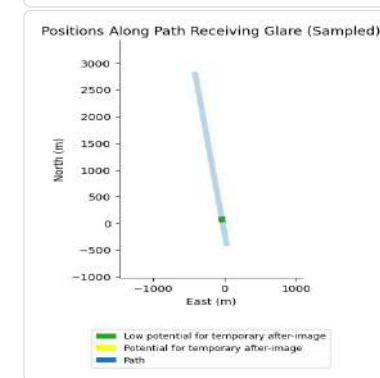
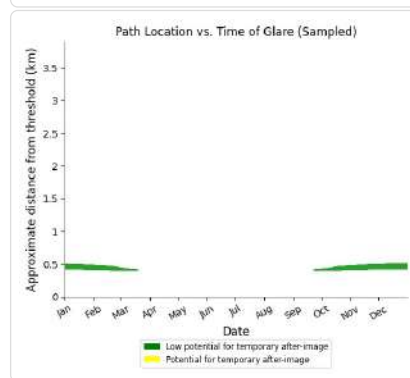
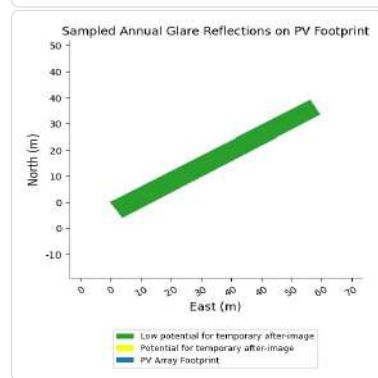
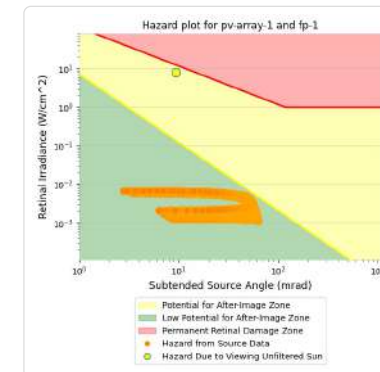
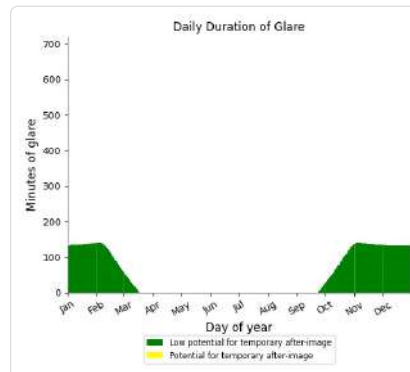
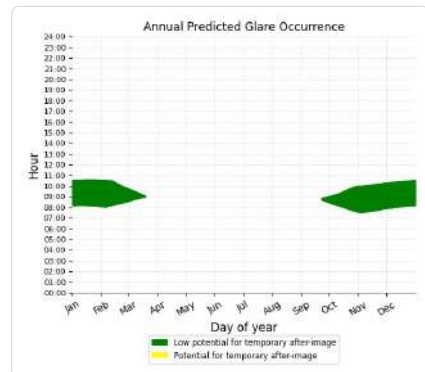
Predicted energy output: 116,600.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	18622	0
FP: FP 2	0	0

PV array 1: FP 1

PV array is expected to produce the following glare for this receptor:

- 18,622 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 1: FP 2

No glare found

PV array 10 low potential for temporary after-image

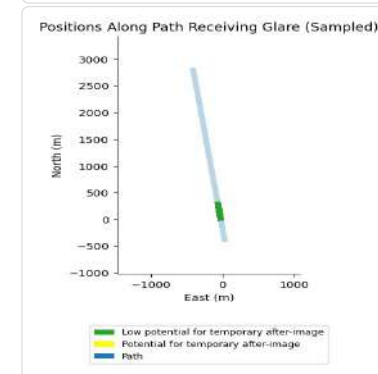
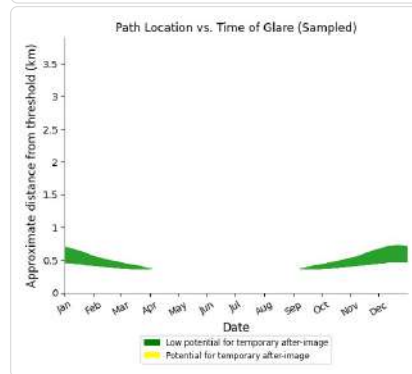
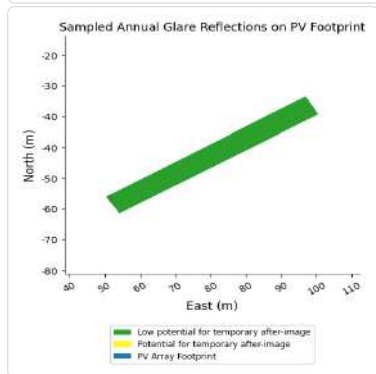
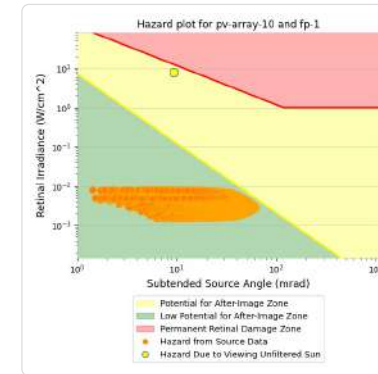
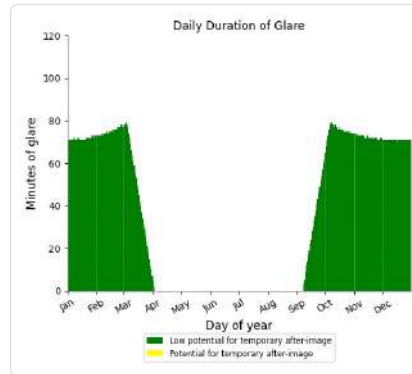
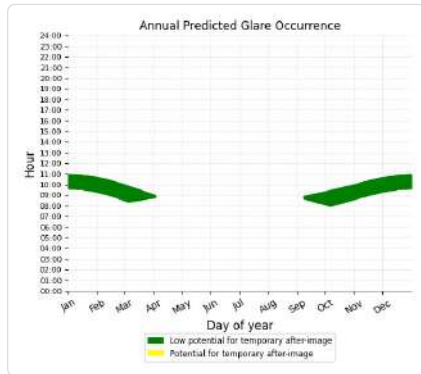
Predicted energy output: 79,560.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	13310	0
FP: FP 2	0	0

PV array 10: FP 1

PV array is expected to produce the following glare for this receptor:

- 13,310 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 10: FP 2

No glare found

PV array 11 low potential for temporary after-image

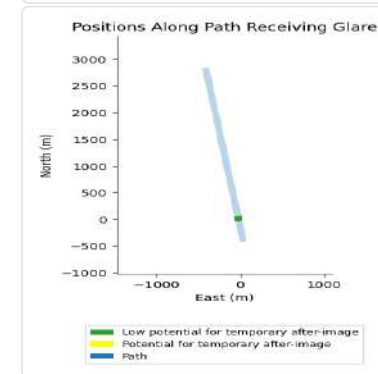
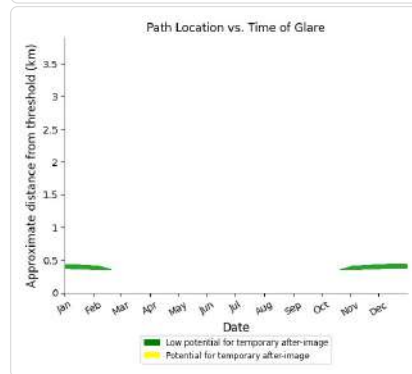
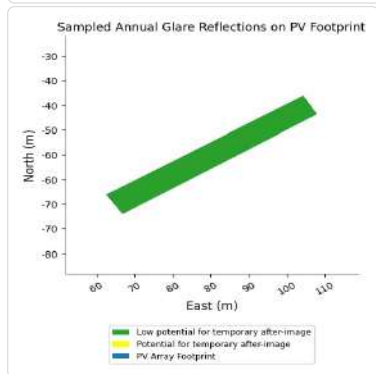
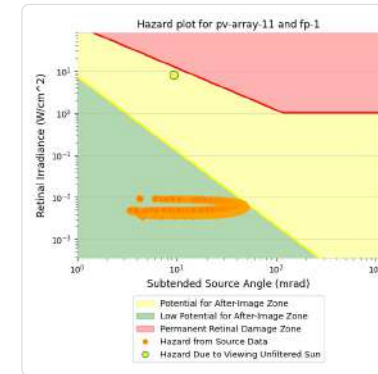
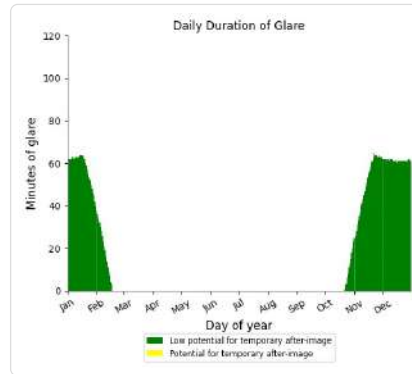
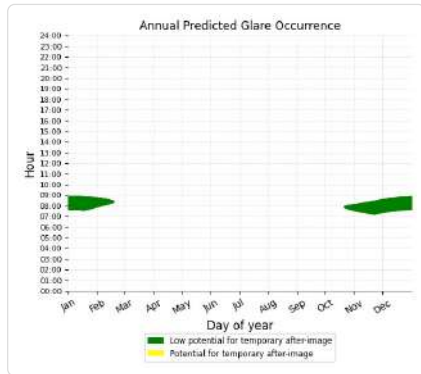
Predicted energy output: 86,750.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	5678	0
FP: FP 2	0	0

PV array 11: FP 1

PV array is expected to produce the following glare for this receptor:

- 5,678 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 11: FP 2

No glare found

PV array 12 low potential for temporary after-image

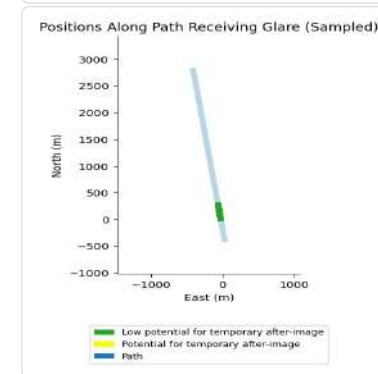
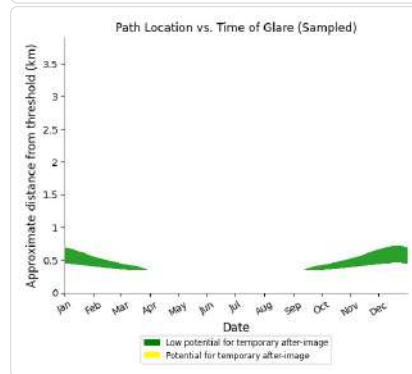
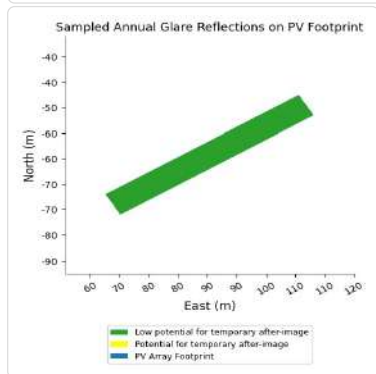
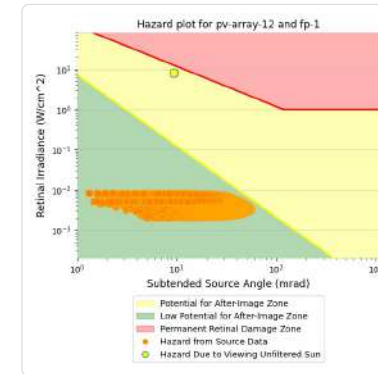
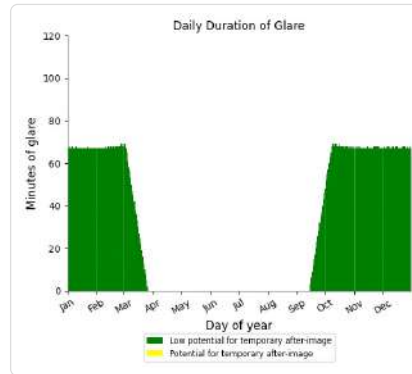
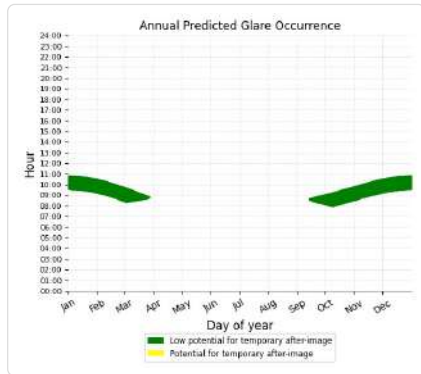
Predicted energy output: 74,250.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	11544	0
FP: FP 2	0	0

PV array 12: FP 1

PV array is expected to produce the following glare for this receptor:

- 11,544 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 12: FP 2

No glare found

PV array 13 low potential for temporary after-image

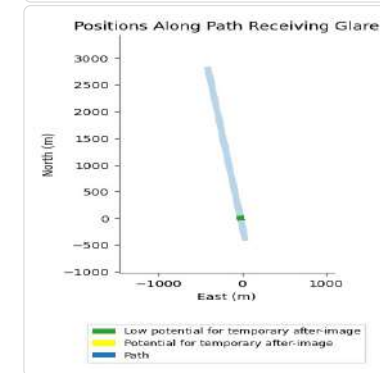
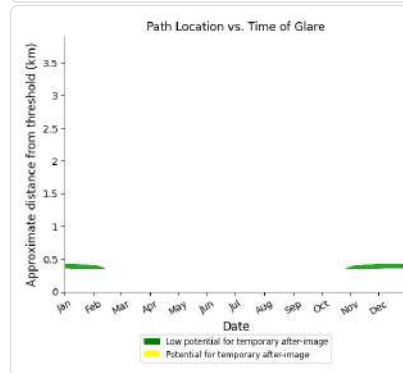
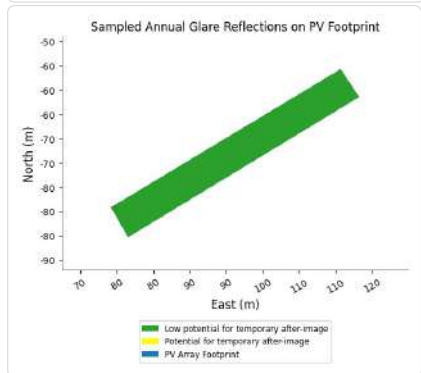
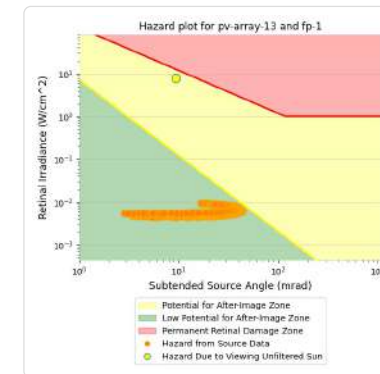
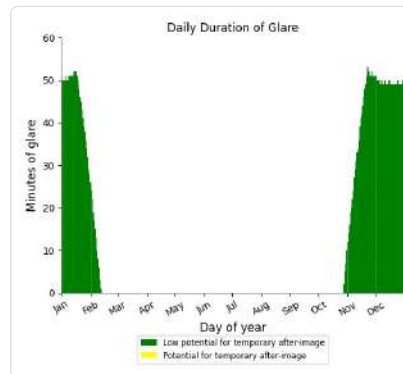
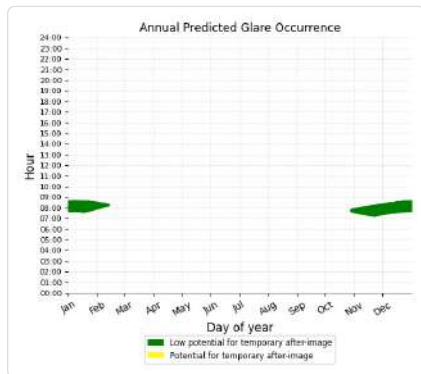
Predicted energy output: 80,750.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	4287	0
FP: FP 2	0	0

PV array 13: FP 1

PV array is expected to produce the following glare for this receptor:

- 4,287 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 13: FP 2

No glare found

PV array 14 low potential for temporary after-image

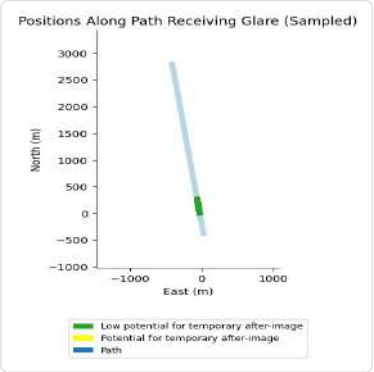
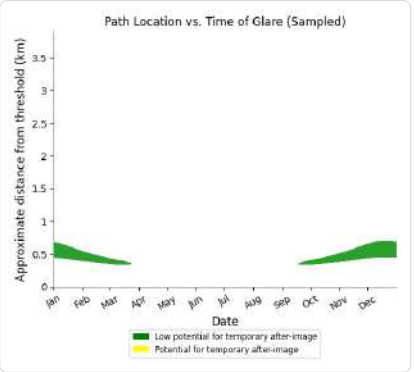
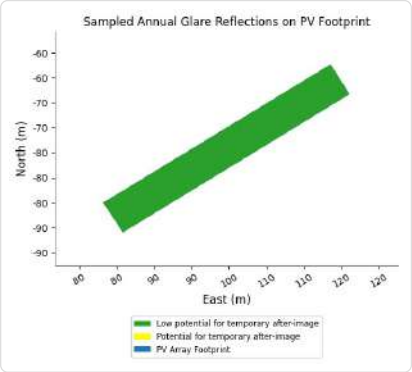
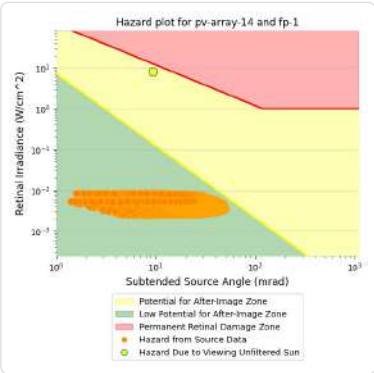
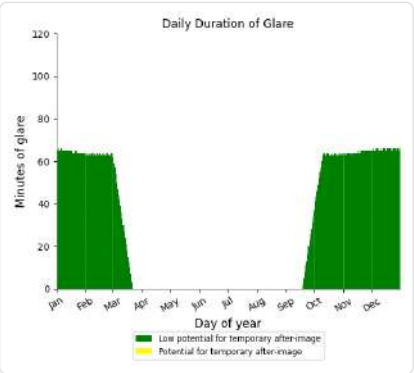
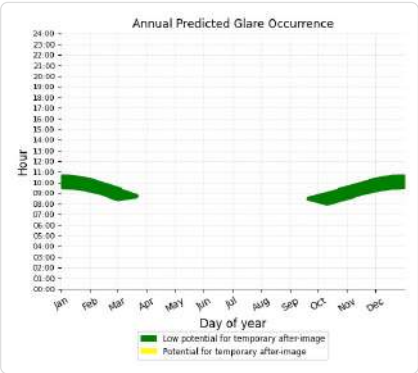
Predicted energy output: 68,940.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	10551	0
FP: FP 2	0	0

PV array 14: FP 1

PV array is expected to produce the following glare for this receptor:

- 10,551 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 14: FP 2

No glare found

PV array 2 low potential for temporary after-image

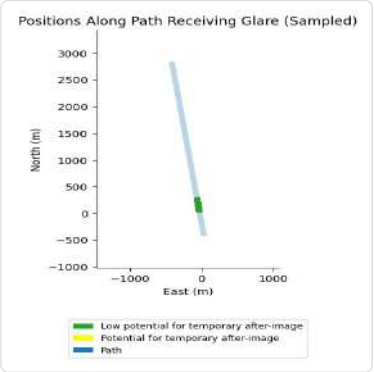
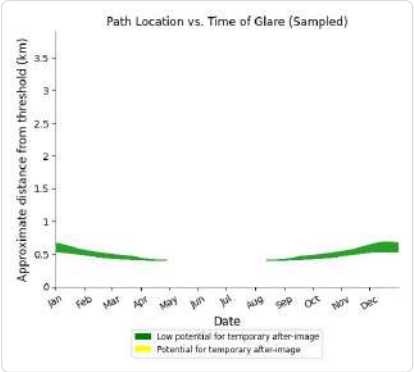
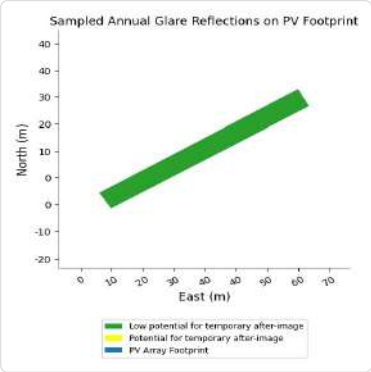
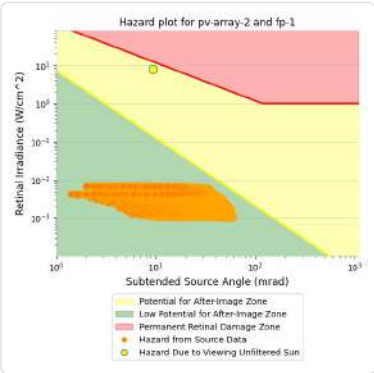
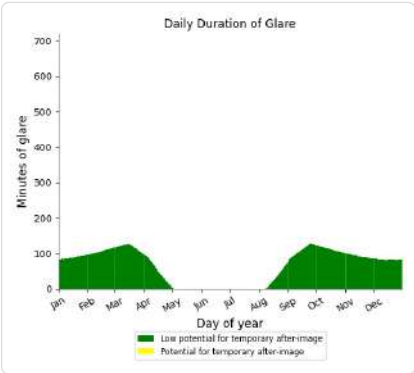
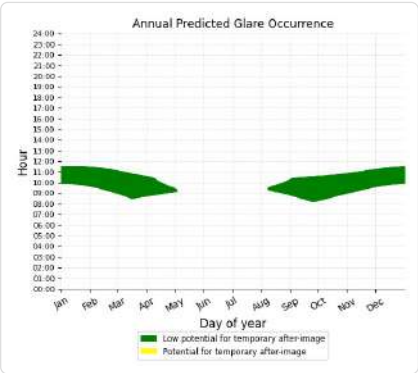
Predicted energy output: 100,700.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	23923	0
FP: FP 2	0	0

PV array 2: FP 1

PV array is expected to produce the following glare for this receptor:

- 23,923 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 2: FP 2

No glare found

PV array 3 low potential for temporary after-image

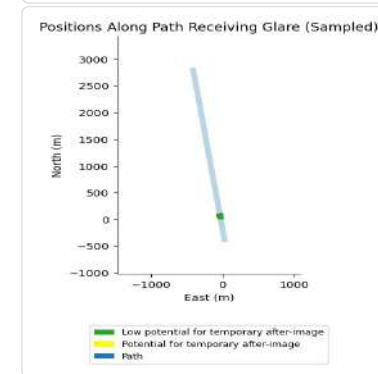
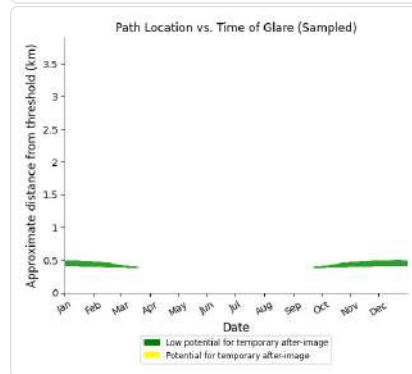
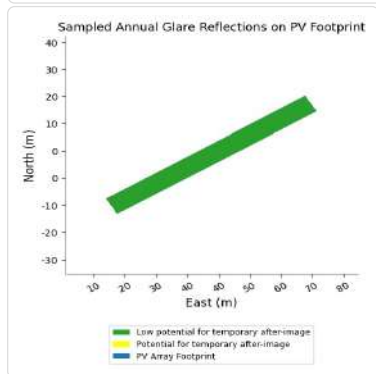
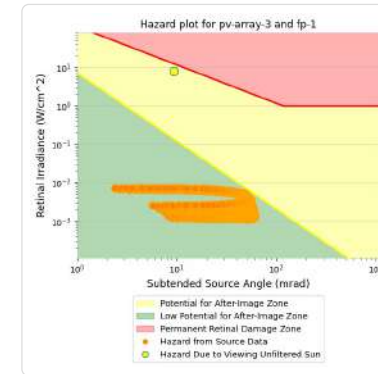
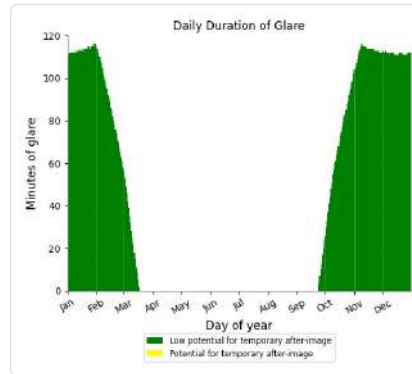
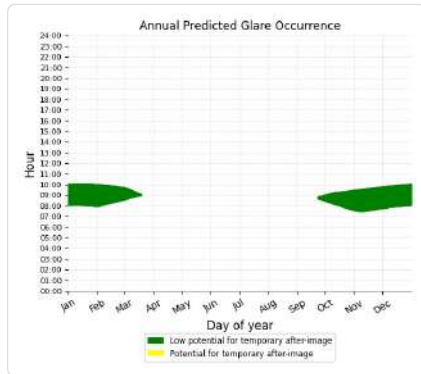
Predicted energy output: 107,700.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	15616	0
FP: FP 2	0	0

PV array 3: FP 1

PV array is expected to produce the following glare for this receptor:

- 15,616 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 3: FP 2

No glare found

PV array 4 low potential for temporary after-image

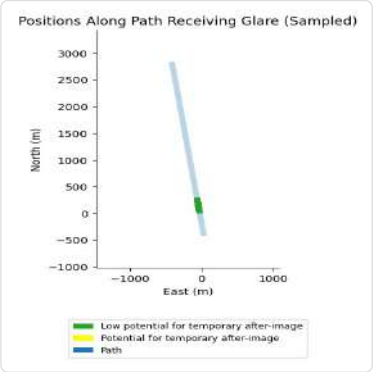
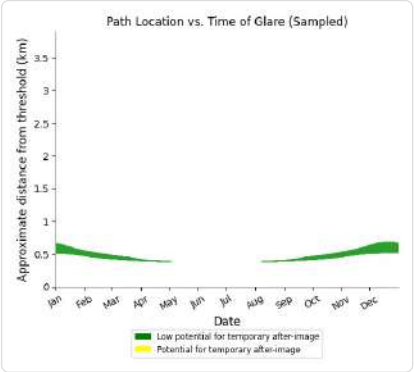
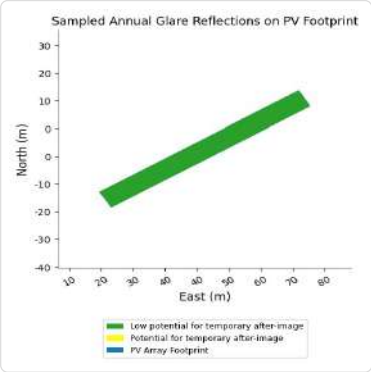
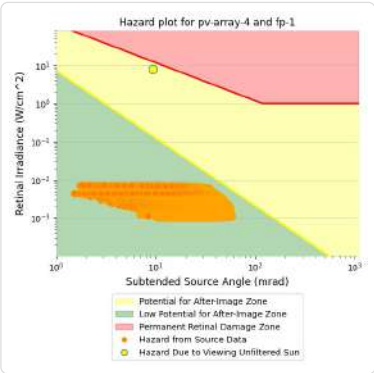
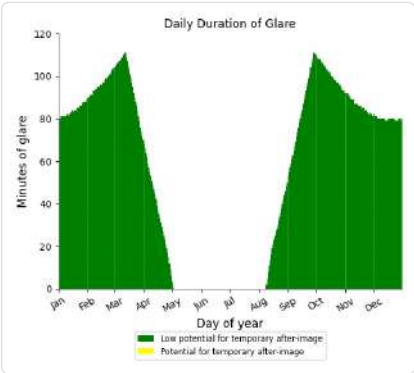
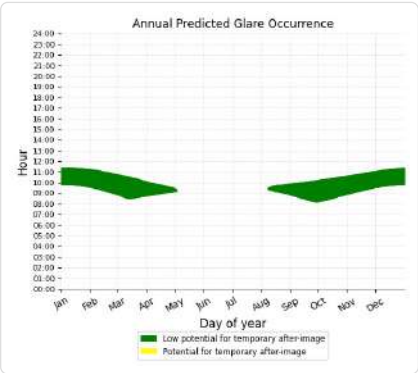
Predicted energy output: 92,780.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	20867	0
FP: FP 2	0	0

PV array 4: FP 1

PV array is expected to produce the following glare for this receptor:

- 20,867 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 4: FP 2

No glare found

PV array 5 low potential for temporary after-image

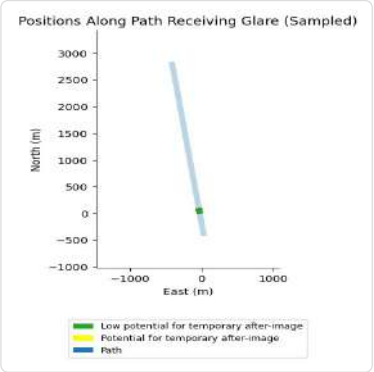
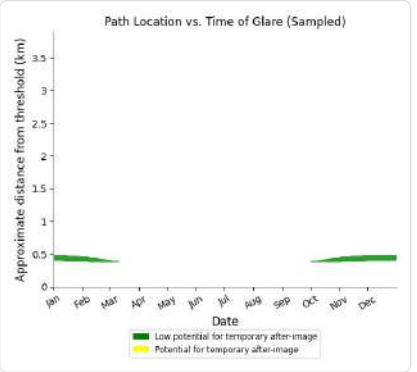
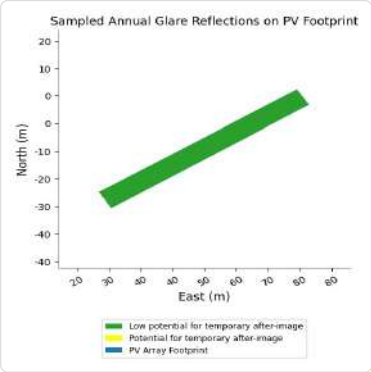
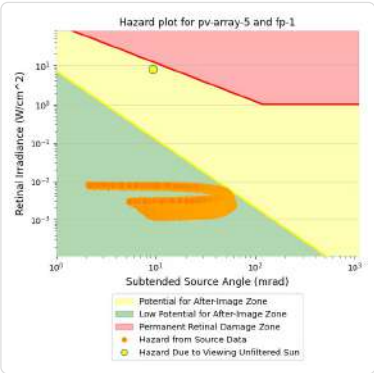
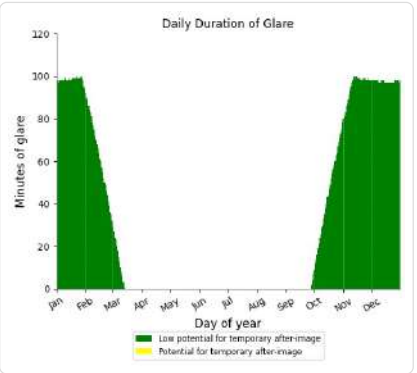
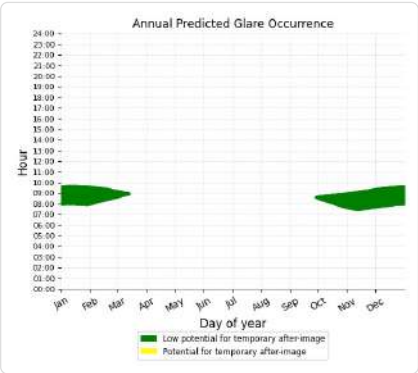
Predicted energy output: 104,700.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	12339	0
FP: FP 2	0	0

PV array 5: FP 1

PV array is expected to produce the following glare for this receptor:

- 12,339 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 5: FP 2

No glare found

PV array 6 low potential for temporary after-image

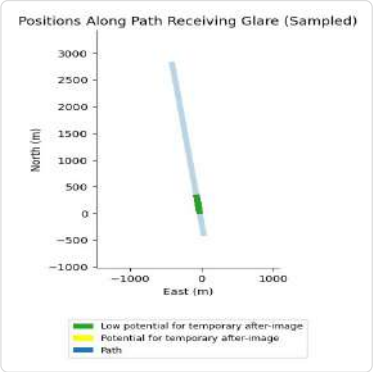
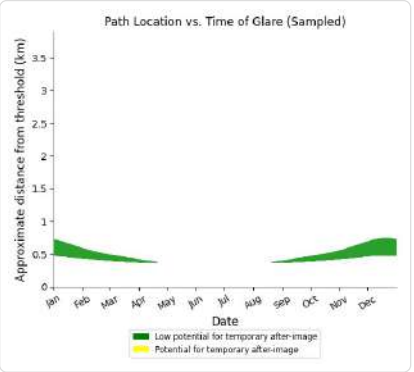
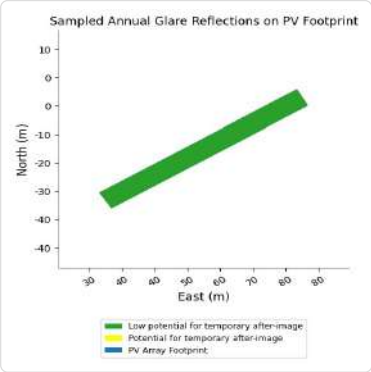
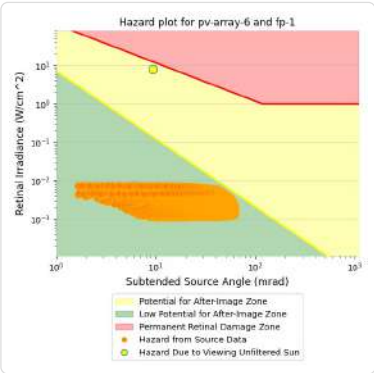
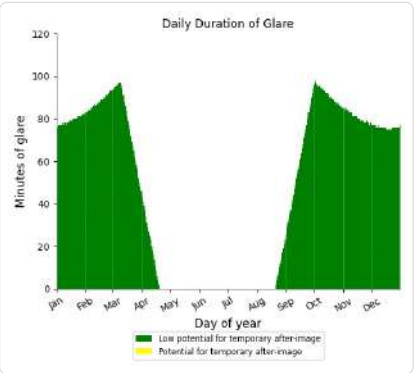
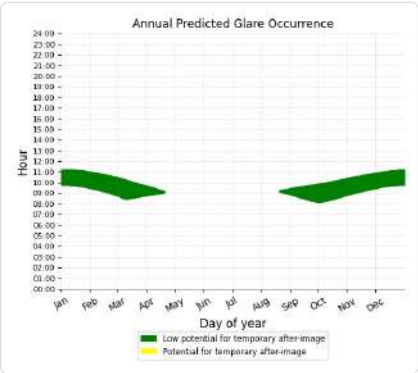
Predicted energy output: 90,210.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	17384	0
FP: FP 2	0	0

PV array 6: FP 1

PV array is expected to produce the following glare for this receptor:

- 17,384 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 6: FP 2

No glare found

PV array 7 low potential for temporary after-image

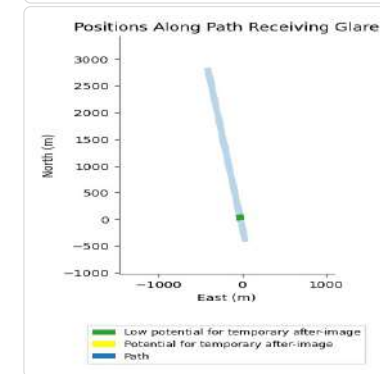
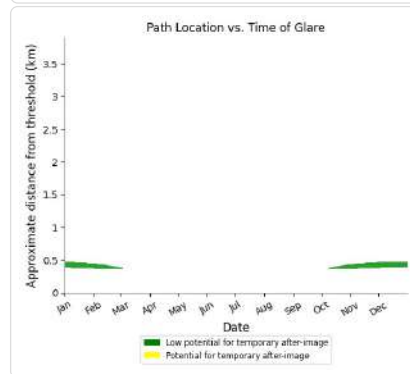
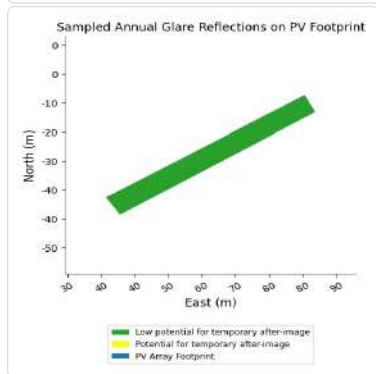
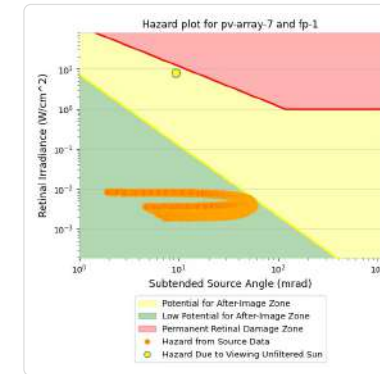
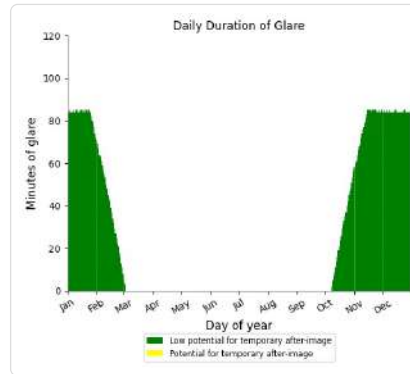
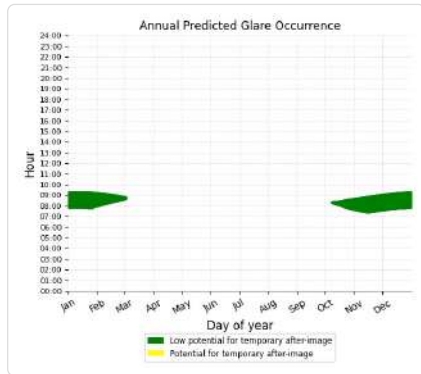
Predicted energy output: 98,670.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	9418	0
FP: FP 2	0	0

PV array 7: FP 1

PV array is expected to produce the following glare for this receptor:

- 9,418 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 7: FP 2

No glare found

PV array 8 low potential for temporary after-image

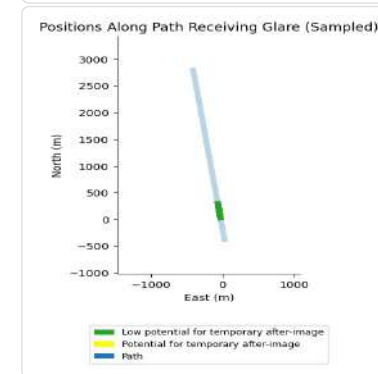
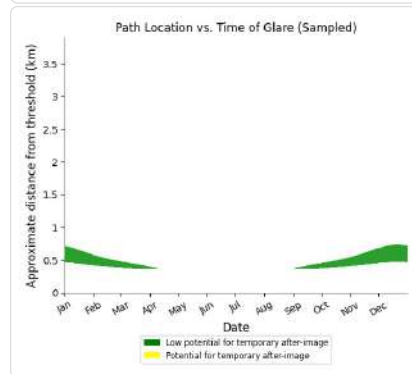
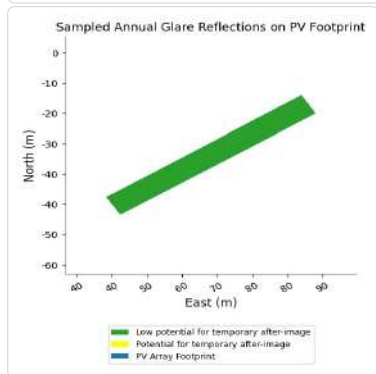
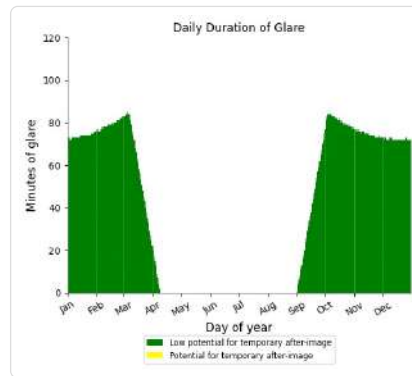
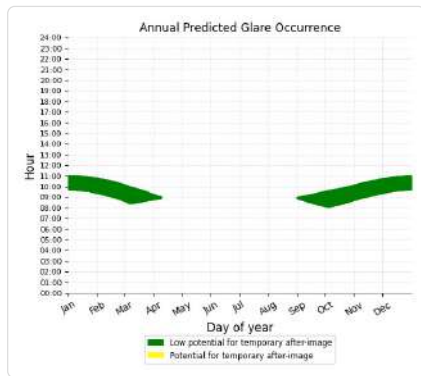
Predicted energy output: 84,860.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	14611	0
FP: FP 2	0	0

PV array 8: FP 1

PV array is expected to produce the following glare for this receptor:

- 14,611 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 8: FP 2

No glare found

PV array 9 low potential for temporary after-image

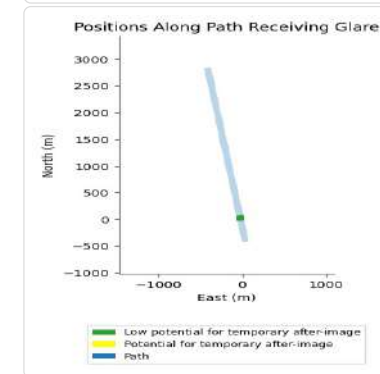
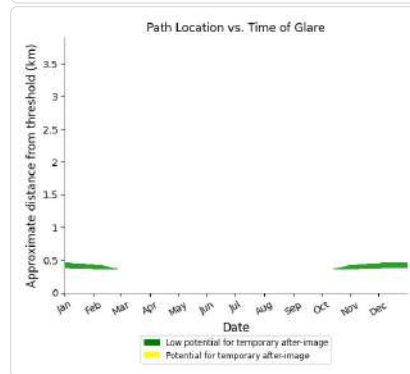
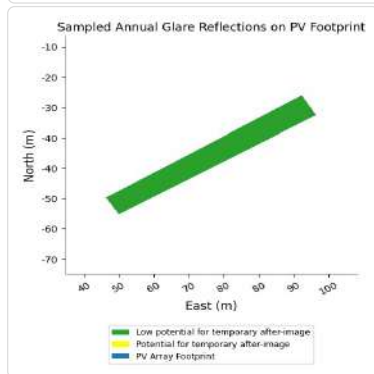
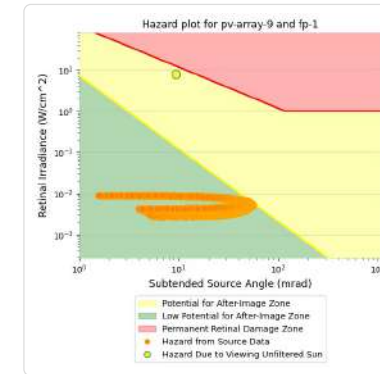
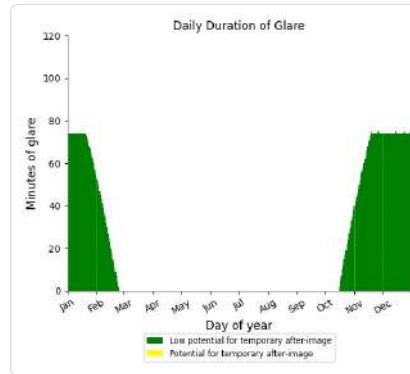
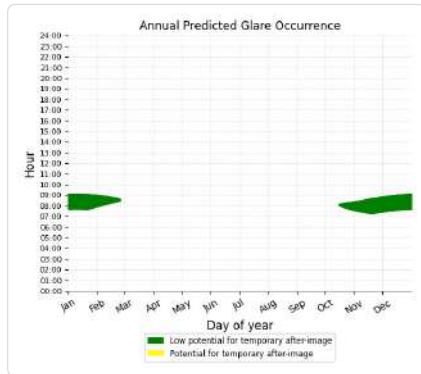
Predicted energy output: 95,710.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	7407	0
FP: FP 2	0	0

PV array 9: FP 1

PV array is expected to produce the following glare for this receptor:

- 7,407 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.



PV array 9: FP 2

No glare found

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not automatically 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 V1 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.
- Refer to the **Help page** for detailed assumptions and limitations not listed here.

FORGESOLAR GLARE ANALYSIS

Project: **OMA s.p.a.**

Site configuration: **OMA spa**

Created 16 Jul, 2024

Updated 17 Jul, 2024

Time-step 1 minute

Timezone offset UTC1

Minimum sun altitude 0.0 deg

DNI peaks at 1,000.0 W/m²

Site ID 124328.21324

Ocular transmission coefficient 0.5

Pupil diameter 0.002 m

Eye focal length 0.017 m

Sun subtended angle 9.3 mrad

PV analysis methodology V2



Glare Policy Adherence

The following table estimates the policy adherence of this glare analysis according to the **2021** U.S. Federal Aviation Administration Policy:

Review of Solar Energy System Projects on Federally-Obligated Airports

This policy may require the following criteria be met for solar energy systems on airport property:

- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics, including 1-minute time step.

ForgeSolar is not affiliated with the U.S. FAA and does not represent or speak officially for the U.S. FAA. ForgeSolar cannot approve or deny projects - results are informational only. Contact the relevant airport and FAA district office for information on policy and requirements.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
ATCT(s)	N/A	No ATCT receptors assessed

The referenced policy can be read at <https://www.federalregister.gov/d/2021-09862>

Component Data

This report includes results for PV arrays and Observation Point ("OP") receptors marked as ATCTs. Components that are not pertinent to the policy, such as routes, flight paths, and vertical surfaces, are excluded.

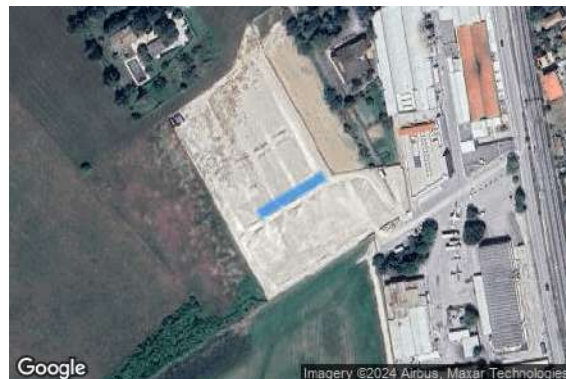
PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 150.0°
Rated power: 59.67 kW
Panel material: Light textured 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	42.943148	12.710646	225.50	3.00	228.50
2	42.943429	12.711295	225.50	3.00	228.50
3	42.943390	12.711326	225.50	3.00	228.50
4	42.943106	12.710683	225.50	3.00	228.50

Name: PV array 10
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 330.0°
Rated power: 45.9 kW
Panel material: Light textured 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	42.942600	12.711240	225.50	3.00	228.50
2	42.942834	12.711791	225.50	3.00	228.50
3	42.942794	12.711824	225.50	3.00	228.50
4	42.942563	12.711274	225.50	3.00	228.50

Name: PV array 11

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 44.37 kW

Panel material: Light textured 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	42.942521	12.711359	225.50	3.00	228.50
2	42.942736	12.711865	225.50	3.00	228.50
3	42.942697	12.711898	225.50	3.00	228.50
4	42.942480	12.711399	225.50	3.00	228.50

Name: PV array 12

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 42.84 kW

Panel material: Light textured 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	42.942479	12.711422	225.50	3.00	228.50
2	42.942688	12.711903	225.50	3.00	228.50
3	42.942647	12.711940	225.50	3.00	228.50
4	42.942436	12.711457	225.50	3.00	228.50

Name: PV array 13

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 41.31 kW

Panel material: Light textured 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	42.942398	12.711517	225.50	3.00	228.50
2	42.942602	12.711979	225.50	3.00	228.50
3	42.942562	12.712015	225.50	3.00	228.50
4	42.942355	12.711551	225.50	3.00	228.50

Name: PV array 14

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 39.78 kW

Panel material: Light textured 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	42.942356	12.711576	225.50	3.00	228.50
2	42.942555	12.712021	225.50	3.00	228.50
3	42.942513	12.712058	225.50	3.00	228.50
4	42.942314	12.711614	225.50	3.00	228.50

Name: PV array 2

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 58.14 kW

Panel material: Light textured 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	42.943108	12.710707	225.50	3.00	228.50
2	42.943384	12.711331	225.50	3.00	228.50
3	42.943340	12.711364	225.50	3.00	228.50
4	42.943068	12.710742	225.50	3.00	228.50

Name: PV array 3

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 55.08 kW

Panel material: Light textured 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	42.943021	12.710785	225.50	3.00	228.50
2	42.943293	12.711407	225.50	3.00	228.50
3	42.943254	12.711442	225.50	3.00	228.50
4	42.942982	12.710817	225.50	3.00	228.50

Name: PV array 4

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 53.55 kW

Panel material: Light textured 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	42.942983	12.710837	225.50	3.00	228.50
2	42.943246	12.711449	225.50	3.00	228.50
3	42.943206	12.711482	225.50	3.00	228.50
4	42.942944	12.710872	225.50	3.00	228.50

Name: PV array 5

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 53.55 kW

Panel material: Light textured 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	42.942898	12.710912	225.50	3.00	228.50
2	42.943164	12.711519	225.50	3.00	228.50
3	42.943125	12.711553	225.50	3.00	228.50
4	42.942856	12.710947	225.50	3.00	228.50

Name: PV array 6

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 52.02 kW

Panel material: Light textured 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	42.942856	12.710971	225.50	3.00	228.50
2	42.943118	12.711561	225.50	3.00	228.50
3	42.943078	12.711594	225.50	3.00	228.50
4	42.942817	12.711006	225.50	3.00	228.50

Name: PV array 7

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 50.49 kW

Panel material: Light textured 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	42.942770	12.711055	225.50	3.00	228.50
2	42.943022	12.711631	225.50	3.00	228.50
3	42.942982	12.711661	225.50	3.00	228.50
4	42.942728	12.711093	225.50	3.00	228.50

Name: PV array 8

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 48.96 kW

Panel material: Light textured 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	42.942733	12.711123	225.50	3.00	228.50
2	42.942975	12.711666	225.50	3.00	228.50
3	42.942933	12.711704	225.50	3.00	228.50
4	42.942693	12.711160	225.50	3.00	228.50

Name: PV array 9

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 48.96 kW

Panel material: Light textured 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	42.942645	12.711200	225.50	3.00	228.50
2	42.942887	12.711746	225.50	3.00	228.50
3	42.942842	12.711784	225.50	3.00	228.50
4	42.942607	12.711234	225.50	3.00	228.50

Observation Point ATCT Receptors

No ATCT receptors were included in the analysis.

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	5.0	150.0	0	0.0	0	0.0	116,600.0
PV array 10	5.0	330.0	0	0.0	0	0.0	79,560.0
PV array 11	5.0	150.0	0	0.0	0	0.0	86,750.0
PV array 12	5.0	330.0	0	0.0	0	0.0	74,250.0
PV array 13	5.0	150.0	0	0.0	0	0.0	80,750.0
PV array 14	5.0	330.0	0	0.0	0	0.0	68,940.0
PV array 2	5.0	330.0	0	0.0	0	0.0	100,700.0
PV array 3	5.0	150.0	0	0.0	0	0.0	107,700.0
PV array 4	5.0	330.0	0	0.0	0	0.0	92,780.0
PV array 5	5.0	150.0	0	0.0	0	0.0	104,700.0
PV array 6	5.0	330.0	0	0.0	0	0.0	90,210.0
PV array 7	5.0	150.0	0	0.0	0	0.0	98,670.0
PV array 8	5.0	330.0	0	0.0	0	0.0	84,860.0
PV array 9	5.0	150.0	0	0.0	0	0.0	95,710.0

No ATCT receptors were included in the analysis.

PV: PV array 1

No ATCT receptors assessed.

PV: PV array 10

No ATCT receptors assessed.

PV: PV array 11

No ATCT receptors assessed.

PV: PV array 12

No ATCT receptors assessed.

PV: PV array 13

No ATCT receptors assessed.

PV: PV array 14

No ATCT receptors assessed.

PV: PV array 2

No ATCT receptors assessed.

PV: PV array 3

No ATCT receptors assessed.

PV: PV array 4

No ATCT receptors assessed.

PV: PV array 5

No ATCT receptors assessed.

PV: PV array 6

No ATCT receptors assessed.

PV: PV array 7

No ATCT receptors assessed.

PV: PV array 8

No ATCT receptors assessed.

PV: PV array 9

No ATCT receptors assessed.

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.

The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.

Several V1 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. This primarily affects V1 analyses of path receptors.

Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.

The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.

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.)

The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.

The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.

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.

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.

Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.

Refer to the Help page at www.forgesolar.com/help/ for assumptions and limitations not listed here.

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

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FORGESOLAR GLARE ANALYSIS

Project: **OMA s.p.a.**

Site configuration: **OMA spa**

Analysis conducted by Guido Di Girolamo (info.digirolamoarchitetti@gmail.com) at 07:42 on 17 Jul, 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)	N/A	No ATCT receptors designated

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/m²
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: 124328.21324
Methodology: V2



PV Array(s)

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 150.0°
Rated power: 59.67 kW
Panel material: Light textured 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	42.943148	12.710646	225.50	3.00	228.50
2	42.943429	12.711295	225.50	3.00	228.50
3	42.943390	12.711326	225.50	3.00	228.50
4	42.943106	12.710683	225.50	3.00	228.50

Name: PV array 10

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 45.9 kW

Panel material: Light textured 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	42.942600	12.711240	225.50	3.00	228.50
2	42.942834	12.711791	225.50	3.00	228.50
3	42.942794	12.711824	225.50	3.00	228.50
4	42.942563	12.711274	225.50	3.00	228.50

Name: PV array 11

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 44.37 kW

Panel material: Light textured 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	42.942521	12.711359	225.50	3.00	228.50
2	42.942736	12.711865	225.50	3.00	228.50
3	42.942697	12.711898	225.50	3.00	228.50
4	42.942480	12.711399	225.50	3.00	228.50

Name: PV array 12

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 42.84 kW

Panel material: Light textured 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	42.942479	12.711422	225.50	3.00	228.50
2	42.942688	12.711903	225.50	3.00	228.50
3	42.942647	12.711940	225.50	3.00	228.50
4	42.942436	12.711457	225.50	3.00	228.50

Name: PV array 13

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 41.31 kW

Panel material: Light textured 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	42.942398	12.711517	225.50	3.00	228.50
2	42.942602	12.711979	225.50	3.00	228.50
3	42.942562	12.712015	225.50	3.00	228.50
4	42.942355	12.711551	225.50	3.00	228.50

Name: PV array 14

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 39.78 kW

Panel material: Light textured 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	42.942356	12.711576	225.50	3.00	228.50
2	42.942555	12.712021	225.50	3.00	228.50
3	42.942513	12.712058	225.50	3.00	228.50
4	42.942314	12.711614	225.50	3.00	228.50

Name: PV array 2

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 58.14 kW

Panel material: Light textured 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	42.943108	12.710707	225.50	3.00	228.50
2	42.943384	12.711331	225.50	3.00	228.50
3	42.943340	12.711364	225.50	3.00	228.50
4	42.943068	12.710742	225.50	3.00	228.50

Name: PV array 3

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 55.08 kW

Panel material: Light textured 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	42.943021	12.710785	225.50	3.00	228.50
2	42.943293	12.711407	225.50	3.00	228.50
3	42.943254	12.711442	225.50	3.00	228.50
4	42.942982	12.710817	225.50	3.00	228.50

Name: PV array 4

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 53.55 kW

Panel material: Light textured 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	42.942983	12.710837	225.50	3.00	228.50
2	42.943246	12.711449	225.50	3.00	228.50
3	42.943206	12.711482	225.50	3.00	228.50
4	42.942944	12.710872	225.50	3.00	228.50

Name: PV array 5

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 53.55 kW

Panel material: Light textured 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	42.942898	12.710912	225.50	3.00	228.50
2	42.943164	12.711519	225.50	3.00	228.50
3	42.943125	12.711553	225.50	3.00	228.50
4	42.942856	12.710947	225.50	3.00	228.50

Name: PV array 6

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 52.02 kW

Panel material: Light textured 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	42.942856	12.710971	225.50	3.00	228.50
2	42.943118	12.711561	225.50	3.00	228.50
3	42.943078	12.711594	225.50	3.00	228.50
4	42.942817	12.711006	225.50	3.00	228.50

Name: PV array 7

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 50.49 kW

Panel material: Light textured 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	42.942770	12.711055	225.50	3.00	228.50
2	42.943022	12.711631	225.50	3.00	228.50
3	42.942982	12.711661	225.50	3.00	228.50
4	42.942728	12.711093	225.50	3.00	228.50

Name: PV array 8

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 330.0°

Rated power: 48.96 kW

Panel material: Light textured 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	42.942733	12.711123	225.50	3.00	228.50
2	42.942975	12.711666	225.50	3.00	228.50
3	42.942933	12.711704	225.50	3.00	228.50
4	42.942693	12.711160	225.50	3.00	228.50

Name: PV array 9

Axis tracking: Fixed (no rotation)

Tilt: 5.0°

Orientation: 150.0°

Rated power: 48.96 kW

Panel material: Light textured 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	42.942645	12.711200	225.50	3.00	228.50
2	42.942887	12.711746	225.50	3.00	228.50
3	42.942842	12.711784	225.50	3.00	228.50
4	42.942607	12.711234	225.50	3.00	228.50

Flight Path Receptor(s)

Name: FP 1

Description:

Threshold height: 15 m

Direction: 172.1°

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	42.939664	12.711045	221.69	15.24	236.93
Two-mile	42.968305	12.705631	240.08	165.53	405.61

Name: FP 2

Description:

Threshold height: 15 m

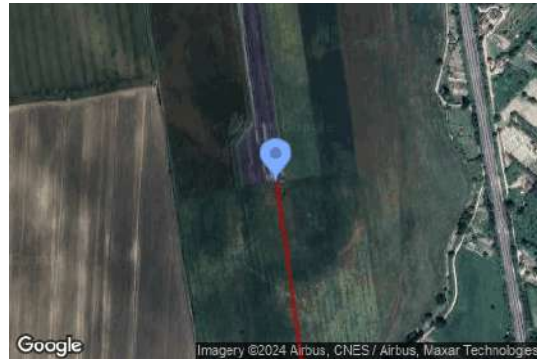
Direction: 352.1°

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	42.927178	12.713466	210.77	15.24	226.01
Two-mile	42.898543	12.718927	208.48	186.22	394.69

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	5.0	150.0	18,622	0	116,600.0
PV array 10	5.0	330.0	13,310	0	79,560.0
PV array 11	5.0	150.0	5,678	0	86,750.0
PV array 12	5.0	330.0	11,544	0	74,250.0
PV array 13	5.0	150.0	4,287	0	80,750.0
PV array 14	5.0	330.0	10,551	0	68,940.0
PV array 2	5.0	330.0	23,923	0	100,700.0
PV array 3	5.0	150.0	15,616	0	107,700.0
PV array 4	5.0	330.0	20,867	0	92,780.0
PV array 5	5.0	150.0	12,339	0	104,700.0
PV array 6	5.0	330.0	17,384	0	90,210.0
PV array 7	5.0	150.0	9,418	0	98,670.0
PV array 8	5.0	330.0	14,611	0	84,860.0
PV array 9	5.0	150.0	7,407	0	95,710.0

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP 1	185557	0
FP 2	0	0

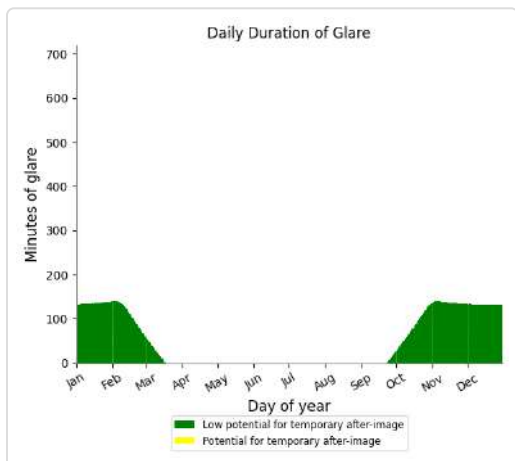
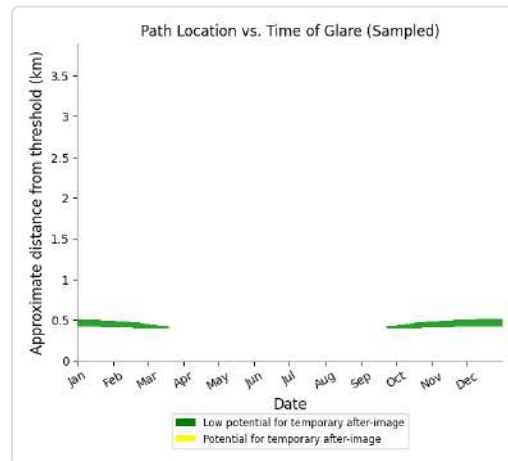
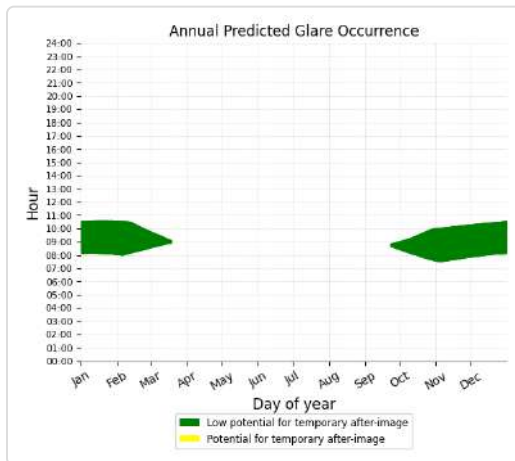
Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	18622	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

18622 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

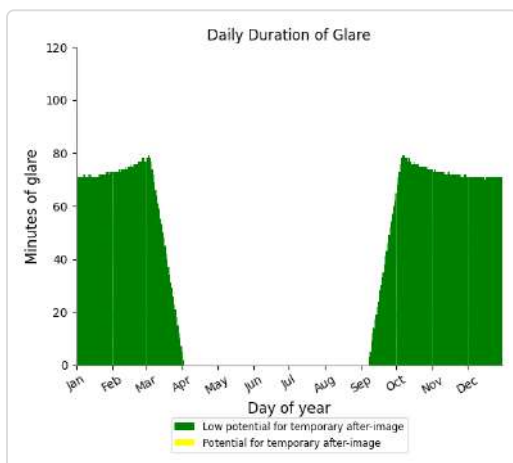
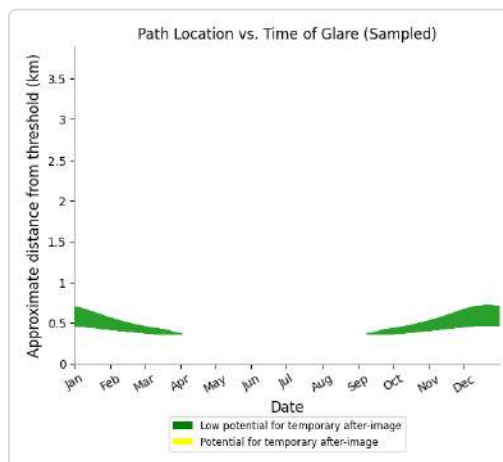
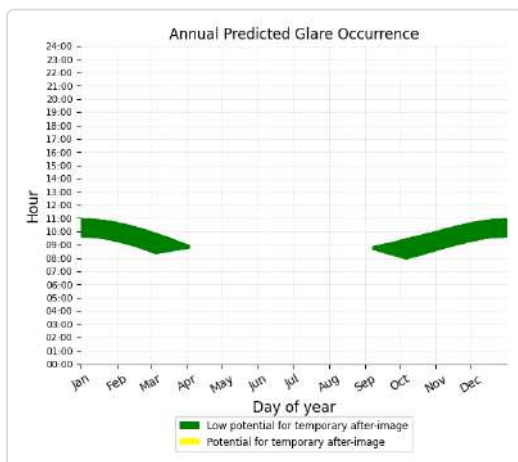
Results for: PV array 10

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	13310	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

13310 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

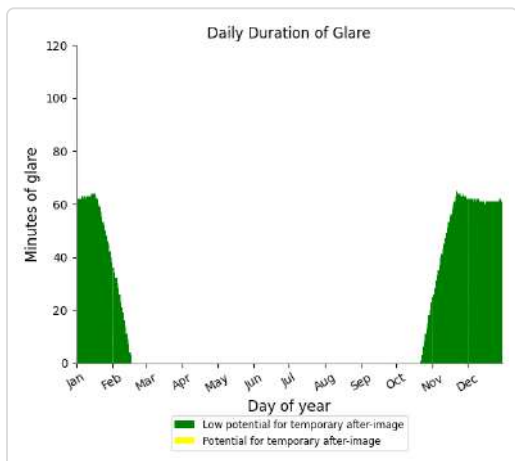
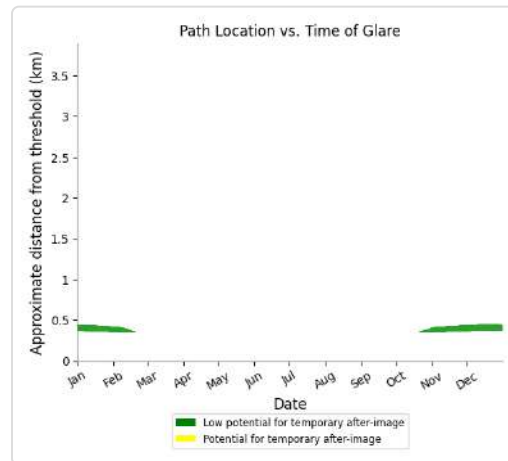
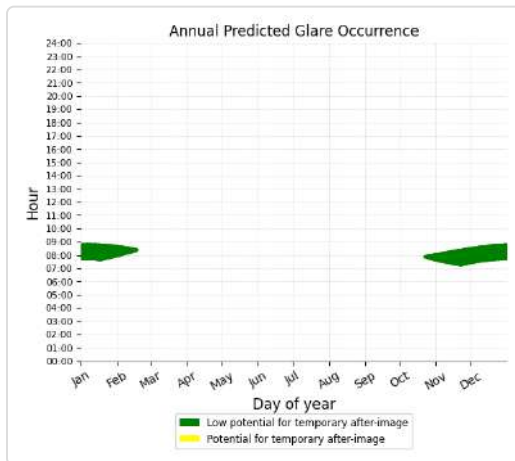
Results for: PV array 11

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	5678	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

5678 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

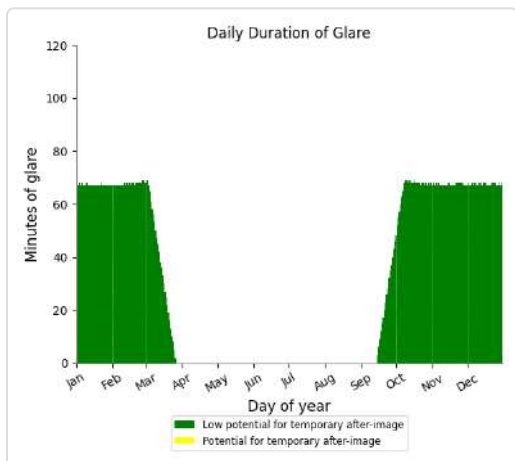
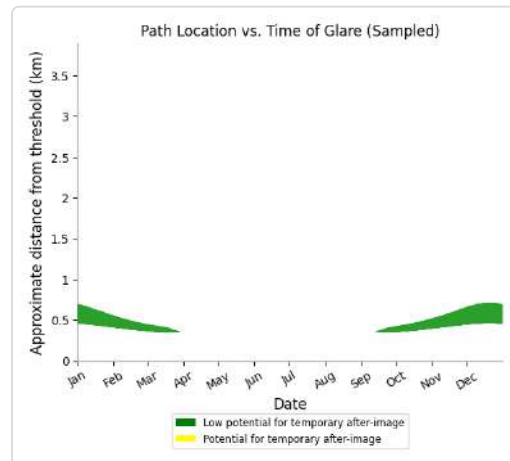
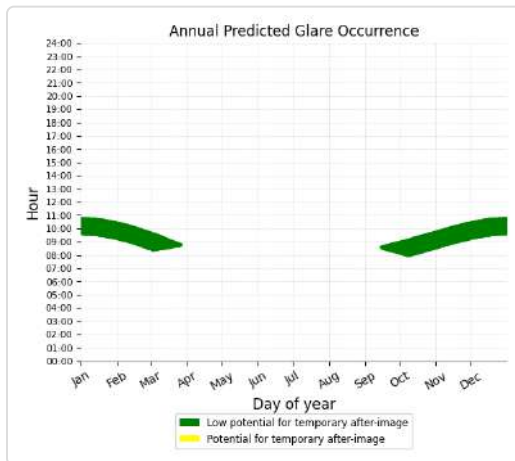
Results for: PV array 12

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	11544	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

11544 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

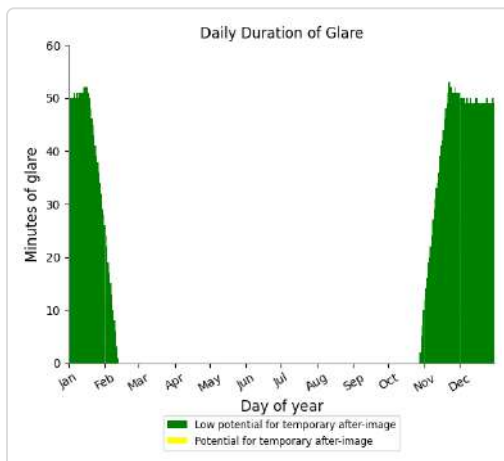
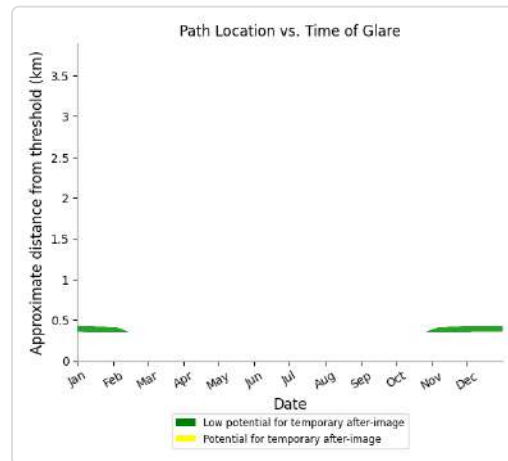
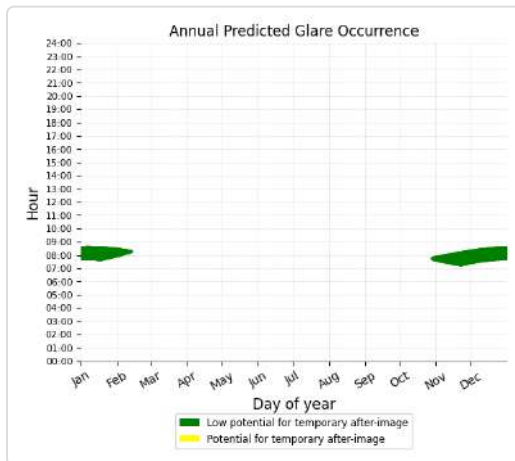
Results for: PV array 13

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	4287	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

4287 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

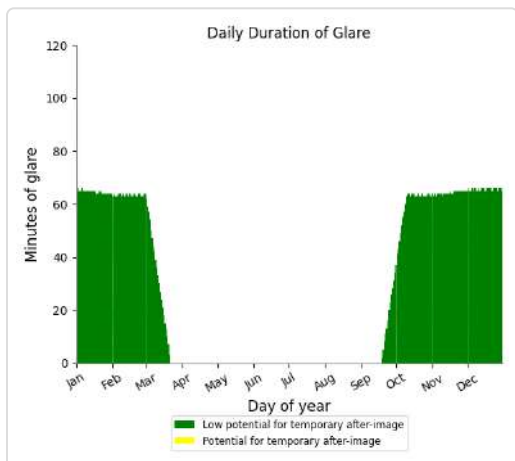
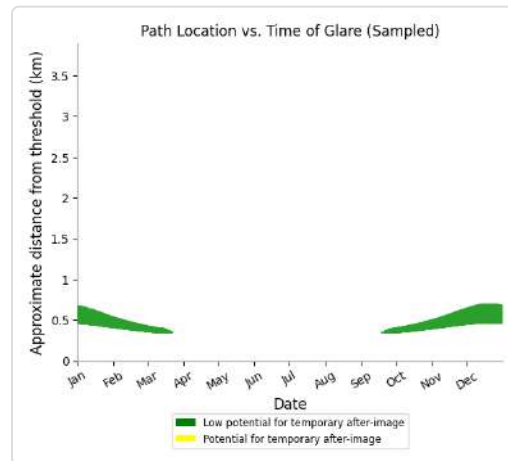
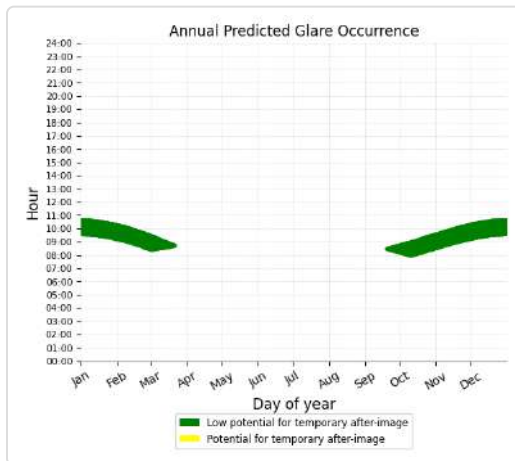
Results for: PV array 14

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	10551	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

10551 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

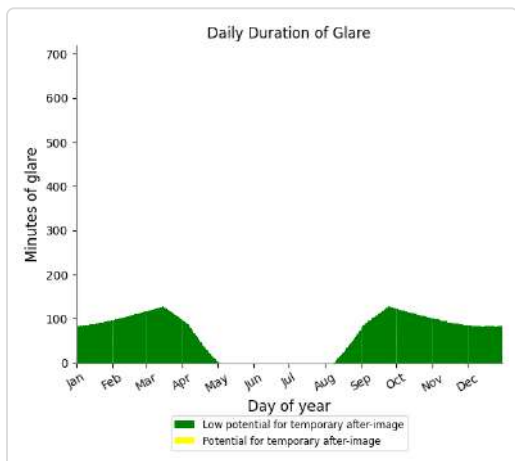
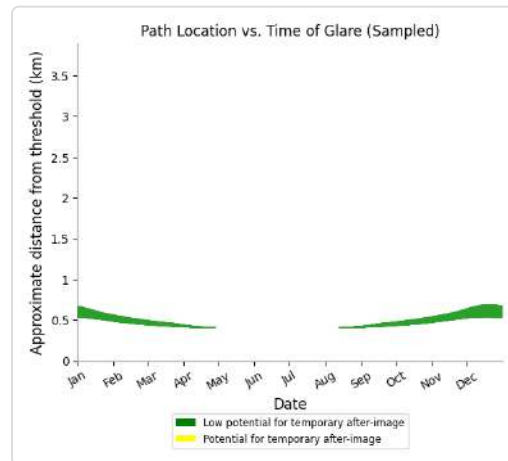
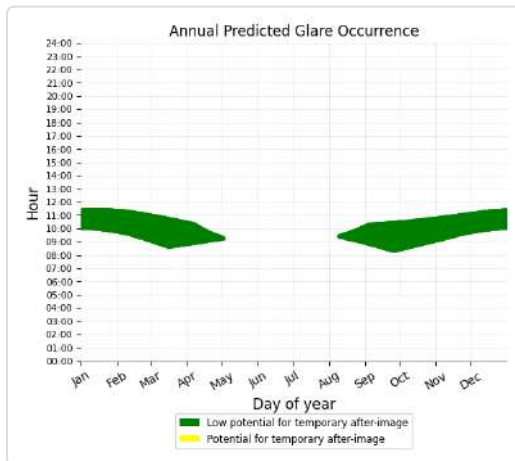
Results for: PV array 2

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	23923	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

23923 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

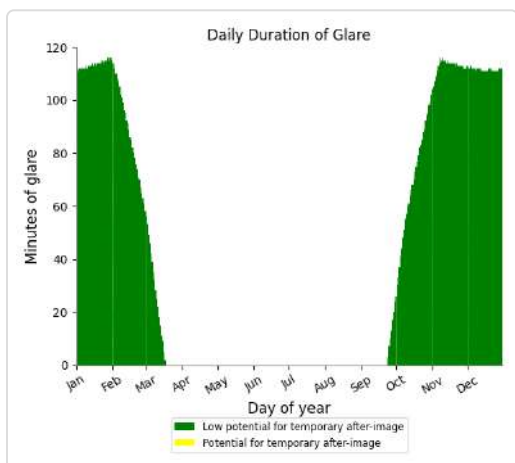
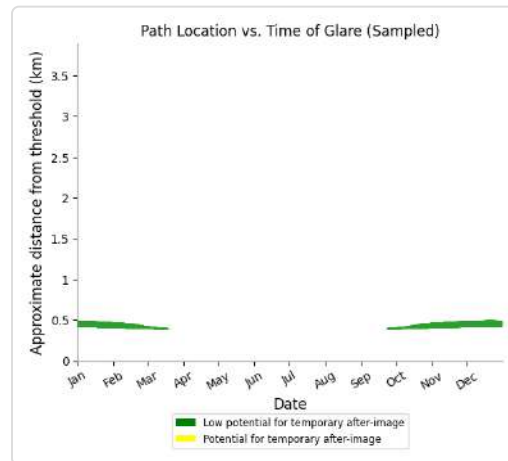
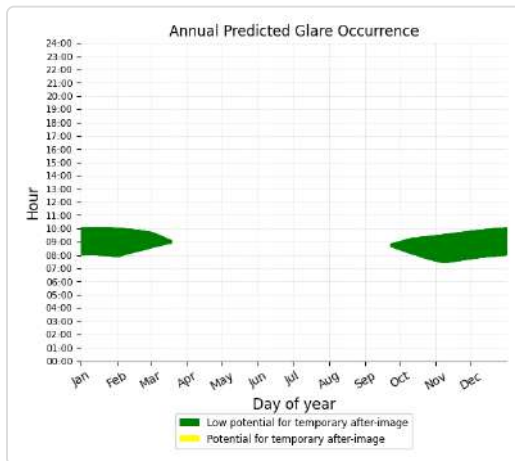
Results for: PV array 3

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	15616	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

15616 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

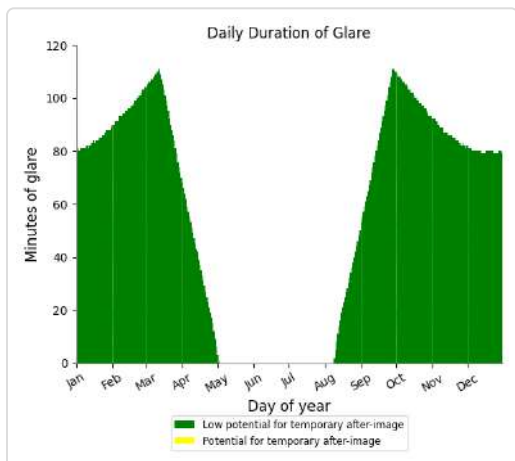
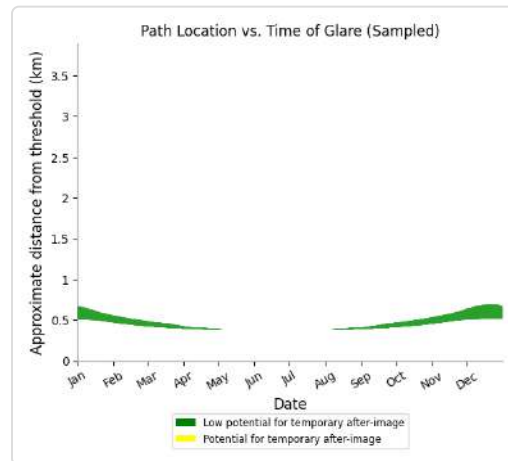
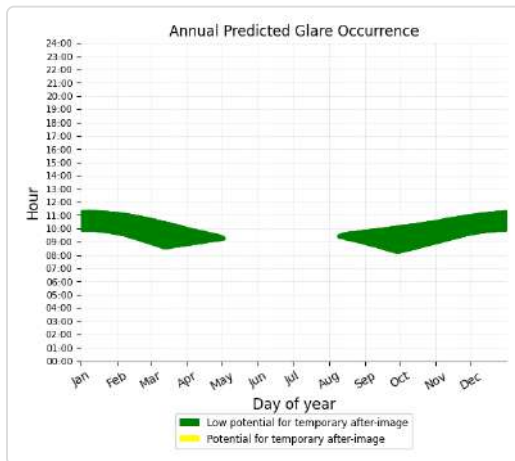
Results for: PV array 4

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	20867	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

20867 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

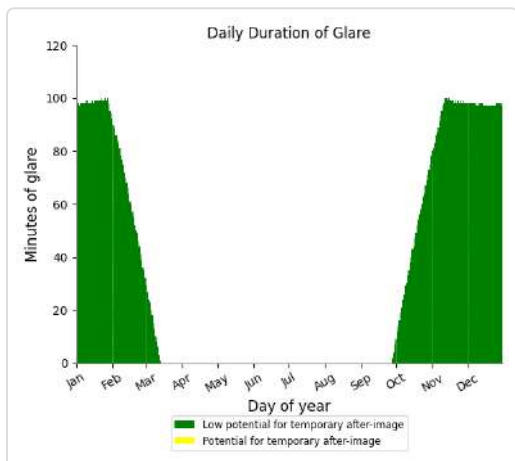
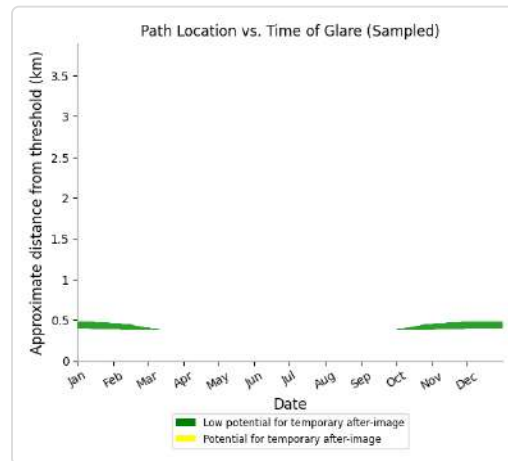
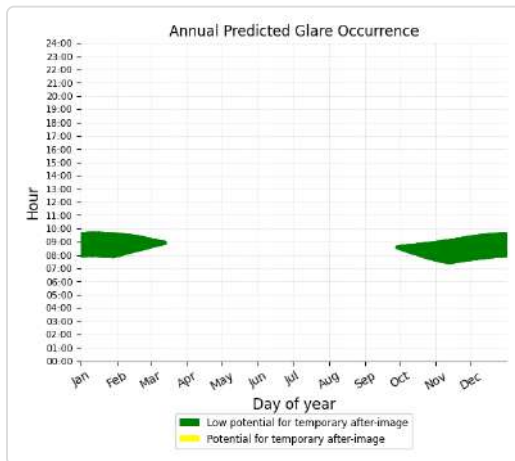
Results for: PV array 5

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	12339	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

12339 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

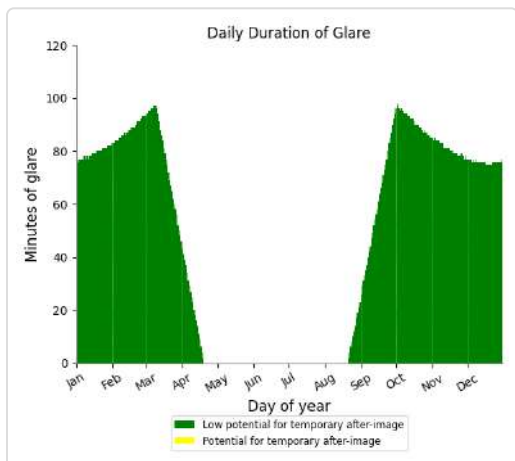
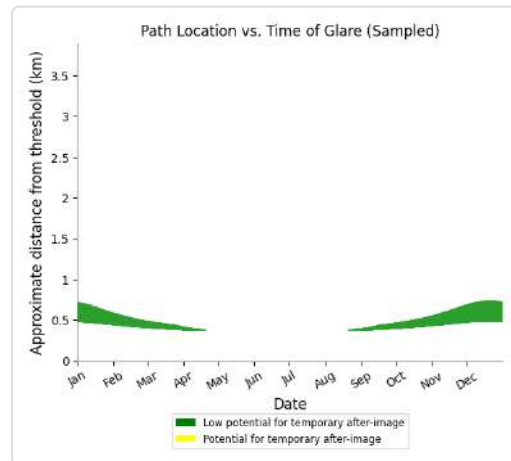
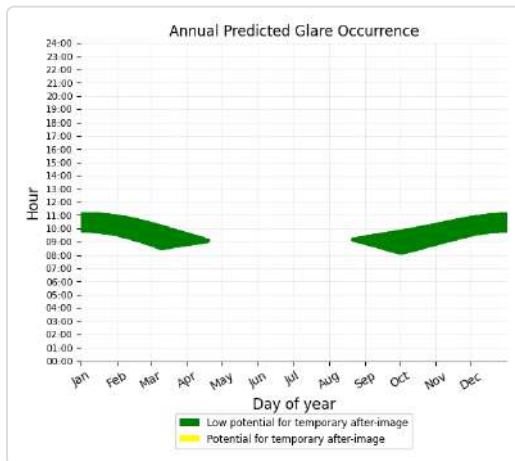
Results for: PV array 6

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	17384	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

17384 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

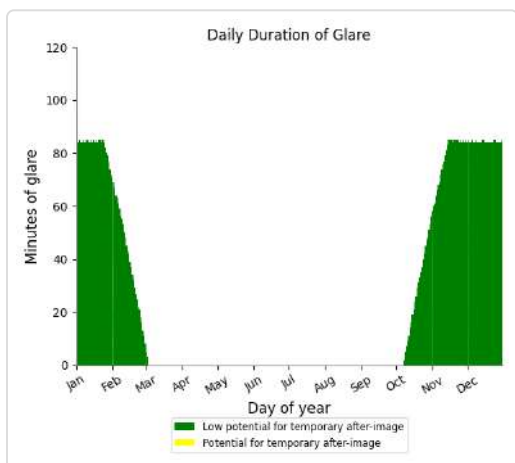
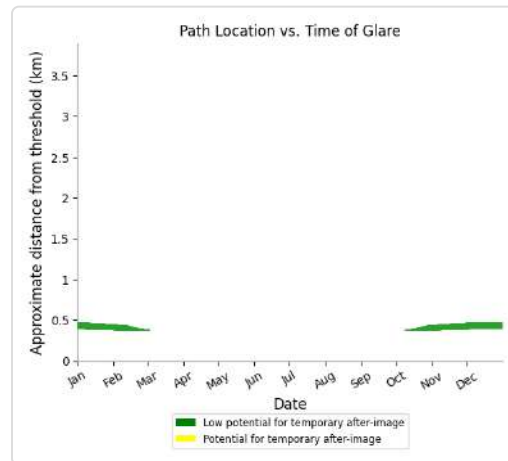
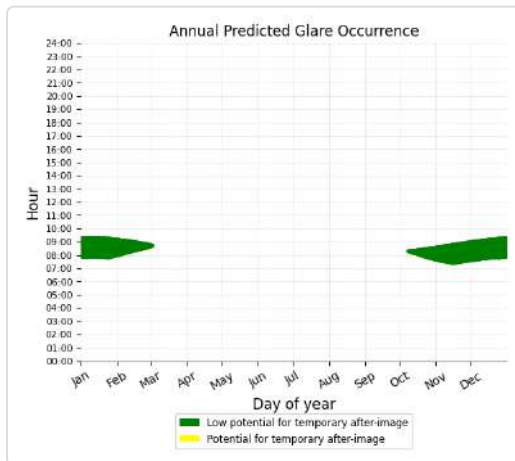
Results for: PV array 7

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	9418	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

9418 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

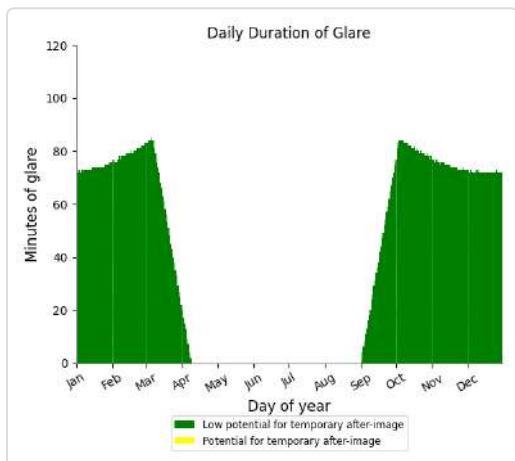
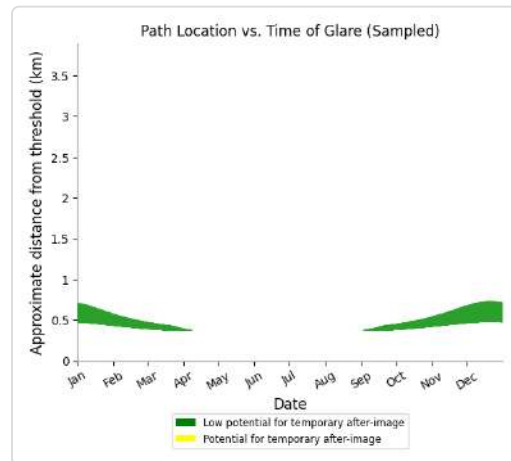
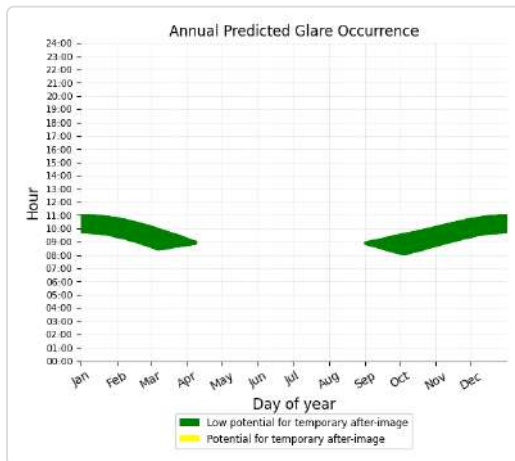
Results for: PV array 8

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	14611	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

14611 minutes of green glare



Flight Path: FP 2

0 minutes of yellow glare

0 minutes of green glare

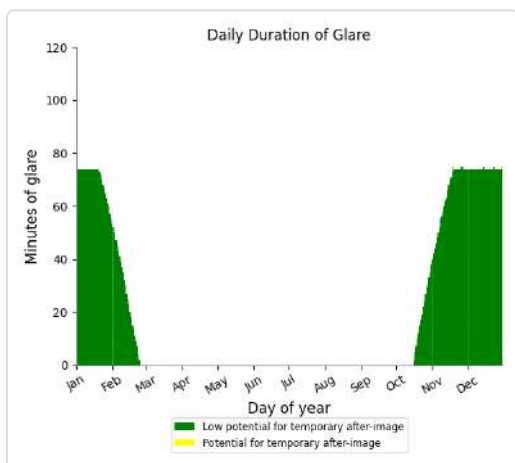
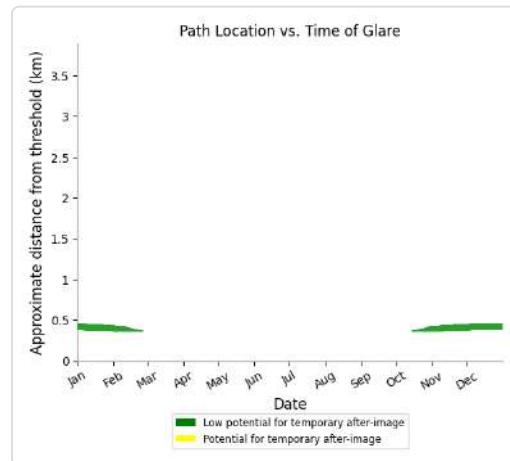
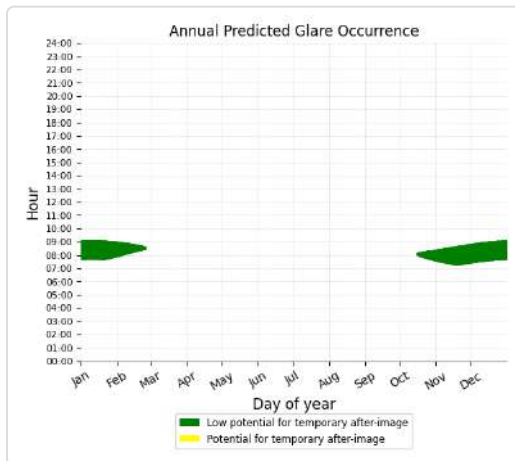
Results for: PV array 9

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	7407	0
FP 2	0	0

Flight Path: FP 1

0 minutes of yellow glare

7407 minutes of green glare



Flight Path: FP 2

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.

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REPORT

Richiedente

Nome/Società:	O.M.A. S.P.A.	Cognome/Rag.	S.P.A.
C.F./P.IVA:		Comune	Foligno
Provincia	Pg	CAP:	06034
Indirizzo:	Via Cagliari	N° Civico:	20
Mail:	commercial@omafoligno.it	PEC:	omafoligno@pcert.postecert.it
Telefono:	074234751	Cellulare:	3469484548
Fax :			

Tecnico

Nome:	Guido	Cognome:	Di Girolamo
Matricola:	1013	Albo:	Architetti

Ostacolo: Impianto fotovoltaico

Materiale:	Silicio e ferro	
☐ Ostacolo posizionato nel Centro Abitato		
☐ Presenza ostacolo con altezza AGL uguale o superiore a 60 m entro raggio 200 m		

Gruppo Geografico

UMBRIA-PG-Foligno-Via Cagliari 20

Nr	Latitudine wgs84	Longitudine wgs84	Quota terreno	Altezza al Top	Elevazione al Top	Raggio
1	42° 56' 35.19" N	12° 42' 38.09" E	225.5 m	3.0 m	228.5 m	0.0 m
	Nessuna interferenza rilevata per gli aeroporti e i sistemi di comunicazione/navigazione/RADAR di ENAV S.p.A. Per i restanti criteri selettivi fare riferimento al documento "Verifica Preliminare" (www.enac.gov.it)					
2	42° 56' 36.6" N	12° 42' 40.94" E	225.5 m	3.0 m	228.5 m	0.0 m
	Nessuna interferenza rilevata per gli aeroporti e i sistemi di comunicazione/navigazione/RADAR di ENAV S.p.A. Per i restanti criteri selettivi fare riferimento al documento "Verifica Preliminare" (www.enac.gov.it)					
3	42° 56' 32.76" N	12° 42' 43.78" E	225.5 m	3.0 m	228.5 m	0.0 m
	Nessuna interferenza rilevata per gli aeroporti e i sistemi di comunicazione/navigazione/RADAR di ENAV S.p.A. Per i restanti criteri selettivi fare riferimento al documento "Verifica Preliminare" (www.enac.gov.it)					
4	42° 56' 31.39" N	12° 42' 41.01" E	225.5 m	3.0 m	228.5 m	0.0 m
	Nessuna interferenza rilevata per gli aeroporti e i sistemi di comunicazione/navigazione/RADAR di ENAV S.p.A. Per i restanti criteri selettivi fare riferimento al documento "Verifica Preliminare" (www.enac.gov.it)					

