

# FORGESOLAR GLARE ANALYSIS

Project: **BRINDISI\_valutazione ENAC**

impianto agrivoltaico da 45,7 MWp superficie occupata 44 ha distanza minima da aeroporto 2 km distanza massima da aeroporto 3 km

Site configuration: **BRINDISI\_rev0**

Analysis conducted by MARCO GRANDE (marco.grande@mat-eria.com) at 09:27 on 18 Apr, 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):

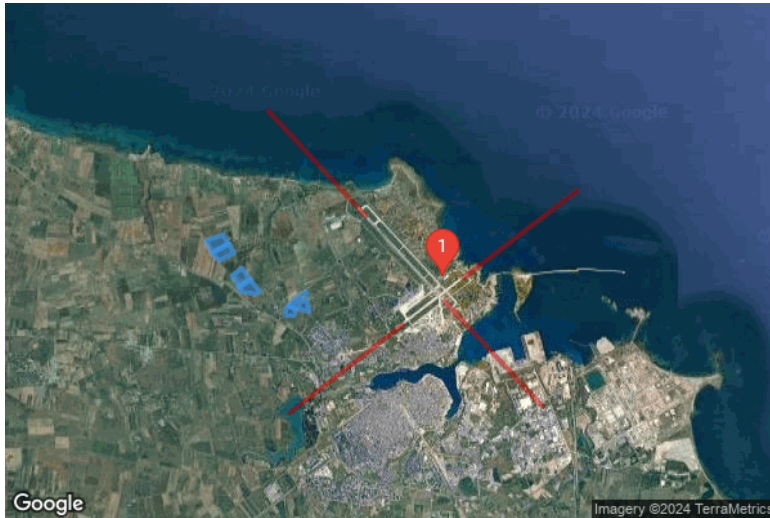
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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<sup>2</sup>  
 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: 117130.20143  
 Methodology: V2



## PV Array(s)

**Name:** PV array 1  
**Description:** lotto 1 del layout  
**Axis tracking:** Single-axis rotation  
**Backtracking:** Shade-slope  
**Tracking axis orientation:** 180.0°  
**Max tracking angle:** 55.0°  
**Resting angle:** 10.0°  
**Ground Coverage Ratio:** 0.4  
**Rated power:** 710.0 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	40.667142	17.886211	13.92	0.00	13.92
2	40.668916	17.890588	12.01	0.00	12.01
3	40.670714	17.889290	11.60	0.00	11.60
4	40.669567	17.884601	12.20	0.00	12.20

**Name:** PV array 2

**Description:** lotto 2 del layout

**Axis tracking:** Single-axis rotation

**Backtracking:** Shade-slope

**Tracking axis orientation:** 180.0°

**Max tracking angle:** 55.0°

**Resting angle:** 10.0°

**Ground Coverage Ratio:** 0.4

**Rated power:** 710.0 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	40.667036	17.886329	13.80	0.00	13.80
2	40.666531	17.886801	13.58	0.00	13.58
3	40.665465	17.888131	13.72	0.00	13.72
4	40.666955	17.892090	12.13	0.00	12.13
5	40.668802	17.890792	12.25	0.00	12.25

**Name:** PV array 3

**Description:** lotto 3 del layout

**Axis tracking:** Single-axis rotation

**Backtracking:** Shade-slope

**Tracking axis orientation:** 180.0°

**Max tracking angle:** 55.0°

**Resting angle:** 10.0°

**Ground Coverage Ratio:** 0.4

**Rated power:** 710.0 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	40.662479	17.891532	13.77	0.00	13.77
2	40.661233	17.892648	14.25	0.00	14.25
3	40.660086	17.893388	14.26	0.00	14.26
4	40.661697	17.896349	12.68	0.00	12.68
5	40.664049	17.894289	13.48	0.00	13.48

**Name:** PV array 4

**Description:** lotto 4 del layout

**Axis tracking:** Single-axis rotation

**Backtracking:** Shade-slope

**Tracking axis orientation:** 180.0°

**Max tracking angle:** 55.0°

**Resting angle:** 10.0°

**Ground Coverage Ratio:** 0.4

**Rated power:** 710.0 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	40.661608	17.896414	13.00	0.00	13.00
2	40.659345	17.898924	14.54	0.00	14.54
3	40.658596	17.897658	14.61	0.00	14.61
4	40.658930	17.896585	14.41	0.00	14.41
5	40.658946	17.895051	13.97	0.00	13.97
6	40.659036	17.894343	14.11	0.00	14.11
7	40.659109	17.894107	14.25	0.00	14.25
8	40.660005	17.893463	14.13	0.00	14.13

**Name:** PV array 5

**Description:** lotto 5 del layout

**Axis tracking:** Single-axis rotation

**Backtracking:** Shade-slope

**Tracking axis orientation:** 180.0°

**Max tracking angle:** 55.0°

**Resting angle:** 10.0°

**Ground Coverage Ratio:** 0.4

**Rated power:** 710.0 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	40.656318	17.906767	22.88	0.00	22.88
2	40.655723	17.905877	23.44	0.00	23.44
3	40.654698	17.905877	23.18	0.00	23.18
4	40.654527	17.905587	23.21	0.00	23.21
5	40.654389	17.907625	23.15	0.00	23.15
6	40.654429	17.908087	23.57	0.00	23.57
7	40.655618	17.908709	22.87	0.00	22.87
8	40.655756	17.908280	22.49	0.00	22.49

**Name:** PV array 6  
**Description:** lotto 6 del layout  
**Axis tracking:** Single-axis rotation  
**Backtracking:** Shade-slope  
**Tracking axis orientation:** 180.0°  
**Max tracking angle:** 55.0°  
**Resting angle:** 10.0°  
**Ground Coverage Ratio:** 0.4  
**Rated power:** 710.0 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	40.656407	17.906917	23.33	0.00	23.33
2	40.658190	17.909170	19.49	0.00	19.49
3	40.659182	17.911445	16.90	0.00	16.90
4	40.658515	17.911584	17.32	0.00	17.32
5	40.658222	17.909707	18.53	0.00	18.53
6	40.657197	17.909900	19.85	0.00	19.85
7	40.657490	17.911595	18.81	0.00	18.81
8	40.655170	17.912121	22.78	0.00	22.78
9	40.655609	17.909599	23.06	0.00	23.06
10	40.656895	17.909278	19.97	0.00	19.97
11	40.656668	17.908730	21.08	0.00	21.08
12	40.655772	17.908430	22.60	0.00	22.60

## Flight Path Receptor(s)

**Name:** FP 05  
**Description:**  
**Threshold height:** 15 m  
**Direction:** 52.1°  
**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	40.652513	17.937070	14.24	15.24	29.48
Two-mile	40.634736	17.906980	18.28	179.88	198.17



**Name:** FP 13  
**Description:**  
**Threshold height:** 15 m  
**Direction:** 137.1°  
**Glide slope:** 3.0°  
**Pilot view restricted?** Yes  
**Vertical view:** 30.0°  
**Azimuthal view:** 50.0°



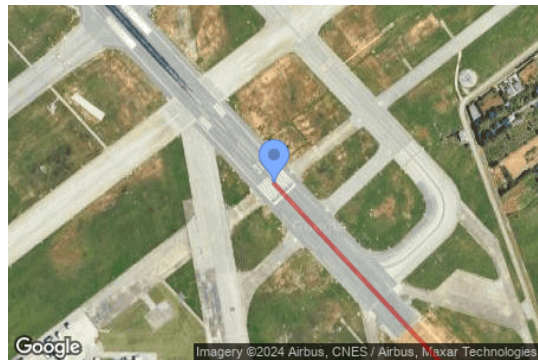
Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	40.674512	17.927188	9.00	15.24	24.24
Two-mile	40.695692	17.901207	-2.22	195.14	192.92

**Name:** FP 23  
**Description:**  
**Threshold height:** 15 m  
**Direction:** 232.6°  
**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	40.662034	17.953436	3.45	15.24	18.69
Two-mile	40.679611	17.983734	-39.04	226.41	187.37

**Name:** FP 31  
**Description:**  
**Threshold height:** 15 m  
**Direction:** 317.0°  
**Glide slope:** 3.0°  
**Pilot view restricted?** Yes  
**Vertical view:** 30.0°  
**Azimuthal view:** 50.0°

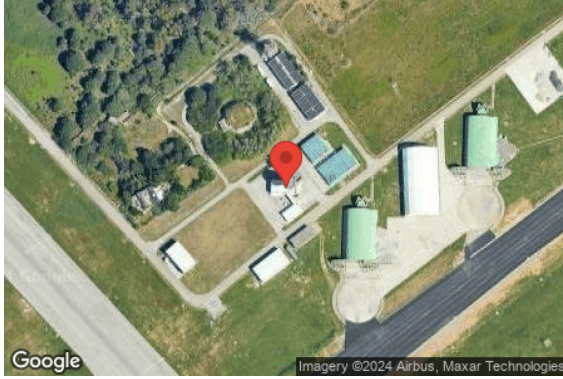


Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	40.657152	17.948389	7.19	15.24	22.43
Two-mile	40.636014	17.974422	8.70	182.42	191.12

## Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	40.662269	17.947830	5.90	15.00

Map image of 1-ATCT



# GLARE ANALYSIS RESULTS

## Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	SA tracking	SA tracking	0	0	1,926,000.0
PV array 2	SA tracking	SA tracking	0	0	1,937,000.0
PV array 3	SA tracking	SA tracking	0	0	1,926,000.0
PV array 4	SA tracking	SA tracking	0	0	1,862,000.0
PV array 5	SA tracking	SA tracking	0	0	1,958,000.0
PV array 6	SA tracking	SA tracking	0	0	1,899,000.0

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP 05	0	0
FP 13	0	0
FP 23	0	0
FP 31	0	0
1-ATCT	0	0

## Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
FP 05	0	0
FP 13	0	0
FP 23	0	0
FP 31	0	0
1-ATCT	0	0

### Flight Path: FP 05

0 minutes of yellow glare

0 minutes of green glare



### Flight Path: FP 13

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 23

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 31

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: PV array 2

Receptor	Green Glare (min)	Yellow Glare (min)
FP 05	0	0
FP 13	0	0
FP 23	0	0
FP 31	0	0
1-ATCT	0	0

### Flight Path: FP 05

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 13

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 23

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 31

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: PV array 3

Receptor	Green Glare (min)	Yellow Glare (min)
FP 05	0	0
FP 13	0	0
FP 23	0	0
FP 31	0	0
1-ATCT	0	0

### Flight Path: FP 05

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 13

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 23

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 31

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: PV array 4

Receptor	Green Glare (min)	Yellow Glare (min)
FP 05	0	0
FP 13	0	0
FP 23	0	0
FP 31	0	0
1-ATCT	0	0

### Flight Path: FP 05

0 minutes of yellow glare

0 minutes of green glare

### Flight Path: FP 13

0 minutes of yellow glare

0 minutes of green glare

### Flight Path: FP 23

0 minutes of yellow glare

0 minutes of green glare

### Flight Path: FP 31

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: PV array 5

Receptor	Green Glare (min)	Yellow Glare (min)
FP 05	0	0
FP 13	0	0
FP 23	0	0
FP 31	0	0
1-ATCT	0	0

### Flight Path: FP 05

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 13

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 23

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 31

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: PV array 6

Receptor	Green Glare (min)	Yellow Glare (min)
FP 05	0	0
FP 13	0	0
FP 23	0	0
FP 31	0	0
1-ATCT	0	0

### Flight Path: FP 05

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 13

0 minutes of yellow glare  
0 minutes of green glare

### Flight Path: FP 23

0 minutes of yellow glare  
0 minutes of green glare

## Flight Path: FP 31

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

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"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/](http://www.forgesolar.com/help/) for assumptions and limitations not listed here.

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